

June 18, 1968

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3,388,782

SERIAL DATA PRINTER HAVING PLURAL HAMMERS ACTUATED IN SEQUENCE

Original Filed May 10, 1966

3 Sheets-Sheet 1

FIG. 1

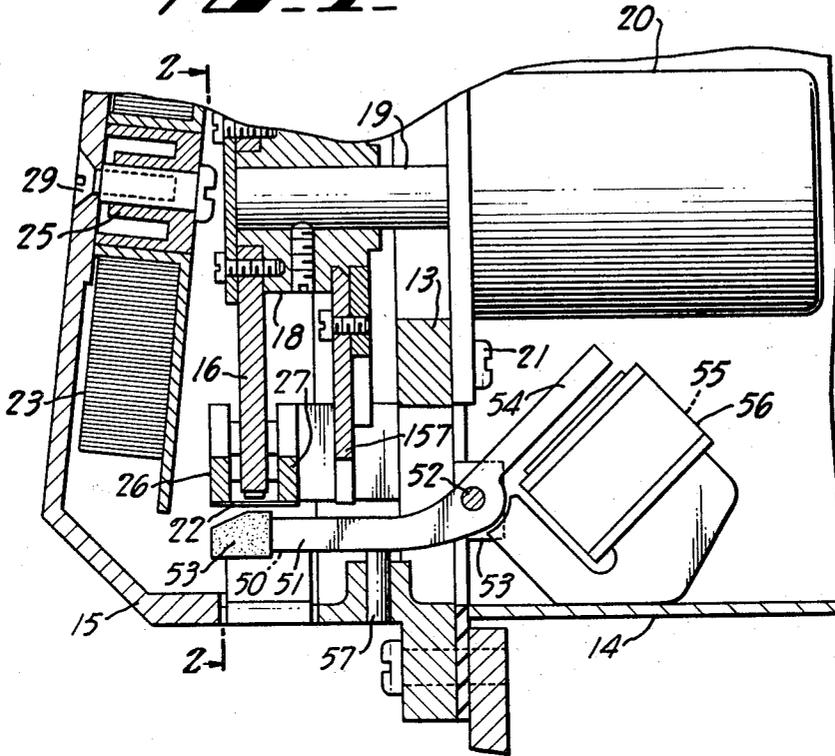
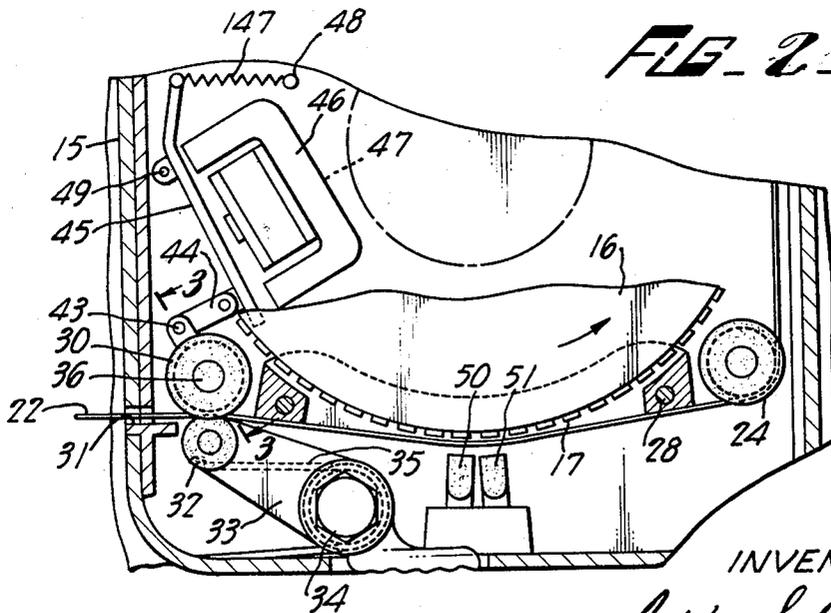


