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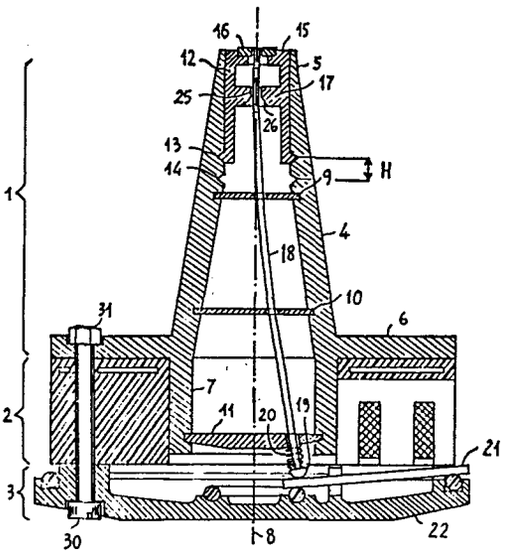
(71) Applicant: **HONEYWELL INFORMATION SYSTEMS ITALIA S.p.A., Via Martiri d'Italia 3, I-10014 Caluso (Torino) (IT)**

(72) Inventor: **Cavallari, Piergiuseppe, Via Carbonari 21/A, I-28100 Novara (IT)**

(54) Needle printing head improved for an easy assembling.

(57) Needle printing head improved for an easy assembling comprising a needle guiding group having a plurality of needles substantially arranged according to an axial direction and guided by a plurality of diaphragms arranged according to said axial direction and perpendicularly to it, wherein two contiguous diaphragms arranged at one end of the needles or at the other one can assume two different axial positions, a working position and an assembling position respectively and, in the assembling position cause controlled bending stresses in the needles and generate, by friction, restraint reactions in axial direction which prevent the axial moving of the needles and lock them in assembling position, making easier the printing head assembling.



EP 0 170 976 A2

Needle printing head improved for an easy assembling

The present invention relates to a needle printing head improved for an easy assembling.

Needle printing heads having a modular structure consisting in groups or modules assembled each other are known in the art.

A typical modular structure is for instance disclosed in US patent n. 4,260,270 which points out the head as constituted by :

- a needle guiding group;
- an electromagnet group;
- an armature retainer group.

US patent 4,230,412 too discloses a typical modular structure of a printing head constituted by:

- a needle guiding group which acts as armature retainer element too;
- an electromagnet group.

The assembling of such kind of printing head is relatively simple, the only fixing of the several groups one another by screws or other equivalent means being required.

However the mounting operation is made difficult by the need to insert the printing needle in the needle guiding group which insertion requi-re a careful and expensive handling.

In fact the needle guiding group is constituted by a conical or pyramidal nose internally provided with transversally arranged hollowed diaphragms and supplied, at the cone basis, with a drilled plate and, on the cone top, with a needle guiding ruby.

Each of the needle is inserted into a corresponding opening in the plate, the diaphragms and the ruby.

Each of the needle is provided with an impact head.

A coil spring is inserted on each needle between the impact head and needle guiding group plate.

When the printing head is assembled, the springs are loaded and the needles kept in a rest position such that the needle printing tip is coplanar to the external side of the guiding ruby at the nose end.

However, during the assembling, when the head is not assembled yet, the springs are released and impose to the needle a position such that the needle printing ends get out from the needle guiding ruby and practically prevent the assembling.

The assembling of the several groups, in fact, involves a pressure exterted on the needles which tend to insert into the needle guiding ruby.

The needles being not guided at the tip, they can stumble over the ruby instead of inserting into it, breaking themselves or displacing the ruby from its housing.

To overcome such inconvenient US patent N. 4,441,828 discloses an improved printing head where the basis of the needle guiding group move axially from a back position nearer to the needle guiding ruby to a more distant working position.

The assembling is complicated by another problem that is the risk that the needles get out not only from the end ruby but from all their housings.

For instance, in the case of the printing heads disclosed by US patent n. 4,260,270 the assembling of the several groups must be performed arranging the armature retaining group with the internal side, that is with the armature housings, turned upwords.

