June 22, 1965 D. E. FOLEY ETAL 3,190,957

ALTERNATING TWO LINE PRINTING DEVICE

Filed Aug. 21, 1962 2 Sheets-Sheet 1

FIG. 1

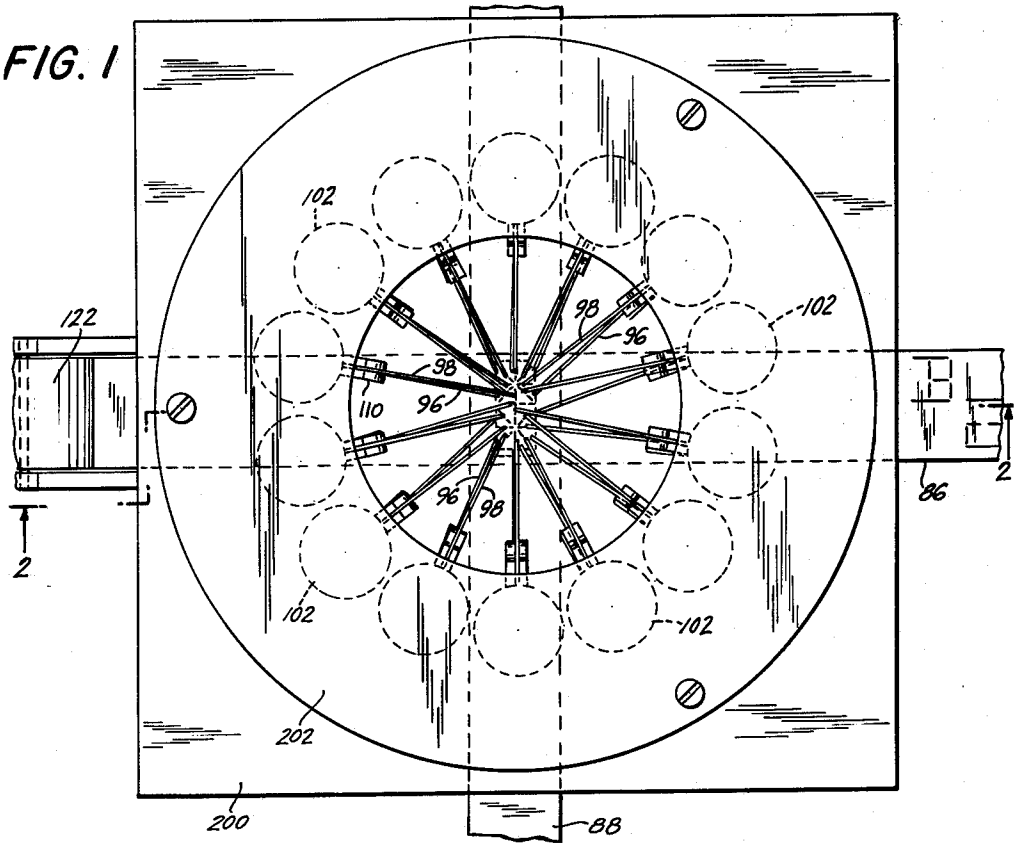
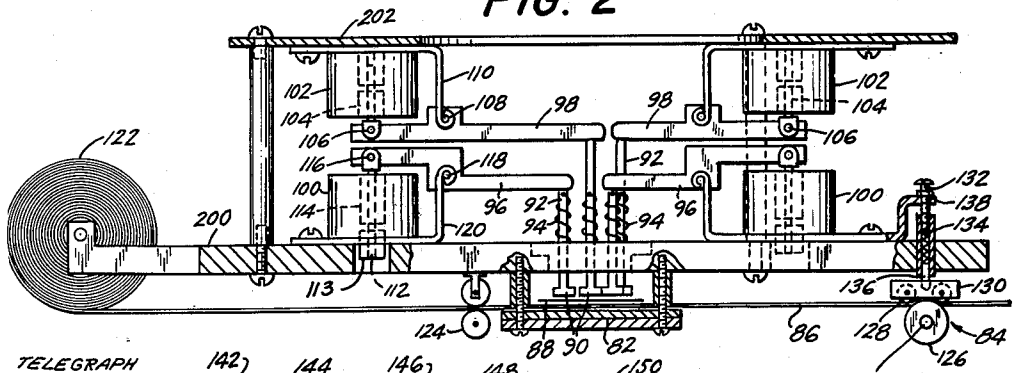


