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Clary

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[54] **HIGH SPEED DRUM PRINTER WITH STEPPING MOTOR TO ADVANCE DRUM AND PAPER**

[75] Inventor: **John G. Clary**, Pasadena, Calif.

[73] Assignee: **Addmaster Corporation**, San Gabriel, Calif.

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[52] **U.S. Cl.** ..... **101/93 C**, 101/99

[51] **Int. Cl.** **B41j 1/28**

[58] **Field of Search** ..... 101/95, 99, 93 C, 101/110

[56] **References Cited**

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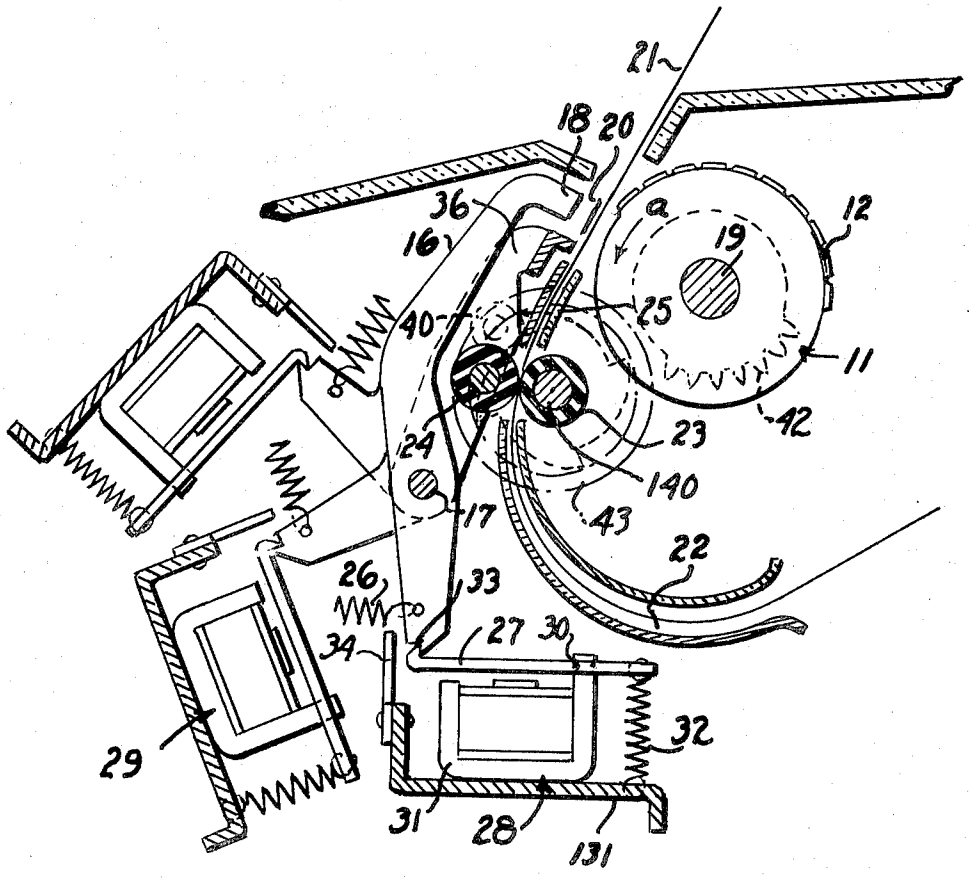
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Primary Examiner—William B. Penn
Assistant Examiner—E. M. Coven

[57] **ABSTRACT**

A parallel data printer including a type drum having columns of type characters thereon. The drum is incrementally driven by a stepper motor under control of a pulsing device. Such pulsing device also advances a counter which emits drum position indicating signals. Denominationally arranged comparator circuits cause actuation of respective print hammers when matches occur between different data signals and the drum position indicating signals. A portion of the type drum is left blank to permit advancement of the paper by the stepper motor after printing has occurred. A signal under control of the drum causes resetting of the counter and stopping of the motor upon completion of a revolution of the drum, preparatory to printing the next line of type.