This is necessary because the armatures are freely arranged in suitable housings of the retaining element.

The electromagnet group must be placed on the armature retaining group and, eventually, the needle guiding group must be placed on the two previous groups with the nose turned upwords.

In this position the reduced friction exterted by the housing on the

needles does not assure their becoming unstrung from the respective housings due to gravity.

Further, independently from the orientation in the space of the needle guiding group, an uncareful handling of the same can cause a temporaneous loading of the spring coupled to each needle and the subsequent release of the same which would throw the needle out of its housing.

In the prior art these inconvenients have been overcome by means of locking pincers which setting on the needles through suitable openings provided in the nose sides, lock the needles in their housings.

The use of locking pincers is however critical as the needles must not undergo uncontrolled bending stresses which could bent or break them. The locking by pincers is therefore particularly careful and laborious and greatly weighs on the assembling time and on the printing head costs.

A partial solution to this problem is further offered by US patent n. 4,441,828 which discloses an improved printing head where the needle guiding group plate is movable from a back position, nearest to the needle guiding ruby, to a more distant working position. The needle assembling is performed with the plate in back position so that the needles do not get out from the guiding ruby even if the retated spring is released. It is however clear that the needle unthreating due to accidental stresses or to gravity is not avoided in case the guiding group is overturned, setting the nose upwords.

These inconvenients are overcome by the improved mosaic head object of the present invention which is provided with means for axially move not only one diaphragm at the end of the needle guiding group, that is the plate or the ruby, but a contiguous diaphragm too.

With the moving of two contiguous diaphragms, the displacement of the needle guiding restraints from their normal position, in normal direction as to the needle run, causes a controlled bending of the needles

themselves, hence elastical reactions opposed by correspondent restraint reactions.

These reactions apply to the needles some contact forces, controlled, that is preestablished, and sufficient to prevent by friction the needle unthreating from the housing due to gravity or to an accidental loading of the springs.

These and other features will appear clearly from the following description and from the drawings where:

Figure 1 shows in section view an improved needle printing head according to the invention.

Figure 2 shows in perspective exploded view an element of the printing head of Fig. 1.

Figure 3 schematically shows the effects on a needle of an axial displacement of two restraints in the printing head of Fig. 2 opposed to the axial displacement of only one needle guiding restraint.

Figure 4 shows in section view a printing head of the type for instance disclosed in US patent n. 4,260,270, but improved in order to enable an easy assembling.

The head is shown with the nose turned upwords to better evidence, in the following, the assembling problems which must be solved.

The head comprises a needle guiding group 1, an electromagnet group 2 and an armature retainer group 3.

The needle guiding group consists of a nose or body 4 elongated in the direction of a longitudinal axis 8, with a generical C section tapered at the hand of top 5, a flange 6 arranged at the basis of nose 4 and extending outward this one and a cylindric or prismatic bush extending at the opposite side of the flange with regard to nose 4.

The needle guiding group can be suitably obtained by casting or by molding.

Nose 4 and bushing 7 are internally provided with needle guiding diaphragms 9, 10, 11 spaced along axis 8 of the group and arranged perpendicularly to it.

Each of the diaphragms is provided with a number of openings equal to the number of the needles to be guided, which are circularly arranged around axis 8, in diaphragm 11, more distant from the top of the nose, then in elliptical configuration, more and more flattened, in the other diaphragms 10, 9.

The top of the nose has a prismatic housing where a slide 12 is inserted axially movable along axis 8.

Two pairs of V shaped grooves 13, 14, axially spaced by a distance H, are provided on the internal sides of the nose in correspondence of the inner portion of the prismatic housing.

Slide 12 has an end 15 where a needle guiding ruby 16 is set which is provided with a number of openings, equal to the number of needles, arranged on one or two lines, or in alternative, provided with one or two contiguous needle guiding grooves.

Slide 12 further has an internal diaphragm 17, it too provided with openings or contiguous grooves for the needle guiding.

A certain number of needles, generally variable from 7 to 24, according to the kind of printing head, is inserted into the diaphragm and the ruby openings.

