

"PRINTER"

The present invention relates to a printer, e.g. a serial printer which performs a printing operation with its print head moving right and left.

5 According to the present invention, there is provided a printer comprising fixed structure, a carriage which is supported by the fixed structure and which is mounted for sliding movement with respect thereto from a home position, a print head mounted on the carriage, and a spring which acts
10 as to urge the carriage to return to the home position, the spring having a coiled portion which is spirally wound around a drum portion of the bobbin, the innermost end portion of the spring being connected to the drum portion solely by frictionally engaging the latter.

15 The bobbin may be rotatably mounted on said structure part, the outermost end portion of the spring being connected to the carriage. Alternatively, the bobbin may be rotatably mounted on the carriage, the outermost end portion of the spring being connected to said structure part.

20 The said structure part may be one of two spaced apart side plates which support guide means on which the carriage is slidably mounted.

25 The coiled portion of the spring may be wound tightly around the drum portion of the bobbin so that the curvature of the said coiled portion is less than that of the drum portion.

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5 The outermost end portion of the spring may be disposed
at a position on or closely adjacent to a line which passes
through the centre of the bobbin and which extends parallel
to the direction of movement of the carriage. In this case,
the said outermost end portion of the spring may be secured
to a connecting means which is rotatably connected to said
carriage or structure part. A portion of the connecting
10 means may be rotatably mounted on a pin which is itself
mounted on said carriage or structure part.

The spring employed in the printer of the present
invention occupies only a small space and is easy to assemble.
Moreover, the pull exerted by the spring may be kept nearly
15 constant irrespective of the distance through which the
carriage has moved so that forward and return movement of the
carriage can be stabilized and there is little change in the
load which the spring applies to means for driving the
carriage.

20 The use of such a spring also reduces the number of
parts which have to be employed in the printer and therefore
makes it less expensive to manufacture the latter.

The arrangement is preferably such that the spring exerts
little side pressure and rotary moment to the carriage so
25 that frictional resistance of the carriage is kept to a minimum.

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The invention is illustrated, merely by way of example, in the accompanying drawings, in which:-

Figure 1 is an elevational view of an essential part of a known serial printer,

5 Figure 2 is a plan view of an essential part of a first embodiment of a serial printer according to the present invention,

Figure 3 is a horizontal sectional view of a bobbin forming part of the printer of Figure 2,

10 Figure 4 is an elevational section of the bobbin shown in Figure 3,

Figure 5 is a horizontal section of another embodiment of a bobbin and a coil spring which can be used in a printer according to the present invention,

15 Figure 6 is a plan view of an essential part of a further embodiment of a serial printer according to the present invention,

20 Figure 7 is a perspective view of one embodiment of a connecting means which may be used in a printer according to the present invention,

Figure 8 is a perspective view of another embodiment of a connecting means which may be used in a printer according to the present invention, and

25 Figures 9 and 10 are diagrams illustrating the operation of the coil spring which forms part of the printer of the present invention.

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Terms such as "left", "right", "upper" and "lower" as used in the description below, are to be understood to refer to directions as seen in the accompanying drawings.

A known serial printer is shown in Figure 1. As shown
5 therein, a carriage 2 of a print head 1 is slidably supported by guide shafts 5, 6 which are secured between side plates 3, 4. A wire rope 7 is connected at one end to the right hand side portion of the carriage 2 and is connected at its other end to the left hand side portion of the carriage 2.
10 The wire rope 7 is guided by pulleys 8, 10 and 11 and is wound around a drive drum 9. A helical spring 13 is provided for returning the carriage 2, the spring 13 being much longer than the stroke of the carriage 2. One end of the spring 13 is connected to the left hand side of the carriage 2 and
15 the other end of it is connected to a fixed pin P. The spring 13 follows a zigzag path by virtue of passing over guide pulleys 14 and 15. When the drive drum 9 is actuated by a motor (not shown) through a gear train (not shown), the carriage 2 moves rightwards against the pull of the spring
20 13. When a clutch (not shown) in the gear train disengages the motor, the carriage 2 is restored to its home position by the pull of the spring 13.

