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(54) Pin printer head for a high definition dot matrix printer.

(57) The head has twenty four pins (11) each welded to the edge (56) of a blade (44) placed in a radial plane. Each blade (44) is rigidly attached to the keeper (41) of a corresponding electromagnet (25), which is placed in a plane perpendicular to that of the corresponding blade The edge (56) is supported by an appendage which can have two different forms (53 and 54) so that the edges (56) of successive blades (44) are radially offset so reducing the distance between these edges and the axis (16) of the head. Blades (44) normally rest against an elastomeric ring (63), the position of which can be adjusted along axis (16).

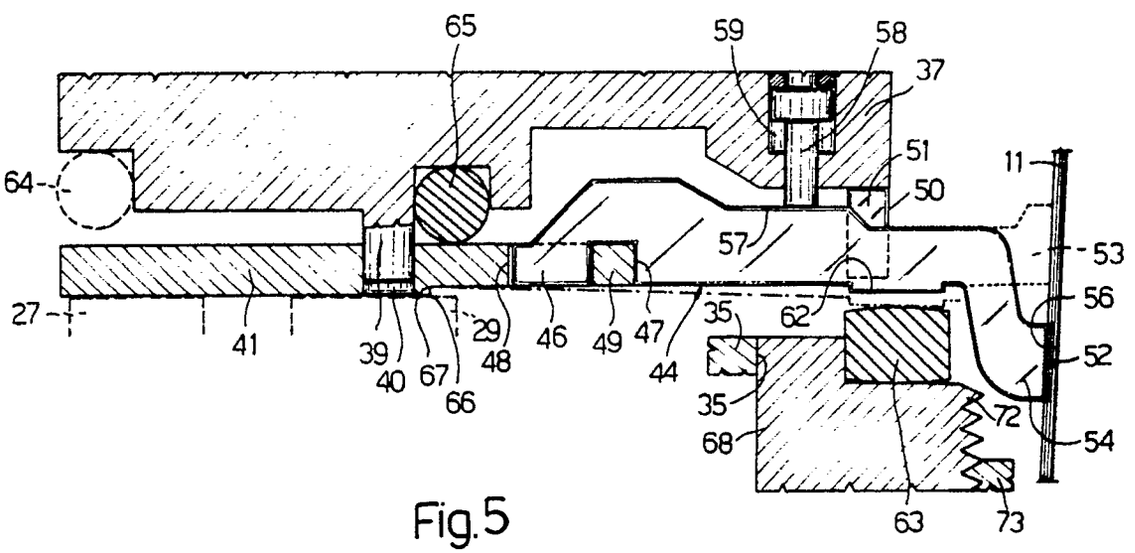

Fig.5

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PIN PRINTER HEAD FOR A HIGH DEFINITION DOT MATRIX PRINTER

This invention relates to a pin printing head for a high definition dot matrix printer.

In printers of the abovementioned type the pins printing individual points are generally individually activated by the keepers of a corresponding series of electromagnets placed circumferentially in the head supporting structure. In heads with a ballistic action each printing pin is provided with a head having a greater diameter than the pin which is pressed directly by the inside end of the keeper. Because the various keepers are arranged radially in order to reduce the inclination of the pins to the striking head at the printing end the width of the internal extremity of the keeper is generally reduced and is connected to a tapering portion of the keeper. This width may not however be less than the diameter of the pin head.

This type of structure is satisfactory for low definition printers, that is with a small number of pins, for example between seven and twelve. In the case of high definition printers, with eighteen or more pins, this structure requires the inclination of the pins to be increased because of the size of the pin heads. On the one hand this requires a greater striking force from the electromagnet and greater strength in the pin return springs, while on the other hand it has the disadvantage of reducing the maximum striking frequency on an individual pin, and therefore the printing rate, while it increases the risk of a pin becoming jammed in its guide.

Heads with a large number of pins in which the keepers are divided into two groups of different lengths so that the internal ends of the pins are placed on two different circumferences have been proposed. These heads have the disadvantage that arms of different lengths are required for the two types of keeper. These therefore generate different striking intensities on their respective pins, with the result that such heads are not suitable for the LQ or NLQ (letter quality or near letter quality) printing required for correspondence.

The object of this invention is to provide a high definition pin printer which does not have the abovementioned disadvantages of known heads and ensures optimum printing quality.