Each needle is guided by the openings of the diaphragms and the ruby, in a straight or slightly flexed run and, however, in a way such that the restraints do not apply significant friction to the needle sliding in axial direction.

Fig. 1 shows, for sake of simplicity, only one needle 18 inserted in its housing.

The lower end of the needle is provided with an impact head 19.

A coil spring 20 is inserted on needle 18, between the lower diaphragm or base plate 11 and head 19. The spring acting on plate 11, tends to

push head 19 and needle 18 downwards.

When the needle guiding group is assembled with an electromagnetic group 2 and an armature retainer group 3, an armature 21, kept in rest position by an armature retaining element 22, bears and keeps in rest position needle 18 and prevents its unthreating from the housings.

When needle 18 is in rest position spring 19 is suitably biased and has an axial development with a shortening of about 1,5 mm., as to the released condition.

When needle 18 is in rest position its printing tip 23 is coplanar to the nose top and to the external or upper surface of the guiding ruby 16.

Fig. 2 shows slide 12 in perspective exploded view.

Such slide is constituted by a prismatic body extending in the direction of axis 8 of the needle guiding group.

The slide has an end 15 having a surface perpendicular to axis 8 and provided with an housing 24 wherein needle guiding ruby 16 is set.

Typically the thickness of such ruby is of about 1 mm.

Slide 12 has a diaphragm 17 provided with a set of openings or with one or more continuous grooves for the needle guiding, in a back position as to end 15 at a distance of about 5-10 mm.

In fig. 2, diaphragm 17 is shown as provided with a groove 25.

Groove 25 is provided with a countersunk throat 26 for allowing an easier insertion of the needles, as clearly shown by the section of fig. 1.

Fig. 2 is considered again and shows slide 12 which is provided with two elastical tongues 126, 27 each one extending along the sides of the slide and ending in a triangular tooth 28, 29 respectively.

The pair of teeth 28, 29 is intended to engage into pair of grooves 13 or, alternatively 14, in order that slide 12, inserted into the cor-

responding housing of nose 4, be able to assume two stable position. The distance H between the two couples of grooves 13, 14 is suitably chosen in order to be equal, or slightly lesser than the springs compression, in their normal loaded, rest position, that is, for instance 2 mm.

When the pair of teeth 28, 29 is inserted into the pair of grooves 13 the slide is in its normal working position.

When the pair of teeth 28, 29 is inserted in the pair of grooves 14 the slide is in a back position which, as explained in the following, assures an easy assembling of the printing head.

Slide 12 positioning can be easily obtained by a push exerted on the slide towards the inside or the outside of nose 4 according to the desired position as to the already existing position.

Electromagnetic group 2 and armature retaining element 3 are of conventional type and can be embodied as disclosed in the already mentioned US patent N. 4,260,270.

Alternatively the electromagnet group can be constituted by a toroidal body of plastic material, where the electromagnet cores, the related windings and the electrical connection elements with an external connector are encased, as for instance disclosed by US patent 4,433,927.

Instead of constructive details a production problem, arising out for the assembling of these elements, is to be pointed out.

The armature retaining group 3 is a kind of cup, provided with housings for the several armatures, where the armatures are freely arranged. Though the armature retaining group 3 cannot be upset as to the position shown in figure without the unthreading of the armatures from their housings.

The unthreading of the armatures from their housings, independently from the armature group position, is prevented by electromagnet group 2, when correctly positioned and fixed to the armature group.

Electromagnet group 2 and armature group retainer 3 can be assembled in an unitary set by means of screws but, owing to encumbrancy and cost reasons, it is desirable to assemble the armature group, the electromagnet group and the needle guiding group by only one operation and by means of common fixing elements.

These fixing elements are for instance shown in the left side of fig. 1 and consists of a screw and locking nut 31 which restrain each other armature group 3 and mounting flange 6 of needle guiding group 1, with interposition of armature group 2.

A plurality of such screws can be used, arranged along armature group 3 and flange 6 periphery.

