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(54) Printer head.

(57) A printer head consists of a yoke (11), magnet members (12) mounted to the yoke, a base plate (14) attached to the front of the yoke (11), and a plurality of head pins (17) provided between the yoke (11) and the base plate (14). In this printer head, the head pins (17) are arranged in straight rows, which are inclined at a specified angle to the direction of stroke of the printer head. The base plate (14) is formed with a plurality of through- holes (18) at positions corresponding to the head pins so that the head pins can be advanced and retracted through the through-holes (18) by the action of the magnet circuit.

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PRINTER HEAD

The present invention relates to a printer head and more specifically to a printer head which is of simplified head construction without requiring a substantial increase in the head stroke.

Rapid development of office automation devices in recent years has led to an increasing use of printers connected with office computers and word processors. The printers have a printer head mounted in a printing section. An example of a conventional printer head is shown in Figure 1.

This printer head consists of a yoke *1* for forming an electromagnetic circuit, a permanent magnet *2* secured to the yoke *1*, an electromagnetic coil *3* mounted close to the permanent magnet *2*, a base plate *4* mounted on the front of the yoke *1*, an armature *6* mounted to a leaf spring *5* clamped between the yoke *1* and the base plate *4*, and a print wire *7* attached to the front end of the armature *6*.

The base plate *4* has almost at its center a forwardly projecting cylindrical wire holder *9*, which has a guide *8* at the front end and contains the print wire *7* therein. The magnet members *2*, *3*, leaf spring *5*, armature *6* and print wire *7* make up a print set and a plurality of the print sets are provided in a plane perpendicular to the center line *0* of the printer head in such a way that these sets are arranged in a circle at angles apart from each other. The same number of print wires *7* as that of the print sets are passed through the wire holder *9* to reach the outlet of the guide *8*. In this type of printer head, 24 print wires *7* for example are used. In a very small space at the guide *8* of the wire holder *9*, the front ends of these print wires *7* are held and lined at equal intervals in a vertical direction perpendicular to the direction of the printer head stroke in such a way that they will not come into contact with each other. For this purpose, very fine wires are used as the print wires *7*.

For printing operation, these 24 print wires cover the height of one line of characters. When the printer head of such a construction is not in operation, electric current is not applied to the electromagnetic coil *3*, so that the armature *6* is attracted to the front surface of the yoke *1* by the action of the permanent magnet *2*. Thus, the leaf spring *5* is deflected rearwardly holding the print wires *7* at a retracted position (in a state shown in Figure 1). When current is passed through the electromagnetic coil *3*, the electromagnetic coil *3* is energized to cancel out the magnetic flux of the permanent magnet *2*. This allows the armature *6* to rapidly part from the yoke surface by the recovery force of the leaf spring *5* attached to the armature *6*, causing the print wires *7* to advance forwardly. As a result, the front end of the print wire *7* abuts against a sheet of recording paper set on a platen (not shown). When the current to the electromagnetic coil *3* is interrupted, the armature *6* is again attracted to the surface of the yoke *1* by the permanent magnet *2*.

With the above-mentioned conventional printer head, however, since the front ends of 24 print wires *7* must be held and lined at equal intervals in the vertical direction at the guide *8* of the wire holder *9* by various means so that they will not contact or strike each other, the manufacture of the printer head becomes very complex and the construction ranging from the magnetic members *2*, *3* to the print wires *7* is complicated.

This invention has been accomplished to overcome the above drawbacks, and its objective is to provide a printer head which is simple in structure and easy to manufacture. This is achieved by the characterising features of claim 1. Advantageously, the invention is further characterized in that short head pins are employed in elements that perform printing, that these head pins are arranged in two or more straight rows which are inclined at a specified angle to the direction of stroke of the printer head, and that a plurality of through-holes are formed in a base plate at positions corresponding to the head pins.