This object is accomplished by the head according to the invention which has maximum simplicity and reliability of operation while reducing the inclination of the pins to a minimum and achieving maximum packing of the electromagnets. In particular the head according to the invention includes a series of pins which are slidably guided towards the printing position by a common support which incorporates a substantially cylindrical portion, the said pins be activated effectively by a corresponding series of electromagnet keepers positioned radially substantially in a plane perpendicular to the axis of the said portion, the said electromagnets being placed circumferentially about a substantially cylindrical structure which is attached coaxially to the said portion and is characterised in that each of the said pins is fixed on a corresponding blade placed in a radial plane with respect to the said axis and attached to a terminal appendage of the corresponding keeper. According to another characteristic of the invention each blade includes an internal appendage with an edge of predetermined length welded to an axial length of the corresponding pin, the said blades being divided into at least two groups, the appendages of a first group of the said blades having a different shape from those of the other group so that the said edge is in a position which is offset along the said axis by a distance of no less than the said length, the blades of the said first group being mounted on the said structure and intercalated with those of the said other group.

These and other characteristics of the invention will be more clearly apparent from the following description of a preferred embodiment provided purely by way of a non-restrictive example with reference to the appended drawings, in which:

Figure 1 is a median section through a pin printing head according to the invention,

Figure 2 is a partial cross-section along the line II-II in Figure 1,

Figure 3 is a plan view of a pin activating keeper in the head on an enlarged scale,

Figures 4 and 5 are two sections along the line IV-IV in Figure 3, illustrating two adjacent activating keepers in their working position.

With reference to Figure 1, 10 generically indicates a common support for a series of printing pins 11. In particular support 10 is constructed of light alloy and has a portion 12 in which a guide is mounted, not illustrated in the drawing. This guide is designed to guide the printing ends of 24 pins 11, placed in two vertical rows which are slightly offset in the conventional way. Portion 12 of support 10 is reinforced above by a vertical rib 13.

Support 10 also has a flange 14 of circular shape which is extended in a substantially cylindrical portion consisting of a sleeve 15 whose axis 16 forms the axis of the head. Sleeve 15 is provided on its extreme edge with four pins 17 (Figure 2), by means of which it is attached to four corresponding appendages 18 of a structure 19 which is also of light alloy.

Structure 19 (Figure 1) has a basic disc 20 of circular shape which internally has a sleeve 21 with

a slightly tapering outside surface provided with a series of prismatic grooves 22 (Figure 2) placed radially with respect to disc 20. On its outer edge disc 20 has a rib 23 for engaging within the end of sleeve 15. Internally rib 23 has a radial projection 24 corresponding to each channel 22.

Both channels 22 and projections 24 are twenty four in number, that is equal to the number of pins 11. Each channel 22 with its corresponding projection 24 forms the seat in which a corresponding electromagnet is fixed, indicated generically by 25, with the object of activating corresponding pin 11.

Each electromagnet 25 includes a magnetic circuit consisting of a block 26 of ferromagnetic material. Block 26 is formed of a prismatic core 27 (Figure 1) around which is placed an electrical coil 28 and another prismatic portion 29 connected to core 27 by means of a crosspiece 30. The end of core 27 and portion 28 form the polar expansions of the magnetic circuit and are coplanar.

In the gap between two adjacent projections 24 (Figure 2) disc 20 has a pair of holes 31 for the passage of the electrical conductors of corresponding coil 28. The various conductors are connected to a plate 32 (Figure 1) of insulating material fixed to disc 20.

Structure 19 also has a central sleeve 33 placed corresponding to a depression 34 in disc 20. Sleeve 33 has a cylindrical cavity 35 while depression 34 has a central hole 35' of lesser diameter than cavity 35 whose function will be better understood below.

Within flange 14 is fixed by means of a pair of bolts 36 a shaped disc 37 of rigid plastics material which has a central hole 38 for the passage of pins 11. Disc 37 is provided internally with a number of axial pegs 39 corresponding to the polar expansion of portions 29, on each of which is engaged a hole 40 (Figures 2 and 3) of a corresponding plate 41 which is thus hinged on peg 39. Plate 41 is of ferromagnetic material and forms the keeper of a corresponding electromagnet 25. Plates 41 are therefore arranged radially substantially in a plane perpendicular to the axis 16 of the head. Each plate 41 includes a principal portion 42 of substantially rectangular shape so as to cover the polar expansions of core 27 and portion 29 of corresponding electromagnet 25. Each plate 41 also has a terminal appendage 43 which is tapered and turned towards axis 16 of the head. Appendage 43 is connected to a blade generically indicated by 44 which is placed in a radial plane with respect to axis 16 perpendicular to the plane of corresponding plate 41. The thickness of blade 44 is equal to the diameter of pin 11 and 1/3 of the thickness of plate 41. Each blade 44 (Figures 3 - 5) has a principal portion 45 which is identical for all the blades, which towards its outer end terminates in a rectangular appendage 46 adjacent to a notch 47 which opens downwards. In turn appendage 43 of each plate 41 is provided with a slot 48 of length equal to that of appendage of 46 which ends in an appendage or crosspiece 49 of thickness equal to the width of notch 47.

