

IMPACT DOT PRINTER AND HEAD THEREFOR

The present invention relates to an impact dot printer and to an impact dot printer head for use in the impact dot printer.

Figure 15 illustrates, in plan view, a typical arrangement of the mechanical parts of an impact dot printer. An impact dot printer head (36) is mounted on a laterally moveable carriage (29). The impact dot head (36) includes a nose (1) having a number of printing wires (7) parallel to and moveable in the direction of the arrows. Accordingly, printing is effected on a printing sheet (39) placed between a platen (37) and an ink ribbon (38).

The prior art will now be described with reference to figures 12 to 14; of which figure 12 is a cross-sectional view along the line X-X in figure 15, figure 13 is an enlarged portion of figure 12 and figure 14 is a partial cross-section along the line Y-Y of figure 12.

Generally each printing wire (7) of an impact dot head (1) is driven utilizing electromagnetic force of a respective solenoid coil (16). The solenoid coils are arrayed in a ring as shown in figure 14 and mounted in a frame (2). A terminal part (12) of each solenoid coil is soldered to a printed board (9) through a hole provided on the bottom face of the frame (2). The frame is fabricated from a magnetic material and generally has electrical conductivity. Consequently, a spacer member (8), made from a non-conductive material such as plastics, is provided between the frame and the printed wiring board to prevent any short-circuits between the parts where electric current flows, such as the terminal part of the coil and the printed wiring board and the frame.

A heat waster (6) is disposed so as to contact the peripheral edge (19) of the frame (7) and the heat generated by the solenoid coil is transferred from a core that



contacts the solenoid coil to the peripheral edge of the frame and is released via the heat waster that abuts therewith.

In some prior art arrangements the coil is directly soldered and fixed to the frame and printed circuit board. Alternatively, in order to facilitate heat radiation from the solenoid coil to the peripheral edge of the frame, a resin (20), such as silicon, is injected in the space between the frame and the coil. The resin used for this purpose is in liquid form when injected and turns into a solid by natural hardening or ultra-violet light hardening in air. These types of impact dot printers and impact dot printer heads have been found to have a number of problems in practice and these are discussed as follows.

The spacer member (8) is provided so as to prevent any short circuits. If the thickness of the spacing member (8) is relatively thin for example less than 0.5mm, then when the coil terminal (12) is being soldered to the pcb (9), solder can flow from the pcb (9) to the frame (2) leading to the possibility of short circuits between the solenoid coil (16) and the frame (2). This leads to a degradation of the quality of the impact dot printer head.

A solution to this problem is to provide a spacing member (8) which is of an adequate thickness to prevent short-circuiting. However, this then leads to a problem in positioning the nose (1) on the frame (2). This is because, the nose (1) has a projecting portion (24) which is inserted into a hole portion (26) of the frame (2) through aligned holes in the pcb (9) and spacer member (8) so as to correctly position the nose (1) on the frame (2). If the spacer member (8) is relatively deep, then the projecting portion (24) may not be long enough to contact the hole on the frame (2). A solution to this problem was to increase the height of the projecting portion (24).

This solution, however, was not satisfactory because the nose (1) and projecting portions (24) are generally manufactured from injection moulded plastic or

from die casting metals such as aluminium. As the height of the projecting portion (24) increases it becomes more difficult to correctly align and couple the nose (1) to the frame (2) because the projecting portion (24) is more likely to fall when fabricated from these materials.

Another known problem involves the resin which is injected in the space between the frame and the coil to improve heat dissipation. If the resin has a low viscosity, then the resin often leaks before it hardens from the gap between the spacer ^{me} number (8) and the pcb (9) through the holes open on the bottom face of the frame. It is regrettable that resin cannot be retained in the desired space but also that this then entails removing the leakage which increases the manufacturing time and complexity in manufacturing.

An obvious solution is thus to provide a resin of high viscosity usually more than $45 \text{ kg m}^{-1}\text{s}^{-1}$ (450 poise). This solution again is not adequate in that because of the high viscosity of the resin (20) it cannot reach the bottom face of the frame (2) to the lower part of the solenoid coil (16) and to the protrusion part (21) of the coil bobbin as shown in figure (13). In addition, such high viscosity resins rarely flow in between the adjoining solenoid coils as shown in figure 14. Consequently, heat dissipation from the solenoid coil (16) is extremely poor particularly when printing at high speeds.

An alternative solution would be to omit the injected resin. However, this limits the heat radiation which may be transferred from the solenoid coil to the core and then radiated to the peripheral edge of the frame through the heat waster. Thus the temperature of the head is inadequately depressed for the exothermic activity per unit time with a conventional heat radiating structure. Accordingly, this limit on heat radiation effectively limits the speed which the impact dot printer head can print. An increase in the printing speed above this limit can lead to problems such as burning of

the solenoid coil thereby damaging the impact dot printer head as well as naturally leading to degradation of printing quality.

A final problem encountered in existing arrangements of impact dot printers and their heads have been with the arrangement of connecting the solenoid coil (16) to the pcb (9) by soldering the coil terminal pin (12) to the pcb (9). When printing, the printing wires are driven which generates vibrations. If there is a winding sag on the coil, friction is caused by the vibration between the coil wire rod at the coiling sag portion and the frame (2). This often leads to the insulating film of the coil wire rod to peel off and short-circuits are set up between the solenoid coil (16) and the frame (2).

An object of the present invention is therefore to provide an impact dot printer and an impact dot printer head which each have a combination of features obviating the aforementioned problems. A highly reliable impact dot printer which can print at high speed is thus provided having the minimum possibility of short-circuiting and simplifies manufacture through allowing an improved arrangement of accurately positioning the nose with respect to the frame.

According to the present invention there is thus provided an impact dot printer having an impact dot printer head which comprises:

at least one solenoid coil disposed in a frame made of soft magnetic material for driving a printing wire;

a printed circuit board electrically connected to said solenoid coil through at least one hole provided in the base of the frame, said pcb having a through hole;

a spacer member located between said frame and said pcb, said spacer having a recess; and

a nose for guiding said printing wire having a projection for engaging said recess via said through hole; characterised in that

a low viscous silicon injected into a space between said solenoid coil and said frame and said spacer member;

said spacer member and said frame have means for laterally and rotationally locking said spacer member to said frame;

said spacer member has a thickness of at least 0.5 mm;

said projection only engages said pcb and said spacer member; and in that said nose and said pcb are provided with a locking arrangement.

Also according to the present invention there is provided an impact dot printer head comprising at least one solenoid coil disposed in a magnetic frame for driving a printing wire;

a printed circuit board electrically connected to said solenoid coil through at least one hole provided in the base of the frame, said pcb having a through hole;

a spacer member located between said frame and said pcb, said spacer having recess; and

a nose for guiding said printing wire having a projection for engaging said recess via said through hole; characterised in that

a low viscous silicon injected into a space between said solenoid coil and said frame and said spacer member;

said spacer member and said frame have means for laterally and rotationally locking said spacer member to said frame;

said spacer member has a thickness of at least 0.5 mm;

said projection only engages said pcb and said spacer member; and in that

said nose and said pcb are provided with a locking arrangement.

Embodiments of the present invention will now be described with reference to the accompanying drawings, of which:

Fig. 1 is a cross-sectional view along the line X-X of Fig. 15 of a first embodiment of the present invention;

Fig. 2 is a perspective expanded view of the first embodiment of the present invention;

Fig. 3 is a perspective expanded view of a second embodiment of the present invention;

Fig. 4 is a cross-sectional view of a third embodiment of the present invention;

Fig. 5 is a perspective view of a fourth embodiment of the present invention;

Fig. 6 is a cross-sectional view of a fifth embodiment of the present invention;

Fig. 7 is a cross-sectional view of a sixth embodiment of the present invention;

Fig. 8 is a cross-sectional view of a seventh embodiment of the present invention;

Fig. 9 is an enlarged view of a portion of Fig. 8.

Fig. 10 is partial lateral cross-section of the seventh embodiment of the present invention;

Fig. 11 is a schematic diagram indicating a relationship of the amount of resin which can be injected with respect to the viscosity of the resin;

Fig. 12 is a cross-sectional view along the line X-X of Fig. 15 illustrating the an impact dot printer of the prior art;

Fig. 13 is an enlarged portion of Fig. 12 illustrating the prior art;

Fig. 14 is a lateral cross-section along the line Y-Y of Fig. 12 illustrating the prior art; and

Fig. 15 is a diagrammatic plan view of a mechanical portion of an impact dot printer.

Fig. 1 is a cross-sectional view of an impact dot head of the first embodiment of the present invention. A printed wiring board (9) is disposed between a nose (1) and a frame (2) through an intermediary of a spacer member (8). The frame (2) has a cylindrical shape ⁽³⁾ and a plate-like bottom face (10) formed on one face thereof.

A plurality of cores (11) are disposed standing in parallel to each other on the other side of the bottom face (10). The frame (2) is made from a magnetic material and a plurality of solenoid coils (16) are mounted on the cores (11). Two coil bobbin protrusion parts (21) are provided and molded in one body with a coil bobbin (17) which each guide a coil wire. A coil terminal pin (12) is driven on the head of the protrusion part (21). Both ends of the coil wire are tied up to the coil terminal pin (12) by being guided by the protrusion part (21) and the protrusion part (21) is inserted into a through hole (42) in the bottom face (10) of the frame (2).

The printed circuit board (9) is laid on the bottom face (10) of the frame (2) through the intermediary of the spacer member (8). A number of holes (13) are provided in the printed circuit board (9) and the spacer member (8) in alignment with the coil terminal pins (12) of the solenoid coil (16). The coil terminal pins (12) on which the coil wire is tied up are extruded through the holes. The extruded portion of the coil terminal pin (12) and the printed wiring board (9) are soldered together. The spacer member (8) is approximately more than 0.5 mm thick for the purpose of preventing a short-circuit if any solder flows to the back of the printed wiring board (9) and contacts the bottom face (10) when the coil terminal pin (12) at the end portion of the coil is soldered to the printed wiring board (9). An insulating plastic is used to fabricate the spacer member (8).