Because a plurality of head pins are arranged in line extending basically in the direction of stroke of the printer head, the intervals between adjacent head pins can be increased without increasing the vertical dimension of the head pin installation space. In more detail, the head pins are arranged in two or more straight rows, not in a single row, which are slightly inclined with respect to the direction of the printer head stroke, so that not only can a large number of head pins be accommodated in a space, which is small in the vertical direction, but also the printer head can be prevented from becoming large in the lateral size. For printing operation, print data for a plurality of characters are sent to the printer head in synchronism with the latter's motion to activate the head pins arranged in tilted rows.

A character being printed by a head pin located at the front position with respect to the direction of the forward stroke of the printer head is staggered in the direction of printer head stroke from a character being printed by a head pin at the rear position. Now, the process of printing each character is examined. A character begins to be printed by the passage of a head pin, which is located at the foremost position with respect to the direction of the printer head stroke, and its printing is ended when the rearmost head pin passes the print position of the character. At the same time that the printing of this character has just finished, the first head pin starts printing any other character located in front of the character in question or has finished the printing of the line.

This invention, therefore, allows a relatively wide

space for the head pins and their drive mechanisms while at the same time maintaining the dots printed by the head pins close enough to each other so that the dots fall in a small vertical space. Another advantage is that since the head pins are divided into two or more straight rows, an extra stroke of the printer head required to print a single line can be minimized.

This invention will be described in more detail in conjunction with an embodiment shown in the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a side cross section of one example of a conventional printer head ;

Figure 2 is a side cross section of one embodiment of a printer head according to this invention;

Figure 3 is a schematic diagram showing head pins installed on a front right half of the printer head as shown in figure 2 and the arrangement of drive mechanisms for the head pins ; and

Figure 4 is a schematic diagram showing the head pins arranged in inclined rows.

Figures 2 to 4 show one embodiment of a printer head according to this invention. Figure 2 is a cross section showing the construction of a print assembly in the printer head ; and Figure 3 is a schematic diagram showing a part of the printer head as viewed from the front.

The printer head of this embodiment consists of a yoke *11* to form an electromagnetic circuit ; a permanent magnet *12* securely mounted to the yoke *11*; an electromagnetic coil *13* wound on the permanent magnet *12* to form, together with the permanent magnet *12*, a magnetic drive member ; a base plate *14* mounted on the front of the yoke *11* ; an armature *16* attached to a leaf spring *15* clamped between the yoke *11* and the base plate *14* ; and a head pin *17* for printing which is attached to the front of the armature *16*.

In this embodiment, the magnetic drive member made up of the permanent magnet *12* and the electromagnetic coil *13*, the leaf spring *15*, the armature *16* and the head pin *17* all combine to form a print assembly. A plurality of print assemblies (for example 24 assemblies) are installed at the back of the base plate *14*, as shown in Figure 3.

The head pin *17* is formed of a rod member shorter than the conventional print wire *7* but which has a larger diameter than the print wire *7*, except at the front end which is pointed into a very small diameter. The number of head pins *17* corresponds to that of the print assemblies. They are divided into two rows of 12 head pins each (see Figure 3). Figure 3 shows the right half, viewed from the front, of the printer head in which upper and lower rows *A1*, *A2* of 12 head pins *17* are arranged. These rows of head pins *17* are lined parallel to each other and inclined at a small specified angle of θ to the direction of printer head stroke or motion (for example, to the horizontal line *H*). The base plate *14* is formed with through-holes *18* at positions corresponding to the head pins *17* so that the head pins *17* can be passed through the holes *18*.

Figure 4 schematically shows the arrangement of the head pins *17*. In the figure, the head pins as a whole are fed toward the right during printing operation, i.e., the forward side is on the right and the backward side is on the left of the drawing. In the upper and lower rows *A1*, *A2* ranging from the first head pins *17a*, *17c* to the last head pins *17b*, *17d*, the head pins *17* are lined at equal intervals or pitches *P*. Since the rows *A1*, *A2* are inclined at an angle of θ, there are vertical deviations between the adjacent head pins *17*. The vertical deviation between each head pins *17* is given by

$$d = P \sin\theta$$

The junction point between the upper and lower rows *A1*, *A2* is correctly adjusted for the vertical deviation. That is, the vertical deviation between the last head pin *17b* of the upper row *A1* and the first head pin 17c of the lower row *A2* is also set to *d*. Hence, the overall vertical distance *D* from the first head pin *17a* to the last head pin *17d* is expressed as

$$D = 23d$$
$$= 23P \sin\theta$$

On the other hand, the total length of the head pin rows is *23P* if the two rows were arranged in one line. In other words, a row of head pins this long is accommodated in such a small vertical space.