Each blade 44 is connected to corresponding plate 41 by inserting appendage 46 of blade 44 into slot 48 of plate 41 in a substantially rigid manner and crosspiece 49 of the latter in notch 47. As a result of the limited travel of which blade 44 and plate 41 are capable between disc 37 and electromagnets 25, each blade 44 remains constantly attached to corresponding plate 41.

Disc 37 is provided with an annular rib 50 (Figure 2) which has a series of radial notches 51 guiding blades 44. The unit plate 41 - blade 44 therefore remains attached by a peg 39 and a corresponding notch 51 in disc 37.

An axial length 52 of corresponding pin 11 is welded to the inner end of each blade 44 (Figures 4 and 5). Section 52 is at a certain distance from the end of pin 11 opposite the printing end. In particular the inner end of blade 44 has an appendage which may have one or other of two different forms indicated by 53 and 54 respectively in the drawings. Each appendage 53 and 54 has an edge 56 of predetermined length to which section 52 is welded. Appendage 53 is slightly extended towards disc 37, while appendage 54 is extended in the opposite direction. Edge 56 of appendage 53 is offset on axis 16 with respect to edge 56 of appendage 54, by a distance greater than the length of edge 56 itself.

Blades 44 can therefore be subdivided into two groups, each of twelve blades 44, of which those in one group have appendage 53 while those in the other group have appendage 54. Blades 44 of the two groups mounted on plates 41 are then assembled on disc 37 which is intercalated between them, with the inevitable increase in the diameter of the welded section 52 of two adjacent pins 11, not reducing the circumferential play between them (Figure 2). Pins 11 may therefore be located at the minimum possible mutual distance and therefore at a minimum distance from axis 16 of the head, with the result that pins 11 have the minimum possible inclination.

Portion 45 of each blade 44 has a shoulder 57 capable of being engaged by a piston 58 placed in a corresponding cylindrical seat 59 in disc 37. A compression spring 61 acting in seat 59 against the flange of piston 58 normally keeps blade 44 supported with one shoulder 62 (Figures 4 and 5) against a stop ring 63 of elastomeric material. Blade 44 in turn holds plate 41 in a resting position in which it rests against a pair of rings 64 and 65 of

elastomeric material mounted in two corresponding annular seats in disc 37, as shown for the lower blade 44 illustrated in Figure 1, and as indicated by dashed and dotted lines in Figures 4 and 5.

When coil 28 (Figure 1) of corresponding electromagnet 25 is excited, plate 41 moves into the printing position resting against the polar expansions of core 27 and portion 29, as indicated for the upper blade 44 illustrated in Figure 1 and as shown by solid lines in Figures 4 and 5.

Corresponding to the polar expansion of portion 29, plate 41 has a step 66 which forms an edge 67 which acts as a fulcrum for rotating plate 41 between its two positions. Edge 67 lies within elastic ring 64 and in a position which is substantially opposite to the contact position with ring 65. In reality edge 67 is slightly outside 65. Plate 41 however remains in constant contact with ring 65, while edge 67 remains in constant contact with the polar expansion of portion 29. In the printing position plate 41 therefore slightly compresses ring 65, the elastic force of which favours restoration and helps to return it to rest when corresponding coil 28 ceases to be excited.

Stop ring 63 for blades 44 is placed in a cavity 35 in sleeve' 33 and rests against an adjusting sleeve 68. The latter can slide axially in cavity 35, but cannot rotate about it because a key 69 engages an axial groove 71 in sleeve 33. Sleeve 68 has an internal thread 72 which engages the threaded cylinder 73 having a head 74 provided with a notch 75 which may be engaged by a screwdriver. The diameter of thread 72 is substantially equal to the diameter of the hole in ring 63 and is such that appendages 54 of blades 44 do not interfere with sleeve 68. Cylinder 73 is provided with a plug 76 which can rotate in hole 35′ of depression 34. Cylinder 73 is locked axially in hole 35′ by an elastic fork 77 which blocks a circlip on plug 76. This therefore ensures that the play between cylinder 73 and depression 34 is taken up, and ring 63 is positioned with extreme accuracy for this purpose.