FIG. 2



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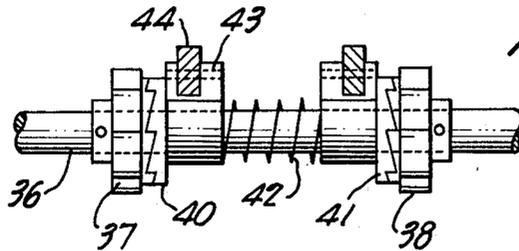


FIG. 3

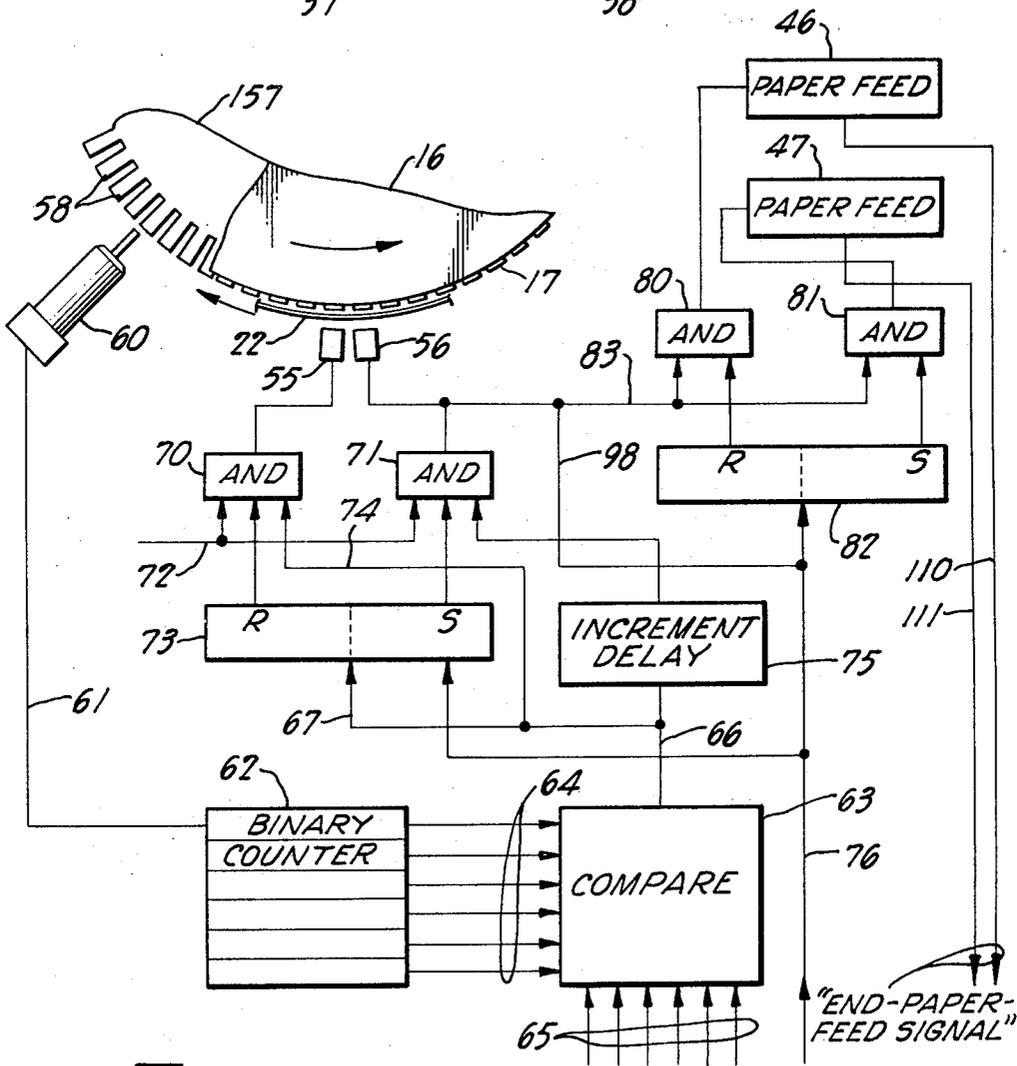


FIG. 4