If the spring 13 is short, the pull exerted by the spring 13 changes according to the position of the carriage 2, and the
25 load applied to the motor and gear train, or to other means for

driving the carriage 2, also changes. This change in load affects the return speed of the carriage 2 and the operation of the carriage therefore becomes unstable. Although it is impossible to eliminate the change of load completely, it is possible to reduce it by minimizing the spring modulus. In order to minimize the spring modulus, however, the spring 13 must be designed to be very long as shown in Figure 1. Consequently, the size or number of the parts used in the printer, e.g. guide pulleys, are increased and the printer becomes laborious to manufacture.

The object of the present invention is to overcome such disadvantages.

In Figure 2 there is therefore shown a first embodiment of a serial printer according to the present invention.

Referring to Figure 2, two guide shafts 18 are provided between and supported by spaced apart side plates 16, 17.

(Only one guide shaft 18 is shown in Figure 2 because a lower guide shaft is not visible by reason of being behind the upper guide shaft). A carriage 19 is slidably supported by the guide shafts 18. The carriage 19 carries a print head 20.

A wire rope 21 is connected at an end portion 21a thereof to the upper right hand side portion of the carriage 19 and is connected at its opposite end portion 21b to the left hand side portion of the carriage. Several turns of the wire rope 21 are wound around a drive drum 22, and the wire rope passes

around a guide pulley 23. A bobbin 25 is rotatably mounted on a pin 24 secured to the left hand side plate 16. Several turns of a spiral or coil spring 26 made of belt type spring material are spirally wound around the bobbin 25. The spring 5 26 pulls the carriage 19. The coiled portion of the spring 26 is wound with a curvature a little smaller than that of a drum portion 25a (Figures 3 and 4) of the bobbin 25 and is coiled tightly about the driven portion 25a without leaving any space as shown in Figures 3 and 4. The spring 26 is secured to the 10 bobbin 25 only by winding around the bobbin, and the innermost end portion of the spring 26 merely contacts the drum portion 25a without being positively secured thereto by connecting means. The outer end portion of the spring 26 is connected to the carriage 19. A platen 27 is provided at a position adjacent 15 to and facing the print head 20.

In operation, when the drive drum 22 rotates clockwise as seen in Figure 2, the carriage 19 moves rightwards by reason of the pull exerted by the wire rope 21 and the spring 26 is stretched rightwards. The innermost portion of the 20 spring 26 frictionally contacts the surface of the drum portion 25a of the bobbin 25, and when the spring 26 is pulled out, the bobbin 25 is rotated about the pin 24. Upon disconnecting a clutch (not shown) in a gear train (not shown) of the drive drum 22, the carriage 19 returns to its home position by the pull 25 exerted by the spring 26. The spring 26 is pulled out nearly

straight as the carriage 19 moves forward. The pull exerted by the spring 26 occurs as it is urged to return to its original coiled shape, and the spring 26 exerts a constant pull force irrespective of the distance through which the carriage 19 has moved. Accordingly, the load applied to the drive means which drives the carriage 19 is kept constant, and the forward and backward speeds of the carriage 19 are maintained stable.

In the above embodiment, the innermost portion of the spring 26 may alternatively be secured to the bobbin 25 by an appropriate means such as adhesive material.

The spring 26 may be wound into a coil leaving space between the turns as shown in Figure 5. In this case, the bobbin 25 may be fixed to the side plate 16. In the case of the spring of Figure 5, there may be some change in the pull exerted by the spring 26 according to the distance through which the carriage 19 has moved.

In another embodiment (not shown) the spring 26 may be rotatably supported on the carriage 19, the outer end portion of the spring being connected to the side plate 16.