From what has been seen above it will be obvious that the connection between blades 44 and pins 11 and plates 41 makes it possible to reduce the distance between them. This distance may be further reduced by axially offsetting the point of attachment between section 52 of the pins and blades 44, and providing the latter with appendages 53 and 54 of different shape. Thus for the same number of pins, blades 44 may be of a length such as to bring the internal ends of pins 11 as close as possible to axis 16, thus reducing the inclination of the latter. The transverse component of pin movement is thus reduced, as is the corresponding friction and the risk of jamming. Finally all pins 11 are activated by keepers 41, 44 which act with the same lever arm, thus ensuring uniformity of striking intensity at various points.

It is obvious that various modifications and improvements may be made to the head described without going beyond the scope of the invention. For example, blades 44 may be of three different types or may be connected to corresponding plates 41 by welding. Also structure 19 may have a different form or maybe integrated in a single piece with the various magnetic circuits of electromagnets 25. Finally the core 27 of each electromagnet may be placed within portion 29 and plates 41 may have a principal portion of a shape other than a rectangular shape.

Claims

1. A pin printing head for a high definition dot matrix printer consisting of a series of pins slidably guided towards the printing position by a common support including a substantially cylindrical portion, the said pins being activated selectively by a corresponding series of electromagnet keepers arranged radially substantially in a plane perpendicular to the axis of the said portion, the said electromagnets being arranged circumferentially on a substantially cylindrical structure fixed coaxially to the said portion, characterised in that each of the pins (11) is fixed on a corresponding blade (44) located in a radial plane with respect to the said axis (16) and attached to a terminal appendage (43) of the corresponding keeper (41).

2. A head according to claim 1, characterised in that each blade (44) has an internal appendage (53, 54) having an edge (56) of predetermined length welded to an axial section (52) of the corresponding pin (11).

3. A head according to claim 2, characterised in that the said blades (44) are divided into at least two groups, the internal appendages (53) of a first group of the said blades having a different shape from that of the internal appendages (54) of the other group of blades, and such as to have the said edge (56) in a position along the said axis which is staggered by a distance of not less than the said length, the blades of one group being mounted on the said structure (18) in an intercalary manner with the blades of the other group.

4. A head according to claims 2 or 3, characterised in that the said axial section (52) is located on each pin (11) at a specific distance from the end of the pin opposite the printing end.

5. A head according to one of the foregoing claims, characterised in that each blade (44) is provided with a shoulder (62) to engage a common stop ring (63), each blade being pressed to engage this stop ring by an individual return spring (61) acting on

the corresponding blade.

6. A head according to claim 5, characterised in that the said stop ring (63) consists of an elastomeric material and is supported by a member (68) placed in an axially adjustable position on the said structure (19).

7. A head according to claim 6, characterised in that the said member (68) consists of a tubular block which can slide axially in a cylindrical cavity (35) in the said structure (19) and is connected thereto by means of a threaded member (73).

8. A head according to one of the foregoing claims from 5 to 7, characterised in that each blade (44) has an external appendage (46) engaging in a slot (48) of the said terminal appendage (43) of the corresponding keeper (41) and a notch (47) engaging a further appendage (49) of the said corresponding keeper.

9. A head according to claim 8, characterised in that each of the said keepers (41) is provided with a hole (40) whereby it is hinged on an axial appendage (39) of a plate (37) borne by the said support (10).

10. A head according to claim 9, characterised in that each of the said keepers (41) is provided with an edge (67) whereby they rest on a polar expansion (29) of the magnetic circuit (26) of the corresponding electromagnet (25), an elastic ring (65) being placed on the said support in a position substantially opposite the said edge, the said keepers being capable of rotating between a resting position and a printing position while remaining in contact with the said elastic ring and each maintaining the said edge in contact with the said polar expansion.

11.A head according to claim 10, characterised in that the said keepers (41) are also normally held by corresponding return springs (61) supported against a second elastic ring (64) located outside the said edge (67).

12. A head according to claims 10 or 11, characterised in that each of the said magnetic circuits is formed of a block (26) of magnetic material comprising two coplanar polar expansions (27 and 29) for each electromagnet, one (27) of which expansion bears the corresponding electrical coil, each keeper (41) resting by means of the said edge (67) on the other (29) of the said polar expansions.