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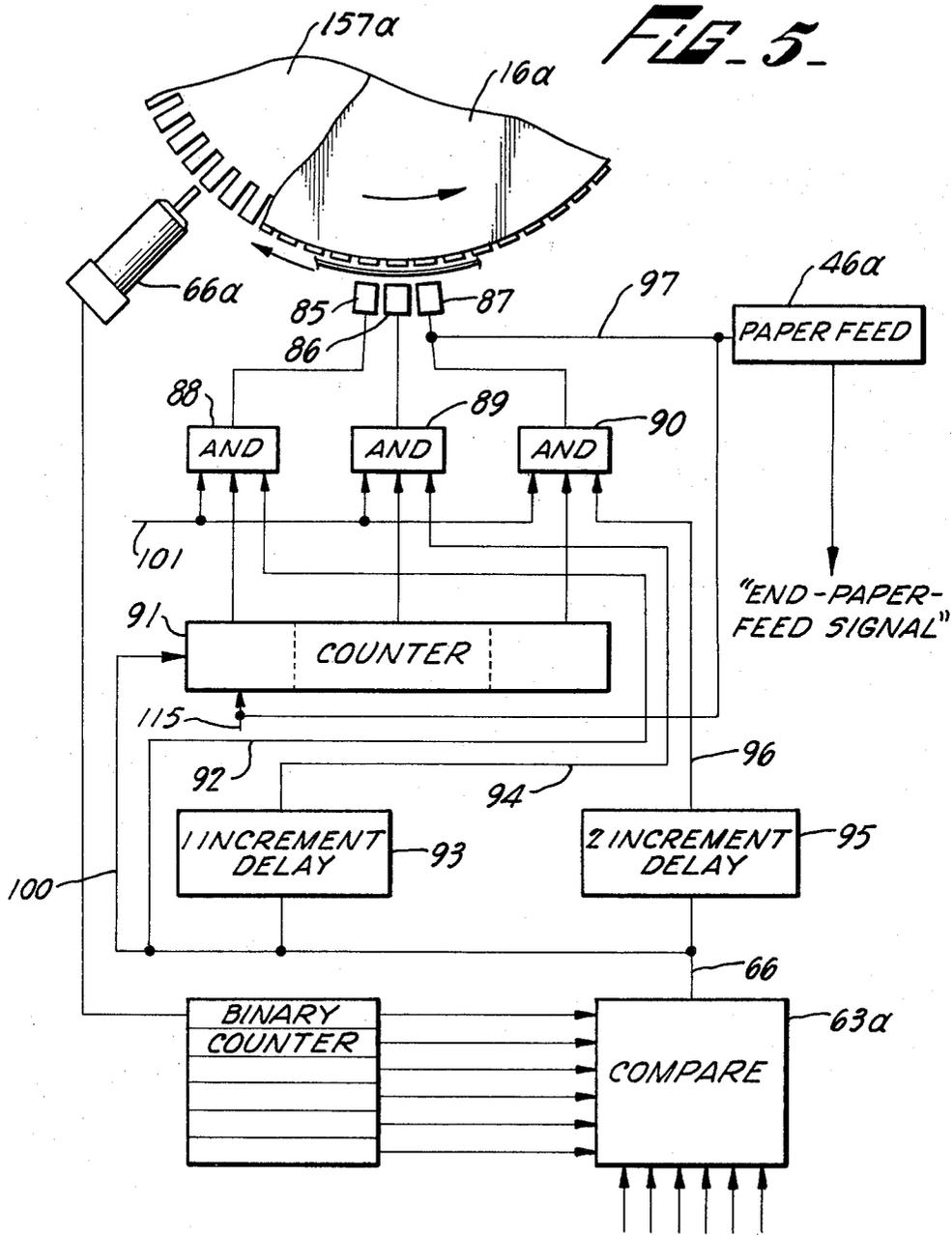
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3 Sheets-Sheet 3



