

July 30, 1963

D. E. FOLEY ET AL
PRINTING DEVICE

3,099,711

Filed June 2, 1961

2 Sheets-Sheet 1

FIG. 1

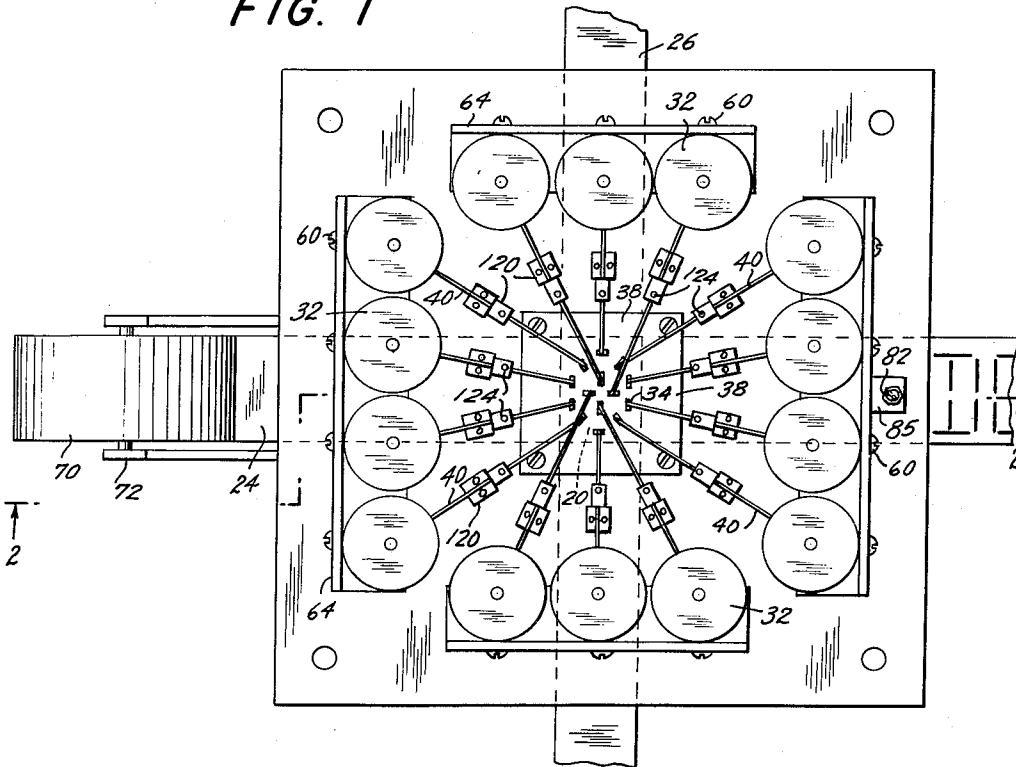
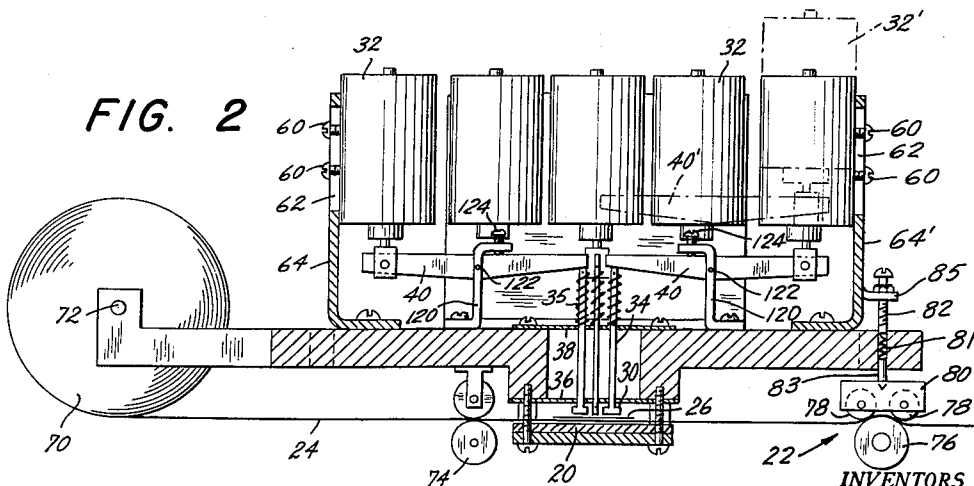