This makes additional space available for the installation of the head pins *17* and their drive mechanisms. Thus, the drive mechanisms each consisting of the yoke *11*, electromagnetic coil *13* and leaf spring *15* are installed behind the base plate *14* in an almost elliptic arrangement. Further, as mentioned above, the head pins *17* can be formed of a rod member which is larger in diameter than the conventional print wires. Another advantage is that even when the head pins *17* are formed shorter than the conventional print wires, the adjacent drive members do not interfere with each other.

Now, the operation of the printer head of the above construction will be described.

The above-mentioned arrangement of the head pins *17* in the printer head of this embodiment is equivalent to installing a large number of head pins *17* (in the above case 24 pins) in a small vertical space. Since the head pins *17* are arranged not in a single straight row but in two rows (they may be arranged in three or more rows), the printer head can be made compact.

For operation, the printer head is fed with print data for a plurality of characters in synchronism with the printer head motion to drive a plurality of head pins arranged in inclined rows. A character being printed by head pins *17a*, *17c* located at the front position with

respect to the direction of the forward stroke of the printer head is staggered in the direction of printer head stroke from a character being printed by head pins *17b*, *17d* at the rear position. Let us look at the process of printing each character. A character begins to be printed by the passage of the head pin *17c* located at the foremost position and its printing is ended when the rearmost head pin *17b* passes the print position of the character. At the same time that the printing of this character has just finished, the first head pin *17c* starts printing any other character located in front of the character in question or has finished the printing of the line.

In this way, the printing of one line of a document is carried out by activating a series of head pins *17* successively, from the first head pin *17c* to the last head pin *17b*, in synchronism with the motion of the printer head.

Claims

1. A printer head comprising :
   a yoke (11) ;
   a magnet member (12) mounted to the yoke to form a magnetic circuit together with the yoke (11) ;
   a base plate (14) provided at the front of the yoke (11) ; and a plurality of head pins (17) provided between the yoke (11) and the base plate (14) in such a manner that the head pins can be advanced and retracted ; characterized in that the head pins (17) are arranged in a line that is inclined at a predetermined oblique angle with respect to the direction of stroke of the printer head, that the base plate (14) is formed with a plurality of through-holes (18) at positions corresponding to the head pins (17), and that the head pins are arranged to be advanced and retracted through the through-holes (18) in the base plate (14) by the action of the magnetic circuit.

2. A printer head as claimed in claim 1, characterized in that head pins (17) are arranged in a plurality of straight rows.

3. A printer head as claimed in claim 2, characterized in that said head pins (17) are arranged in two straight rows.

4. A printer head as claimed in claim 2 or, characterized in that through-holes (18) formed in the base plate (14) are arranged in a plurality of rows that conform to the arrangement of the head pins (17).