It is clear that, in this case, during the assembling operation, the nose of the needle guiding group must be arranged upwords and the unthreating of the needles from their housings for gravity, not only their unthreating from the ruby, must be prevented.

This result is achieved by the use of the axially movable slide where an axial shift is imparted not only to end ruby 16 but to a contiguous diaphragm too, as diaphragm 17.

Substantially the axial shift of ruby 16 and of contiguous diaphragm 17 causes a restraint shift as to their normal position and therefore a disturbance of the normal needle position.

The needle undergoes elastical reactions opposed by restraint reactions which rise to values much greater than the ones occurring when the needle is in normal position or when the axial shift occurs for only one restraint, and which, owing to the friction between needle and restraints, prevent its unthreating.

This feature is shown in fig. 3 where, for simplicity sake, assumption is made that in normal condition the needle is not bent and has the rectilinear trend shown by continuous line 32 defined by guiding diaphragms 16, 9, 10, 11 substantially at the same distance.

The incidence angle of needle guiding group as to axis 8 is typically of 5°, but in fig. 3 it is exagerated to evidence the phenomenon.
In this condition restraints 16, 9, 10, 11 do not perform any action on the needle, which is free to fall down owing to its weight.
If restraint 16 is moved in axial direction, for instance 2 mm., a perpendicular translation of 2·tg·5° = 2·0,0875 = 0,1750 mm. corresponds to the axial shift and restraint 16 moves to the position indicated by reference number 16A.
The needle is therefore compelled to bend and get the position shown by hatched line 33.
The needle bending is small, so the elastic reactions and the corresponding restraint reactions have small values.
All the more reason, the resisting action of the restraint to needle axial shifts determined by the friction coefficient (which is kept as low as possible for a better needles performance) is very reduced and insufficient to assure the needle locking and prevent their unthreating from the housing.
If next to ruby 16 a further restraint or guiding element 17 is inserted, axially movable like ruby 16, the normal needle working condition according to line 32 are not modified.
However when ruby 16 is moved to position 16A, restraint 17 goes to position 17A and the needle is compelled to bend and assume the position stated by hatched line 34.
It is clear that under the same translation of restraints, the needle bending is much greater than in the previous case and, consequently, the restraint reactions and the friction forces the restraints can perform on the needle are greater too.
Therefore the shift of ruby 16 and diaphragm 17 not only assures the needle insertion in ruby 16 even when the spring, as 20, is released, but also causes restraint reactions which assure the effective locking of the needle in its housing and prevent its unthreating.

Similar considerations can be made in the case the normal position of the needle is not rectilinear but slightly bent.

It is to be noted that on the basis of the restraint geometry, the material elasticity modulus and the needle section it is possible to establish, in rigorous way, the stress undergone by the needle and the restraint reactions, so that the needle stress is strictly controlled and the breakage or damage risk is avoided.

Since the fundamental purpose of the invention is the one to reduce the distance between ruby 16 and basis plate 11 during the assembling phase assuring at the same time a controlled needle performance, it is clear that alternatively to ruby 16 and diaphragm 17 mounted on slide 12 the bases plate can be mounted into the needle guiding group in order to be capable of an axial shift together with a contiguous diaphragm.

Fig. 4 only shows the details of this solution useful to its understanding.

In Fig. 4 the ruby is directly set onto the nose of the needle guiding group.

On the contrary plate 11, together with a contiguous diaphragm 11A, is housed (possibly with friction) into a cylindric or prismatic shaped housing 34 of bushing 7 in order to be able to take up different axial positions.

In fig. 4 plates 11 and 11A are shown in their normal working position.

Plates 11 and 11A can be pushed in a back position up to laying against a ledge 35 to allow the needle insertion and the head assembling.

When plate 11 is in this position, with the needles correctly inserted into the housings and locked therein, the head assembling can be performed without the risk of needle removal and unthreating from their housings.

When the assembling is completed plate 11 can be set again in working

position by a screw 36 which, through armature retaining element 22, hold in a threaded housing of plates 11 and 11A.

A bushing 37 integral to retaining element 22, arranges for a ledge 38 assuring the correct working position of plate 11.

