

"WIRE DRIVE UNIT FOR USE IN A WIRE DOT PRINT HEAD"

The present invention relates to a wire drive unit for use in a wire dot print head.

U.S. Patent No. 4,348,120 discloses a spring-charged print head having a plurality of wire drivers composed of
5 a permanent magnet, wires, electromagnets and other components, the wire drivers being arranged in a circular pattern. The permanent magnet is ring-shaped and shared by the wire drivers. The wires are fixed at an angle of about 90° to a leaf spring. With this construction, the
10 head has an unnecessarily large outside diameter, the head components are complex in shape, and the head cannot be assembled with ease.

Since the magnetic circuits for the wires are not separated from each other, there is magnetic interference
15 between the electromagnets. The wire speeds vary from each other in dependence upon the number of coils being energized, and this results in varying printing densities and sometimes in printing failures. One solution is to change the coil driving conditions, in dependence on printing patterns, so as
20 to achieve equal wire speeds. This arrangement however requires an expensive apparatus.

There are limitations on higher-speed operation of the head due to large inertia of the movable components, and the head consumes an unnecessarily large amount of electric power and suffers from the problem of excessive heating.

5 Leaf springs which constitute a means of driving the wires are subjected to secondary vibrations, thereby causing the wires to move unstably. This has posed a limitation on operation at higher speeds. To cope with this, cross springs have been employed as wire drive springs. However, these
10 springs are complex in construction, and the head cannot be assembled easily and the cost of the head is unnecessarily great.

According to the present invention, there is provided a wire drive unit for use in a wire dot print head comprising
15 a leaf spring; a plunger fixed to the leaf spring; a permanent magnet whose magnetic flux acts on the plunger so as to urge the leaf spring to flex towards the magnet; a coil which, when energised, produces flux in opposition to the said magnetic flux so that the leaf spring is released
20 from being flexed towards the magnet; and a wire holder member secured to the leaf spring, the wire holder member holding a printing wire which extends at an angle not exceeding 15° to the leaf spring at least substantially throughout its length.

The wire holder member may be a sheet metal member.

The leaf spring may have a bent projection at a free end thereof, said bent projection being secured to the wire holder member.

5 Alternatively, or additionally, the leaf spring may be secured to the wire holder member by the plunger.

Fixing members may be provided between which said leaf spring is fixed, one of said fixing members being disposed on a side of said leaf spring remote from said magnet and extending close to the centre of the effective spring portion of said leaf spring.

10 A portion of the wire holder member may be wrapped around the wire.

The wire holder member and the wire may be secured together by resistance welding.

A stop may be provided for engagement with the wire holder member when the leaf spring is flexed, and this stop may, if desired, be wedge-shaped.

15 The stop may be provided adjacent a portion of the wire holder member which is connected to the wire.

The invention also comprises a wire dot print head provided with a plurality of wire drive units as set forth above, the wire drive units being arranged substantially in a circular array, each leaf spring extending parallel to the central axis of the print head.

20 The head may be provided with a member having slits for guiding the sides of the wire holder members.

Alternatively, the head may be provided with a wire

guide plate having a projection provided with grooves which communicate with guide holes in the wire guide plate, the printing wires passing through said grooves and holes.

5 The permanent magnets of the various wire drive units are preferably magnetically independent of each other, with substantially no mutual magnetic interference.

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

10 Figure 1 is a cross-sectional view of a single deck, 12 wire, wire dot print head incorporating a plurality of wire drive units according to the present invention;

Figure 2 is an exploded perspective view of a wire drive unit used in the wire dot print head shown in Figure 1;

15 Figure 3(a) is a schematic diagram of a leaf spring used in the wire dot print head of Figure 1;

Figure 3(b) is a graph illustrating the displacement with time of the distal end of a wire shown in Figure 3(a);

Figure 4(a) is a cross-sectional view of a known wire dot printer head;