A spring holder (14) for holding a reset spring (15) is disposed at an inner circumference position of the core (11) of the frame (2). Then, on the upper face of the frame (2), a first yoke (3) and a second yoke (4) are mounted and a lever (18) is mounted facing the core (11) by being guided by the first yoke (3) and the second yoke (4). A printing wire (7) is fixed to the tip of the lever (18) and is urged in the reset direction by the reset spring (15). A damper (40) is mounted at the middle of a lever holder (5) abutting the upper face of the spring holder (14).

In the construction as described above, electric power is selectively fed to the solenoid coil (16) through being connected to the printed wiring board (9) in accordance with printing signals. A magnetic circuit is created from the frame (2), the first yoke (3), the second yoke (4) and the lever (18). The lever (18) is thus advanced to give an impact force to the printing wire (7) so as to form dots on a printing sheet (39).

Fig. 2 is a perspective view illustrating the first embodiment of the present invention. As shown in this figure, a projecting portion (27) is provided which rises from the peripheral edge portion of the spacer member (8). The frame (2) and the spacer member (8) are laterally positioned by contiguously engaging the projecting portion (27) to the peripheral portion of the frame (2).

Positioning in the rotation direction is then carried out by engaging a hole or recess portion (28) created on the bottom face (10) and a convex portion (25) created on the spacer member (8).

The spacer member (8) and the nose (1) are positioned in the rotation direction by engaging a hole portion (26) created on the spacer member (8) and the pcb (9) with a concave portion (24) created on the nose (1).

Positioning of the center is carried out by engaging the inner circumference (30) of the spacer member (8) with a cylindrical portion (31) created on the nose (1).

Moreover, three cylindrical convex portions (23) are provided on the nose (1) and are abutted to a bottom face (35) of the spacer member (8) to position the spacer member (8) and the nose (1) in the laminating or axial direction.

On the printed wiring board (9), holes (33) having larger diameter than the cylindrical convex portion (23) are provided in the same respective coordinate positions as the convex portions (23) created on the nose (1). Naturally, more than three convex portions (23) and respective holes (33) may be provided.



A frame assembly (41) comprising the frame (2), the spacer member (8), the printed wiring board (9) and the solenoid coil (16) thus structured is mounted to the nose (1). The three cylindrical convex portions (23) created on the nose (1) engage the holes (33) on the printed wiring board (9) and the convex portion (24) created on the nose (1) engages the hole portion (26) created on the spacer member (8) and the pcb (9). Thus dislocation of the frame assembly (41) and the nose (1) can be prevented by this locking mechanism.

Naturally, the convex portion (24) and the convex portions (23) on the nose (1) need not have a cylindrical shape but may have a column shape with any cross-section such as square or elliptical. Moreover, the cross-sectional shape of the hole portion (26) of the spacer member (8) need not be the same cross-section of the convex portion (24), just so long as it is a shape that allows positioning of the spacer member (8) to the nose (1) in the rotation direction. Furthermore, the hole (26) of the spacer member (8) need not be a through hole but may be concave in shape so as to permit engagement of the convex portion (24) of the nose (1).

Alternatively, the second embodiment as shown in figure (3) has a projecting portion (27) of the spacer member (8) which is circumferential so that the projecting portion (27a) engages the whole peripheral portion of the frame (2).

In the aforementioned structure the spacer member (8) is made from an insulating ceramic or a metallic member, such as aluminium, on which an insulating coating is applied. This structure allows heat generated by the solenoid coil (16) to be transferred from the core (11) of the frame (2) to the bottom face (10) of the frame (2) and from the bottom face (10) to the spacer member (8).

With this structure the ratio of the area of the frame (2) that abuts the spacer member (8) and the area of the peripheral edge of the frame (2) that abuts a radiation member (6) (shown in Fig. 1) is almost 2:1 to 1:1. That is to say, the area of the frame (2) that abuts the spacer member (8) is larger than the area of the spacer

member (8) that abuts the radiation member (6). Also the temperature of the bottom face (10) of the frame (2) is usually higher since the bottom face (10) is closer to the heat generated, compared to the peripheral edge (19) of the frame (2). Accordingly, the quantity of heat transferred to the spacer member (8) is larger than that transferred to the radiation member (6).

It has been found that this quantity of heat cannot be effectively released if the thickness of the spacer member (8) is in the range 0.1 mm to 0.4 mm. Fortunately, when the spacer member (8) is made from the material as described before and the thickness is increased to more than 0.5 mm, then this provides sufficient heat radiating effects because as the thickness increases, the volume of the spacer member (8) increases leading to an increase in the thermal capacity. Indeed the first embodiment shown in Fig. 1, includes a heat waster (6) which contacts the peripheral edge (19) and in this case, almost twice the heat radiating effects compared to the past can be obtained.

Fig. 4 shows a third embodiment of the present invention. In this embodiment, the hole portion (13) in the spacer member (8) which allows the coil terminal pin (12) to pass there through is enlarged so that the solenoid coil (16) and the coil protrusion portion (21) terminating the coil bobbin (17) do not touch. Thus, the spacer member (8) need not be fabricated from a material having an electrical insulating quality as in the first and second embodiments.

As a result, the only property required of the spacer member (8) is to have an excellent heat transfer quality and so metals such as aluminium, and zinc or materials such as ceramics (aluminium oxide, zirconium oxide, zirconium dioxide) may be used. This not only increases the design freedom compared to the first and second embodiments, but also significantly lowers the cost, since insulation becomes unnecessary when a metal is used for the spacer member (8). A further advantage of

this third embodiment is that if solder does flow to the back of the pcb (9) then it is more difficult to contact the spacer member (8).

Fig. 5 shows a fourth embodiment of the present invention. In this embodiment, in order to release even more heat transferred to the spacer member (8), the spacer member (8) is extruded outside of the impact dot printer head and the extruded portion is made into a heat releasing fin structure (32).

In addition the spacer member (8) can be extended to the peripheral edge (19) to provide a heat radiating fin as shown in Fig. 6. Thus by providing the heat radiating fin as large as the space allows, the impact dot printer head can have even better heat resistance.

Fig. 7 shows the sixth embodiment of the present invention. In this embodiment, in order to release still more heat transferred to the spacer member (8), the spacer member (8) is extruded and an extruded portion (22) is abutted to the carriage (29) on which the impact dot printer head is mounted. As a result, the heat is transferred and released from the solenoid coil (16) to the frame (2), the spacer member (8), the extruded portion (22) and to the carriage (29), thereby making the impact dot printer head have an excellent heat radiating characteristic.

The seventh embodiment is shown in Fig. 8. As discussed above the spacer member (8) is provided in order to prevent solder from flowing into the back of the printed wiring board (9) to contact the bottom face (10) and thereby to cause a short-circuit when the coil terminal pin (12) of the coil terminal portion is soldered to the printed wiring board (9). However, as the spacer member (8) is much thicker, silicon (34) can be injected without any leaking, even if a low viscous silicon is used.

Fig. 9 is an enlarged view of a portion of Fig. 8 illustrating the seventh embodiment of the present invention. As seen from the figure, the thickness t of the spacer member (8) is thickened to more than 0.5 mm, so that even if a low viscous silicon (34) is injected, it hardens when it flows in the middle of the spacer member

(8). Accordingly, low viscous silicon can be used even as low as $25 \text{ kg m}^{-1} \text{ s}^{-1}$ (250 poise) of viscosity without reaching to and leaking at the printed wiring board (9). The low viscous silicon used here is a liquid type, room temperature hardening, silicon in which alumina oxide is added as a filler in a low molecular weight silicon oil. It is liquid when injected and hardens by a condensed bridging reaction by reacting with moisture in the air after injection and becomes a dealcohol type silicon rubber.

As shown in Fig. 9, because the low viscous silicon (34) flows through the through hole (42) provided on the bottom face of the frame (2) and into the middle of the spacer member (8) and hardens therein, the coil bobbin projecting portion (21) is fixed to the frame (2) and the spacer member (8) by the low viscous silicon (34). Thus, even if there is a winding sag on the solenoid coil (16), it prevents a short-circuit caused by friction and wear of the coil wire and the frame (2) due to the effect of vibration generated when the printing wire (7) of the impact dot head (36) is driven.

The low viscous silicon (34) also flows in between the adjoining solenoid coils (16) because of the low viscosity of the silicon (34) as shown in Fig. 10 and as a result, silicon is applied all round the solenoid coils (16).

Low viscous silicon in the range $5 \text{ to } 40 \text{ kg m}^{-1} \text{ s}^{-1}$ (50 to 400 poise) of viscosity is suitable so that the silicon fully flows into all the necessary parts and still does not leak when it is injected.

The heat radiating performance of the impact dot head (36) is proportional to the amount of injected silicon. However, as shown in Fig. 11, silicon having more than $40 \text{ kg m}^{-1} \text{ s}^{-1}$ (400 poise) of viscosity cannot be fully injected since the viscosity is too high. However, silicon having a low viscosity of less than $40 \text{ kg m}^{-1} \text{ s}^{-1}$ (400 poise) ensures that the injection amount is acceptable. Also when the thickness of the spacer member (8) is less than 0.5 mm, silicon leaks between the spacer member (8)

and the printed wiring board (9) through the hole (42) opened on the frame (2) if the silicon viscosity is less than $5 \text{ kg m}^{-1}\text{s}^{-1}$ (50 poise), because the viscosity is too low. In addition to that, it becomes difficult to control the amount to be injected, so that the viscosity is preferably more than $5 \text{ kg m}^{-1}\text{s}^{-1}$ (50 poise). From the above two considerations, 5 to $40 \text{ kg m}^{-1}\text{s}^{-1}$ (50 to 400 poise) of viscosity is most suitable for efficient production and heat radiating performance.

As described above, the present invention allows the spacer member to be thicker without causing any problems in positioning the nose and the frame yet reliably prevents a short-circuit between the printed wiring board and the frame and between the coil and the frame during soldering. Furthermore, by thickening the spacer member to more than 0.5 mm and making it from such materials as a ceramic having excellent heat conductivity and electrical insulating quality, or as a metallic member on which insulating coating is applied, the heat generated in the frame can be effectively radiated.

Furthermore, if the hole in the spacer member is enlarged so that the solenoid coil and the hole for inserting coil protrusion portion do not touch, the spacer member need not be fabricated from material having electrical insulation and a material having excellent heat transfer quality can be used for the spacer member. Moreover, the heat radiating quality can be improved by extruding the spacer member to the outside to make a fin structure and further by abutting it to the carriage.