Fig. 1
Prior Art

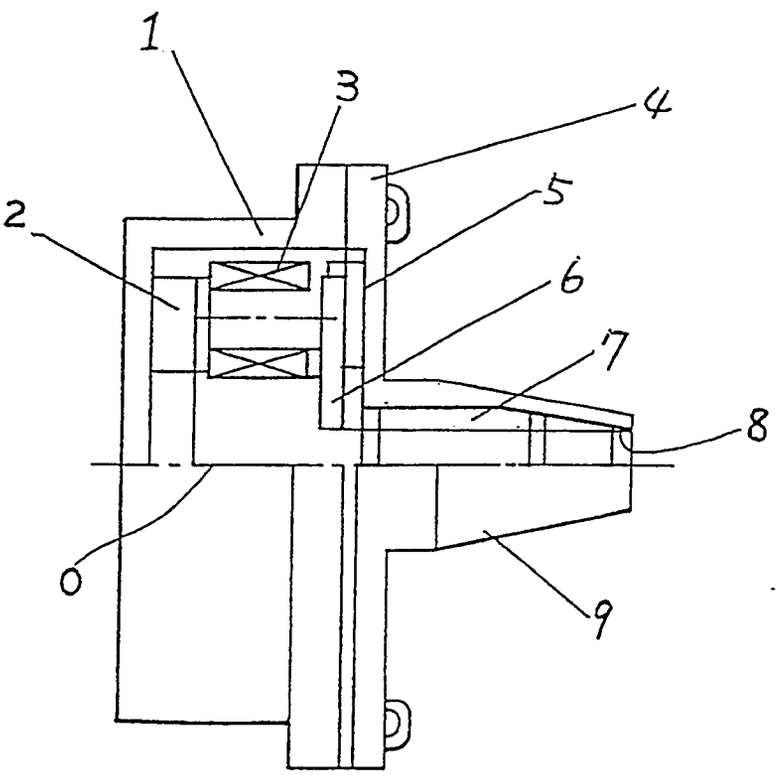

Fig. 2