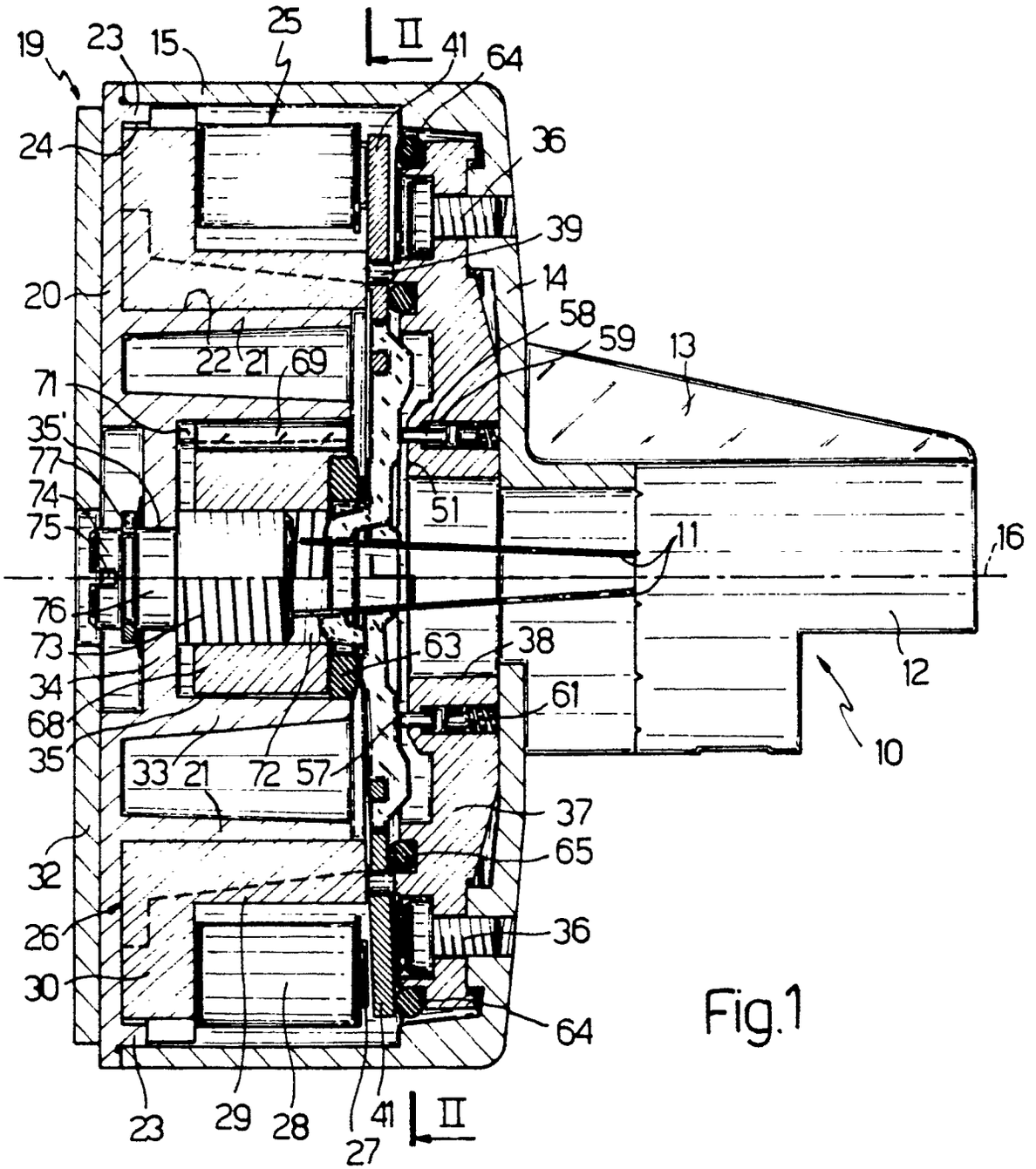
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Fig.1

