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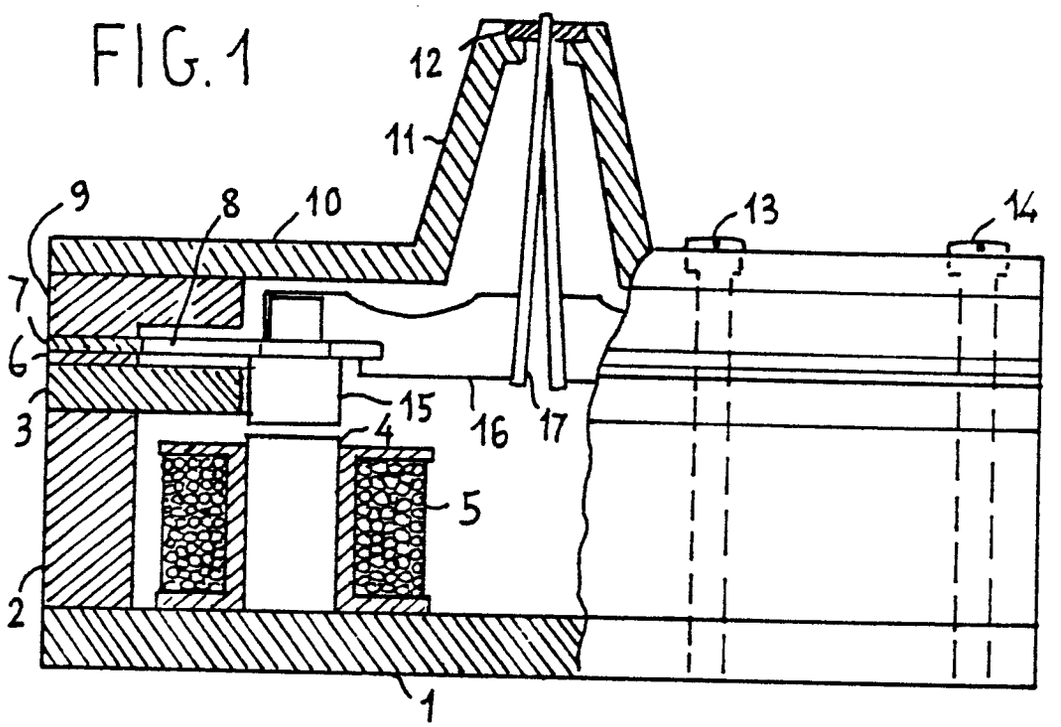
(54) **Needle printing head.**

(57) A needle printing head, of the permanent magnet type where resilient armatures are released owing to the energization of demagnetizing coils and where each of the armatures comprises a resilient magnetic leaf cantilever mounted, an actuation arm extending beyond a free end of the leaf in form of a rigid plate arranged perpendicularly to the leaf plane and fixed to the leaf by means of a cogging groove into which the free end of the leaf is inserted and by welding of the contact surfaces of the two elements.

FIG. 1



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Needle printing head

The present invention relates to a needle printing head and more specifically to an improvement of the actuation armatures of the printing needles.

It is know that among the various kinds of impact matrix printing heads the permanent magnet printing heads have recently been introduces on the market.

These printing heads offer the advantage of requiring a lower electrical feedint power and allow more compact embodiments and higher performances.

However more sophisticated manufacturing technologies and a more complex product design are needed to produce them.

In said printing heads a plurality of magnetic circuits (each of which comprises a magnetic core with a permanent magnet and a demagnetizing coil) are radially arranged round a centre.

For each one of said circuits, a leaf spring which is radially arranged round the same centre, constitutes a movable armature that closes the magnetic circuit.

The leaf spring is cantilever fixed in the outer area, with respect to the centre, and it extends radially inwards, almost right to the centre, with an actuator arm.

A printing needle is fixed to the end of said actuator arm, substantially perpendicular to the leaf spring plane.

Normally the magnetic circuit is magnetized owing to the effect of the permanent magnet so that the leaf spring is normally actracted by the magnetic circuit in a bent position and therefore the spring is elastically biased.

When the demagnetizing coil is energized the magnetic field generated by the coil neutralizes the field generated by the permanent magnet thus causing the leaf spring to be relased.

Due to this release a printing stroke is applied to the needle in the direction of the same and the needle performs a print on a print media.

The leaf springs, or armatures, are a critical element of said printing heads because, in time, them under go relevant and repeated stress which leads to fatigue failure.