FIG. 2



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FIG. 3

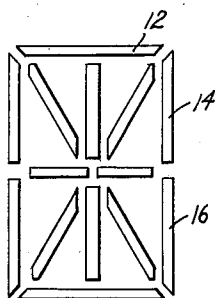


FIG. 4

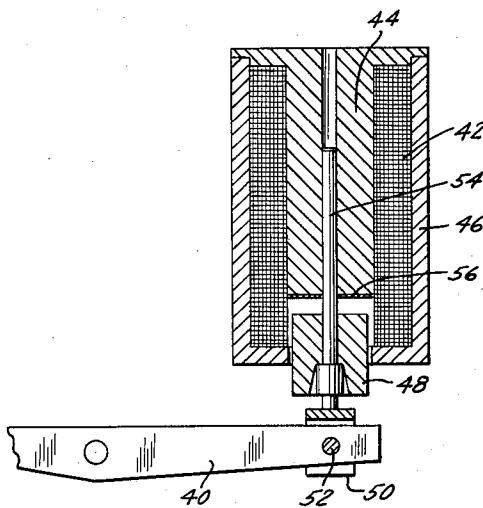


FIG. 5

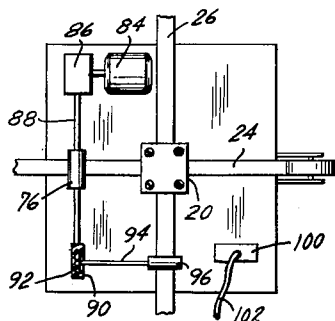


FIG. 6

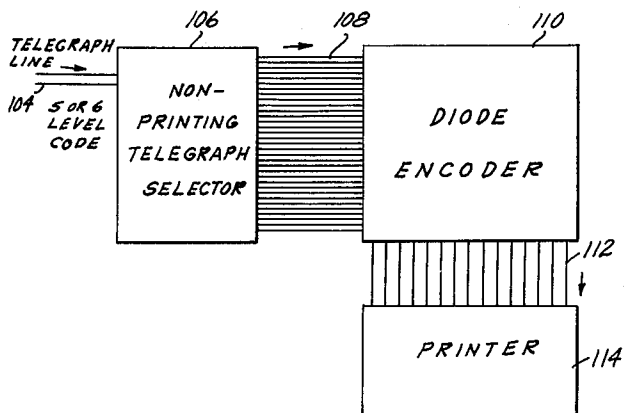
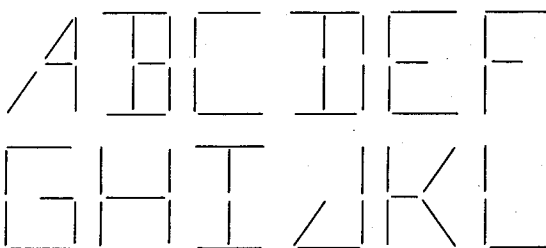


FIG. 7

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3,099,711

PRINTING DEVICE

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Filed June 2, 1961, Ser. No. 123,340
14 Claims. (Cl. 178—30)

This invention relates to printers, and more particularly to telegraph printers.

The usual telegraph printer employs a print wheel or cylinder carrying "alpha-numeric" characters. This must be bodily moved and rotated relative to a printing station, and complex mechanism is needed to move the same to the different desired characters. For high speed printing this raises serious problems of inertia because of the necessary movement of the cylinder and of all the related mechanism which moves the same.

The object of the present invention is to overcome the foregoing difficulty, and to provide a relatively inertialess printing mechanism. For this purpose we provide an array of independently movable type segments at the printing station. As is already known in the display readout field, the segments may be so arranged that they may be selectively used to make up any desired alpha-numeric character. Circuitry is already known in the readout field to energize different combinations of segments to produce a desired character. In our printer the segments are very small, and the printing movement of a segment may be quite small, say 0.015 inch, so that little problem of inertia arises even when printing at high speed. To print numeric characters alone only seven segments are needed, and to print the alpha-numeric characters fourteen segments are sufficient, although a greater number could be provided for more elaborate or refined appearance of the resulting type.