20 Figure 4(b) is a diagram showing the arrangement of coils in the head shown in Figure 4a;

Figure 5(a) is a schematic diagram of a leaf spring used in the wire dot printer head of Figures 4(a) and 4(b);

25 Figure 5(b) is a graph illustrating the displacement with time of the distal end of a wire shown in Figure 5(a);

Figure 6 is a set of views showing a wire holder member and a leaf spring connected thereto, these parts being employed in the wire dot print head of Figure 1;

5 Figure 7 is a set of views illustrative of the wire holder member and a wire connected thereto employed in the wire dot print head of Figure 1,

Figure 8 is a perspective view of a wire holder member guide used in the wire dot printer head of Figure 1;

10 Figure 9 is a view showing the wire dot print head, with a rear cover omitted from illustration, according to the embodiment shown in Figure 1;

Figure 10 is a further cross-sectional view which is identical to Figure 1 except for certain reference numerals and reference letters thereon;

15 Figure 11 is a cross-sectional view of a double-deck wire dot print head incorporating wire drive units according to the present invention; and

Figure 12 is a perspective view of a wire guide plate which forms part of the wire dot print head of the Figure 11 construction.

20 The present invention will be described first in comparison with a previously known print head illustrated in Figures 4(a) and 4(b). As shown in Figure 4(a), the prior print head comprises a permanent magnet 101, a core 104, an upper yoke 108, a lower yoke 103, and a spacer 102 which jointly

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form a magnetic circuit. An armature 105 is disposed in the magnetic circuit and can be attracted by the core 104 under a magnetic flux generated by the permanent magnet 101, thus deforming a leaf spring 107 one end of which is secured to the armature 105. When a current is passed through a coil 106 wound on the core 104 for a certain period of time to enable the coil 106 to produce a magnetic force in a direction such as to cancel out the magnetic flux from the permanent magnet 101, the armature 105 moves away from the core 104 and turns under the force of the leaf spring 107 so as to cause a wire 110 fixed to the distal end of the armature 105 to project from the print head so that the distal or printing end of the wire 110 hits a sheet of print paper (not shown in Figure 4). When the current is cut off, the armature 105 is attracted to the core 104 again and the wire 110 is allowed to return to its standby position.

Although Figure 4(a) shows only one wire drive unit comprising a permanent magnet 101, core 104, upper yoke 108, lower yoke 103, spacer 102, armature 105, leaf spring 107, coil 106 and wire 110, in fact as shown in Figure 4(b) there are twelve equi-angularly spaced apart wire drive units.

Figure 5(b) is a graph which illustrates the displacement with time of the distal end of each of the wires 110. It is known that the wire 110 is subjected to

a time delay before it enters a return stroke after having hit the print paper 50, and this results in an increased period of time being required for the wire to move back and forth. To explain this phenomenon, Figure 5(a) schematically shows the leaf spring 107 positioned immediately after the wire 110 has hit the sheet of print paper 50. When the wire 110 hits the sheet of print paper 50, the leaf spring 107 is deformed as shown under a moment M imposed by the impact on the armature 105 about the centre of impact and also due to the inertia of the leaf spring 107. Therefore, the leaf spring 107 undergoes secondary vibrations which lead to the phenomenon illustrated in Figure 5(b). This increases the interval of time it takes for the wire 110 to move back and forth, and renders print head operation unstable when the printer head is driven at high frequencies, thus making it difficult to provide a highly responsive operation.

To improve the foregoing print head, one known arrangement uses two springs disposed in cross-cross relation as shown in U.S. Patent No. 4,136,978. The latter arrangement is, however, disadvantageous in that the parts used are complex in shape and structure, and cannot be machined and assembled efficiently.

Limitations on an attempt to reduce the inertial mass of the movable parts in the prior arrangement will be

described by using specific representative numerical values with reference to Figure 4.