6 Claims, 4 Drawing Figures



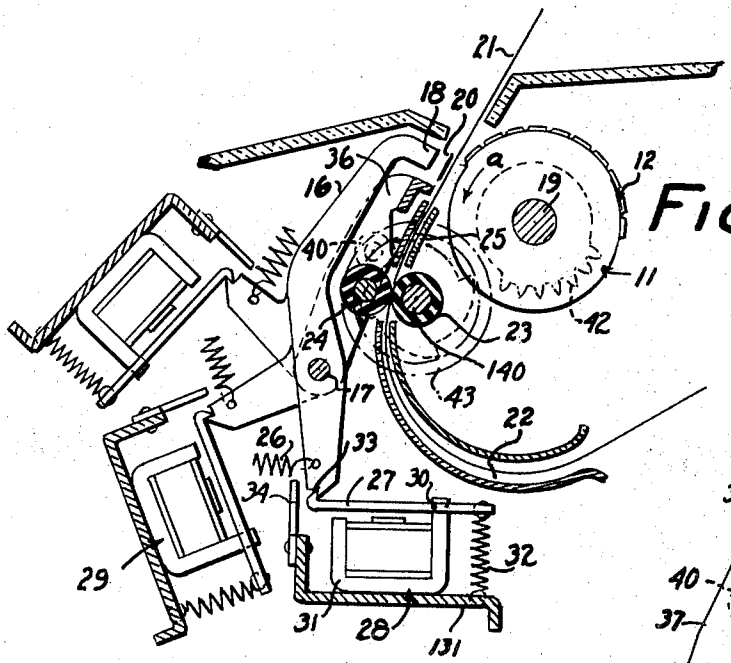


FIG. 1.

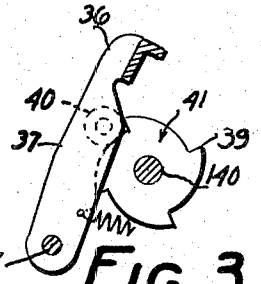
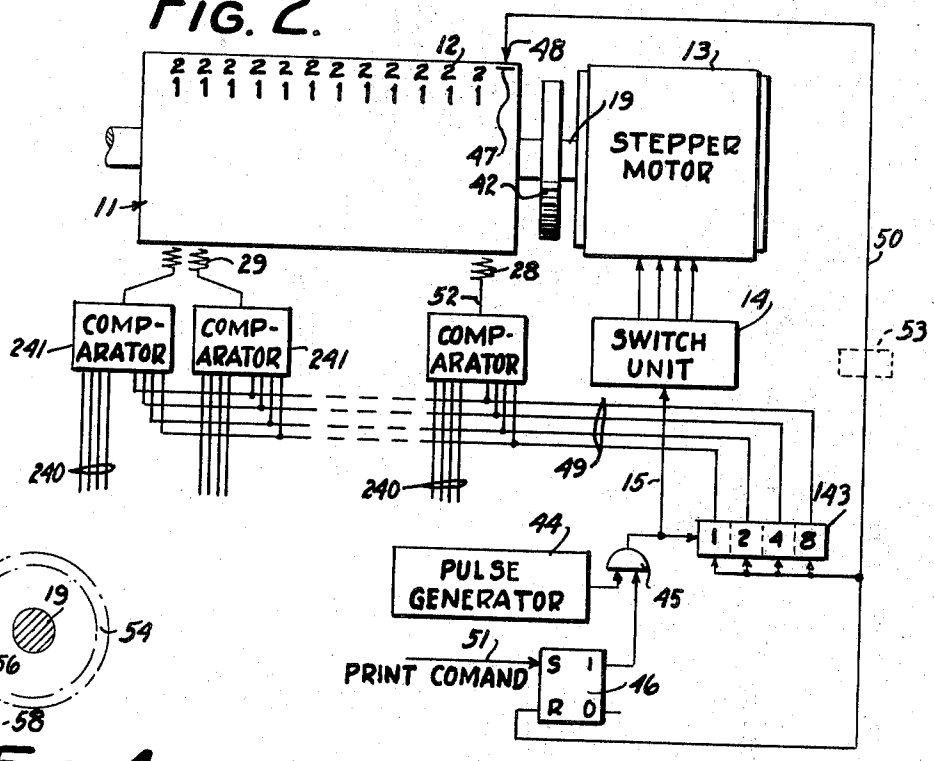