It is further clear that the invention can be applied not only to needle printing heads where needles and electromagnets are arranged on the same side as to the armatures, but also to printing heads where the electromagnets and the needles are arranged on opposite sides as to the actraction armatures, as for instance disclosed by US patent n. 4,230,038.

It is clear that for this embodiment, as the armature retaining element is integral to the needle guiding group, the solution shown in fig. 4 must be slightly modified and the working position of basis plate 11 can be defined by a shoulder provided with a ledge obtained in the electromagnet group instead of the armature retaining element.

It is further clear that several changes can be brought to the disclosed embodiments without departing from the scope of the invention. For instance the slide of Fig. 2 can be provided with only one flexible tongue, instead of two, the relation teeth-grooves can be reversed (grooves into tongues and teeth on the sides of the needle guiding group) and other positioning elements such as screws or stop pins can be used to replace the couple teeth-grooves.

Likewise the needle guiding friction that in the description is performed by a plurality of diaphragms, that is by elements of thin thickness can be performed by one or more continuous guiding elements extending along the needles of the kind disclosed for instance by US patent N. 4,081,067 and by English patent N. 1,450,346.

Claims

1. Improved needle printing head comprising a needle guiding group, an electromagnet group and an armature retaining group, possibly integral to said needle guiding group, a plurality of guiding elements arranged along the needles and comprising a first element or end ruby, arranged in correspondence of a needle printing end and a second end element or basis plate arranged next to the opposed needle end provided with an impact head, said elements guiding the needles substantially according to an axial direction common to said needles,
each of said needles being kept in rest position, when the head is assembled, by a spring acting between said second end element and the impact head of the needle, said spring being compression loaded with shortening H as to the released status,
characterised by that it comprises:
adjustable mounting means for locating one of said end elements and a further contiguous guiding element at a distance, in said axial direction, equal to a preestablished working distance from the other end element and at a distance shorter than said preestablished working distance of a quantity not lesser than said shortening H.

2. Improved printing head as per claim 1, characterised by that said adjustable mounting means consist of a slide, mounted on said needle guiding group and sliding in said axial direction from an assembling position to a working position, the distance between said two positions being not lesser than said shortening H, said first end element being set into said slide, a further guiding element being integral to said slide.

3. Improved printing head, as per claim 2, characterized by that said slide is provided with flexible means ended by an insertion tooth and by that said needle guiding group is provided with two grooves at least for said insertion tooth, each of them defining for said slide, said assembling position and said working position respectively.

4. Improved printing head as per claim 2 characterised by that said adjustable mounting means consist of a prismatic/cylindrical shaped housing in said needle guiding element for the mounting, slidable in said axial direction, and movable from an assembling position to a working position, of said second end element and of a contiguous guiding element, the distance between said two positions being not lower than said shortening H, said second end element and said contiguous guiding element being in form of a spool axially movable in said housing.

5. Improved printing head as per claim 4 characterised by that said spool is arranged in working position by an axial screw which returns said spool against a ledge on said armature retaining element.

6. Improved printing head as per claim 4 characterised by that said spool is arranged in working position by an axial screw which returns said spool against a ledge on said electromagnet group.