Furthermore, the heat generated in the solenoid coil can be effectively transferred and radiated by injecting silicon to the bottom face of the frame, the lower part of the solenoid coil, the terminal part of the solenoid coil and to the spacer member without leaking even if low viscous silicon is used.

The improvements of the heat radiating and transferring performances remarkably improve the heat radiating performance of the impact dot head. Furthermore, since the silicon can be injected to the bottom face of the frame, the

lower part of the solenoid coil, the terminal portion of the solenoid coil and to the spacer member, any short-circuit that might be caused by the friction and wear of the coil wire rod and the frame due to the effect of vibrations generated when the printing wire of the impact dot head is driven, can be prevented even if there exists a winding sag on the solenoid coil.

From above effects, an impact dot printer provided with such a highly reliable impact dot head whose heat radiating performance is remarkably improved can be realized.

The embodiments of the present invention have been described above by way of example only and it will be appreciated by a person skilled in the art that modifications may be made without departing from the scope of the present invention defined in the appended claims.

**CLAIMS**

1. An impact dot printer having an impact dot printer head which comprises:
at least one solenoid coil (16) disposed in a frame (2) made of a magnetic material for driving a printing wire (7);
a printed circuit board (9) electrically connected to said solenoid coil (16) through at least one hole (42) provided in the base of the frame (2), said pcb having a through hole (26);
a spacer member (8) located between said frame (2) and said pcb (9), said spacer having a recess (26); and
a nose (1) for guiding said printing wire (7) having a projection (24) for engaging said recess (26) and said through hole (26); characterised in that
a low viscous silicon injected into a space between said solenoid coil and said frame and said spacer member;
said spacer member (8) and said frame (2) have means (27, 27a, 25, 28) for laterally and rotationally locking said spacer member (8) to said frame(2);
said spacer member (8) has a thickness of at least 0.5mm;
said projection (24) only engages said pcb (9) and said spacer member (8);
and in that
said nose (1) and said pcb (9) are provided with a locking arrangement (23, 33).
2. An impact dot printer as claimed in claim 1, in which said means for laterally and rotationally locking said spacer member (8) to said frame (2) includes at least one projection portion (27) at the perimeter of the spacer member (8) for contiguously engaging said perimeter of said frame (2) and a peg (25) disposed on said spacer member (8) for engaging a recess (28) provided on the base of said frame (2).





3. An impact dot printer as claimed in claim 2, in which there is one continuous projection portion (27a) at the perimeter of said spacer member (8).
4. An impact dot printer as claimed in any one of claims 1 to 3, further comprising a cylindrical portion disposed in the center of said nose (1) for engaging a hole (30) disposed in each of said pcb (9) and said spacer member (8).
5. An impact dot printer as claimed in any one of claims 1 to 4, in which said locking arrangement (23, 33) comprises at least one peg (23) provided on said nose (1) for engaging a respective through hole (33) disposed in said pcb (9).
6. An impact dot printer as claimed in any one of claims 1 to 5, in which said spacer member is extruded outside the impact dot printer head to form a heat-radiating fin structure (32).
7. An impact dot printer as claimed in claim 6, in which said extruded spacer member is abutted to a carriage (29) on which said head is mounted.
8. An impact dot printer as claimed in any one of claims 1 to 7, in which the viscosity of said low viscous silicon is $5 \text{ to } 40 \text{ kg m}^{-1} \text{ s}^{-1}$ (50 to 400 poise).
9. An impact dot printer head comprising
at least one solenoid coil (16) disposed in a magnetic frame (2) for driving a printing wire (7);
a printed circuit board (9) electrically connected to said solenoid coil (16) through at least one hole (42) provided in the base of the frame (2), said pcb having a through hole (26);



a spacer member (8) located between said frame (2) and said pcb (9), said spacer having a recess (26); and

a nose (1) for guiding said printing wire (7) having a projection (24) for engaging said recess (26) and said through hole (26); characterised in that

a low viscous silicon injected into a space between said solenoid coil and said frame and said spacer member;

said spacer member (8) and said frame (2) having means (27, 27a, 25, 28) for laterally and rotationally locking said spacer member (8) to said frame(2);

said spacer member (8) having a thickness of at least 0.5mm;

said projection (24) only engaging said pcb (9) and said spacer member (8);
and in that

said nose (1) and said pcb (9) are provided with a locking arrangement (23, 33).



ABSTRACT**IMPACT DOT PRINTER AND HEAD THEREFOR**

Hitherto impact dot printers have encountered problems of short circuiting between the printed circuit board (9) and the solenoid coil (16); accurate positioning of the nose (1) and the frame (2); providing adequate heat dissipation to allow high speed printing; and providing sufficient damping at the coil terminal (12)/pcb (9) junction to allow for vibrations caused by printing.

All of the above problems have been obviated by providing a partial or complete circumferential wall (27, 27a) on the spacer member (8) and a rotational locking mechanism (28, 25, 24, 26, 23, 33) between the frame (2), spacer member (8), pcb (9) and nose (1).