FIG. 3.

FIG. 2.



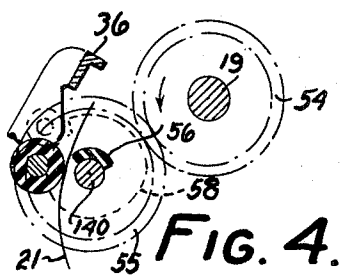


FIG. 4.

HIGH SPEED DRUM PRINTER WITH STEPPING MOTOR TO ADVANCE DRUM AND PAPER

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to high speed parallel data printers, such as are used in connection with data processing equipment, and has particular reference to a data printer embodying a rotatable print drum including a plurality of denominationally arranged columns of type characters extending around the periphery thereof. As selected type characters in different denominational columns pass a printing line, imprints from such type characters are transferred to a paper strip.

2. Description of the Prior Art

Heretofore, high speed parallel data printers have generally been of the print-on-the-fly type wherein a printing drum having a columns of type characters thereon is rotated at a constant speed and as selected type characters pass the printing line, type hammers are actuated to imprint the paper against such type characters.

Since the type drum is moving at a constant speed, extremely accurate timing must be effected in actuating the hammers to produce an acceptable line of print. Both mechanical and electrical devices have been employed herefore to actuate the print hammers. Mechanical hammer actuating devices are generally complicated and expensive while electrical hammer actuating devices are subject to different adverse operating conditions which could effect the timing, such as variations in temperature, vibration, deterioration of electrical components, etc.

Also, such timing is difficult to maintain over extended periods of time, thus requiring at least occasional adjustments.

Also, print-on-the-fly printers tend to smudge the imprint of the type characters since the hammers maintain the paper in contact with the type characters for a finite period of time while such underlying type characters are in movement.

Further, prior art parallel printers generally require clocking or timing circuits controlled by the drum to indicate the instant drum position at all times.

SUMMARY OF THE INVENTION

In general, the present invention comprises a stepper motor for incrementally rotating a type drum in a manner to successfully and stationarily position different rows of type characters at the printing line, thus obviating the necessity of any critical and precise timing of the hammer actuating devices and also eliminating any tendency to smudge the imprinted type characters.

In order to simplify the printer, power derived from the stepper motor is also used to advance the paper after printing a complete line. For this purpose, the type drum is rotated one complete revolution during the printing of each line of print but the type characters extend only partly around the periphery of the drum, the remaining portion being left blank to allow for advancement of the paper.

A further feature of the invention is the absence of a clocking or timing circuit under control of the drum to indicate the position thereof as each row of type characters approaches the printing line.

Accordingly, a principle object of the invention is to provide a simple and relatively inexpensive, high speed, parallel data printer.

Another object is to eliminate the need for precise timing of actuation of type hammers, such as is required in printers having a constantly rotating type drum.

Another object is to provide a parallel data printer of the above type having a single stepper motor for both rotating the type drum and for advancing the paper relative to a printing line.

A still further object is to eliminate the need for a clocking or timing device controlled by the type drum for controlling the actuation of the type hammers.

BRIEF DESCRIPTION OF THE DRAWINGS

The manner in which the above and other objects of the invention are accomplished will be readily understood in reference to the following specification when read in conjunction with the accompanying drawings, wherein:

FIG. 1 is a transverse sectional view through a parallel data printer embodying one form of the present invention.