To accomplish the foregoing general object, and other more specific objects which will hereinafter appear, our invention resides in the printing device and the elements thereof and their relation one to another, as are hereinafter more particularly described in the following specification. The specification is accompanied by drawings in which:

FIG. 1 is a rear elevation of a printing device embodying features of our invention, with the cover or housing removed;

FIG. 2 is a transverse section taken approximately in the plane of the line 2—2 of FIG. 1;

FIG. 3 shows the array of fourteen segments here employed;

FIG. 4 is a fragmentary section through one of the electromagnetic means, drawn to enlarged scale;

FIG. 5 is a front view of the printer;

FIG. 6 shows how the segments cooperate in different combinations to form characters; and

FIG. 7 is a schematic diagram explanatory of how a telegraphic signal may be converted to operate the array of electromagnetic means of the printer.

Referring to the drawing, and more particularly to FIG. 3, we there show an array of fourteen segments or lines 12, 14, 16, etc. In practise these segments are so tiny that the entire array occupies the space permitted for a single type character. By simultaneously printing selected combinations of segments, any desired alpha-numeric character may be printed, as shown by the letters "A" through "L" in FIG. 6.

Referring now to FIGS. 1 and 2 of the drawing, the printer comprises a platen 20 which acts as a printing station. A means generally designated 22 moves paper 24 past the printing station. There is also an ink ribbon 26 at the printing station, and an array of independently movable type segments 30. The paper 24 and ink ribbon

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26 are disposed between the platen 20 and the type segments 30. There are independently operable means connected to each segment to move the same toward the platen to cause printing of the segment on the paper. These are preferably electromagnetic means, there being an array of such means indicated at 32.

Considered in greater detail, each segment 30 is carried at the end of a noncircular shank 34, which is slidable through and guided by matrix plates 36 and 38. These have mating noncircular holes so that the segments are kept in proper orientation as well as location. Operating levers 40 radiate outward from the shanks 34, and are of appropriate length to reach the ring of electromagnetic means 32, which in the present case are disposed as shown in FIG. 1. As here illustrated the levers are pivoted at an intermediate point, and their outer ends are drawn away from the platen when a magnet is energized, thereby moving their inner ends and the corresponding shank 34 and segment 30 toward the platen. The segment thus acts as a print hammer which causes printing of a line corresponding to the segment on the paper. However, the segment is quite tiny and requires only slight movement with little inertia.

Each lever 40 is carried by a bracket 120, the upright portion of which carries the lever pivot 122. At its upper end (meaning upper as viewed in FIG. 2, because in practise this usually would be either the lower end or the rear end) the bracket is turned to support an adjustable stop screw 124. This screw limits the upward movement of the inner end of the lever, and consequently limits the upward movement of the printing segments under the influence of their individual compression or return springs. Each shank 34 is urged upward by a compression spring 35, the upper end of which bears against a pin fixed transversely thru the shank near its upper end.

Because of the slight movement required the electromagnetic means may be of a special kind, bearing resemblance to and yet differing from the more usual forms of solenoid and magnet. The construction is shown in FIG. 4, in which it will be seen that the winding or coil 42 is disposed between a stationary center core 44 and an outer core 46. The center core 44 is somewhat shorter than the outer core 46. The device further has a short movable center core 48 which is aligned with the stationary center core 44. The movable core 48 is connected to lever 40, as shown by the yoke 50 and pin 52.

In practise the magnet parts may be kept in alignment by a nonmagnetic guide rod 54. This may, for example, be made of aluminum, and it serves further to carry the yoke 50. A nonmagnetic washer 56 preferably is provided at the end of core 44 to prevent sticking of the movable core to the stationary core, in the event of some residual magnetism. By using "Armco" iron with appropriate heat treatment, the residual magnetism may be reduced to so negligible an amount that the washer 56 may be reduced to a thin copper coating on the end of stationary core 44.

With a complex array of segments, as shown in FIG. 3, it may be necessary to have some of the operating levers cross others. This is readily accomplished by making the shank of one segment longer, and then raising the lever and magnet which operates that shank. This change is shown in broken lines in FIG. 2 by the lever 40' and magnet 32'. In one particular example most of the shanks were $\frac{7}{8}$ inch long, and a few involving cross-over were $1\frac{1}{4}$ inch long, the difference of $\frac{3}{8}$ inch being adequate for the offset or crossed lever and its magnet. In FIG. 2 the amount of offset has been exaggerated for clarity.