Fig. 2

Fig 1

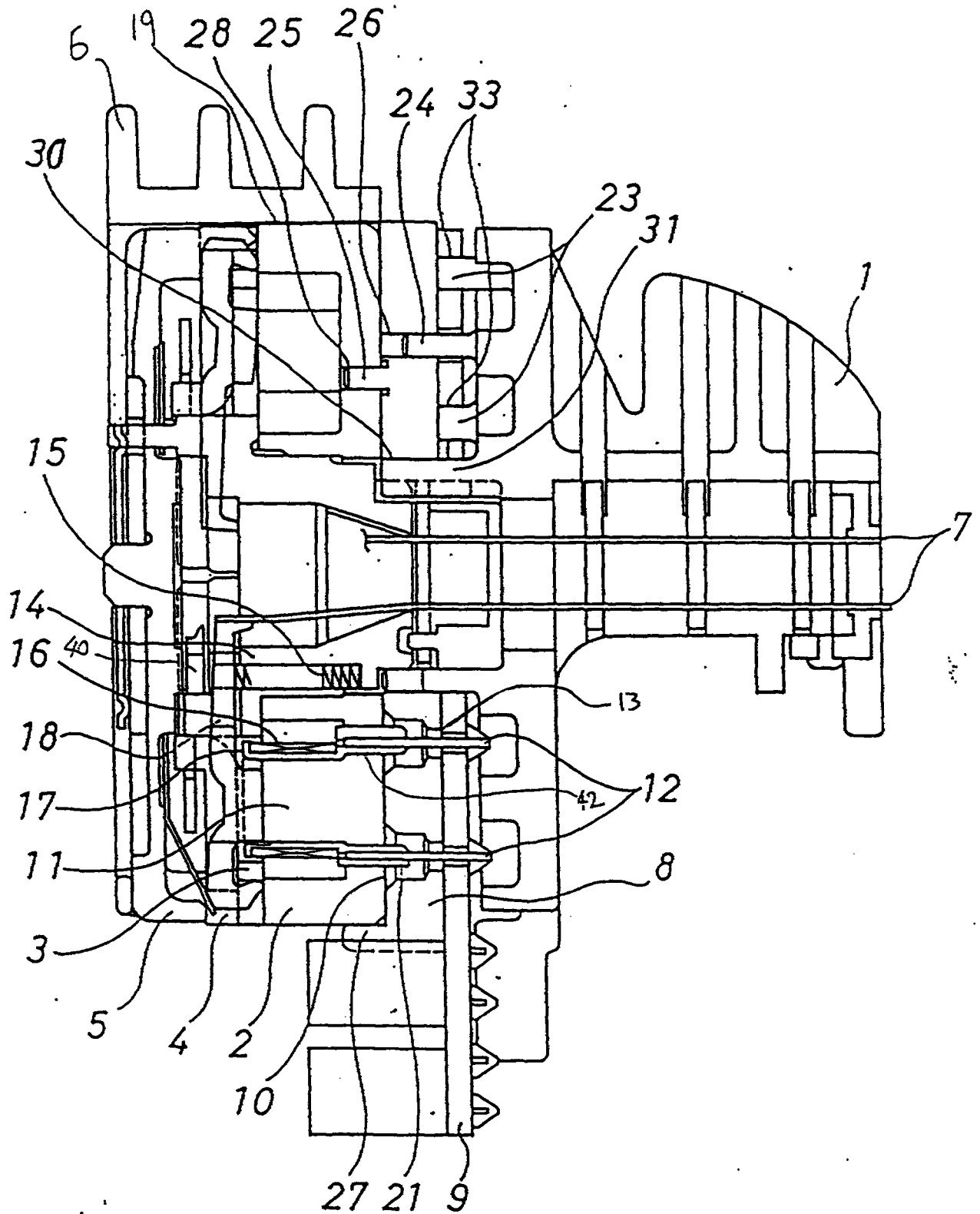


Fig. 2

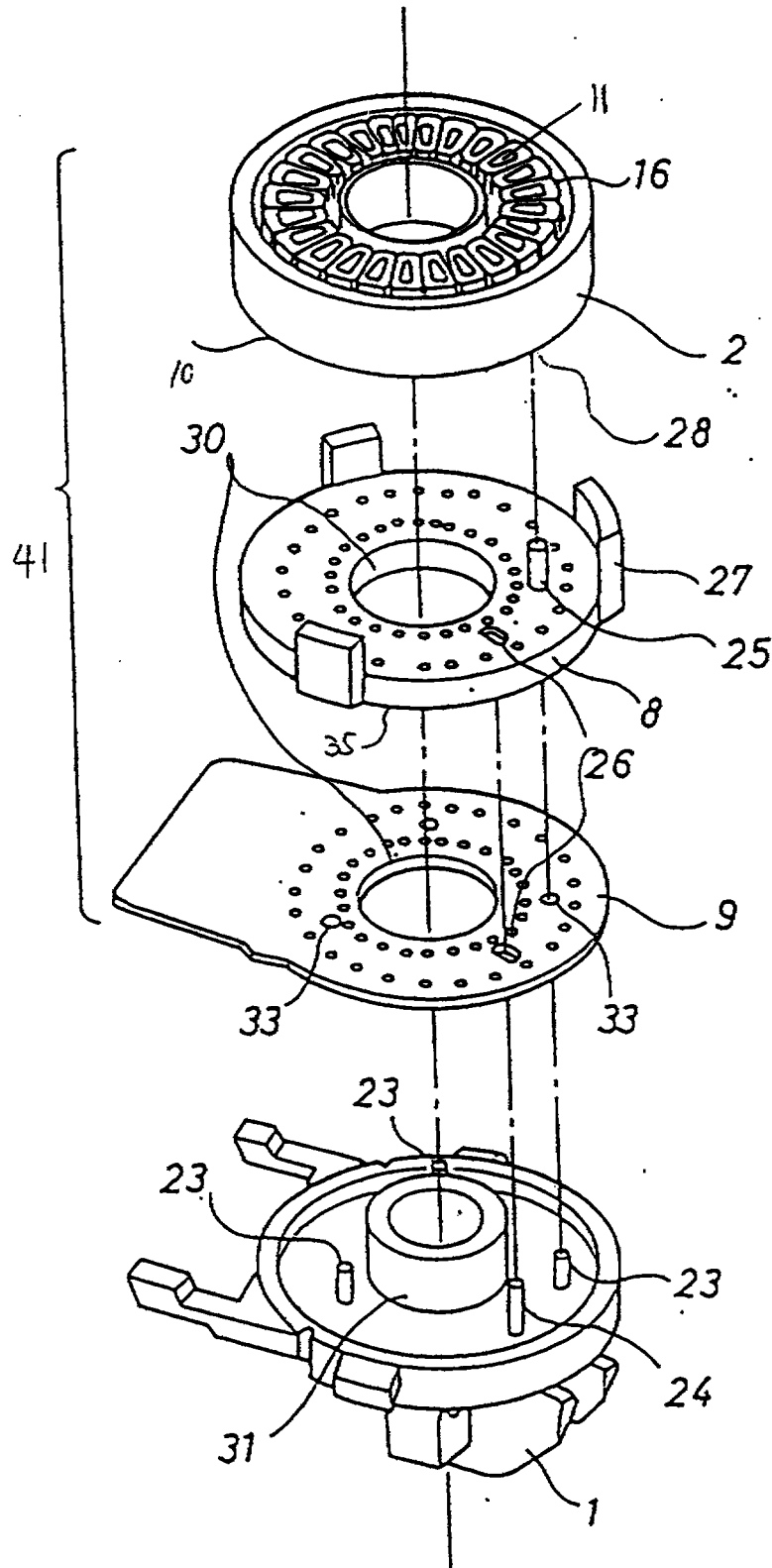


Fig 3

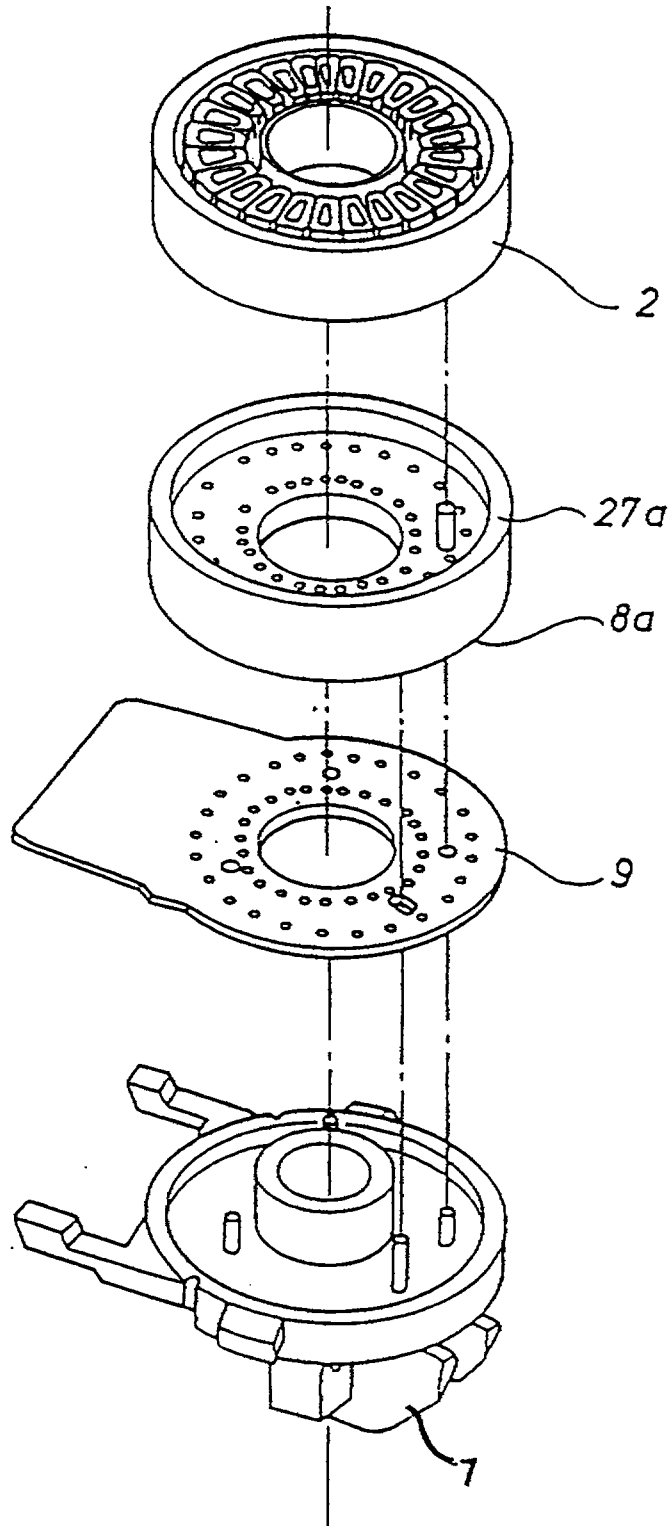


Fig 4