FIG. 2 is a schematic view of the printer and controls therefore.

FIG. 3 is a transverse sectional view showing the hammer retracting bail and drive cam therefore.

FIG. 4 is a view similar to FIG. 1 but with parts omitted and illustrating a modified form of the invention.

DESCRIPTION OF THE EMBODIMENT SHOWN IN FIGS. 1 TO 3

Referring particularly to FIGS. 1 and 2, the printer shown therein comprises a type drum 11 having a plurality of columns of raised type characters 12 extending around a portion of the periphery thereof, each column containing a complete numerical font of type characters ranging in value from 1 to 9 and 0. Similar characters in the different columns are also arranged in rows extending along the length of the drum, i.e., all are located in one row, all are located in a next adjacent row, etc.

The type drum 11 is incrementally rotated by a stepper motor 13 in the direction of arrow *a*. The motor 11 may be of conventional construction and is suitably controlled by a controller switch unit 14 also of conventional construction. Pulses applied to an input line 15 are distributed by the switch unit 14 to incrementally advance the motor 11.

In the embodiment shown in FIGS. 1 to 3, the motor 13 advances the type drum 24 steps per revolution, i.e., 15° per step. Such motor and control switch unit 14 may be obtained commercially, for example, from the Superior Electric Co. of Bristol, Connecticut.

A plurality of denominationally arranged printing hammers 16 are aligned with respective ones of the columns of type characters 12. Such hammers are independently pivoted on a common stationary shaft 17 and have aligned imprinting heads 18 located in front of a printing ribbon 20 which extends along the length of the drum 11. A paper strip 21, forming a record medium, is fed from a suitable supply roll (not shown) and is guided by a guide chute 22, between a feed roll 23 of elastomeric material or the like and a pressure roll 24, the latter being effective to maintain the paper 21 in frictional engagement with the roll 23. The paper

strip is further guided by a second chute **25**, between the ribbon **20** and the periphery of the type drum **11**.

The printing hammers **16** are independently urged clockwise by tensioned springs **26** but are normally held in their illustrated cocked positioned by latches **27** forming the armatures of electromagnets **28, 29**, etc. Each of the latches **27** is pivotally supported at **30** on a magnet frame **31** forming part of the associated electromagnet and is urged clockwise by a tensioned spring **32** into engagement with a latching shoulder **33** formed on the respective print hammer. Adjacent hammers are differently shaped and the respective electromagnets are staggered about the shaft **17** to permit closer lateral spacing of the hammers **16** than would otherwise be possible. The various magnets **28, 29**, etc., are supported by cross braces **131** forming part of the printer framework.

Upon energizing an electromagnet, i.e., **28**, its latch **27** will release the respective print hammer **16** to the action of its spring **26**, causing the print head **18** to impact the adjacent portions of the ribbon **20** and paper **21** against an underlying type character **12** so as to imprint such character on the paper. During the latter part of this impacting movement, the lower end of the hammer **16** strikes a relatively stiff leaf spring **34** supported by the adjacent brace **131**. The spring **34** then yields to permit printing impact but then immediately returns the hammer slightly in a counterclockwise direction to eliminate smudging or phantom printing.

Means are provided to recock the hammers **16** during the latter part of a revolution of the drum **11**, and after the various type characters have passed the printing line. For this purpose, a recocking bail **36** (see also FIG. **3**) is provided which extends along the length of the type drum **11** and has downwardly extending arms **37** pivotally supported on the shaft **17**. Rollers, one of which is shown at **40**, on the bail arms **37** engage cams **41** mounted on shaft **140** which also carries the feed roll **23**. A mutilated gear **42** on the stepper motor shaft **19** is arranged to mesh with a full gear **43** mounted on the shaft **40**.