FIG. 2



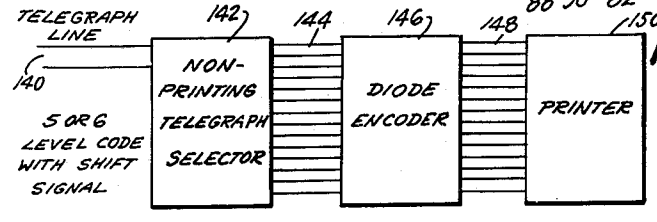


FIG. 3

CONTINUOSLY DRIVEN

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FIG. 4

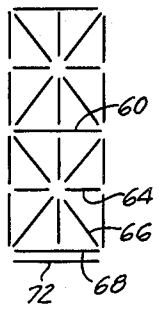


FIG. 5

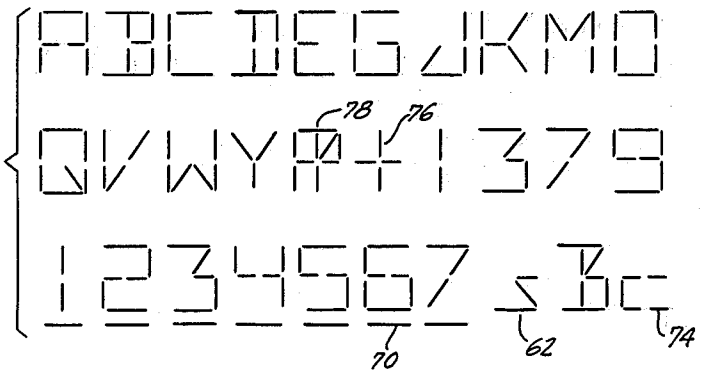


FIG. 6

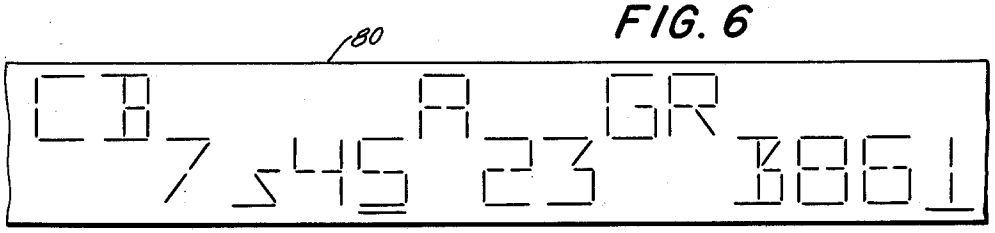


FIG. 7

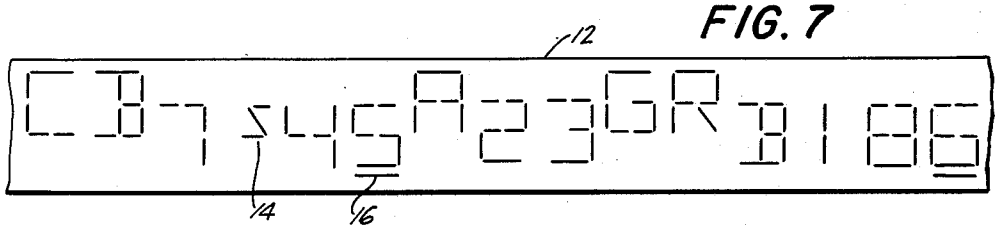


FIG. 8

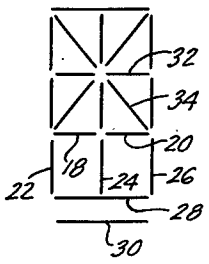


FIG. 9

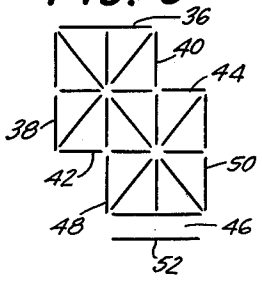
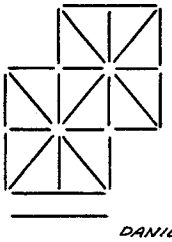


FIG. 10



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3,190,957

ALTERNATING TWO LINE PRINTING DEVICE

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Filed Aug. 21, 1962, Ser. No. 218,394
15 Claims. (Cl. 178—30)

This invention relates to printers, and more particularly to printers for "ticker tape," that is, telegraph printers for reporting stock quotations and other such transactions.