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SERIAL DATA PRINTER HAVING PLURAL HAMMERS ACTUATED IN SEQUENCE

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Continuation of application Ser. No. 548,981, May 10, 1966. This application June 5, 1967, Ser. No. 645,538
6 Claims. (Cl. 197-49)

ABSTRACT OF THE DISCLOSURE

A data printer having a continuously rotating type wheel with two print hammers spaced apart a distance equal to the spacing between adjacent type characters on the print wheel and arranged so that the hammers are operated in sequence.

This application is a continuation of Ser. No. 548,981, filed May 10, 1966, now abandoned.

This invention relates to data printers and has particular reference to serial printers of the print-on-the-fly type wherein a type hammer is operated to impress a paper record medium against a selected one of a font of type characters carried by a constantly rotating type wheel.

One of the limiting factors in the speed of printing operation of such serial printers is the time required for the printing hammer to advance into printing impact with the paper and then to retract to its initial or rest position preparatory to effecting a new print. During such retracting stroke, which normally takes approximately the same length of time as the advancing stroke, a newly selected type character may pass by the hammer, thereby requiring the printing operation to be held up until the type wheel makes a complete revolution or until a new font of type characters comes into printing range to again bring such newly selected type character into cooperative relation with the hammer.

It therefore becomes a principal object of the present invention to increase the printing speed of a print-on-the-fly type serial printer.

Another object is to enable one of a plurality of print hammers associated with a printer of the above type to effect printing while another is being retracted from printing impact.

Another object is to provide a high speed intermittent paper feed mechanism for printers.

Another object is to provide a printer of the above type which is simple and economical to manufacture.

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

FIG. 1 is a sectional view, partly broken away, of a serial printer embodying a preferred form of the present invention.

FIG. 2 is a sectional view, partly broken away and taken substantially along line 2-2 of FIG. 1.

FIG. 3 is a sectional view taken along line 3-3 of FIG. 2, illustrating the paper tape feeding mechanism.

FIG. 4 is a schematic view illustrating the circuit for controlling the printer.

FIG. 5 is a schematic view illustrating a modified form of the invention in which three print hammers are utilized.

Referring to FIGS. 1 to 3 in particular, the printer disclosed therein is somewhat similar to that disclosed and claimed in the copending application of D. O. Rasmussen et al., Ser. No. 532,469, filed on Mar. 7, 1966.

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Reference may be had to said application for a disclosure of parts of the printer not fully disclosed herein.

The printer comprises a body part 13 to the rear of which is secured a housing shell 14. A cap member 15 is removably secured to the forward end of the printer.

A continuously rotating type wheel 16 is provided having a series of regularly spaced type characters 17 formed around the periphery thereof, the characters forming a complete font. The type wheel is mounted on a hub 18 fastened to the shaft 19 of a constant speed electric motor 20 which rotates the type wheel in a counterclockwise direction, as viewed in FIG. 2. The motor 20 is secured to the body part 13 by screws 21.

Means are provided to guide and feed a narrow paper tape 22 from a supply roll 23 into close proximity to the undersurface of the type wheel 16. The supply roll is mounted on a spool 25 rotatably supported on a spindle 29 carried by the cap member 15. The tape is suitably treated to render an imprint of a type character thereon visible.

Suitable guide rollers, one of which is shown at 24, guide the tape from the supply roll 23 onto arcuate guide shoes 26 and 27 located on opposite sides of the type wheel 16 and secured by screws 28 to the body part 13. The guide shoes 26 and 27 guide the tape adjacent the periphery of the type wheel and toward a feed roller 30 from whence it passes through an opening 31 to the exterior of the printer.