Shortly after passage of the last row of type characters **12** past the printing line, located behind the ribbon **20**, the multilated gear **42** engages and drives the gear **43** to rotate the feed roll **23**, and cams **41** one quarter revolution in a clockwise direction and thus cause one of four equi-spaced lobes **39** on each of the cams **41** to rock the bail **36** and thereby rock print hammers counterclockwise until the latter are recocked by the latches **27**. During such recocking movement, the feed roll **23** advances the paper strip **21** to a new print line position. Suitable detent means (not shown) is provided to locate the feed roll **23** and cams **41** in one of their four angular positions, as shown in FIG. **3**, after advancement of the gear **43** by the mutilated gear **42**.

Although the control circuitry for the printer is shown for illustration purposes as being operable according to the binary coded decimal system, it will be apparent to those skilled in the art that with obvious modifications other types of coded circuits could be used, such as decimal coded input circuitry.

As shown in FIG. **2**, denominationally arranged groups **240** of four binary weighted lines each are connected to respective comparator circuits **241** of conventional construction. Comparator circuits **241** are also connected in parallel to a group **49** of four binary weighted lines which are connected to the outputs of successive stages of a four-state binary counter **143**. The latter counter is stepped by a pulse generator **44** through an And gate **45** which is under control of a flip-flop **46**. Pulses applied to the counter **143** are also applied over line **15** to step the motor **13** concurrently with the stepping of the counter.

Indexing means is provided to initially establish isochronism between the type drum **11** and the counter **143** and to stop the drum and reset the counter at the end of a complete revolution of the latter as it reaches its initial position shown in FIG. **1**. For this purpose, a magnetic mark **47**, which may also take the form of a permanent magnet slug, is formed on the type drum **11** and is adapted to generate an indexing pulse in a magnetic sensor or pick-up head diagramatically indicated at **48** during a step of the motor **13** just prior of movement of the type drum **11** into its initial position. Sensor **48** transfers such indexing pulse over a line **50** to reset the counter **143** and to reset the flip-flop **46** so as to close And gate **45**.

It will be noted that in the initial position of the type drum **11** the leading row of type characters is located one step removed from the printing line.

When the printer is initially placed into operation, a false print command pulse is applied over a line **51** to set the flip-flop **46** to open gate **45**, causing the pulse generator **44** to pulse the stepper motor **13** and counter until the type drum **11** moves into its position shown in FIG. **1** at which time an index pulse generated in sensor **48** is applied over line **50** to reset the counter **143** and flip-flop **46** to arrest the motor. Thereafter, binary coded decimal signals, representing a number to be printed, are applied in parallel over the various groups of data lines **240** and a true print command pulse is applied over line **51** to set the flip-flop **46** to concurrently step the motor **13** and counter **143**. When a match occurs between data signals applied over one or more of the groups of data lines **240** and drum position indicating signals applied over the group of lines **49**, representing the selected type character or characters arriving at the printing line, an output signal is applied over a line **52** from the appropriate comparator unit or units **241** to the respective electromagnet or electromagnets i.e., **28, 29**, etc., to fire the respective hammer or hammers **16** and thus cause an imprint.

A suitable delay circuit **53** may be placed in series in circuit with the line **50** to insure that the hammers **16** are fired only when the type drum **11** is at rest.

After all of the type characters **12** have passed the printing line, the pulse generator **44** will continue to step both the motor **13** and the counter **143**, causing gear **42** to drive shaft **140** to recock the hammers **16** and advance the paper as noted herebefore. Although the counter **143** will be further stepped during the continued advance of the motor to its initial position, no further printing can occur even though data signals may continue to be applied to the data input lines **240** since the print hammers will be in the process of being moved to recocked positions by the time the counter **143** has recycled.

Just prior to the end of a complete revolution of the type drum **11**, the index mark **47** will generate an indexing pulse to reset the counter **143** and flip-flop **46**, thus arresting the motor in its initial illustrated position.