An earlier patent application, Serial No. 123,340, filed June 2, 1961, by two of the present inventors, Daniel E. Foley and Alfred Skrobisch, since issued on July 30, 1963, as Patent No. 3,099,711, discloses a printer which comprises an array of independently movable type segments, with means connected to each segment to move the same to cause printing of the segments, and to simultaneously print those segments which make up a desired alpha-numeric character. The said printer has the advantage of operating at very high speed, and one object of the present invention is to adapt the said printer to print ticker tape for stock quotations or the like.

On ticker tape it is customary to use two lines in alternation. The upper line identifies the company, and the lower line indicates the number of shares and the sale price or bid price, etc. The present practice is to shift the position of a print wheel between the upper line and the lower line. However, such printers operate slower than is wanted for modern needs. It would be possible to shift the tape in transverse direction, but that too would limit the operating speed.

In accordance with a feature and object of the present invention, two arrays of segments are provided, and one or more segments work in common for both the upper and lower characters. For this purpose the arrays overlap, the overlap in one form of the invention being about one half a character; in another form being about one quarter of a character; and in another form being only a single segment. This use of common segments is advantageous in that it helps compensate for extra symbols needed for ticker tape, and it brings the upper and lower lines in somewhat overlapped position, making possible the use of a narrower paper tape, or what is more important in actual practice, making possible the use of larger characters while retaining the same width of tape.

The segments are carried at the ends of noncircular shanks, and are operated by levers radiating outward from the shanks to a ring of electromagnetic means operatively connected to the levers. With two arrays, as here provided, it is very difficult to make room for the large number of levers and solenoids required. This difficulty is overcome by the provision of two sets of levers radiating outward, and two rings of solenoids. These may be superposed.

To accomplish the foregoing general objects, and other more specific objects which will hereinafter appear, our invention resides in the printer elements 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 plan view of a printer embodying features of the present invention;

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

FIG. 3 is a schematic diagram explanatory of how a telegraphic signal may be converted to operate the arrays of electromagnetic means in the printer;

FIG. 4 shows two superposed arrays of segments with a common horizontal segment;

FIG. 5 shows how the segments cooperate in different

combinations to form alpha-numeric characters and special symbols used on ticker tape;

FIG. 6 shows a piece of ticker tape printed with stock quotations by the segments of FIG. 4;

FIG. 7 shows another piece of ticker tape printed by means of arrays which overlap about half a chracter;

FIG. 8 shows the overlapping arrays of segments used to print the ticker tape of FIG. 7;

FIG. 9 shows another form in which the arrays overlap about one-quarter of a character; and

FIG. 10 shows still another arrangement of two arrays which overlap about one-quarter of a character.

Referring to the drawing, and more particularly to FIG. 7, the ticker tape **12** has alternately used upper and lower lines of characters, but the displacement between the upper and lower characters is only about half the height of a character. The small "s" indicated at **14** represents "shares." The horizontal line **16** beneath a numeral is a fraction line representing eighths of a point. Thus, the tape of FIG. 7 shows that seven hundred of the CB company shares were sold at four and five-eighths; that 100 A company shares were sold at twenty-three; and that the bid price for GR company shares was eighteen and six-eighths.

The characters are printed by simultaneous movement of appropriate segments. The array of segments is shown in FIG. 8. The vertical, horizontal and diagonal segments making up the upper two-thirds of the array shown in FIG. 8 corresponds to the array in the aforesaid copending application Ser. No. 123,340, except that in the present case there are two short segments at **18** and **20**, instead of one long segment. To make up a lower array, we have added three vertical segments **22**, **24**, and **26**, and a horizontal segment **28**. These correspond to the lower half of a character in the lower line, and thus the segments may be considered to comprise an upper array and a lower array which overlap for about half their height. The horizontal segment **30** is added as the fraction line shown at **16** in FIG. 7.