Furthermore in order to be able to work at high frequencies they must have a suitable stiffening and, at the same time, a minimal inertia.

In pratice, it is appropriate that said armatures have an adequate elasticity near the cog so as to bend in the plane that is perpendicular to the leaf plane, whereas in correspondence with the actuator arm they must be very stiff so as to avoid deformation to occur in the plane that is perpendicular to the leaf plane.

Generally this result is obtained by fixing on one of the faces of the actuator arm, through resistance welding or brazing, a stiffening rib arranged perpendicularly to the leaf spring plane.

An embodiment of this kind is described, for example, in the U.S. Patent N° 4.295.250.

However this solution is not quite satisfactory because the alternate stress applied to the armature causes, in time, the detachment of the stiffening rib and, as a result of this, the printing head failure. This drawback is overcome by the needle printing head, which is the object of the present invention where the stiffening of the armature is obtained by means of a stiffening rib extending radially inwards to constitute the actuator arm. This stiffening rib is fixed by means of a cogging groove at the free end of the leaf spring so as to obtain a clamp active on both spring faces.

This and other features will appear more clearly from the following description of a preferred embodiment of the invention and from the enclosed drawings where:

Fig. 1 shows, in a partial sectional view, a preferred ambodiment of the printing head according to the present invention.

Fig. 2 and 3 show, in top and sectional view respectively, an actuation armature of the printing head shown in Fig. 1.

Fig. 4 show in front view a stiffening rib for the armature.

Fig. 5, shows in front view, the armature depitched in Fig. 2 assembled with the stiffening rib shown in Fig. 4.

Fig. 6 shows in perspective view the armature depitched in Fig. 5.

Fig. 1 shows, in partial sectional view, a preferred embodiment of a printing head according to the present invention.

The printing head comprises a base circular plate 1 made of magnetic material which is axially magnetized, a toroidal ring 3 made of magnetic material, a plurality of cylindrical magnetic cores which are radially arranged round the central axis of the printing head. A coil is inserted on each one of these magnetic cores.

One of these cores and the corresponding coil are shown in Fig. 1. where they are indicated by reference numbers 4 and 5 respectively. The printing head comprises also a thin circular ring 6 made of magnetic material and a further circular ring 7 made of a material as elastic and magnetic as steel, which is provided with a plurality of elastic leaves that extend inwards towards the central axis

of the printing head. Their number is equal to that of the cylindrical magnetic cores and each one of these leaves is radially aligned with a corresponding cylindrical core.

Fig. 1 shows one of these elastic leaves which is indicated by reference number 8.

Furthermore the printing heas comprises a circular ring 8 that retains ring 7 and a closing LID - (10) which is provided with a nose on the end of which a ruby needle guide (12) is mounted.

The various elements 1,2,3,6,7,9,10 are so rigidly packed as to constitute a single assembly which is held together by means of screw set in suitable seats, two of which, 13 and 14, are shown with dashed lines in Fig. 1.

Each of the elastic leaves, as 8, is provided with a post 15 made of magnetic material which is axially aligned with a corresponding cylindric core - (as 4).

The various cores, as 4, board 1, and rings 2,3,6,7 form a plurality of magnetic circuits, each of which is closed by a movable armature formed by an elastic leaf and by a post.

When there is no stress, the elastic leaves 8 extend in a plane which is perpendicular to the axis of the printing head and a small gap, in the order of 0,3 mm, is present between the lower faces of the post as 15 and the top of cores as 4.

However the magnetic field developed by the permanent magnet 3 normally causes the elastic leaves as 8 to be bent and attracted towards the cores as 4, so that the posts are in contact with cores as 4.

The selective energization of the various coils as 5 permits the various magnetic circuits to be selectively demagnetized and the various armatures consituted by leaves as 8 to be selectively release too.

At the free end each leaf as 8 is provided with an actuation arm which is constituted by a stiffening rib 16 which extends radially towards the printing head axis and is perpendicular to the leaf plane.

At the end of each stiffening rib a printing needle as 17 is fixed which inserts its Vip in the needle guide ruby 12.

When a strip as 8 is released, the corresponding needle 17 protrudes with its tip from the needle guide ruby 12 thus permitting a dot to be printed on a printing support.

Fig. 2 and 3 show in plan and sectional view, and in greater detail, the shape and structure of one the various armatures. As already mentioned the armature consists of a leaf 8 made of elastic and magnetic material that extends radially from an external ring 7 towards the centre of ring 0.