The tape is held in frictional engagement with the feed roller 30 by a pressure roller 32 carried by a lever 33 pivotally supported at 34 and yieldably forced upwardly by a torsion spring 35.

The paper tape is advanced two increments or type character spaces at a time toward the left (in FIG. 2) as an incident to each second print operation. Also, according to the preferred embodiment of the invention, two alternately operable paper feed mechanisms are provided, the purpose of which will become apparent later on.

Referring to FIGS. 2 and 3, the shaft 36 carrying the feed roller 30 is rotatably supported in suitable bearings, not shown, and has attached thereto a pair of spaced ratchet wheels 37 and 38. Ratchet pawls 40 and 41 are slidably and rotatably mounted on the shaft and are yieldably held in driving engagement with the wheels 37 and 38, respectively, by a compression spring 42. The hub of each pawl has an arm 43 thereon which is pivotally connected by a link 44 to the armature 45 of a respective electromagnet 46, 47.

Upon energization of one of the magnets, the associated pawl is actuated to advance the tape 22 two increments. Thereafter, the armature 45 and associated pawl are returned to their positions about a respective pivot support 49 by a spring 147 tensioned between the armature and a frame stud 48.

A pair of independently operable print hammers 50 and 51 are provided in side-by-side relation for imprinting the tape 22 against selected ones of the type characters 17. The hammers are spaced apart a distance equal to the space between two adjacent type characters 17 and are fulcrumed on a pivot pin 52 supported by brackets 53 integral with the body part 13. Each hammer has an impact head 53 thereon of plastic, or the like, and a tail portion 54 forming the armature of a respective electromagnet 55, 56.

Normally, each hammer is held in a retracted position (shown in FIG. 1) by a permanent magnet 57. However, upon energization of either of the magnets 55 and 56 the respective hammer will be rocked clockwise, causing its printhead 53 to imprint the tape against one of the type characters.

For the purpose of accurately timing the impacting of the hammers 50 and 51 and tape 22 against selected type

characters, a timing disc 157 of ferrous metal is suitably secured to the hub 18 and has a plurality of regularly spaced radial slots 58 therearound which, when the type wheel is rotated, move past an induction type pulse generating head 60. As each tab formed by two adjacent slots 58 moves past the head 60, it generates a timing or clock pulse which is transferred through conductor 61 to a six-bit binary counter 62. This occurs each time a type character passes in cooperative relation with one of the hammers.

The counter 62 registers in binary form a representation of the values of the different type characters as they pass into cooperative relation with the hammer 50 and this registration is applied as combinations of voltage levels to one set of input terminals 64 of a comparison circuit 63. The latter circuit may be of any suitable design such as, for example, that shown in the copending patent application of Carmi Ariel, Ser. No. 418,845, filed on Dec. 16, 1964.

When a representation of a character to be printed is applied in the form of a combination of voltage levels from a suitable data processing device or the like to a set of terminals 65 of the circuit 63 and such combination is matched by signals applied to the set of terminals 64, an output signal is supplied over conductor 66 to effect a print by one or the other of the hammers 50 and 51. For this purpose, the hammer magnets 55 and 56 are controlled by respective three input "and" gates 70 and 71. One input of each of such "and" gates is controlled by clocking conductor 72 over which clocking pulses are derived from the head 60 or from a similar head controlled by the timing disc 157.

The "and" gates 70 and 71 are alternately conditioned by a flip-flop circuit 73 connected as a binary element with its "set" terminal connected to a conditioning input of the gate 71 and its "reset" terminal connected to a conditioning input of gate 70. The gate 70 is controlled by matching signals directly from the comparison circuit 63 through conductors 66 and 74 while the gate 71 is controlled from circuit 63 by a delay circuit 75 having a one-increment delay time equal to the time required for two adjacent type characters to pass one of the hammers.