All needed characters may be obtained from the array of FIG. 8. For example, the small "s" representing "shares," and shown at **14** in FIG. 7, is obtained by using the segments **32**, **34** and **20**.

FIG. 9 shows two arrays of segments which overlap for about one-quarter of the area of either array. The alpha-numeric characters for the upper line are obtained from the rectangle bounded by horizontal segments **36** and **42**, and vertical segments **38** and **40**. The characters for the lower line are obtained from the rectangle of segments bounded by the upper line **44**, the lower line **46** and the vertical lines **48**, **50**. The fraction line **52** is an extra symbol, as already explained.

FIG. 10 shows a somewhat similar array in which the overlap in vertical direction again is one-half a character, and in which the overlap in area corresponds to one-quarter of a character, but in which the displacement of a lower character relative to an upper character is somewhat to the left, instead of somewhat to the right as shown in FIG. 9.

The amount of overlap may be less, and yet considerable advantage retained. FIG. 4 illustrates upper and lower arrays of segments which have in common only the horizontal segment **60**. Typical letters and numerals obtainable from the upper or lower array are illustrated in FIG. 5. The small "s" marked **62** in FIG. 5 is obtained from the segments **64**, **66**, and **68** in FIG. 4. The fraction line **70** in FIG. 5 is obtained from segment **72** in FIG. 4. The small "c" marked **74** in FIG. 5 represents "cash"; the symbol "B" represents "bid," and the symbol somewhat like a paragraph sign at **78** means "preferred." These symbols are already known and used on ticker tape.

A piece of ticker tape printed by means of the arrays of segments of FIG. 4 is shown at **80** in FIG. 6. This indicates that seven hundred shares of the DB Co. were sold at four and five-eighths; that 100 A company shares were sold at twenty-three; and that the bid price for GR company shares was eighty-six and one-eighth.

A structural embodiment of the printer is illustrated in FIGS. 1 and 2 of the drawing. Referring to FIGURE 2 the printer comprises a platen **82** at a printing station, with means **84** to move a paper tape **86** past the printing station. A self-inking or pressure sensitive tape might be employed, but more usually an inked ribbon **88** is used, which is also located at the printing station, and is moved in a direction transverse to that of the paper tape **86**, as shown in FIG. 1.

Self-inking paper would be similarly printed by impact printing. Such paper includes a dye between a backing sheet and a top covering surface, the latter being bruised or penetrated by the printing operation to expose the dye, so that in effect the ink ribbon is incorporated in the paper tape. However, such paper is more expensive than ordinary ticker tape, which therefore is preferred.

There are two arrays of independently movable type segments, some of which are indicated at **90** in FIG. 2. Close inspection of the center of FIG. 1 will show that the arrays here illustrated correspond to those shown in FIG. 4, the segments being shown as single lines. The paper **86** and ribbon **88** have the platen **82** therebeneath, and the type segments **90** thereabove.

Then there are independently operable means connected to each segment to move the same toward the platen **82** (FIG. 2) in order to simultaneously print those segments which make up a desired alpha-numeric character for the upper line or for the lower line of print on the tape. Considered more specifically, each segment **90** (FIG. 2) is carried at the lower end of a non-circular shank **92**, the latter being disposed generally perpendicular to the platen **82**. The shanks are normally raised by small individual compression springs **94**. There are levers **96** and **98** which radiate outward from the shanks, and two rings of electromagnetic means **100** and **102** operatively connected one to each lever, to move its shank toward the platen.

The electromagnetic means **100** and **102** are solenoids. The solenoids **102**, when energized, attract ferrous cores **104**, the lower ends of which are connected at **106** to levers **98**. The levers are pivoted at **108** in bearings forming part of an angle piece **110** which is combined with a solenoid **102**, making up in effect, an operating module.

In practice, only a very slight movement is needed at the segment and at the solenoid core, and the solenoid therefore may be made somewhat like a magnet, the structure being the same as that described in the aforesaid copending application Serial No. 123,340. It is there explained that each solenoid may have a stationary outer and inner core coaxially arranged, with a small movable core, and with very little air gap between the stationary inner core and the movable core. The result is that the movable core **104** is attracted by the stationary inner core acting as an electromagnet, in addition to being attracted in solenoid fashion by the field of the solenoid. A non-magnetic guide pin on the movable core passes slidably through the fixed core. However, other forms of solenoid or magnet may be used.