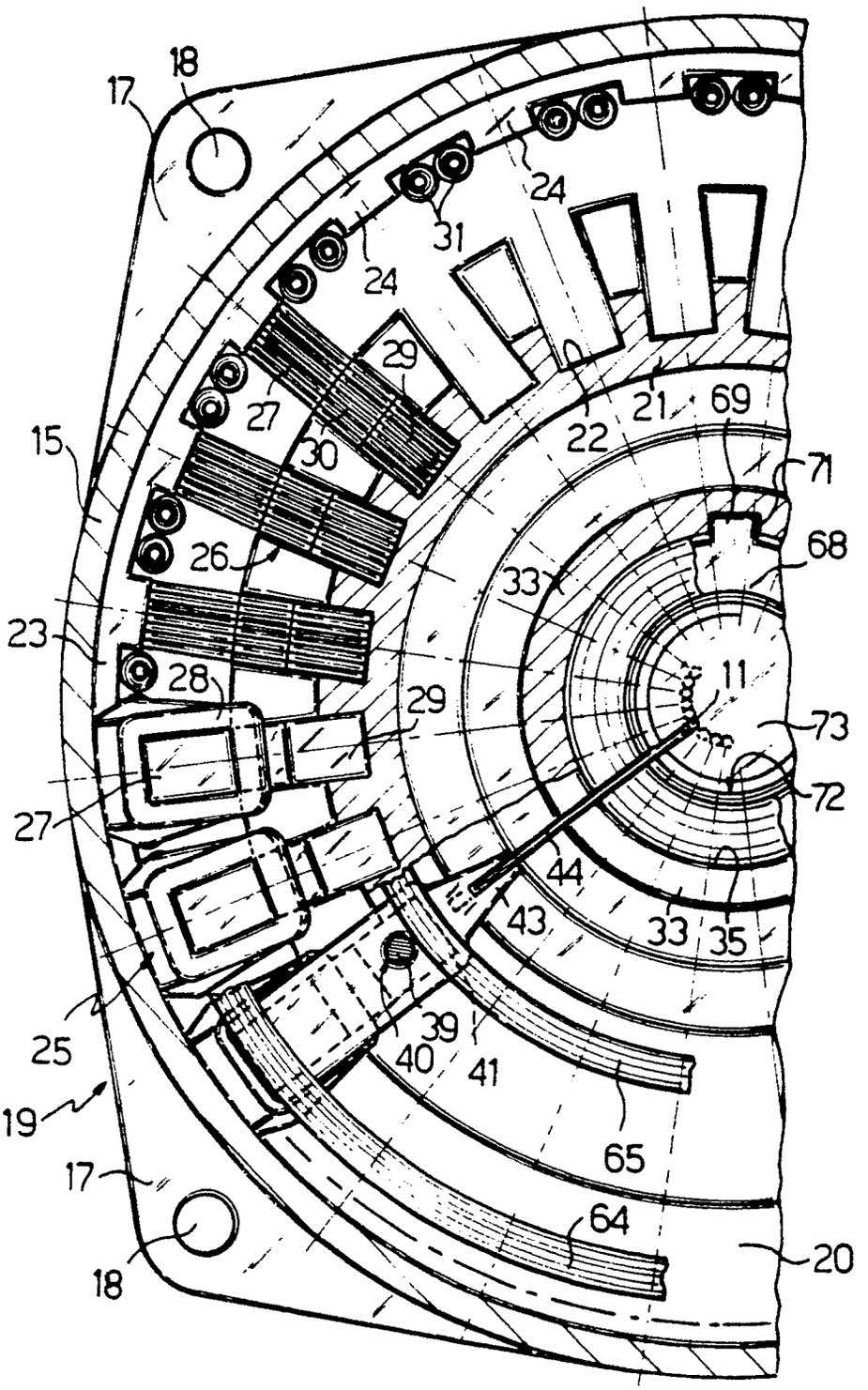
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Fig. 2