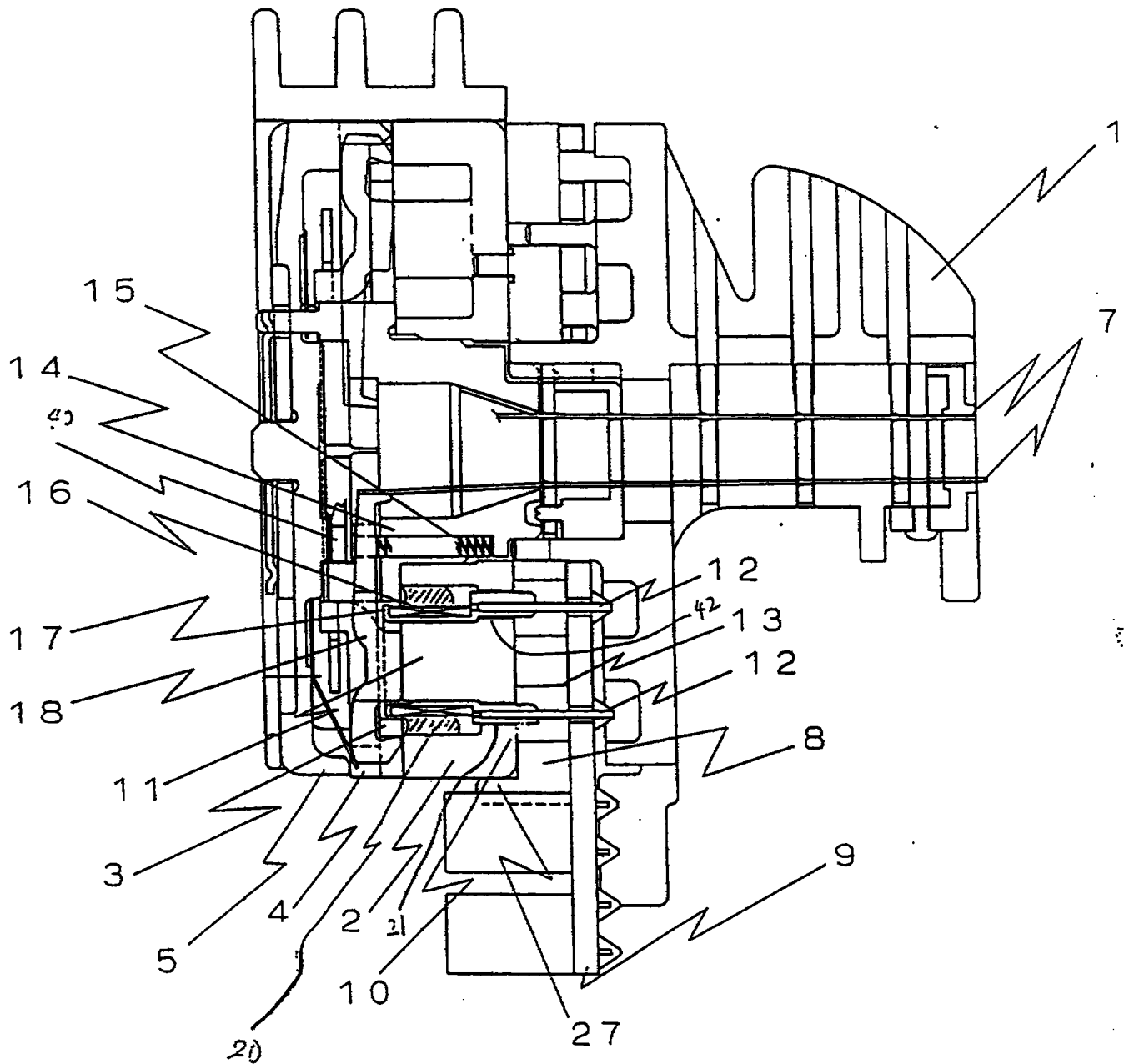


Fig. 5

ORIGINAL

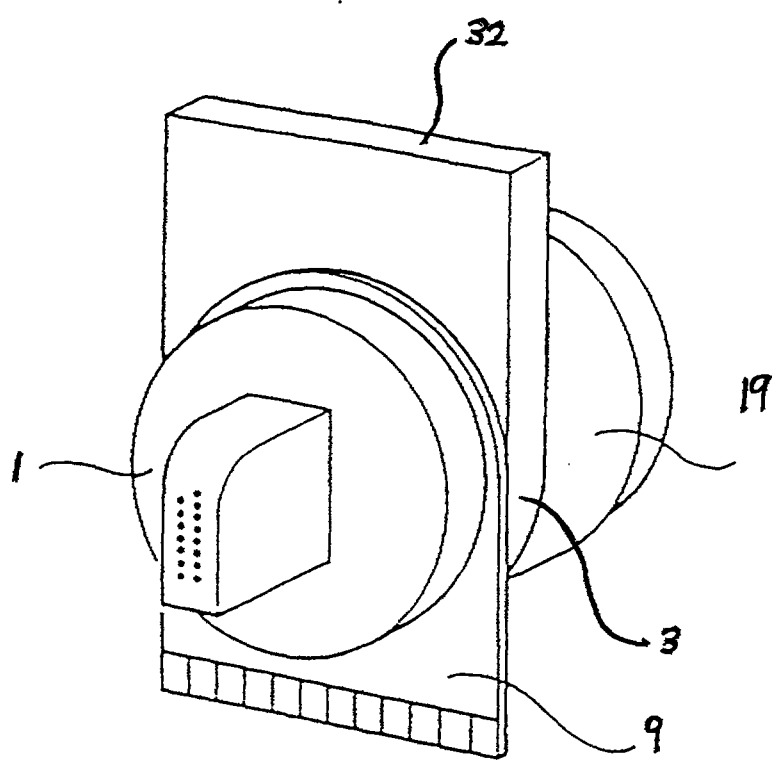


Fig. 1.5

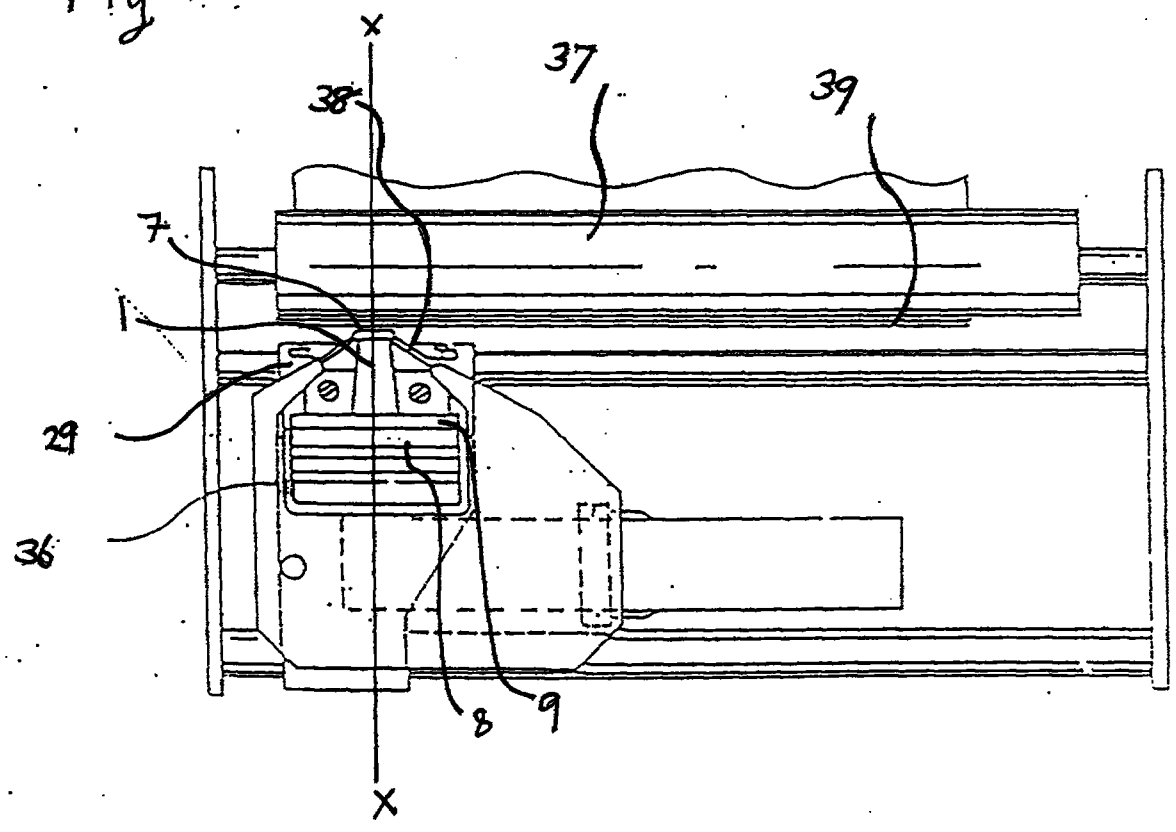


Fig 6.