If an attractive force of 1 Kg weight, for example, is to be obtained, then the core 104 is required to have a diameter $E = 3$ mm, and the coil 106 wound therearound should have an outside diameter $D =$ about 8 mm taking into account the number of turns and electrical resistance of the coil 106. Where a 12-wire print head is to be constructed with these dimensions, the distance R between the centre of the coil 106 and the centre of the head is derived from the following geometrical relationship shown in Figure 4(b);

$$\frac{D}{2R} \geq \sin \left(\frac{360^\circ}{2 \times 12} \right)$$

and is expressed as $R \geq 15.6$ mm. Therefore, the distance R should be of the order of 16mm.

Let the length L of the leaf spring 107 be 5 mm taking stresses and a spring constant into consideration, and let the centre P of rotation of the armature 105 be regarded as being disposed substantially centrally of the leaf spring 107. Therefore, the ratio x of the stroke of the wire 110 to the displacement of the armature 105, is given by:

$$x = \frac{L/2 + (E/2) + B}{(L/2) + (E/2)},$$

where L is the unsupported length of the leaf spring 107 and B is the lever length, i.e. the distance from the centre of the core 104 to the distal end of the armature 105.

Based on dynamics considerations relating to the required attractive force, the printing energy and the required wire stroke, the ratio $\underline{r}$ is preferably of the order of 3, and by substituting the foregoing numerical values,

5 $B = 8$ mm. When the printing end of the wire 110 is positioned on the central axis of the head, the amount C of wire displacement adjacent the armature 105 is $C = R - B = 8$ mm, since $R = 16$ mm and $B = 8$ mm. If the wire 110 is straight and hits the sheet of print paper 50 at an angle $\theta = 3^\circ$, for example, the length ℓ of the wire
10 110 becomes 153 mm. For highly responsive operation, it is necessary, in essence, to reduce the inertial mass of the movable parts. With the known print head construction, as described above, the fixed driven end of the wire 110 cannot be positioned closely to the central axis of the head due to the
15 limitations imposed by the position of the coil 106, and hence the wire 110 is of an undesirable length and the inertial mass is undesirably high, resulting in limitation on high speed operation of the print head. In an effort to position the coil 106 more closely to the central axis of the head and
20 reduce the distance R , various proposals have been made which include cores of triangular and sectorial cross sections and an increased lever length B . However, these attempts have had the drawback that the parts cannot be machined and assembled easily and that the attractive force
25 required is greater.

It would be possible to select a suitable curvature of the wire 110 to increase the angle at which the driven end of the wire is attached to the armature 105, thereby shortening the wire. The angle however would have to be selected in the range in which the wire 110 could be driven without undue dynamic strain, and this constitutes a limitation on efforts to achieve a more lightweight wire.

The present invention has been made to eliminate the foregoing prior difficulties.

The present invention will now be described with reference to an embodiment thereof shown in Figures 1 and 2. As shown in Figures 1 and 2, a wire dot print head comprises a head body 27 in which is mounted a plurality of wire drive units 30 (Figure 2) each of which comprises a core 2 fixed to a lower yoke 3. A permanent magnet 1 is sandwiched between the lower yoke 3 and an upper yoke 4 and is secured in position by an attachment shaft 12. A leaf spring 7 and a sheet metal wire holder member or lever 8 are secured together by a plunger 6, the leaf spring 7 extending parallel to the central axis J of the print head. Since these components are not subjected to high temperatures which would be experienced by welding the parts together as in the prior arrangements, the resiliency of the leaf spring 7 and the magnetic property of the permanent magnet 1 are not adversely effected. The parts are not required to be complex in shape

for the purpose of being welded together, and can be small in size and lightweight.