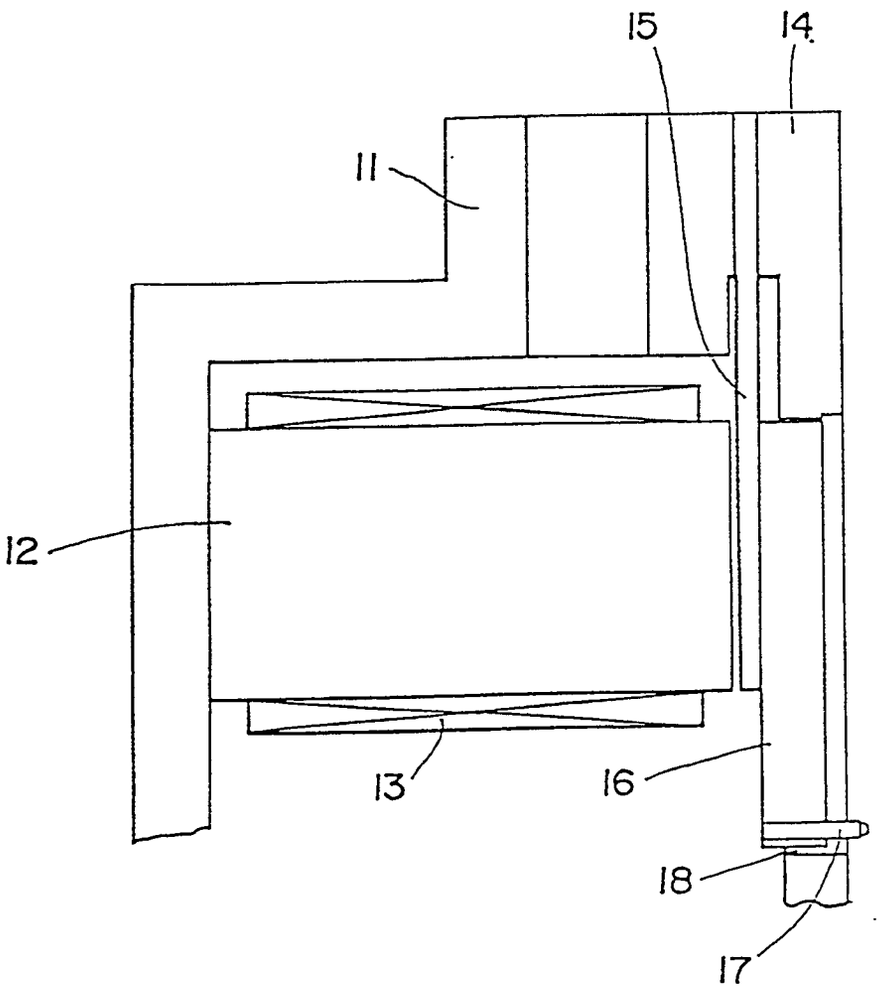

Fig. 3

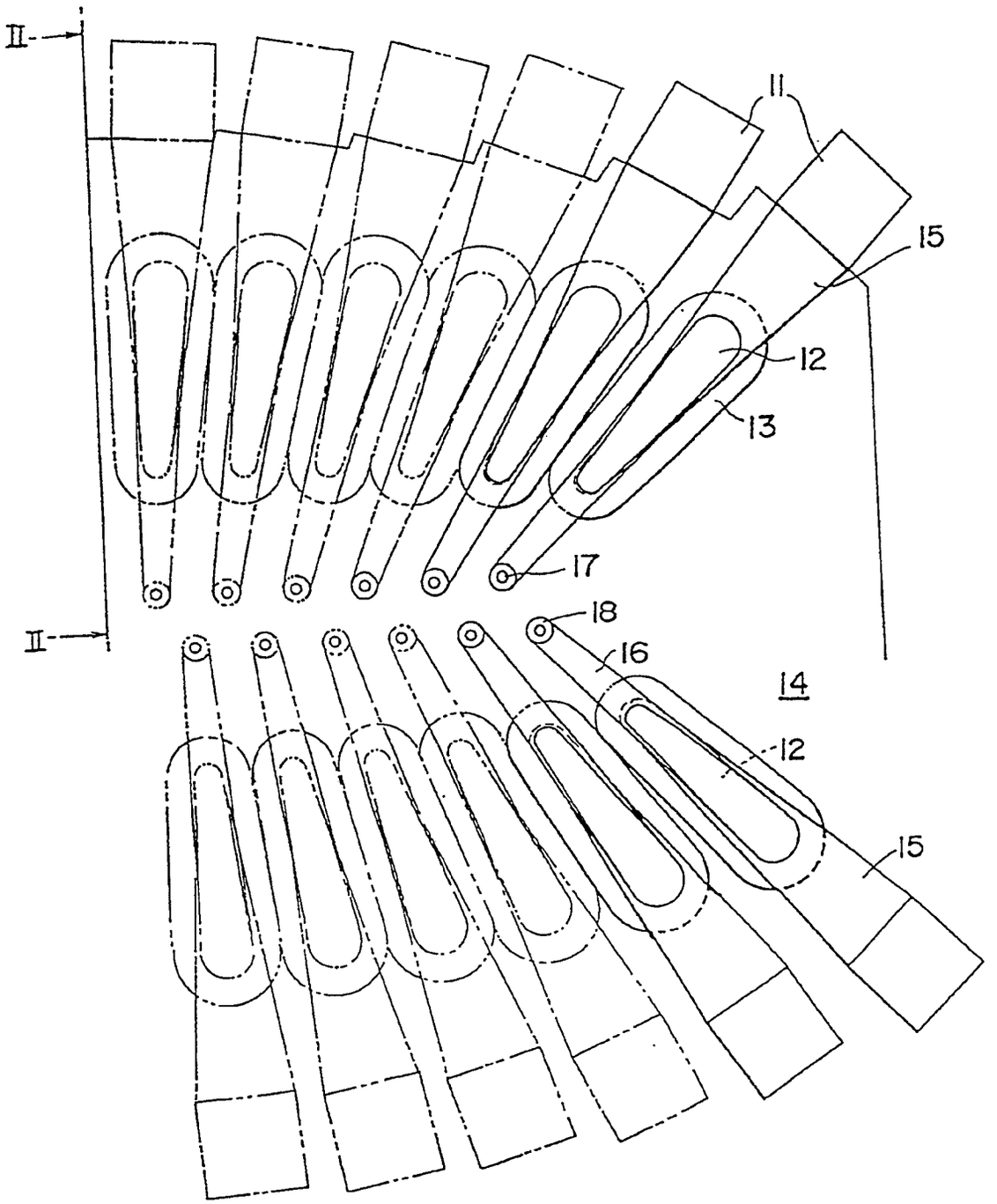

Fig. 4