Figure 6 shows a further embodiment of the present invention which is generally similar to that of Figures 2-4 and which for this reason will not be described in detail, like reference numerals indicating like parts. In the Figure 6 embodiment, however, a different means is used

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for connecting the spring 26 to the carriage 19. One feature is that the outer end portion of the spring 26 is connected to the carriage 19 at a position on or closely adjacent to a line 28 which crosses the centre of the bobbin 25 and of the coiled portion of the spring 26 and which extends parallel to the direction of movement of the carriage 19. Another feature is that the outer end portion of the spring 26 is rotatably connected to the carriage 19. A pin 29 is mounted on the carriage 19 and the pin 29 is located on the line 28 which passes through the centre of the bobbin 25 parallel to the direction of movement of the carriage 19. A connecting means 30 for connecting the spring 26 to the carriage 19 is provided at the outer end portion of the spring 26. The connecting means 30 has a tubular portion which is rotatably mounted on the pin 29. The shape of the connecting means 30 may be varied appropriately. For example, in Figure 8, a connecting means 31 is shown which is provided with a bent flange portion 31a having a hole 31b to engage with the pin 29.

With regard to the manner in which the carriage 19 of the Figure 6 embodiment is returned to its home position, the following facts have been confirmed by experiment. If the pin 29 is positioned at a position 29' or 29" (Figure 9) other than on the line 28, a vertical component of a force F_2 or F_3 is applied to the pin 29 and the carriage 19 is moved

eccentrically so as to be forced against one of the
guide shafts 18, whereby frictional resistance is increased.
On the contrary, in the case of the Figure 6 embodiment,
since the pin 29 is positioned on the line 28, the component
of force, such as F_2 or F_3 , described above does not exist,
and only a force F_1 acts along the direction of movement
of the carriage 19. The frictional resistance of the carriage
19 against the guide shafts 18 is relatively low and the
carriage slides smoothly. Further, if the connecting means
30 were fixed securely to the pin 29, a rotary moment M
would act on the pin 29 when the carriage 19 moves as shown
in Figure 10, and the frictional resistance of the carriage
would be high. In the Figure 6 embodiment, however, such
a rotary moment does not occur, since the connecting means
30 is rotatably connected to the pin 29.

The rotary moment M , however, decreases as the carriage
19 moves away from the bobbin 25. Therefore if the bobbin 25
is provided at a position sufficiently distant from the home
position of the carriage 19, the effect of the rotary moment
 M is negligibly small and in that case the connecting means
30 may be non-rotatably fixed to the pin 29.

C L A I M S

1. A printer comprising fixed structure, a carriage which is supported by the fixed structure and which is mounted for sliding movement with respect thereto from a home position, a print head mounted on the carriage, and
5 a spring which acts between the carriage and a part of said fixed structure so as to urge the carriage to return to the home position, the spring having a coiled portion which is spirally wound around a drum portion of a bobbin, the innermost end portion of the spring being connected to the
10 drum portion solely by frictionally engaging the latter.
2. A printer as claimed in claim 1 in which the bobbin is rotatably mounted on said structure part, the outermost end portion of the spring being connected to the carriage.
- 15 3. A printer as claimed in claim 1 in which the bobbin is rotatably mounted on the carriage, the outermost end portion of the spring being connected to said structure part.
4. A printer as claimed in any preceding claim in which
20 the said structure part is one of two spaced apart side plates which support guide means on which the carriage is slidably mounted.



5. A printer as claimed in any preceding claim in which the coiled portion of the spring is wound tightly around the drum portion of the bobbin so that the curvature of the said coiled portion is less than that of the drum portion.
- 5 6. A printer as claimed in claim 1 in which the outermost end portion of the spring is disposed at a position on or closely adjacent to a line which passes through the centre of the bobbin and which extends parallel to the direction of movement of the carriage.
- 10 7. A printer as claimed in claim 6 in which the said outermost end portion of the spring is secured to a connecting means which is rotatably connected to said carriage or structure part.
- 15 8. A printer as claimed in claim 7 in which a portion of the connecting means is rotatably mounted on a pin which is itself mounted on said carriage or structure part.
9. A printer substantially as hereinbefore described with reference to and as shown in Figures 2-10 of the accompanying drawings.