As shown in Figure 6, the leaf spring 7 at its free end has a bent projection 7a which is joined to the lever 8 by resistance welding. The joint between the lever 8 and the plunger 6 is rendered highly rigid, and movement of the leaf spring 7 is transmitted by the lever 8 to a printing wire 9 in such a way as not to delay starting of movement of the printing wire 9. This enables the print head to be responsive at high speeds and frees the printing wire 9 from excessive bending loads, with the result that the wire will be prevented from being broken and vibrated. When the lever 8 and the leaf spring 7 are to be fixed in position by the plunger 6, all that is necessary is that the lever 8 and the leaf spring 7 should be appropriately positioned. The lever 8 welded to the leaf spring 7 is prevented from being laterally vibrated in operation. As will be seen from Figure 6(b), the printing wire 9 extends substantially parallel to the leaf spring 7 throughout the length of the printing wire 9.

As illustrated in Figure 7, the lever 8 is made of thin sheet material and has a distal end which is curved about the wire 9, the lever 8 and the wire 9 being secured together by resistance welding. These parts are thus simple in construction and can be machined with ease. Even if the wire 9 and the lever 8 contact each other over some length, their inertial mass is

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small and their inertia is small, and they can be joined with a high bonding strength. Since the resistance welding produces localized heat only for a short interval of time, the junction between the wire 9 and the lever 8 is not subjected to a large thermal load, the mechanical strength of the wire 9 is retained, and the wire 9 and the lever 8 can be joined together in a shorter period of time than they would be joined by brazing. The wire 9 and the lever 8 can be mutually positioned easily for improved assembly as they are not in abutting engagement.

The leaf spring 7 is fastened by the attachment shaft 12 so as to be fixed between the upper yoke 4 and a pressure plate 10, whereby the members 4, 10 constitute fixing members between which the leaf spring 7 is fixed. The presser plate 10 is disposed on the side of the leaf spring 7 remote from the magnet 1 and extends close to the centre of the effective spring portion of the leaf spring 7. The presser plate 10 has a portion 10c (Figure 2) serving as an abutment which is engaged by the lever 8 when the latter is in a standby condition. A wedge-shaped stopper 11 of rubber is attached to the presser plate 10 for engagement with the lever 8. The stopper 11 is provided adjacent a portion of the lever 8 which is connected to the wire 9. A coil 5 wound on the core 2 has two resilient terminals 15, 16.

Although for ease of description reference has been made to a single wire drive unit 30 and a single wire 9, in practice there are twelve such wire drive units 30 for respectively driving twelve wires 9. Each of these wire drive units 30 is separately assembled, and then removably mounted in the head body 27 in a substantially circular array. For assembly, a plurality of wire guides 18-23

are placed beforehand in a head frame 13, and each wire drive unit 30 is mounted in the head frame 13 with the projection 10a and a projection 10b of the presser plate 10 being fitted in a guide hole 13a provided in the head frame 13.

Figure 8 is a perspective view of a lever guide 24, and Figure 9 is illustrative of the head body 27 with a rear cover 25 removed therefrom. The lever guide 24 has wider slits 24a and narrower slits 24b, and an end face 24c with a step for engagement with the rear cover 25. Each of the drive units 30 is assembled into the head body 27 by first setting the wire guides 18-23 and the lever guide 24 in the head frame 13 and then inserting a portion 10e (Figure 9) of each presser plate 10 in the respective slit 24a in the lever guide 24 and the projection 10a in the respective guide hole 13a in the head frame 13. As shown in Figure 9, projections 10f of the presser plates 10 engage an inner peripheral surface of the lever guide 24 for positioning the drive units 30 radially. The levers 8 are guided at their side surfaces by the slits 24b in the lever guide 24 so that the levers 8 can be prevented from being transversely vibrated. The terminals 15, 16 are pressed into electrical contact with a corresponding pattern on a circuit board 17. A rubber sheet 14 is interposed between the head frame 13 and the drive units 30 for eliminating difficulties in assembly due to variations in the lengths

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of the drive units 30 and preventing noise from being produced. The rear cover 25 is resiliently secured to the head frame 13 by an attachment spring 26. The printer head is thus assembled.