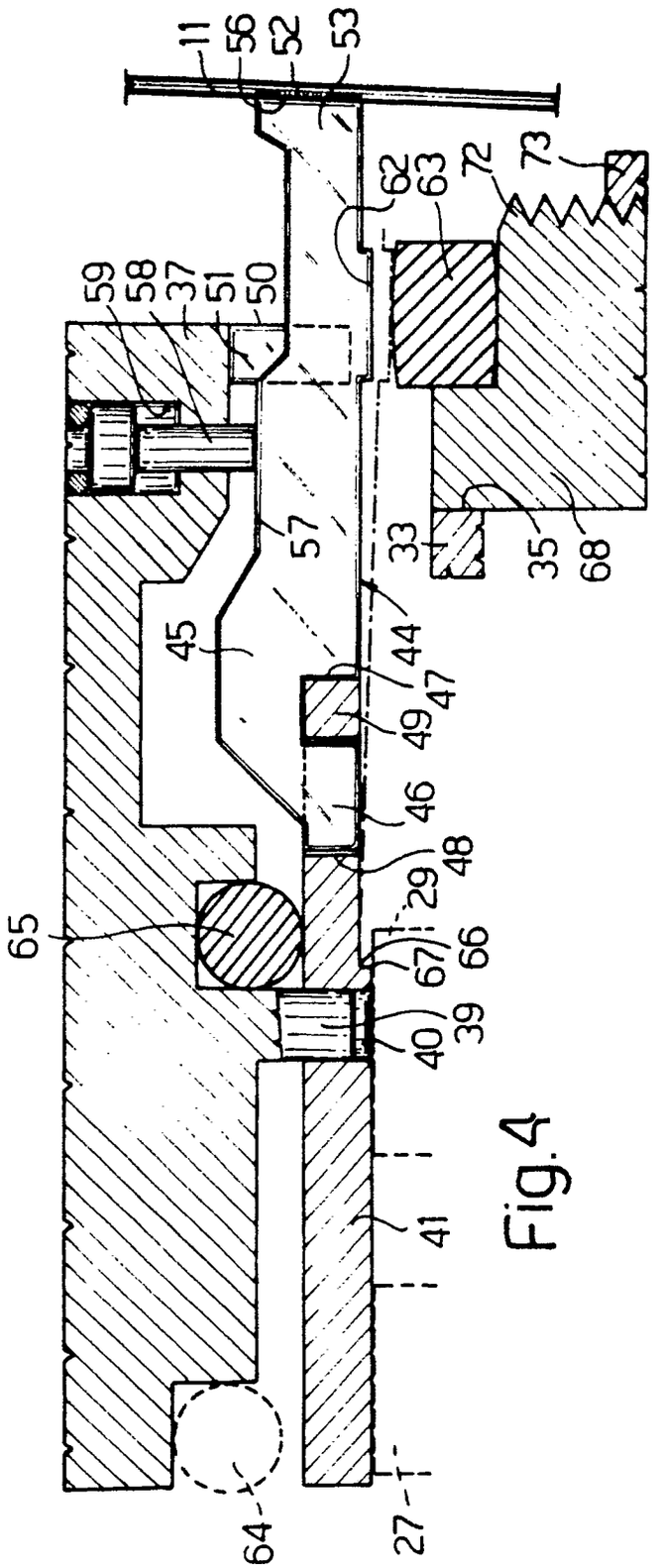
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Fig.4

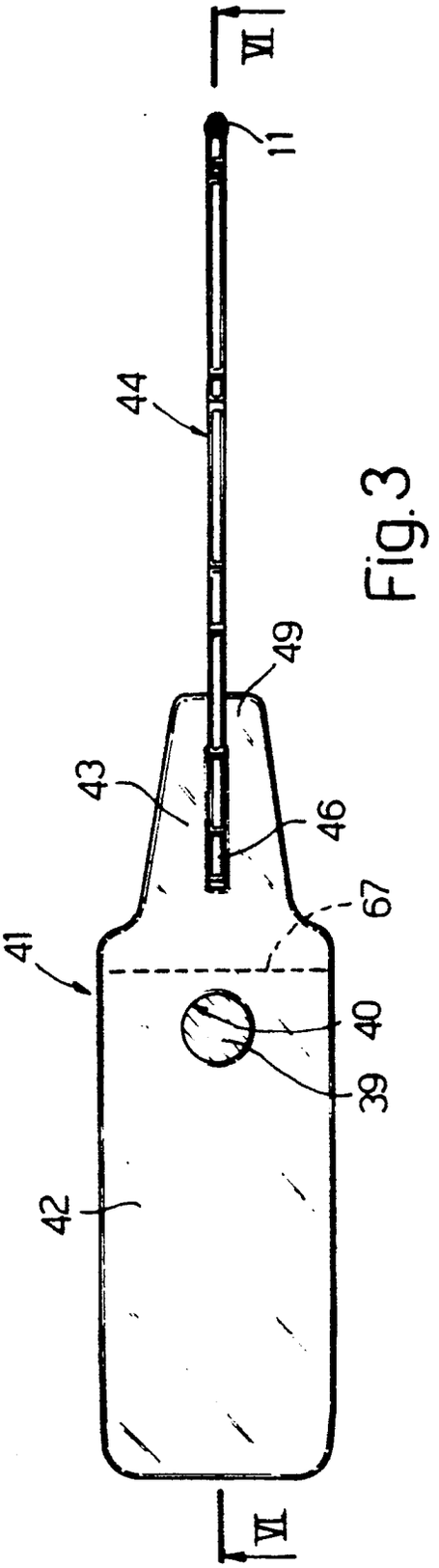
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Fig.3