The lower deck of levers and solenoids could simply duplicate the upper deck so far described. However, for compactness the levers **96** are disposed above, instead of below, the solenoids, but then their outer ends must be raised rather than lowered. For this reason the non-magnetic guide pin **112** of the movable core **113** passes all the way through the field core **114** and is connected at its upper end at **116** to the lever **96**. The latter is pivoted at **118** on a bracket **120**, which is combined with solenoid **100** to constitute one operating module.

The reason both decks have fourteen magnets, even though there is a common horizontal segment (**60** in FIG. 4), is that the deck which otherwise would have thirteen instead of fourteen segments has a fourteenth magnet for the fraction line which represents eighths of a point (the line **72** of FIG. 4).

The feed of the inked ribbon **88** (FIG. 1) may be provided as in the copending application Serial No. 123,340. The paper tape **86** is supplied from a suitable roll **122**, and is led between guide rollers **124** (FIG. 2) to the feed mechanism **84** previously mentioned. More specifically, there is a pull capstan **126** which is driven continuously by a suitable drive motor. The paper is held against the capstan by pressure rollers **128** carried in a bearing block **130**, the resulting pressure being adjustable by means of an adjusting screw **132** bearing against a compression spring **134** which in turn bears on a pin **136**, and so on the block **130**. Screw **132** is threaded in a bracket **138**, and the adjustment may be locked by a lock nut.

The drive of the capstan **126** is very simple because it is continuous. We have found it unnecessary to use the usual pawl and ratchet mechanism for intermittent feed, and instead the motor drives the capstan **126** continuously, and it bears with a comparative light force on the tape, so that the tape is readily stopped by the action of the print segments themselves when they come down against the paper to print.

No blurring of the resulting type is caused, and the spacing of the type along the tape is uniform for FIGS. 4 and 8 because of the uniform synchronized intervals at which the telegraphic code pulses are transmitted. The desired slip drive may be provided between the motor (not shown) and the capstan **126**, or as in the present case, between the capstan and the paper tape.

The wiring of the printer itself is elementary, and requires no wiring diagram, there being simply one wire leading to each magnet coil, with a common return for all of the coils. Thus, in the present case there are fourteen segments for the upper array in FIG. 4, thirteen segments for the lower array, and an additional segment for the fraction line **72**, making twenty-eight segments in all. For this there are twenty-eight solenoids, fourteen secured to the lower deck **200**, and fourteen secured to the upper deck **202**. Connection may be made by means of a suitable multiple prong detachable connector having twenty-nine or more pins.

The magnets are energized by appropriate conversion circuitry. Such circuitry is disclosed in a copending 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. 3, the incoming telegraph signal may be supplied over a two-wire line indicated at **140**. This receives binary code bits transmitted in a conventional code, say a five or six level code. These bits may be changed in a suitable device **142**, which may be termed a non-printing telegraph selector. Such a selector can be an electromechanical device, or an electronic selector employing shift registers. It may establish sixty-four characters handled through sixty-four lines, reducible to thirty-two by the use of a shift arrangement, plus another line for gating. In practice there are usually more lines, to meet special needs. Such devices are known, and they change the binary code bits transmitted seriatim over telegraph line **140**, to plural wire multiple code bits transmitted simultaneously. The output is supplied through lines **144** to a diode encoder **146**, embodying the circuitry of the aforesaid Foley application, Serial No. 78,565. The output of encoder **146** is a twenty-eight level output which may be supplied over twenty-eight wires and a common return, indicated at **148**, and leading to the printer **150**, this being a printer

with twenty-eight magnets as above described. The lines indicated at 144 and 148 in FIG. 3 are not numerically correct, being reduced in number for clarity.