5 The operation of the printer head will now be described. The plunger 6 of each drive unit 30 is attracted to the core 2 under a magnetic flux generated by the respective permanent magnet 1 to keep the respective leaf spring 7 in a biased position. When a current is passed through the
10 respective coil 5 to produce a magnetic force which cancels out the magnetic field from the permanent magnet 1, the plunger 6 is released from the core 2 and the lever 8 is turned to cause the respective wire 9 to project outwardly of the head body 27. The wire 9 is forced into engagement with the print paper with
15 the interposition of an ink ribbon (not shown). After a dot has been formed by the wire 9 on the print paper, the plunger 6 is attracted to the core 2 again and the wire 9 returns to the standby position. Simultaneously, the lever 8 hits the stopper 11 at the same time that the plunger 6 hits the core 2.
20 Therefore, the wire 9 is prevented from moving past its standby position and is stopped quickly in the standby position with a small rebound. The moving system including the wire 9 is accordingly operated stably without any disturbance particularly when it is driven at high frequencies. The print
25 head is thus rendered highly responsive in operation.

As shown in Figure 1, the presser plate portion 10c and the stopper 11 have slanting abutment surfaces respectively. Since the stopper 11 is slidable up and down, its surface 11' which engages the lever 8 can be adjusted back and forth (in lateral directions as shown in Figure 1). Even when the standby position of the lever 8 varies due, for example, to machining inaccuracies of the parts, the lever 8 can be set in an optimum position by sliding the stopper 11 up and down.

In the present embodiment, the stopper 11 is made of polyurethane and has a sufficient degree of rigidity, impact-resistance, and wear-resistance to limit the stroke of the lever in the standby position thereof.

With the construction according to this embodiment, any impact at the time the plunger 6 and the core 2 hit each other is reduced so that these parts are subjected only to much reduced wear and deformation.

Since the lever 8 undergoes no residual vibrations and the movement of the wire 9 is not disturbed during high-frequency operation, any bending load on the wire 9 is lowered and the service life of the wire 9 is increased.

As illustrated in Figure 3(b), the displacement with time of each wire 9 in the case of the embodiment of Figure 1 is such that after the wire 9 has hit the print paper 50, the wire 9 quickly enters its return stroke and is

brought to a stop because the leaf spring 7 is arranged parallel to the central axis J of the print head and has a high rigidity against impact. The printing wire 9 extends substantially parallel to the leaf spring 7. According to experiments, when the printing wire 9 extends at an angle not exceeding 15° to the leaf spring 7 good results are achieved. Figure 3(a) schematically shows the leaf spring 7 positioned immediately after the wire 9 has engaged the print paper 50. As shown, a moment M imposed on the lever 8 about the centre of impact is directed lengthwise of the leaf spring 7, which is protected from being easily deformed by forces applied in that direction. The leaf spring 7 is also free from secondary vibrations. The time interval required for the wire 9 to move back and forth is shortened, and the wire can operate stably when driven at high frequencies so as to ensure highly responsive operation.

As shown in Figure 10, which is identical to Figure 1 except for the use of certain reference letters and numerals, the presser plate 10 has a leaf spring attachment 10d extending close to the centre S of the effective spring length of the leaf spring 7. Since the leaf spring 7 is freely movable in the direction of an arrow C throughout the entire effective spring length, the portion of the leaf spring 7 which extends from the centre S to the end of the leaf spring 7 attached to the plunger 6 is limited by the leaf spring attachment 10d in its movement in the direction of an arrow H. Since the leaf spring attachment 10d extends closely to the centre of the effective spring length of the leaf spring 7, the leaf spring 7 is prevented from secondary vibrations to allow the wire 9

to return rapidly to the standby position after a printing operation has been carried out.

The reduction of the weight of the movable parts will now be described. The dimensions of components will be explained on the basis of specific numerical values as with the example given above. Assuming that the core diameter $E = 3$ mm and the coil outside diameter $D = 8$ mm for a 12-wire printer head, the distance R from the centre J of the printer head to the core end surface K can be derived from:

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$$\frac{D}{2R} = \sin \left(\frac{360^\circ}{2 \times 12} \right)$$

and is given by $R = 16$.