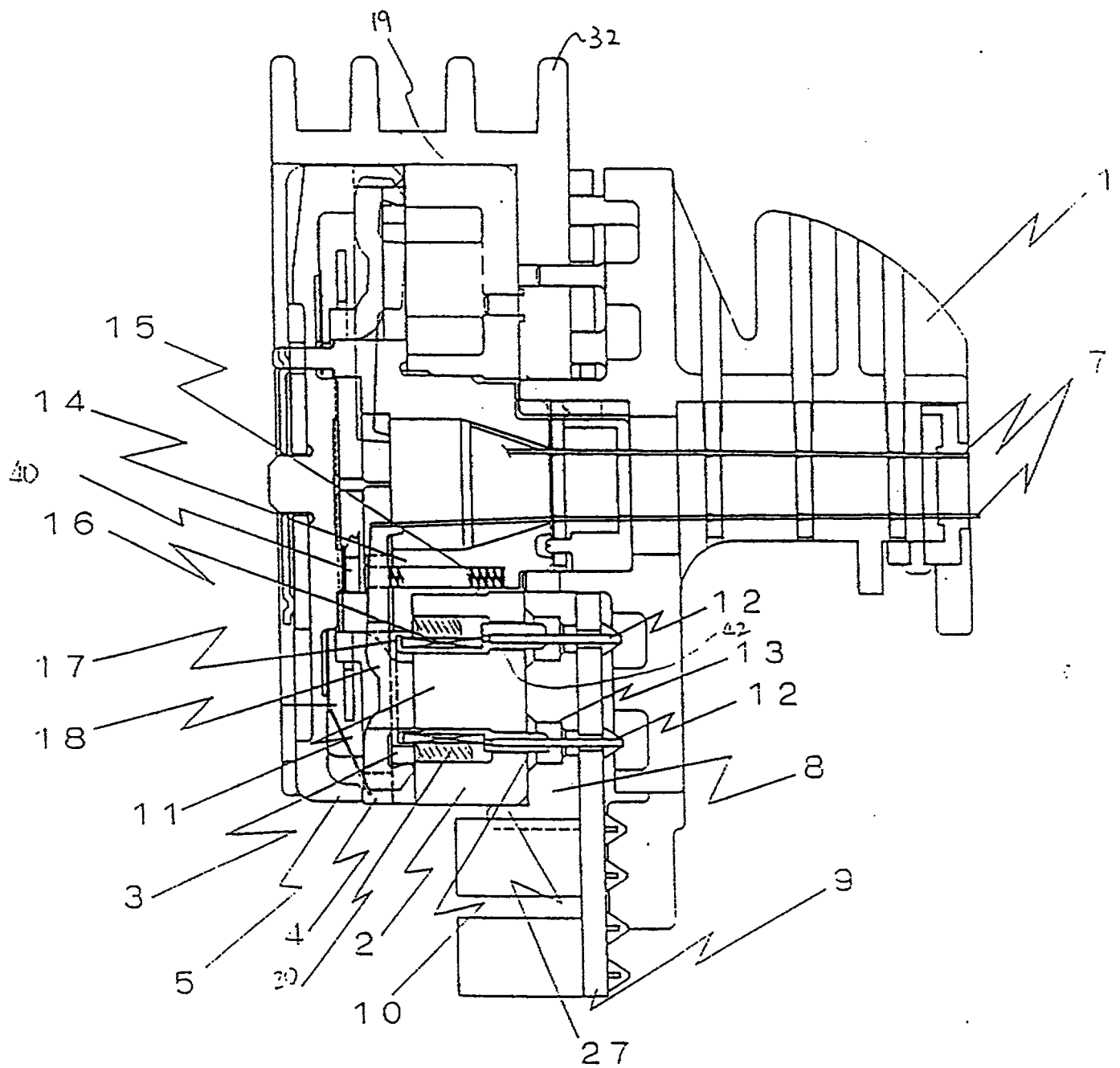


Fig 7

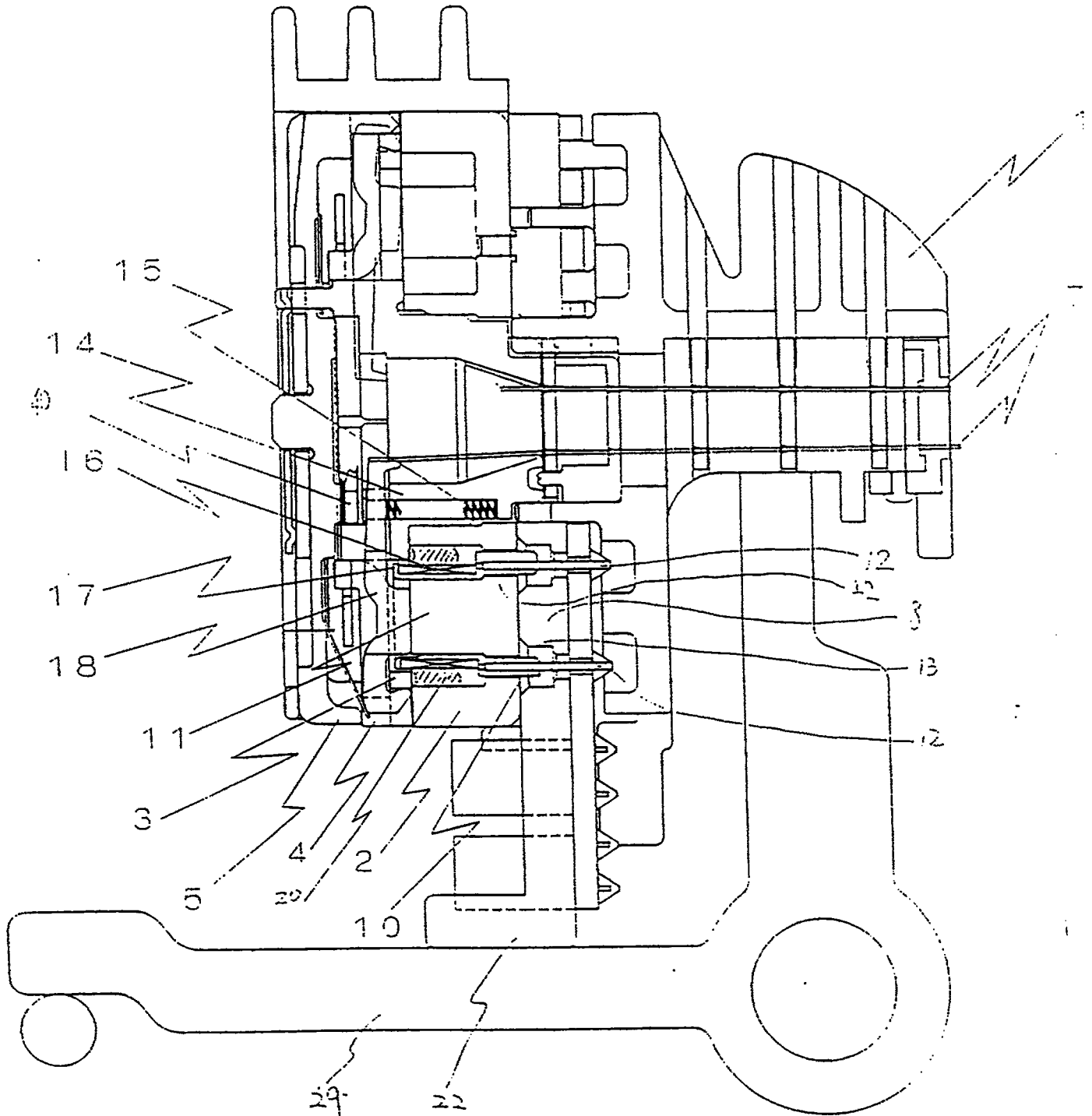


Fig. 8

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ORIGINAL

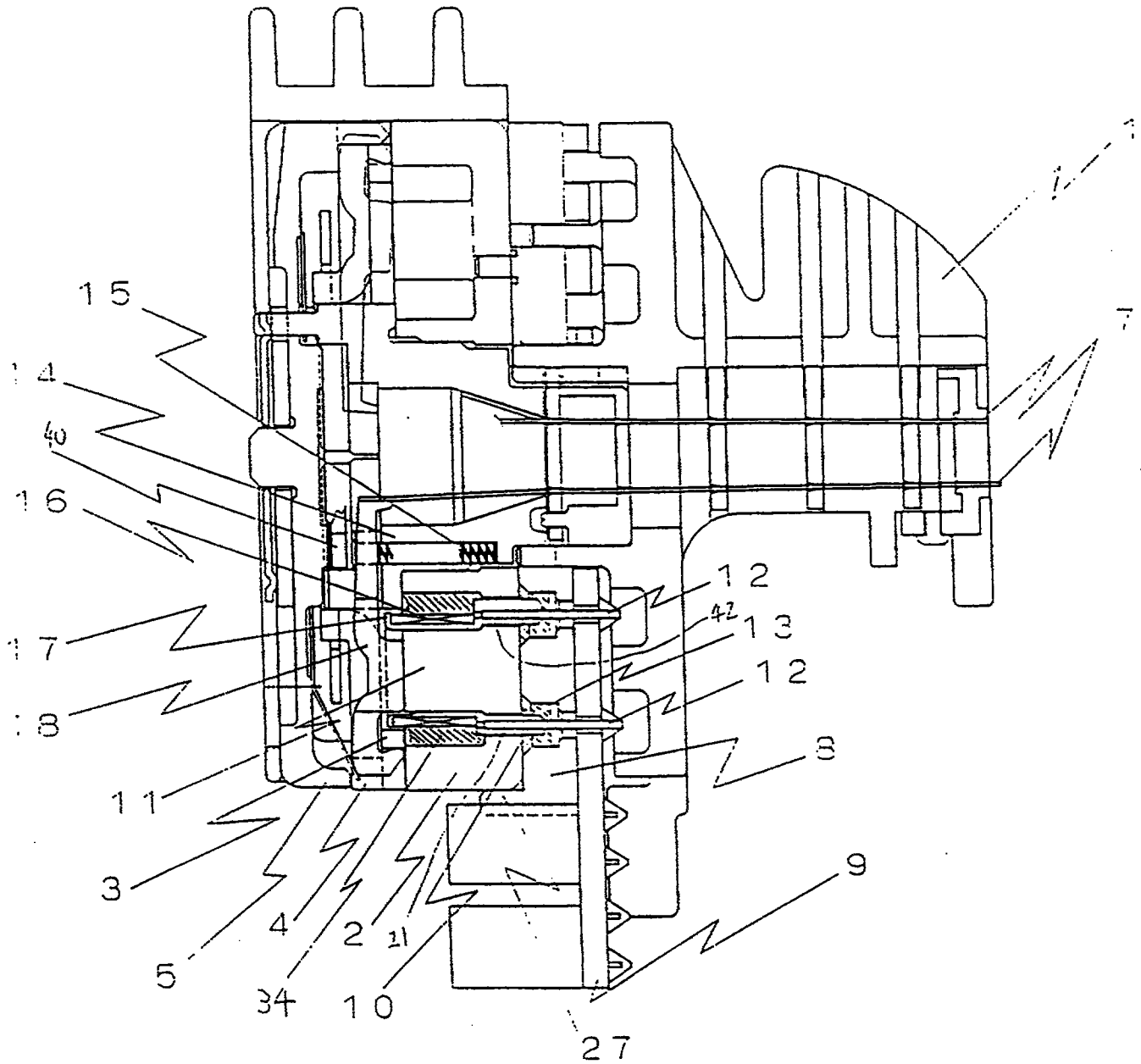
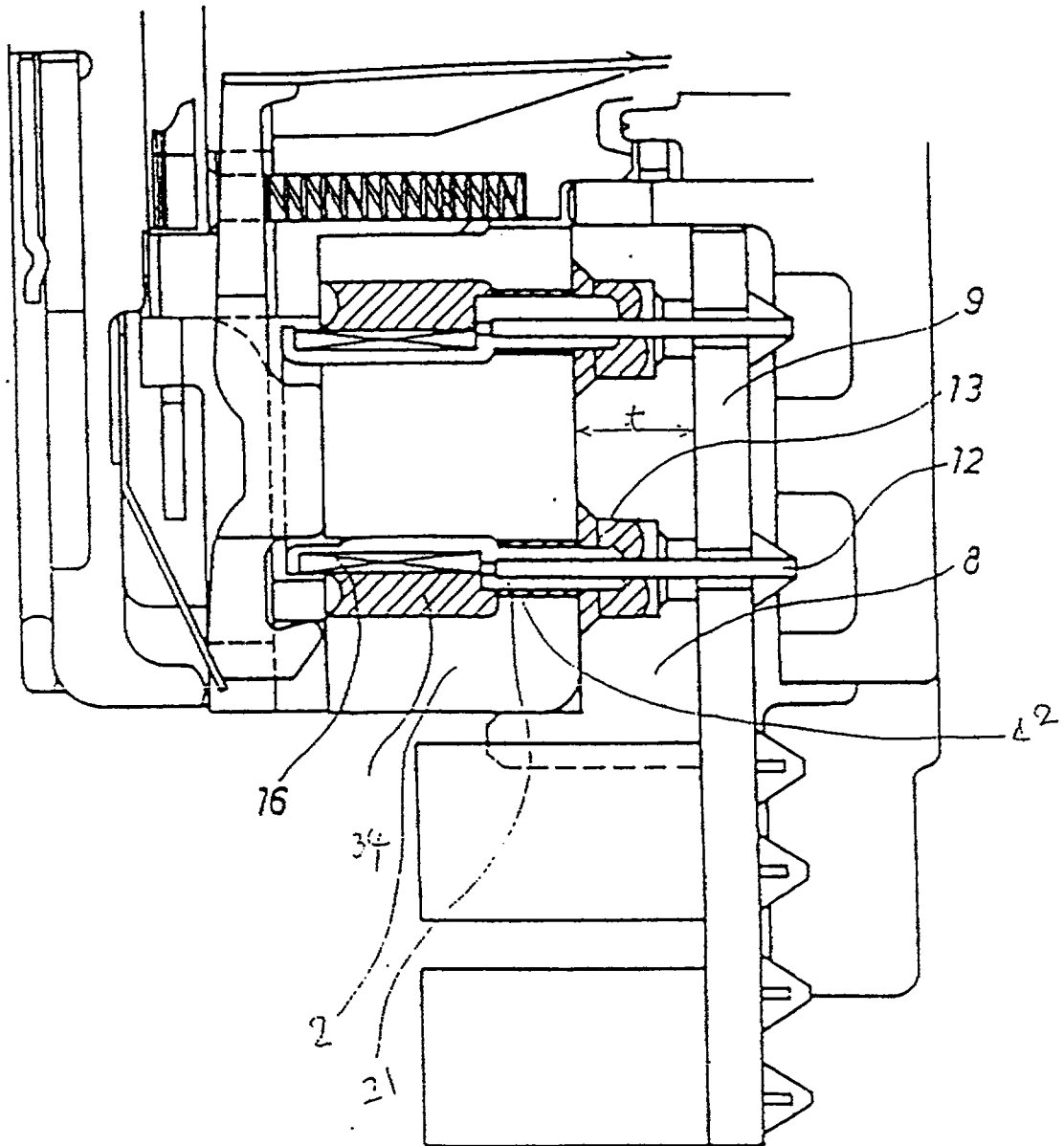