To adjust the location of the magnets, they are mounted on their support plates by means of screws received in slots. This is best shown in FIG. 2, in which the mount-

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ing screws 60 are slidable in a vertical slot 62 in a mounting plate 64. FIG. 1 shows how a number of magnets are mounted on each of four such mounting plates, and in every case the height of the magnet is adjustable.

The movement or travel of the movable magnet core is minimized by appropriate adjustment of the stop screws 124. The compression springs 35 (FIG. 2) bear on the cross pins passing through the shanks 34. The shanks bear against the levers, which in turn bear against the stop screws, and so limit the downward movement of the magnet core. When the magnet is energized the upward movement of the magnet core is limited by contact of the printing segment against the paper and platen. The height of the magnet then is adjusted to afford this desired range of movement with the magnet operating most efficiently, that is, with the movable core as close as possible to the stationary core, but with some remaining clearance when the segment hits the paper.

In a modified design the brackets 120 and 64 were combined, there being an individual bracket for each magnet and lever, and the magnets then were located around the periphery of a circle, so that the levers all have substantially the same length. The upright outer end of the bracket carried a magnet; the upright inner end of the bracket carried the lever pivot; and the horizontal inner end of the bracket carried the stop screw, substantially as here shown.

In the present case the printing is applied to a narrow tape rather than a page or sheet. The paper tape 24 is supplied from a roll 70 rotatably mounted at 72. The tape runs through guide rollers 74 past the printing station to a pull capstan 76. The paper is held against capstan 76 by pressure rollers 78 carried in a bearing block 80, and the resulting pressure is adjustable by means of an adjusting screw 82 bearing against a spring 81 which in turn bears on a pin 83 and so on block 80. Screw 82 is threaded in lug 85, which may be excised and displaced from bracket 64'.

Referring now to FIG. 5, the capstan 76 is driven by a miniature motor 84 through reduction gearing 86 having an output shaft 88. A interesting feature of the present printer is that it is not necessary to provide the usual pawl and ratchet mechanism for intermittent feed of the tape. Instead motor 84 drives the tape frictionally, with a comparatively light force, such that the tape is readily stopped by the action of the print segments when they engage the paper.

No blurring of the resulting type is caused, and the spacing of the characters along the tape is uniform because of the uniform synchronized intervals at which the telegraphic code pulses are transmitted. The desired slip drive may be provided by a frictional slip clutch between motor 84 and capstan 76, but in the present case the arrangement is even simpler, in that the slippage takes place at the capstan itself. Reverting to FIG. 2, the pressure screw 82 is so adjusted as to provide the desired friction and slippage.

The ink ribbon 26 previously referred to preferably extends transversely of the paper tape 24. This is shown in FIG. 5, and the ink ribbon may be driven by the motor 84 previously referred to. For this purpose shaft 88 is extended and carries a worm 90 meshing with a gear 92 on a shaft 94 carrying capstan 96 which engages the ink ribbon. The motion of the ink ribbon may be much slower than that of the paper. Here again an intermittent feed may be provided, if desired, but we have found that continuous feed may be successfully used with the printing mechanism here shown. The motion of the ribbon is arrested at the instant the type segments or hammers strike the ribbon.

The wiring of the printer is elementary, and requires no wiring diagram. There is simply one wire leading to each magnet, with a common return wire for all of the magnets. Thus in the present case there are fifteen wires leading to the printer, for fourteen magnets, and the con-

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nection may be made by a suitable multiple prong connector having fifteen or more pins, this being indicated at 100 in FIG. 5, with the flexible wire cable 102 comprising fifteen wires.

The simultaneous operation of different combinations of magnets presupposes the availability of appropriate coded combinations of pulses. This may be provided by conversion circuitry. Such circuitry is disclosed in a co-pending application of one of the present inventors, Daniel E. Foley, this being Serial No. 78,565, filed December 27, 1960, and entitled "Information Display Means."

Referring to FIG. 7, the incoming telegraph signal may be supplied over a two-wire line indicated at 104. This receives binary code bits transmitted in a conventional code, say a five or a six level code. These may be changed in a suitable device 106 which may be termed a non-printing telegraph selector. Such a selector can be an electro-mechanical device or an electronic selector employing shift registers. It may establish sixty-four characters handled through sixty-four lines, reducible to thirty-two by use of a shift arrangement, plus another for gating. In practise there usually are more lines, say fifty lines, to provide as well for special symbols such as fractions, etc. Such devices are known and they change the binary code bits transmitted serially over telegraph line 104 to plural wire multiple code bits. The output is supplied through lines 108 to a diode encoder 110 embodying the circuitry of the aforesaid Foley application, Serial No. 78,565. The output of the encoder 110 is a fourteen level output which may be supplied over fourteen wires with a common return, indicated at 112, and leading to the printer 114, this being the printer with fourteen magnets as above described.