FIG. **4** illustrates a modified form of the printer in which elements similar to those shown in FIGS. **1** to **3** are identified by similar reference numbers. In this

case, a full gear **54** is substituted for the multilated gear **42** of FIG. **1**. Gear **54** is in continual mesh with a gear **55** attached to the paper feed shaft **140** so as to rotate the shaft **140** one complete revolution during each revolution of the type drum. A partial paper feed roll **56** is located so that during the first part of a revolution of the type drum **11** and while printing is occurring, the feed roll will be ineffective to advance the paper **21**, while during the latter part of the revolution of the type drum and after printing has been completed, the raised portion of the feed roll will advance the paper to the next print line. Also, the hammer recocking cams are modified as shown at **58** to rock the recocking bail **36** at the start of the second half revolution of the shaft **40**, after the printing operation.

Although the printer is disclosed as having a numerical printing font only, it will be apparent that the printer could be readily modified to incorporate an alpha-numerical or other printing font as well.

I claim:

1. A data printer comprising

a rotatable type drum having a plurality of columns of type characters thereon,

said type characters extending about a first part only of the periphery of said drum,

printing devices associated with respective ones of said columns for transferring an imprint of any of said type characters in respective ones of said rows onto a record medium,

a stepper motor for incrementally rotating said type drum to successively position different ones of said type characters in printing relation to said printing devices,

comparing devices for comparing drum position indicating signals and data signals and for causing operation of respective ones of said printing devices when said drum position indicating signals correspond to said data signals,

a counting device for applying drum position indicating signals to each of said comparing devices,

means for applying data signals to each of said comparing devices,

pulsing means for concurrently causing stepping of said counting device and said counter,

means operable by said stepper motor during movement of a second part of said periphery of said drum past said printing devices for advancing said record medium from one line printing position to a next,

means controlled by said drum after said advancement of said record medium for providing an index signal, and

means responsive to said index signal for rendering said pulsing means ineffective.

2. A data printer according to claim **1** comprising

means responsive to said index signal for resetting said counter to an initial counting position.

3. A data printer according to claim **2** wherein said index signal providing means provides said index signal when the first of said type characters in said rows are located one step removed from said printing devices.

4. A data printer comprising

a rotatable type drum having a plurality of columns of type characters thereon,

said type characters extending about a first part only of the periphery of said drum,

printing devices associated with respective ones of said columns for transferring an imprint of any of said type characters in respective ones of said rows onto a record medium,

a stepper motor for incrementally rotating said type drum to successively position different ones of said type characters in printing relation to said printing devices,

comparing devices for comparing drum position indicating signals and data signals and for causing operation of respective ones of said printing devices when said drum position indicating signals correspond to said data signals,

a counting device for applying drum position indicating signals to each of said comparing devices,

means for applying data signals to each of said comparing devices,

pulsing means for concurrently causing stepping of said counting device and said motor,

means operable by said stepping motor during movement of the remaining part of said periphery of said drum past said printing devices for advancing said record medium from one line printing position to a next,

means operable after said advancement of said record medium and prior to movement of a first of said type characters in cooperative relation with a respective one of said printing devices for providing an index signal,

means responsive to said index signal for rendering said pulsing means ineffective, and

means for selectively rendering said pulsing means effective.

5. A data printer according to claim **4** wherein said record medium advancing means comprises

a record medium drive roller,

a (first) driven gear operatively connected to said roller, and

a drive gear for driving said driven gear,

said drive gear having gear teeth about a portion only of the periphery thereof,

said drive gear being operable to drive said driven gear only after passage of all the said type characters past said printing devices.

6. A data printer according to claim **4** wherein said record medium advancing means comprises

a drive roller engagable with said record medium for advancing said record medium, and

means operable by said motor for rotating said roller,

said roller having a record medium engaging surface over a portion only of the periphery thereof,

said surface being arranged to advance said record medium only after passage of all the said type characters past said printing devices.

* * * * *