Initially, the flip-flop 73 is preferably arranged in "set" condition by a signal selectively applied over conductor 76. Accordingly, when a character to be printed arrives in cooperative relation with the head 50, as indicated by an output signal applied by the comparison circuit 63, such signal will be applied over conductors 66 and 67 to reset the flip-flop 73, thus conditioning "and" gate 70 to open and gate 71 to close. Slightly thereafter, depending on suitable delay characteristics included in the circuit, the print signal will be applied over conductor 74 which will now be passed by gate 70 to energize the print magnet 55 to imprint the selected character.

As the selected type character moves into cooperative relation with the second hammer, the same print signal will be passed by the delay circuit 75 but at this time the gate 71 will be normally closed.

It should be understood that since an appreciable amount of time lapses between application of a pulse to a print magnet and impact of the respective hammer, the signal will arrive at the magnet several type character times before the type character selected reaches the hammer.

Upon matching by circuit 63 of the set of signals representing the next character to be printed, a second print signal will be applied over conductors 66 and 67 to the flip-flop 73 to set the latter, such print signal being also applied over conductor 74 to "and" gate 70 and subsequently through the delay circuit 75 to the "and" gate 71. Since the characteristics of the circuit are such as to cause switching of the flip-flop before the print signal can pass gate 70, the gate 70 will be closed and gate 71 will be opened. Thus, when the newly selected type character reaches its proper position relative to the second hammer

51, the print signal will pass through the gate 71 to energize print magnet 56.

Upon receipt of the next print signal, the flip-flop 73 will again be reset to cause the hammer 50 to print, and the preceding cycle will follow.

It will be noted from the above that one hammer can be advanced while the other is being retracted. Thus, for example, assuming that the value 11 is to be printed, the hammer 50 would first be actuated to print the first character "1" and after a single character time space, the hammer 51 would be actuated to print against the same type character to print the second character "1," thereby saving the time otherwise required for the print wheel to make a complete revolution.

As noted heretofore, a double paper feeding mechanism including the electromagnets 46 and 47 is provided in which the electromagnets are arranged to be operated alternately. The magnets 46 and 47 are connected to the outputs of "and" gates 80 and 81, respectively. These gates are alternately conditioned by a flip-flop circuit 82 connected as a binary element and having its "set" terminal connected to one input of the "and" gate 81 and its "reset" terminal connected to one input of the gate 80.

Whenever a print signal is applied to the magnet 56 of the second hammer 51, such signal is also applied to the flip-flop 82 over conductor 98 to switch the same to an alternate condition. At the same time, the print signal will be applied over conductor 83 to the conditioned one of the "and" gates 80 and 81 so as to energize one or the other of the paper feed magnets 46 and 47. Suitable delay characteristics are incorporated in the circuit to insure switching prior to passage of the signal through one or the other of the gates 80 and 81.

Suitable switching circuits 110 and 111 are controlled by the respective magnets 46 and 47 to inhibit transmission of signals to the terminals 65 of the comparison circuit 63 until the paper tape has been advanced. However, transmission of such signal is reenabled prior to retraction of the feed pawls 40 and 44 by their respective springs 147.

Accordingly, in cases where the characters are printed in rapid succession, one of the magnets 46 and 47 may be advancing its pawl and the paper feed roll 30 while the other pawl is being retracted so that printing and tape feeding need not be held up pending retraction of one of such pawls.

Selective spacing of the tape at any time may be accomplished by applying a signal over conductor 76, which signal is transmitted over conductors 98 and 83 to energize one of the magnets 46 and 47. Such signal will also, as noted heretofore, set the flip-flop circuit 73 preparatory to a no printing operation.

FIG. 5 illustrates a modified form of the invention in which three printing hammers (not shown) are provided. Such hammers are spaced apart distances equal to the spacing between adjacent type characters and are actuated by respective electromagnets schematically indicated at 85, 86 and 87. In this case, respective "and" gates 88, 89 and 90 control the electromagnets and such "and" gates are, in turn, sequentially conditioned by a ring counter 91 of suitable design. That is, the successive stages of the counter 91 are connected to conditioning inputs of respective ones of the "and" gates 88, 89 and 90.