In correspondence with the connection to ring 7, leaf 8 is suitably radiused to the ring through radiuses 18, 19.

The free end of the leaf is suitably rounded.

Near its free end leaf 8 has a circular opening into which a magnetic post 15 is inserted and fixed.

To this end the magnetic post is provided with a stop collar 18 having the same diameter as the circular opening and a height equal to the thikness of the leaf, which is inserted in the circular opening of the leaf.

The diameter of the post is much greater than that of the stop collar, so as to offer the leaf, when these two elements are assembled, a stop ledge.

The two elements can be fixed to each other by calking of the stop collar.

Besides the stop collar and on the same side of stop collar 18, post 15 has a cylindrical appendix whose diameter is sligthly lesser than that of stop collar 18.

In said appendix a diametral grooves 20 having a suitable width is provided, with orientation towards axis 0 of the printing head. It is designed to receive stiffening rib 16 which acts as an actuation arm.

Fig. 4 shows in detail, in front view, siffening rib 16.

A stiffening rib consists of a small plate made of a material as resistant as steel, having a suitable thickness (for instance 0,5 mm) and a generically elongated and rectangular shape.

Stiffening rib 16 has a straight edge 21 which has been designed to rest on one of the faces of strip 8 and a terminal portion 22 for insertion into groove 20 of Appendix 19.

In addition this siffening rib has a groove 23 which separates straight edge 21 from a retaining tooth 24.

Groove 23 is intended to receive the distal end of strip 8 which is cogged therein.

At the end of rib 16, which is opposite to the terminal portion 22, a printing needle 17 is fixed through brazing or laser welding.

Fig. 5 shows in front view stiffening rib 16 Which is set on the armature formed by strip 8 and post 15.

In this position rib 16 is fixed and rigidly held in place through either brazing or laser welding.

Fig. 6 shows in perpective view the armature completed with the printing needle actuation arm which is constituted by stiffening rib 16 and evidences the various areas along which either brazing or welding of the composing elements can be carried out.

The use of a stiffening rib of the describe form ensures a strong structural bond resistant to alternate stress.

In fact, with reference to Fig. 5 it can be noticed that whenever the armature is released and as a result of this needle is projected upwards, the welding areas undergo stress which is caused by a clockwise movement that is determined by inertial mass of both the needle and the rib. This inertia tends to make said rib 16 to rotate clockwise round cogging and to detach terminal portion 22 from the leaf 8.

This stress is easily absorbed by a wide welding area which pratically extends along the whole terminal portion 22 embedded in Appendix 19 which, in its turn, is an integral part of post 15.

Conversely, when the armature is recalled in the biases position, the welding areas undergo the stress that is caused by a counter clockwise movement which tends to make the rib rotate round its distal point B leaning on the leaf.

Missing tooth 24 such rotation would be obstacolated mainly by the limited welding area, near point A, which undergoes tensile stress with the possibility of rapid fatigue failure.

Vice versa the presence of tooth 24 determines the following two effects: on the one hand it allows the realization of a wider and more winding welding area in correspondence with the cogging, on the other hand it allows the stress to be transmitted directly to rib 16 through tooth 24.

The weld material that might be present between tooth 24 and the end of strip 8 undergoes a compression stress rather than a tension stress.

Therefore the maximum stress it allows is much higher and also much less affected by fatigue.