We have found it feasible to employ small magnets or solenoids requiring only one watt of power each. In the particular case here illustrated the magnets are 1/4 inch long and 0.72 inch in all-over diameter. The radial levers 40 have a length well under two inches, and a thickness of 1/16 inch. The magnets are energized only a small fraction of the time, that is, during printing pulses. At speeds over 300 words per minute the time for an individual stroke is less than 15 milliseconds. Continuous paper feed and ribbon feed are feasible, with a friction slip drive, the hammer or printing action of the segments arresting the movement, and without noticeable blurring of the print. All segments print simultaneously, thus producing a complete character in a single printing stroke, and the paper then moves the full spacing to the next character.

It is believed that the construction and operation of our improved printing device, as well as the advantages thereof, will be apparent from the foregoing detailed description. It will also be apparent that while we have shown and described our printing device in a preferred form, changes may be made without departing from the scope of the invention, as sought to be defined in the following claims. In the claims the reference to a desired "alpha-numeric" character is not intended to exclude a printer which prints only numeric characters or only some alphabetic characters, and which therefore may need only a lesser number of segments.

The reference in the claims to a "friction slip drive" is intended to include slippage either at the paper, or between the motor and the capstan. The reference in the claims to an inked ribbon is not intended to exclude the use of self-inking paper which uses impact for printing, the same as when using an inked ribbon.

We claim:

1. A printer comprising a platen at a printing station, means to move paper past the printing station, an ink ribbon at the printing station, an array of independently movable type segments at the printing station, each segment being elongated to print a short line, there being horizontal, vertical, and diagonal segments, said paper

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and ribbon being disposed between said platen and said type segments, independently operable electromagnetic means connected to each segment to move the same toward the platen to cause printing of the segment on the paper, in order to simultaneously print all those segments which make up a desired alpha-numeric character.

2. A printer comprising a platen at a printing station, means to move paper past the printing station, an ink ribbon at the printing station, an array of independently movable type segments at the printing station, said paper and ribbon being disposed between said platen and said type segments, independently operable means connected to each segment to move the same toward the platen to cause printing of the segment on the paper, in order to simultaneously print all those segments which make up a desired alpha-numeric character, the paper being a narrow tape, and the means to move the same including a capstan roller, and motor means to continuously drive the said capstan roller and paper with a friction-slip drive such that the paper is stopped by the printing action of the segments.

3. A printer comprising a platen at a printing station, means to move paper past the printing station, an ink ribbon at the printing station, an array of independently movable type segments at the printing station, each segment being elongated to print a short line, there being horizontal, vertical, and diagonal segments, said paper and ribbon being disposed between said platen and said type segments, electromagnetic means operatively connected to each segment to move the same toward the platen to cause printing of the segment on the paper, and circuitry to simultaneously energize a selected number of said electromagnetic means to simultaneously print all those segments which make up a desired alpha-numeric character.

4. A printer comprising a platen at a printing station, means to move paper past the printing station, an ink ribbon at the printing station, an array of independently movable type segments at the printing station, said paper and ribbon being disposed between said platen and said type segments, electromagnetic means operatively connected to each segment to move the same toward the platen to cause printing of the segment on the paper, and circuitry to simultaneously energize a selected number of said electromagnetic means to simultaneously print all those segments which make up a desired alpha-numeric character, the paper being a narrow tape, and the means to move the same including a capstan roller, and motor means to continuously drive the said capstan roller and paper with a friction-slip drive such that the paper is stopped by the printing action of the segments.

5. A printer comprising a platen at a printing station, means to move paper past the printing station, an ink ribbon at the printing station, an array of independently movable type segments at the printing station, each segment being elongated to print a short line, there being horizontal, vertical, and diagonal segments, said paper and ribbon being disposed between said platen and said type segments, each segment being carried at the end of a non-circular shank disposed generally perpendicular to the platen, levers radiating outward from the shanks, and an array of electromagnetic means operatively connected one to each lever to move its shank toward the platen to cause printing of the segment on the paper.