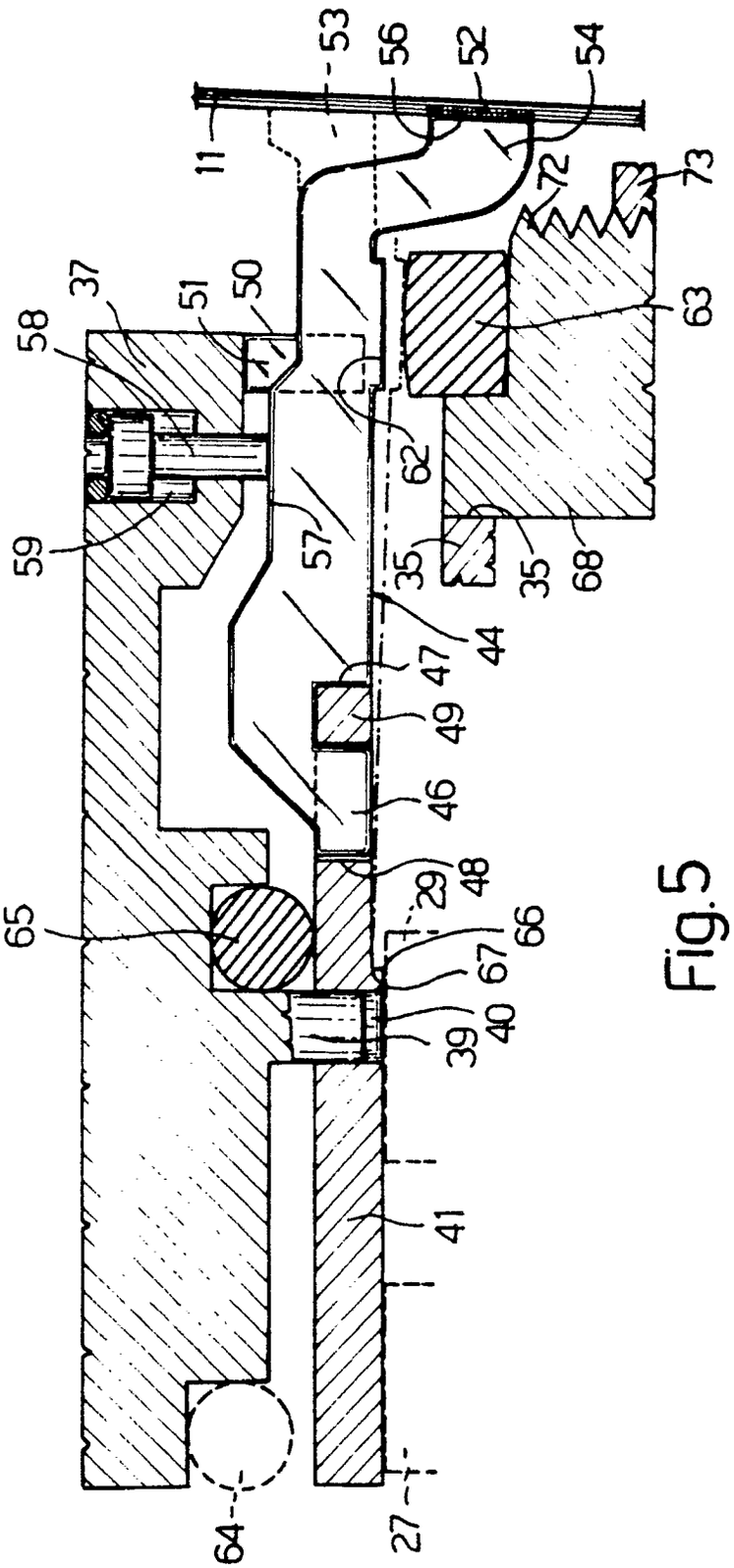
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Fig.5

European Patent Office

EUROPEAN SEARCH REPORT

Application Number EP 90112607.8

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	US - A - 4 652 158 (ASANO) * Totality *	1,2,4	B 41 J 2/275 B 41 J 2/235
A	--	8,12	
A	US - A - 4 583 871 (OCHIAI) * Totality *	1,2,4, 5,12	
A	-- US - A - 4 230 412 (HEBERT) * Fig. 2 *	1,5,6, 9,10, 12	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

B 41 J

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
VIENNA	01-10-1990	WITTMANN

CATEGORY OF CITED DOCUMENTS

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