Claims

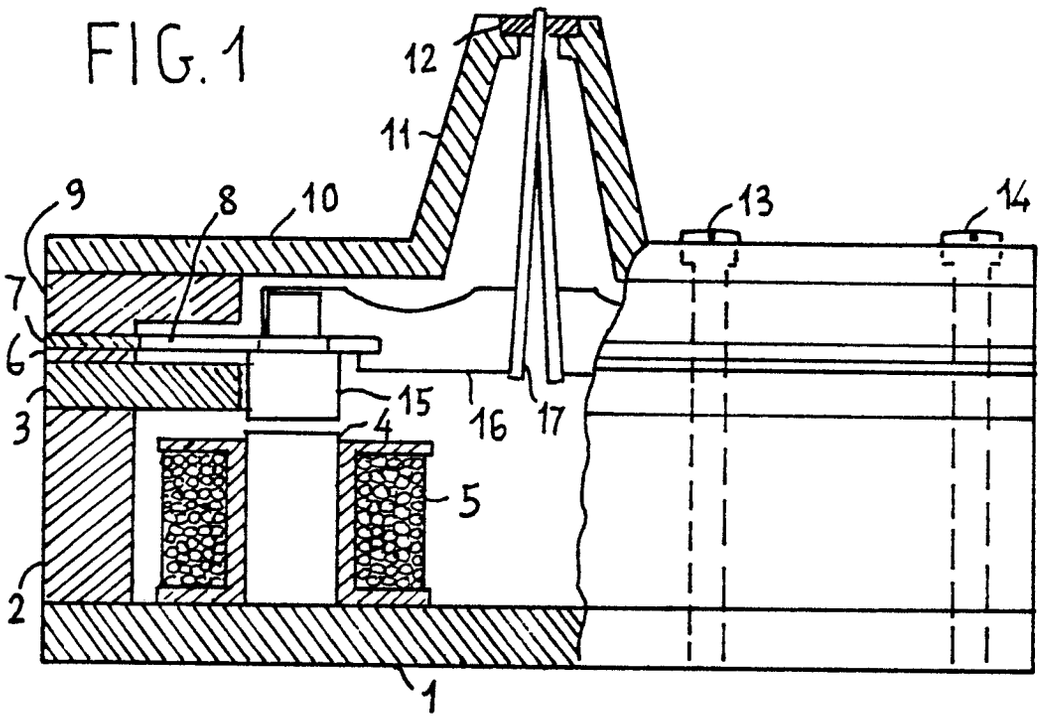
1. Needle printing head wherein a plurality of magnetic circuits, each having a permanent magnet, a demagnetizing coil and a movable armature in form of resilient and magnetic leaf cantilever fixed at one end and normally elastically bent so as to close the magnetic circuit, a free end of the leaf extending in a printing needle actuation arm, characterized in that each of the movable armatures comprises:

-a resilient and magnetic leaf having a circular opening with axis perpendicular to the leaf plane and arranged near the free end of the leaf.

-a post of magnetic material having a stop collar and a cylindrical-appendix in opposition to said post as to said stop collar, said collar being inserted in said circular opening, said cylindrical appendix being provided with a diametral groove,

-an actuation arm in form of a plate arranged perpendicularly to the plane of said leaf and having a first end inserted into said diametral groove, a flat edge laying on one face of said leaf, a keeping tooth protruding from said flat edge, a cogging groove defined by said flat edge and a side tooth, the free end of said leaf being inserted in said cogging groove, said leaf, said post and said actuation arm being fixed together through brazing or welding of respective contact areas.