6. A printer comprising a platen at a printing station, means to move paper past the printing station, an ink ribbon at the printing station, an array of independently movable type segments at the printing station, each segment being elongated to print a short line, said paper and ribbon being disposed between said platen and said type segments, each segment being carried at the end of a non-circular shank disposed generally perpendicular to the platen, levers radiating outward from the shanks, an array of electromagnetic means operatively connected one to each lever to move its shank toward the platen to

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cause printing of the segment on the paper, and circuitry to energize a selected number of said electromagnetic means to print those segments which make up a desired alpha-numeric character.

7. A printer comprising a platen at a printing station, means to move paper past the printing station, an ink ribbon at the printing station, an array of independently movable type segments at the printing station, each segment being elongated to print a short line, there being horizontal, vertical, and diagonal segments, said paper and ribbon being disposed between said platen and said type segments, each segment being carried at the end of a non-circular shank disposed generally perpendicular to the platen, levers radiating outward from the shanks, an array of electromagnetic means operatively connected one to each lever to move its shank toward the platen to cause printing of the segment on the paper, and circuitry to simultaneously energize a selected number of said electromagnetic means to simultaneously print all those segments which make up a desired alpha-numeric character.

8. A printer comprising a platen at a printing station, means to move paper past the printing station, an ink ribbon at the printing station, an array of independently movable type segments at the printing station, each segment being elongated to print a short line, said paper and ribbon being disposed between said platen and said type segments, each segment being carried at the end of a non-circular shank disposed generally perpendicular to the platen, levers radiating outward from the shanks, and an array of electromagnetic means operatively connected one to each lever to move its shank toward the platen to cause printing of the segment on the paper, each electromagnetic means having a winding disposed between a stationary center core and an outer core, the stationary center core being somewhat shorter than the outer core, and a short movable center core aligned with the stationary center core, said movable center core being connected to one of said levers.

9. A printer comprising a platen at a printing station, means to move paper past the printing station, an ink ribbon at the printing station, an array of independently movable type segments at the printing station, each segment being elongated to print a short line, said paper and ribbon being disposed between said platen and said type segments, each segment being carried at the end of a non-circular shank disposed generally perpendicular to the platen, levers radiating outward from the shanks, and an array of electromagnetic means operatively connected one to each lever to move its shank toward the platen to cause printing of the segment on the paper, and circuitry to energize a selected number of said electromagnetic means to print those segments which make up a desired alpha-numeric character, each electromagnetic means having a winding disposed between a stationary center core and an outer core, the stationary center core being somewhat shorter than the outer core, and a short movable center core aligned with the stationary center core, said movable center core being connected to one of said levers.

10. A printer comprising a platen at a printing station, means to move paper past the printing station, an ink ribbon at the printing station, an array of independently movable type segments at the printing station, each segment being elongated to print a short line, said paper and ribbon being disposed between said platen and said type segments, each segment being carried at the end of a non-circular shank disposed generally perpendicular to the platen, levers radiating outward from the shanks, and an array of electromagnetic means operatively connected one to each lever to move its shank toward the platen to cause printing of the segment on the paper, and circuitry to simultaneously energize a selected number of said electromagnetic means to simultaneously print all those segments which make up a desired alpha-numeric

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character, each electromagnetic means having a winding disposed between a stationary center core and an outer core, the stationary center core being somewhat shorter than the outer core, and a short movable center core alined with the stationary center core, said movable center core being connected to one of said levers.

11. A printer as defined in claim 5, in which the paper is a narrow tape, and in which the means to move the paper includes a capstan roller, and motor means to continuously drive the said capstan roller and paper with a friction slip drive such that the paper is stopped by the printing action of the segments.

12. A printer as defined in claim 7, in which the paper is a narrow tape, and in which the means to move the paper includes a capstan roller, and motor means to continuously drive the said capstan roller and paper with a friction slip drive such that the paper is stopped by the printing action of the segments.

13. A printer as defined in claim 8, in which the paper

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is a narrow tape, and in which the means to move the paper includes a capstan roller, and motor means to continuously drive the said capstan roller and paper with a friction slip drive such that the paper is stopped by the printing action of the segments.

14. A printer as defined in claim 10, in which the paper is a narrow tape, and in which the means to move the paper includes a capstan roller, and motor means to continuously drive the said capstan roller and paper with a friction slip drive such that the paper is stopped by the printing action of the segments.

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