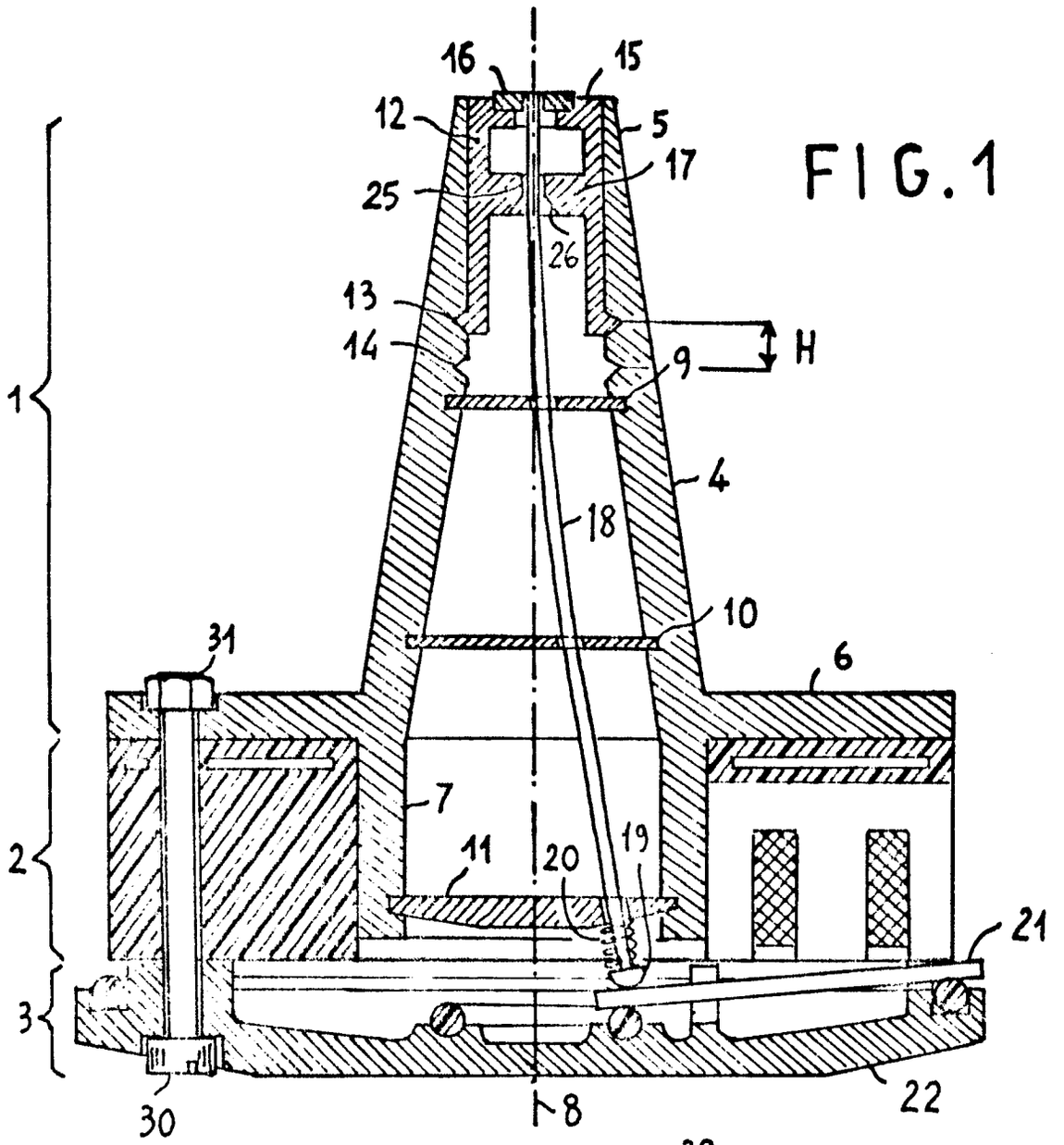

16
15
12
5
17
25
26
13
14
H
9
1
4
18
10
31
6
7
2
11
20