It may be desired to have each array of magnets complete insofar as the control circuitry is concerned, so that duplicate circuitry may be used for the upper array and for the lower array. In such case all that is needed is to make one solenoid winding special, this being the winding for the common segment (60 in FIG. 4). The special solenoid is given two windings, insulated from one another, and either of which is capable of actuating the core. In such case one winding is included in the circuitry for the upper array, and the other winding is included in the circuitry for the lower array. There then would be twenty-nine instead of twenty-eight wires at 148 (plus a common return). The twenty-ninth wire and magnet would be for the extra horizontal segment (72 in FIG. 4) representing a fraction line or eighths of a point.

The magnets may be quite small, requiring only one watt of power each. They are energized only a very small time, and operate successfully at printing speeds of over three-hundred words per minute, at which speed the time for an individual stroke is less than fifteen milliseconds. 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.

The standard ticker tape has a width of ¾ inch, and has type having a height of 3/16 inch, there being a ⅛ inch space at the top, center, and bottom of the tape. With the present printer the height of the type is easily increased to 5/16 inch, with a margin at the top and bottom of slightly over 1/16 inch, the overall height of the two lines of type being about 19/32 inch because of the overlap at the common horizontal segment. The type is larger and more easily legible than on the ticker tape now used, in addition to being printed at higher speed. The type may be made clearer than that shown in FIGS. 5, 6, and 7 because in the drawing the gaps between segments have been exaggerated for clarity.

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.

We claim:

1. Apparatus for alternately printing alpha-numeric characters on upper and lower lines, without line feed, as on a ticker tape for stock quotation, said apparatus comprising means for character feed, an array of movable elemental printing segments used simultaneously in different combinations to make up alpha-numeric characters for the upper line and for the lower line, one or more of said segments serving in common for both the upper and lower lines.

2. A printer comprising a platen at a printing station, means to move a paper tape past the printing station, two arrays of independently movable type segments at the printing station for printing alternately on two lines, said paper being disposed between said platen and said type segments, and 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 those segments of one array or the other which make up a desired alpha-numeric character on the upper line or the lower line.

3. A printer comprising a platen at a printing station, means to move a paper tape past the printing station, two arrays of independently movable type segments at the printing station for printing alternately on two lines, said paper 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 those segments which make up a desired alpha-numeric character on the upper line or the lower line, said arrays of the upper and lower lines being in partially overlapping relation so that at least one of the segments is common to the upper and lower arrays.

4. A printer comprising a platen at a printing station, means to move a paper tape past the printing station, an ink ribbon at the printing station, two arrays of independently movable type segments at the printing station for printing alternately on two lines, 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 those segments which make up a desired alpha-numeric character on the upper line or the lower line, said arrays of the upper and lower lines being in partially overlapping relation so that at least one of the segments is common to the upper and lower arrays.

5. A printer comprising a platen at a printing station, means to move a paper tape past the printing station, two arrays of independently movable type segments at the printing station for printing alternately on two lines, said paper 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 those segments which make up a desired alpha-numeric character on the upper line or the lower line, said arrays of the upper and lower lines being in partially overlapping relation so that at least one of the segments is common to the upper and lower arrays, the means to move the paper including a capstan roller and motor means to continuously drive the same with a friction slip drive such that the paper is stopped by the printing action of the segments.

6. A printer comprising a platen at a printing station, means to move a paper tape past the printing station, two arrays of independently movable type segments at the printing station for printing alternately on two lines, said paper being disposed between said platen and said type segments, each segment being carried at the end of a noncircular shank disposed generally perpendicular to the platen, levers radiating outward from the shanks, a ring 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, 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 on the upper line or the lower line, the aforesaid circuitry being responsive to a shift signal to shift the energization as between the upper and lower array.

7. A printer comprising a platen at a printing station, means to move a paper tape past the printing station, two arrays of independently movable type segments at the printing station for printing alternately on two lines, said paper being disposed between said platen and said type segments, each segment being carried at the end of a noncircular shank disposed generally perpendicular to the platen, levers radiating outward from the shanks, a ring 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, 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 on

the upper line or the lower line, the aforesaid circuitry being responsive to a shift signal to shift the energization as between the upper and lower array, the means to move the paper including a capstan roller and motor means to continuously drive the same with a friction slip drive such that the paper is stopped by the printing action of the segments.