FIG. 1



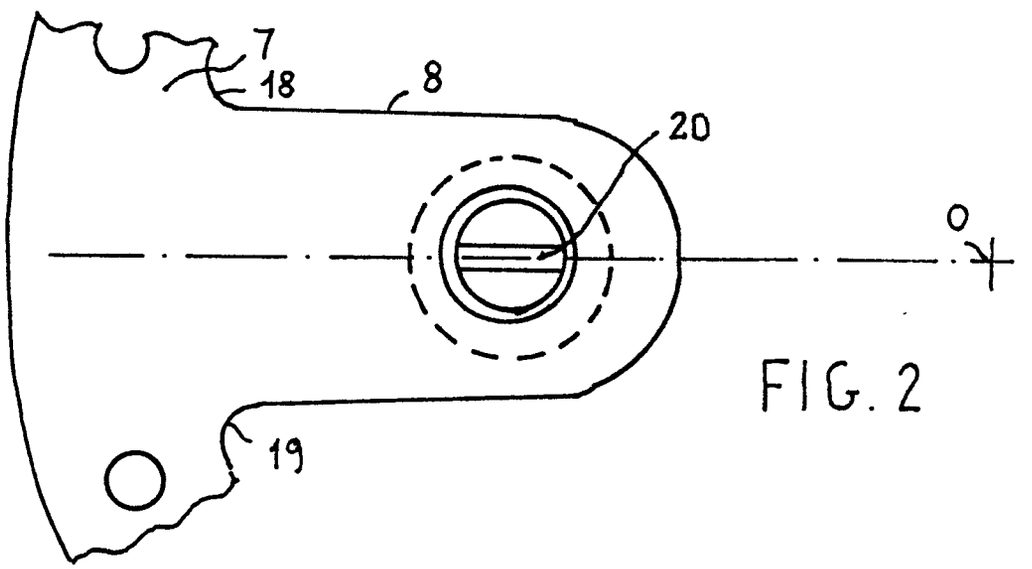


FIG. 2

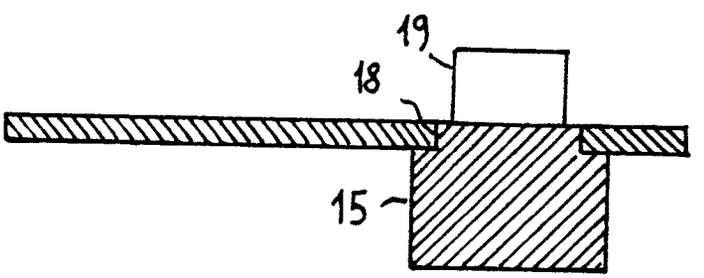
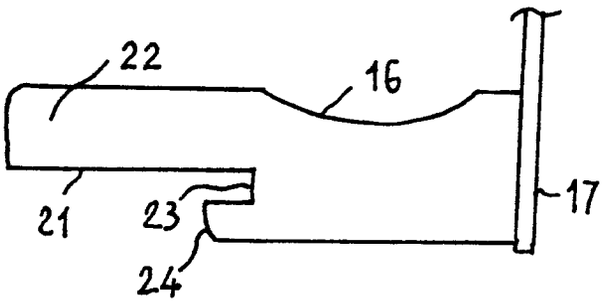


FIG. 3

FIG. 4



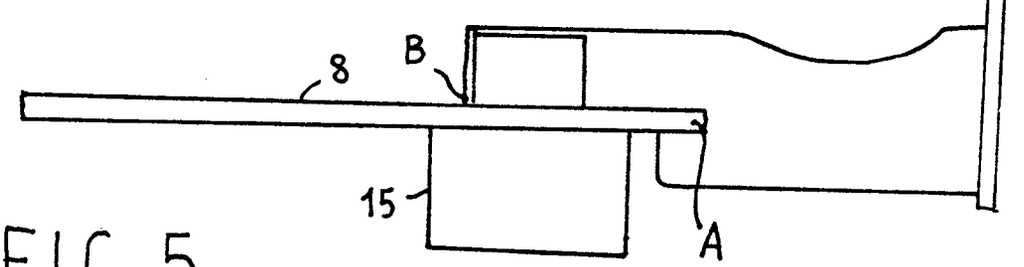


FIG. 5

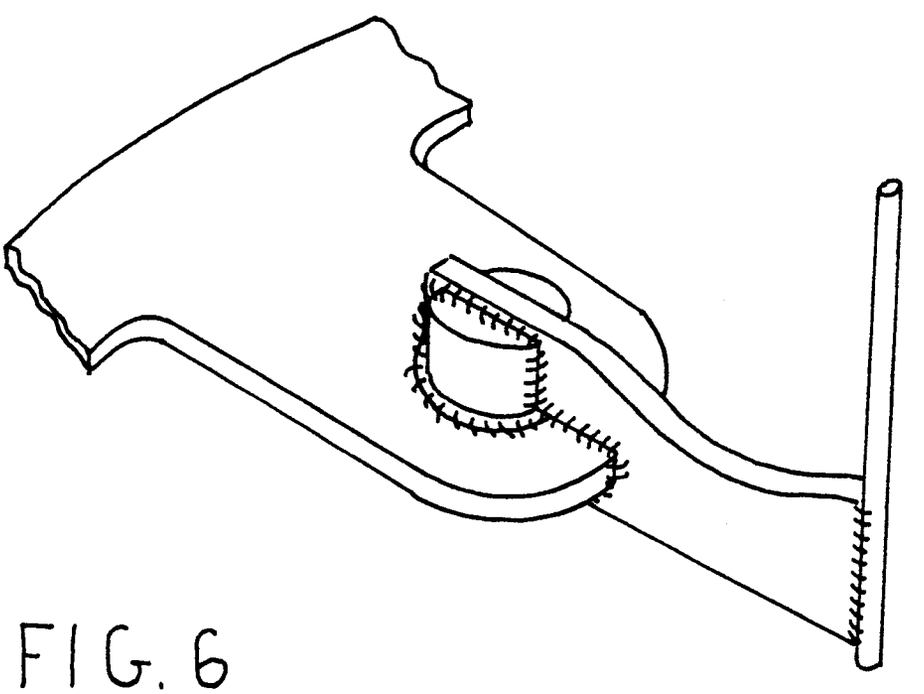


FIG. 6