19
21
3
30
8
22

FIG.1

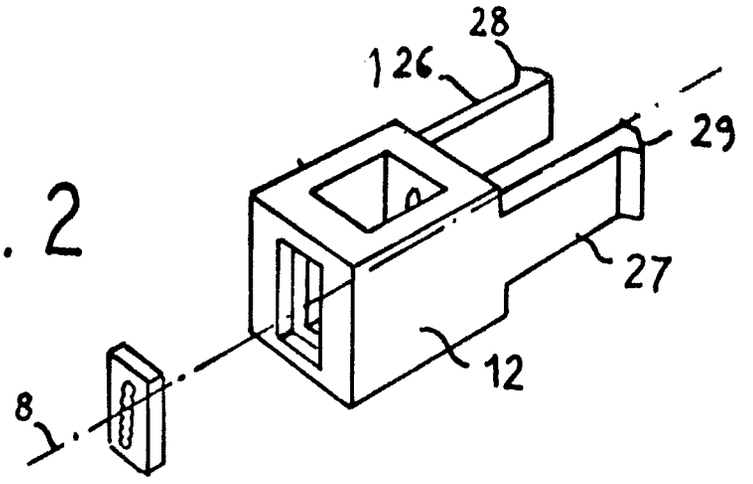

28
126
29
27
12
8

FIG. 2