8. A printer comprising a platen at a printing station, means to move a paper tape past the printing station, two arrays of independently movable type segments at the printing station for printing alternately on two lines, said paper being disposed between said platen and said type segments, each segment being carried at the end of a noncircular shank disposed generally perpendicular to the platen, levers radiating outward from the shanks, a ring 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, 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 on the upper line or the lower line, said arrays of the upper and lower lines being in partially overlapping relation so that at least one of the segments is common to the upper and lower arrays.

9. A printer comprising a platen at a printing station, means to move a paper tape past the printing station, two arrays of independently movable type segments at the printing station for printing alternately on two lines, said paper being disposed between said platen and said type segments, each segment being carried at the end of a noncircular shank disposed generally perpendicular to the platen, levers radiating outward from the shanks, a ring 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, 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 on the upper line or the lower line, said arrays of the upper and lower lines being in partially overlapping relation so that at least one of the segments is common to the upper and lower arrays, the means to move the paper including a capstan roller and motor means to continuously drive the same with a friction slip drive such that the paper is stopped by the printing action of the segments.

10. A printer comprising a platen at a printing station, means to move a paper tape past the printing station, an ink ribbon at the printing station, two arrays of independently movable type segments at the printing station for printing alternately on two lines, said paper and ribbon being disposed between said platen and said type segments, each segment being carried at the end of a noncircular shank disposed generally perpendicular to the platen, levers radiating outward from the shanks, a ring 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, 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 on the upper line or the lower line, said arrays of the upper and lower lines being in partially overlapping relation so that at least one of the segments is common to the upper and lower arrays, the aforesaid circuitry being responsive to a shift signal to shift the energization as between the upper and lower array.

11. A printer comprising a platen at a printing station, means to move a paper tape past the printing station, two arrays of independently movable type segments at the printing station for printing alternately on two lines, said paper being disposed between said platen and said type segments, each segment being carried at the end of a noncircular shank disposed generally perpendicular to the platen, two sets of levers radiating outward from the shanks, two rings 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 on the upper line or the lower line.

12. A printer comprising a platen at a printing station, means to move a paper tape past the printing station, two arrays of independently movable type segments at the printing station for printing alternately on two lines, said paper being disposed between said platen and said type segments, each segment being carried at the end of a noncircular shank disposed generally perpendicular to the platen, two sets of levers radiating outward from the shanks, two rings 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, 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 on the upper line or the lower line, the aforesaid circuitry being responsive to a shift signal to shift the energization as between the upper and lower array, the means to move the paper including a capstan roller and motor means to continuously drive the same with a friction slip drive such that the paper is stopped by the printing action of the segments.

13. A printer comprising a platen at a printing station, means to move a paper tape past the printing station, two arrays of independently movable type segments at the printing station for printing alternately on two lines, said paper being disposed between said platen and said type segments, each segment being carried at the end of a noncircular shank disposed generally perpendicular to the platen, two sets of levers radiating outward from the shanks, two rings 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 on the upper line or the lower line, said arrays of the upper and lower lines being in partially overlapping relation so that at least one of the segments is common to the upper and lower arrays.

14. A printer comprising a platen at a printing station, means to move a paper tape past the printing station, two arrays of independently movable type segments at the printing station for printing alternately on two lines, said paper being disposed between said platen and said type segments, each segment being carried at the end of a noncircular shank disposed generally perpendicular to the platen, two sets of levers radiating outward from the shanks, two rings 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, 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 on the upper line or the lower line, said arrays of the upper and lower lines being in partially overlapping relation so that at least one of the segments is common to the upper and lower arrays, the means to move the paper including a capstan roller and motor means to continuously drive the same with a friction slip drive such that the paper is stopped by the printing action of the segments.

15. A printer comprising a platen at a printing station, means to move a paper tape past the printing station, an ink ribbon at the printing station, two arrays of independently movable type segments at the printing station for printing alternately on two lines, said paper and ribbon being disposed betwen said platen and said type

segments, each segment being carried at the end of a noncircular shank disposed generally perpendicular to the platen, two sets of levers radiating outward from the shanks, two rings 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, 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 on the upper line or the lower line, said arrays of the upper and lower lines being in partially overlapping relation so that at least one of the segments is common

to the upper and lower arrays, the aforesaid circuitry being responsive to a shift signal to shift the energization as between the upper and lower array.

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