Let the distance F from the core and surface K to the leaf spring 7 be 2mm, the length L of the leaf spring be 5mm as indicated above, and the ratio r of the wire stroke to the plunger displacement be 3, and let the centre P of rotation of the lever 8 be regarded as being positioned substantially centrally of the effective spring length of the leaf spring 7. The length G of the lever can then be found from the following equation:

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$$r = \frac{G}{\frac{L}{2} + \frac{E}{2}} = 3$$

and is 12 mm. Therefore, the amount C of displacement of the wire 9 is $C = R - (F + G) = 2$ mm. Where the wire 9 is a straight one and the angle θ at which the wire 9 hits the print paper

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50 is 3° , the necessary wire length $l = 38.2$ mm. Accordingly, the mass of the wire, which is a major portion of the inertial mass of the movable parts, is reduced to 1/4 of that of the known construction. Thus, the movable parts of the print head of Figure 1 is much lighter in weight for high speed printing operation.

A double-deck, 24 wire dot print head employing drive units 30 with 12 wires in each of front and rear head portions will now be described with reference to Figures 11 and 12.

Figure 12 is a perspective view of a wire guide plate 223 having a plate-like projection 223a dividing groups of guide holes from each other and having U-shaped grooves 223b provided on both lateral sides thereof. The U-shaped grooves 223b communicate with guide holes 223-13 to 223-24 (the guide holes 223-19 to 223-24 are not seen as they are positioned to the right of the projection 223a) for printing wires in the rear head portion. Guide holes 223-1 to 223-12 for printing wires in the front head portion are provided so as to surround the guide holes 223-13 to 223-24 for the rear printing wires. Wire guide attachment shafts 230 (Figure 11) are inserted through holes 223d.

The plate-like projection 223a has on its end a projection 223c for engagement by a rear wire guide 229. The wire guide plate 223 and wire guides 219, 220, 221, 222

in the front head portion are positioned and secured together by the wire guide attachment shafts 230. The wire guide 223 in the front head portion of the wire guide 229 in the rear head portion are relatively positioned by the projection 223c held in engagement with the wire guide 229.

For assembling the print head of Figures 11 and 12, front drive units are first attached to a front head frame 231 by inserting printing wires 9f into the front guide holes 223-1 to 223-12 in the wire guide 223 so as to allow the printing wires 9f to be guided through the wire guides 222, 221, 220, 219, 218. Then, a rear head frame 232 is attached to the front head frame 231. When assembling drive units into the rear head frame 232, printing wires 9r are first inserted into guide holes in a rear wire guide 224 and then through wire guides 225, 226, 228, 229. When the printing wires 9r reach the plate-like projection 223a of the wire guide 223, they are guided by the U-shaped grooves 223b in the projection 223a into the guide holes 223-13 to 223-24 in the wire guide 223, and into the guide holes of the wire guides 223, 222, 221, 220, 219 and 218, thus completing the assembling of the drive units. In this manner, twelve drive units are assembled in the rear head frame 232, and then a rear cover 233 is attached. Thereafter, the head frames are secured together by an attachment leaf spring

234. The assembling of the print head is thus finished.

In the case of the wire dot printer head of Figures 11 and 12 which has front and rear head units, spaced wire guides 223, 228 are provided and the plate-like projection 223a with the U-shaped grooves 223b for guiding the printing wires is mounted on the wire guide which is located at the driven ends of the wires. When the printing wires are inserted, they are guided by the U-shaped grooves 223b properly into the wire guide holes. Therefore, the printing wires can be inserted easily in a short period of time. The print head can thus be assembled with the utmost ease. While in the embodiment of Figures 11 and 12 the spaced wire guides 223, 228 are relatively positioned through mutual engagement, only the plate-like projection 223a with the U-shaped grooves is highly effective in allowing the wires to be inserted easily in position.