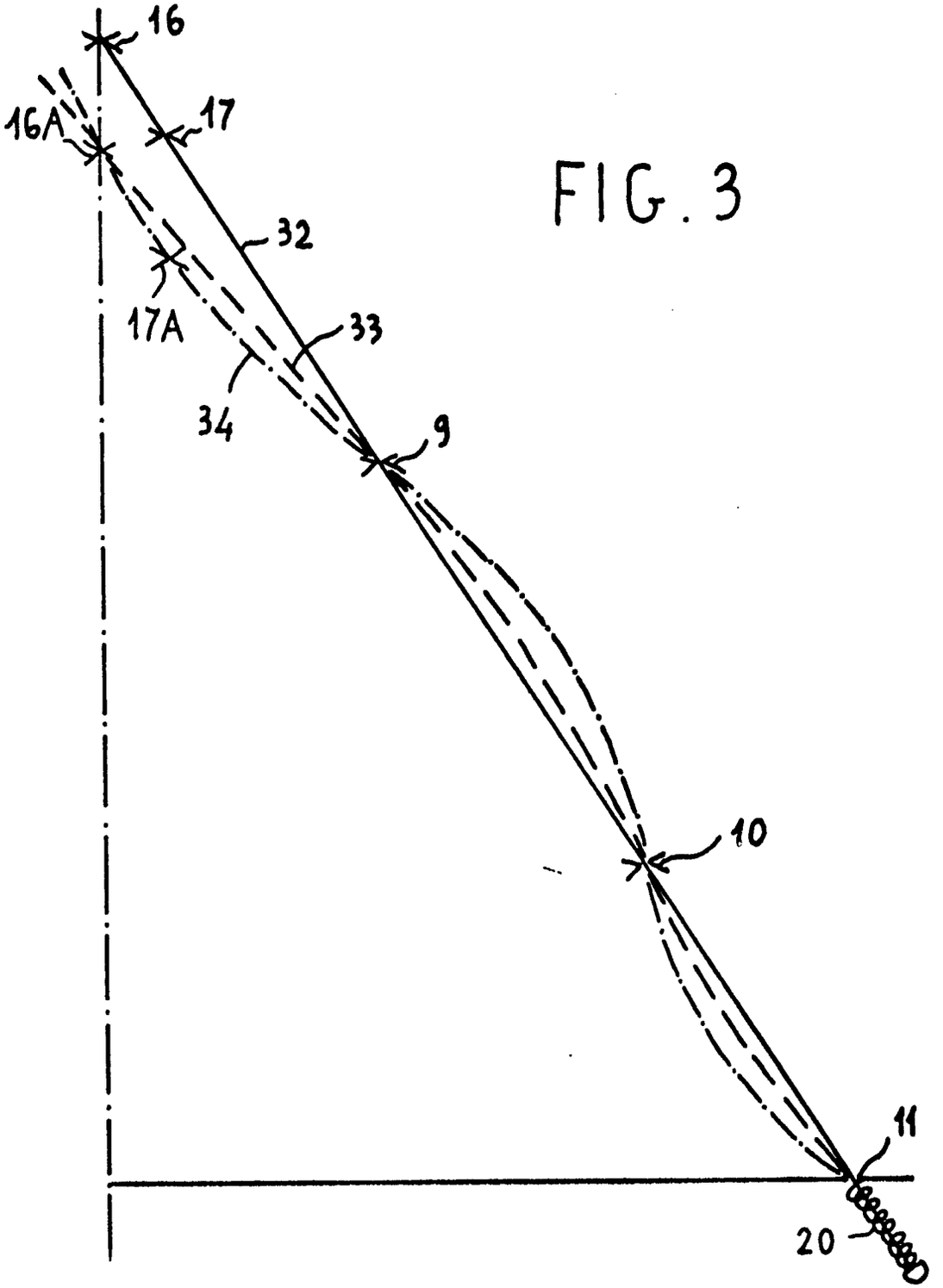


FIG. 3

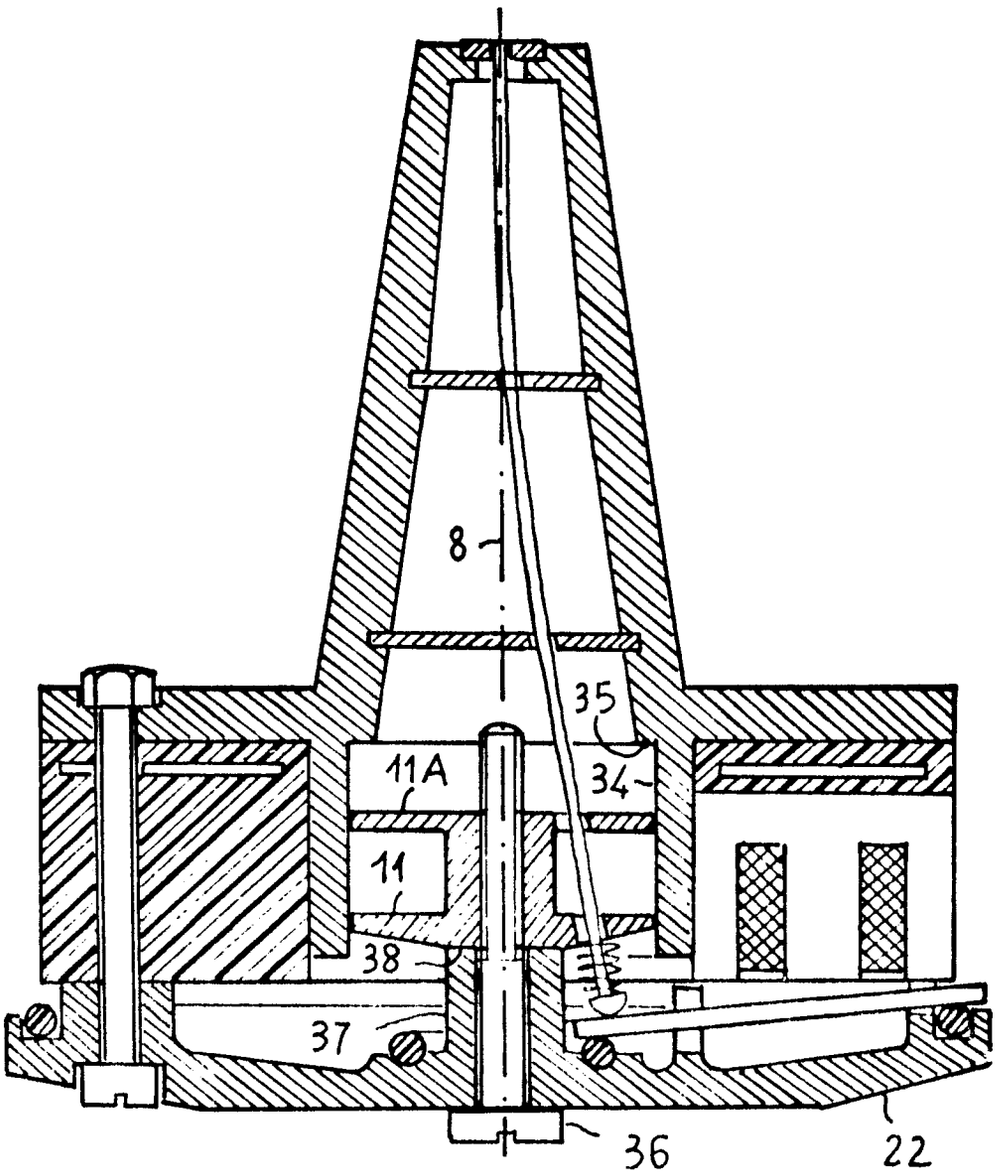


FIG. 4