Fig 9



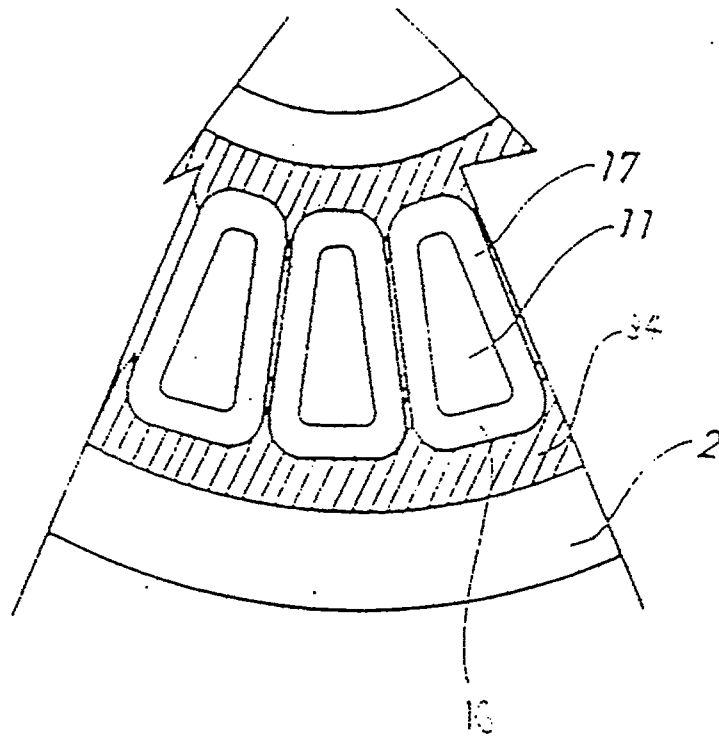


Fig 10

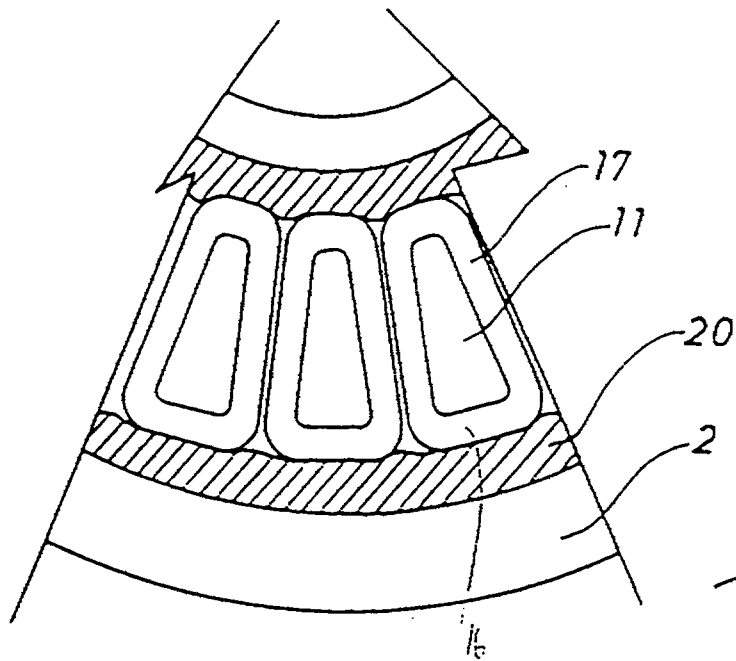


Fig 14

Prior Art

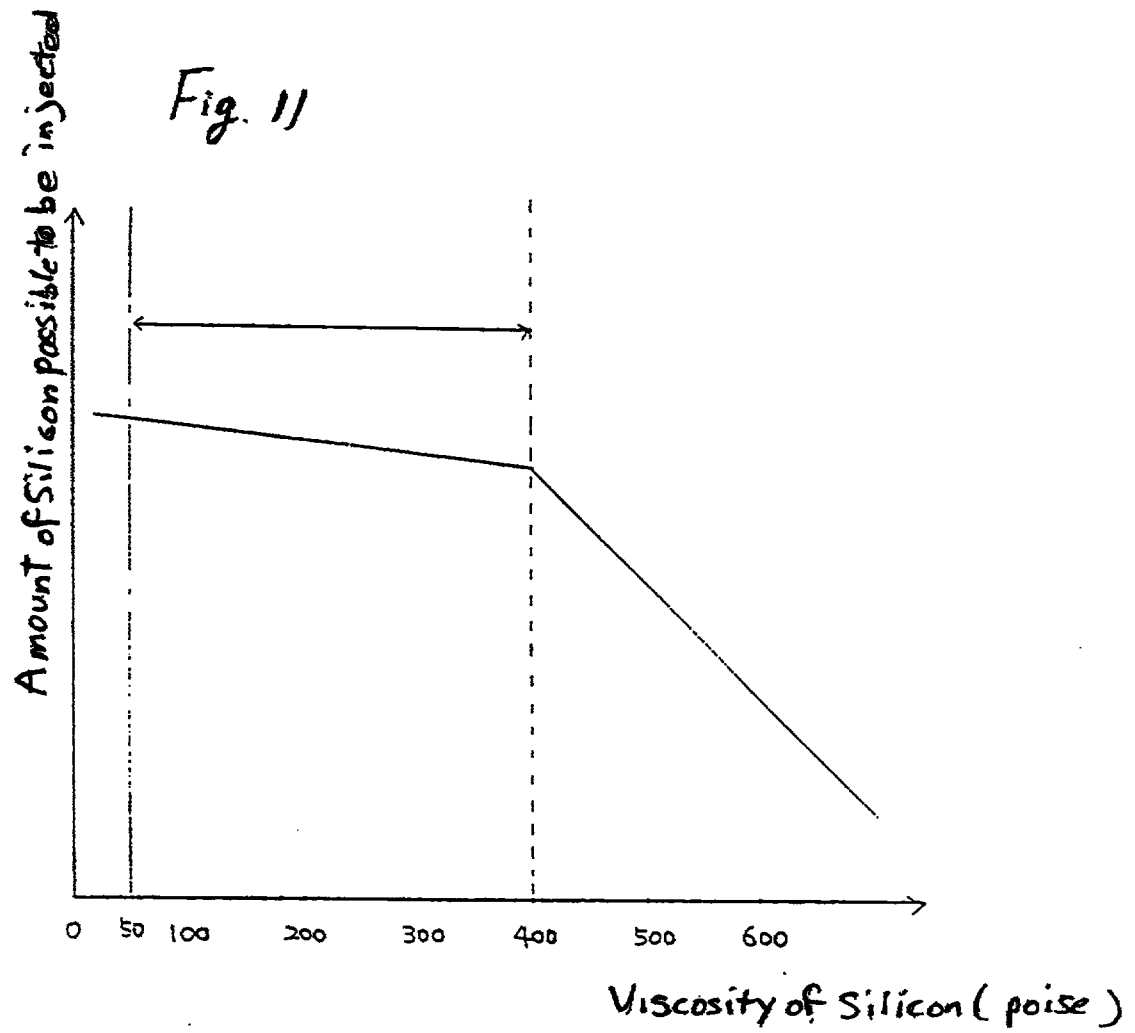
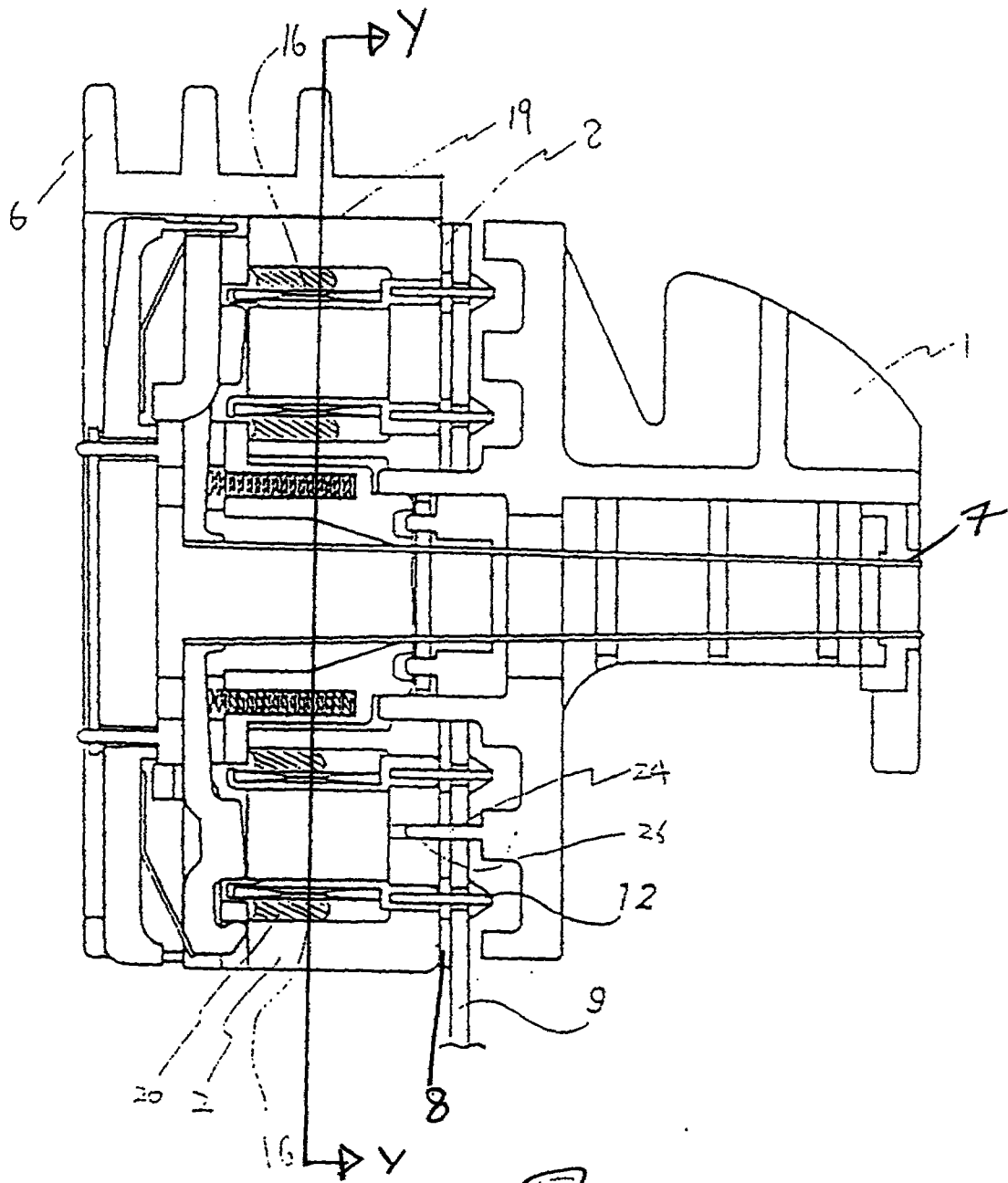
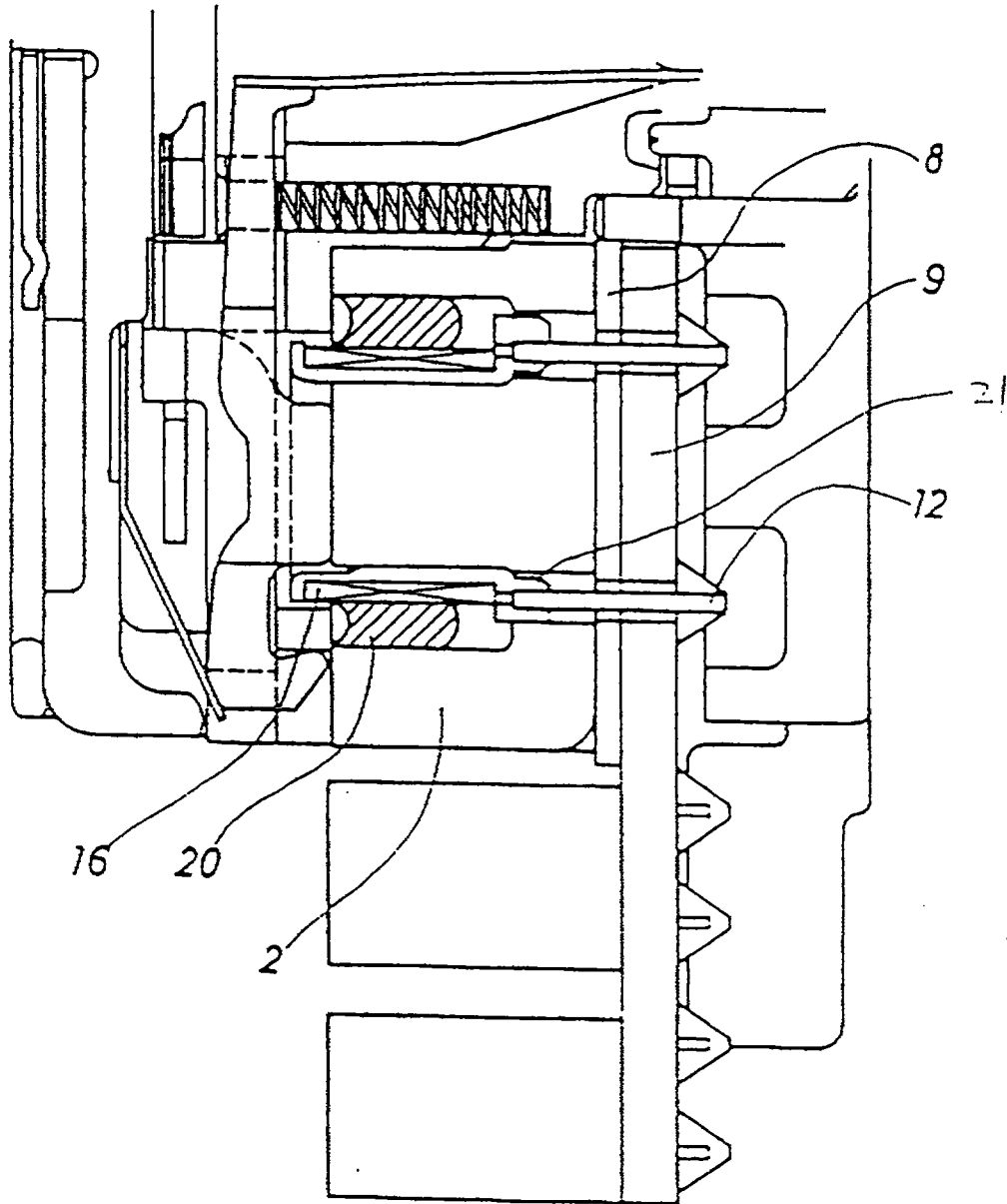