The counter 91 is stepped by print pulses received via conductor 100 from a comparison circuit 63a which is similar to the circuit 63 of FIG. 4.

The print signals are also applied directly from the output conductor 66 of the circuit 63a and through conductor 92 to an input of gate 88. Such print signals also are applied through a one-increment delay circuit 93, similar to circuit 75 of FIG. 4, and through conductor 94 to an input of the "and" gate 89. Such print signals are also applied through a two-increment delay circuit 95 and conductor 96 to an input of the "and" gate 90. The gates are clocked by clock pulses fed through conductor 101 from

a suitable timing device operable synchronously with the type wheel 16a.

Accordingly, the print hammers are fired in succession as appropriate type characters pass in cooperative relation thereto and any one hammer may be advanced while a preceding hammer is being retracted.

In this embodiment, a single tape feed mechanism is provided, utilizing a single electromagnet 46a which is energized by a print signal applied to the third print magnet 87, through conductor 97. However, a double paper feed mechanism, similar to that illustrated in connection with FIGS. 3 and 4, may be equally well utilized if the type feed signals occur too rapidly for the single feed mechanism to operate properly.

A type space and counter resetting circuit 115 is provided to selectively reset the counter and to advance the tape when desired.

Although the invention has been described in detail and certain specific terms and languages have been used, it is to be understood that the present disclosure is illustrative rather than restrictive and that changes and modifications may be made without departing from the spirit or scope of the invention as set forth in the claims appended hereto.

Having thus described the invention, what is desired to be secured by United States Letters Patent is:

1. A serial data printer comprising a type wheel having at least a single circumferential band of type characters spaced around the periphery thereof,
means for rotating said type wheel,
a plurality of normally disabled independently operable impression devices spaced along said type wheel periphery in juxtaposed character spaces in the path of movement of said circumferential band such that each character in said circumferential band passes by each of said impression devices,
means for guiding a record medium intermediate said type wheel and said impression devices,
said guiding means guiding said record medium at right angles to the axis of rotation of said type wheel,
means for invariably conditioning said impression devices for operation in a predetermined sequence only, said sequence being the same as the sequence in which any given character on said type wheel passes said plurality of impression devices whereby said impression devices are invariably actuated in a sequence which is identical to the sequence in which they are placed along the periphery of said type wheel, and control means for effecting a printing impression by a conditioned one of said impression devices when a desired character to be printed is opposite said conditioned impression device.

2. A serial data printer according to claim 1 comprising means for advancing said record medium as an incident to a printing impression by a predetermined one only of said impression devices.

3. A serial data printer according to claim 1 comprising means for advancing said record medium after printing impressions by all of said impression devices.

4. A serial data printer according to claim 1 wherein said conditioning means is effective in response to operation of one of said impression means to condition a succeeding one of said impression devices.

5. A serial data printer according to claim 1 wherein said control means comprises a signal device for applying a printing impression signal to each of said impression devices when a desired type character is opposite a first one of said devices, and

means for delaying transmission of said signal to a succeeding one of said impression devices.

6. A serial data printer comprising a type wheel having at least a single circumferential band of type characters spaced around the periphery thereof,

means for rotating said type wheel,

a pair of normally disabled independently operable impression devices spaced along said type wheel periphery in juxtaposed character spaces in the path of movement of said circumferential band such that each character in said circumferential band passes by each of said impression devices,

means for guiding a portion of a record medium intermediate said type wheel periphery and said impression devices,

said guiding means guiding said portion of said record medium at right angles to the axis of rotation of said type wheel,

means including a binary element for invariably alternately conditioning said impression devices for operation,

control means for causing a conditioned one of said impression devices to effect a printing impression on said record medium when a desired character to be printed passes opposite said conditioned impression device, and

means responsive to enablement of each of said impression devices for actuating said binary element.

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