In the case of the above-mentioned embodiments of the present invention, the movable parts can be reduced in weight and the leaf springs rendered stable in operation and capable of high-speed operation through a simple construction, resulting in a highly responsive print head. Each lever 8 can be prepared simply by bending a thin plate which has a required degree of rigidity, is lightweight, and can easily be attached to the respective leaf spring. Consequently, components can be machined and assembled with much more ease than in known arrangements.



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The drive units containing permanent magnets are magnetically independent of each other with no mutual magnetic interference. The overall print head can be small in size and lightweight.

- 5 The numerical values referred to above in describing the conventional construction and the embodiments of the present invention are illustrative only, and should not be interpreted as being limitative in determining the scope of the invention.





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C L A I M S

1. A wire drive unit for use in a wire dot print head comprising a leaf spring; a plunger fixed to the leaf spring; a permanent magnet whose magnetic flux acts on the plunger so as to urge the leaf spring to flex towards the magnet; a coil which, when energised, produces flux in opposition to the said magnetic flux so that the leaf spring is released from being flexed towards the magnet; and a wire holder member secured to the leaf spring, the wire holder member holding a printing wire which extends at an angle not exceeding 15° to the leaf spring at least substantially throughout its length.
2. A wire drive unit as claimed in claim 1 in which the wire holder member is a sheet metal member.
3. A wire drive unit as claimed in claim 1 or 2 in which the leaf spring has a bent projection at a free end thereof, said bent projection being secured to the wire holder member.
4. A wire drive unit as claimed in any preceding claim in which the leaf spring is secured to the wire holder member by the plunger.



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5. A wire drive unit as claimed in any preceding claim comprising fixing members between which said leaf spring is fixed, one of said fixing members being disposed on a side of said leaf spring remote from said magnet and extending close to the centre of the effective spring portion of said leaf spring.
6. A wire drive unit as claimed in any preceding claim in which a portion of the wire holder member is wrapped around the wire.
7. A wire drive unit as claimed in any preceding claim in which the wire holder member and the wire are secured together by resistance welding.
8. A wire drive unit as claimed in any preceding claim in which a stop is provided for engagement with the wire holder member when the leaf spring is flexed.
9. A wire drive unit as claimed in claim 8 in which the stop is provided adjacent a portion of the wire holder member which is connected to the wire.
10. A wire drive unit as claimed in claim 8 or 9 in which the stop is wedge-shaped.
11. A wire drive unit substantially as hereinbefore described with reference to and as shown in Figures 1-3 and 6-12 of the accompanying drawings.



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- 5 12. A wire dot print head provided with a plurality of wire drive units as claimed in any preceding claim, the wire drive units being arranged substantially in a circular array, each leaf spring extending parallel to the central axis of the print head.
13. A wire dot print head as claimed in claim 12 in which the head is provided with a member having slits for guiding the sides of the wire holder members.
- 10 14. A wire dot print head as claimed in claim 12 in which the head is provided with a wire guide plate having a projection provided with grooves which communicate with guide holes in the wire guide plate, the printing wires passing through said grooves and holes.
- 15 15. A wire dot print head as claimed in any of claims 12-14 in which the permanent magnets of the various wire drive units are magnetically independent of each other, with substantially no mutual magnetic interference.
- 20 16. A wire dot print head substantially as hereinbefore described with reference to and as shown in Figures 1-3 and 6-12 of the accompanying drawings.



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17. A wire dot print head including a plurality of wire drive units arranged substantially in a circular pattern and each comprising: a leaf spring; a plunger fixed to said leaf spring; a permanent magnet for attracting said plunger in a direction to bias said leaf spring; a demagnetizing coil for cancelling a magnetic flux from said permanent magnet to release said plunger from said permanent magnet; and a lever fixed to said leaf spring and holding a printing wire, said leaf spring extending parallel to a central axis of the print head.
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