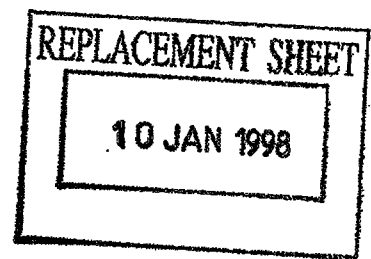
Fig. 12



Prior Art

Fig. 13





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IMPACT DOT PRINTER AND HEAD THEREFOR

The present invention relates to an impact dot printer and to an impact dot printer head for use in the impact dot printer.

Figure 15 illustrates, in plan view, a typical arrangement of the mechanical parts of an impact dot printer. An impact dot printer head (36) is mounted on a laterally moveable carriage (29). The impact dot head (36) includes a nose (1) having a number of printing wires (7) parallel to and moveable in the direction of the arrows. Accordingly, printing is effected on a printing sheet (39) placed between a platen (37) and an ink ribbon (38). One such printhead is disclosed in EP-A-0372 557.

The prior art will now be described with reference to figures 12 to 14; of which figure 12 is a cross-sectional view along the line X-X in figure 15, figure 13 is an enlarged portion of figure 12 and figure 14 is a partial cross-section along the line Y-Y of figure 12.

Generally each printing wire (7) of an impact dot head (1) is driven utilizing electromagnetic force of a respective solenoid coil (16). The solenoid coils are arrayed in a ring as shown in figure 14 and mounted in a frame (2). A terminal part (12) of each solenoid coil is soldered to a printed board (9) through a hole provided on the bottom face of the frame (2). The frame is fabricated from a magnetic material and generally has electrical conductivity. Consequently, a spacer member (8), made from a non-conductive material such as plastics, is provided between the frame and the printed wiring board to prevent any short-circuits between the parts where electric current flows, such as the terminal part of the coil and the printed wiring board and the frame.

A heat waster (6) is disposed so as to contact the peripheral edge (19) of the frame (7) and the heat generated by the solenoid coil is transferred from a core that

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In the construction as described above, electric power is selectively fed to the solenoid coil (16) through being connected to the printed wiring board (9) in accordance with printing signals. A magnetic circuit is created from the frame (2), the first yoke (3), the second yoke (4) and the lever (18). The lever (18) is thus advanced to give an impact force to the printing wire (7) so as to form dots on a printing sheet (39).

Fig. 2 is a perspective view illustrating the first embodiment of the present invention. As shown in this figure, a projecting portion (27) is provided which rises from the peripheral edge portion of the spacer member (8). The frame (2) and the spacer member (8) are laterally positioned by continuously engaging the projecting portion (27) to the peripheral portion of the frame (2).

Positioning in the rotation direction is then carried out by engaging a hole or recess portion (28) created on the bottom face (10) and a convex portion (25) created on the spacer member (8).

The spacer member (8) and the nose (1) are positioned in the rotation direction by engaging a hole portion (26) created on the spacer member (8) and the pcb (9) with a convex portion (24) created on the nose (1).

Positioning of the center is carried out by engaging the inner circumference (30) of the spacer member (8) with a cylindrical portion (31) created on the nose (1).

Moreover, three cylindrical convex portions (23) are provided on the nose (1) and are abutted to a bottom face (35) of the spacer member (8) to position the spacer member (8) and the nose (1) in the laminating or axial direction.

On the printed wiring board (9), holes (33) having larger diameter than the cylindrical convex portion (23) are provided in the same respective coordinate positions as the convex portions (23) created on the nose (1). Naturally, more than three convex portions (23) and respective holes (33) may be provided.

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CLAIMS

1. An impact dot printer having an impact dot printer head which comprises:
at least one solenoid coil (16) disposed in a frame (2) made of a magnetic material for driving a printing wire (7);
a printed circuit board pcb (9) electrically connected to said solenoid coil (16)
through at least one hole (42) provided in the base of the frame (2), said pcb having a through hole (26);
a spacer member (8) located between said frame (2) and said pcb (9), said spacer having a recess (26); and
a nose (1) for guiding said printing wire (7) having a projection (24) for engaging said recess (26) and said through hole (26); characterised in that
a low viscous silicon injected into a space between said solenoid coil and said frame and said spacer member;
said spacer member (8) and said frame (2) have means (27, 27a, 25, 28) for laterally and rotationally locking said spacer member (8) to said frame(2);
said spacer member (8) has a thickness of at least 0.5mm;
said projection (24) only engages said pcb (9) and said spacer member (8);
and in that
said nose (1) and said pcb (9) are provided with a locking arrangement (23, 33).
2. An impact dot printer as claimed in claim 1, in which said means for laterally and rotationally locking said spacer member (8) to said frame (2) includes at least one projection portion (27) at the perimeter of the spacer member (8) for contiguously engaging said perimeter of said frame (2) and a peg (25) disposed on said spacer member (8) for engaging a recess (28) provided on the base of said frame (2).

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3. An impact dot printer as claimed in claim 2, in which there is one continuous projection portion (27a) at the perimeter of said spacer member (8).
4. An impact dot printer as claimed in any one of claims 1 to 3, further comprising a cylindrical portion disposed in the center of said nose (1) for engaging a hole (30) disposed in each of said pcb (9) and said spacer member (8).
5. An impact dot printer as claimed in any one of claims 1 to 4, in which said locking arrangement (23, 33) comprises at least one peg (23) provided on said nose (1) for engaging a respective through hole (33) disposed in said pcb (9).
6. An impact dot printer as claimed in any one of claims 1 to 5, in which said spacer member is extruded outside the impact dot printer head to form a heat-radiating fin structure (32).
7. An impact dot printer as claimed in claim 6, in which said extruded spacer member is abutted to a carriage (29) on which said head is mounted.
8. An impact dot printer as claimed in any one of claims 1 to 7, in which the viscosity of said low viscous silicon is $5 \text{ to } 40 \text{ kg m}^{-1} \text{ s}^{-1}$ (50 to 400 poise).
9. An impact dot printer head comprising
at least one solenoid coil (16) disposed in a magnetic frame (2) for driving a printing wire (7);
a printed circuit board pcb (9) electrically connected to said solenoid coil (16)
through at least one hole (42) provided in the base of the frame (2), said pcb having a through hole (26);

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