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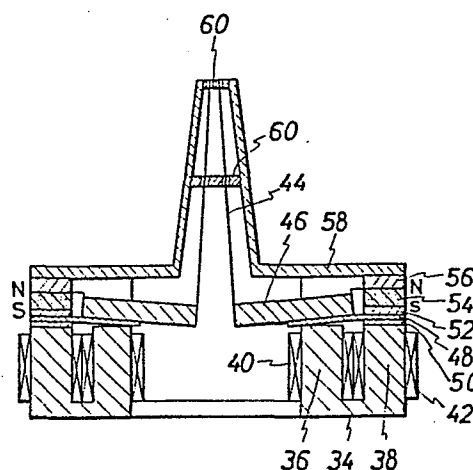
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54 Dot impact printing head.

57 A dot impact printing head comprises a printing element including a dot pin (44) and an armature (40), which is secured to a plate spring (48), a permanent magnet (54) for forming a magnetic path deflecting the plate spring (48), and an electromagnet mechanism (36,38,40,42) which forms a magnetic flux erasing the main magnetic path of the permanent (54) and thus cancelling the deflection of the plate spring (48). The permanent magnet (54) is the other side of the plate spring (48) from the electromagnet (36,38,40,42) and is arranged in the vicinity of the armature (46).

FIG. 5



DOT IMPACT PRINTING HEAD

The present invention relates to dot impact printing heads.

5

As as an example of a proposed dot impact printing head, there can be mentioned a charge type dot impact printing head in which a plate spring is deflected or this deflection is cancelled by magnetic fluxes formed
10 by a permanent magnet and an exciting coil having a core. The action of the plate spring is transmitted to a pin to effect the printing operation.

If the magnetic flux for operating the plate spring is
15 effectively formed, the printing operation will be performed more effectively.

This conventional dot impact printing head will now be described with reference to the accompanying drawings,
20 in which:

Fig. 1 is a sectional side view of the conventional dot impact printing head;

25 Fig. 2 is a plan view of this conventional printing head;

Fig. 3 is a sectional side view showing a part of this conventional printing head in the non-printing state; and

5

Fig. 4 is a sectional side view showing a part of the conventional printing head in the printing state.

In the drawings, reference numeral 10 represents a
10 base plate, reference 12 represents a core radially
arranged on this base plate 10, reference numeral 14
represents an exciting coil arranged to correspond to
the core 12 and form an electromagnet mechanism with
the core 12, reference numeral 16 represents an
15 annular permanent magnet attached to the base plate 10
to surround the exciting coils 14 having cores 12,
which form the electromagnet mechanism, and reference
numeral 18 represents an annular yoke attached to the
permanent magnet.

20

Reference numeral 20 represents a dot pin, and
reference numeral 22 represents an armature radially
arranged on a plate spring 24. One end of the dot pin
20 is secured to the end portion of the armature 22.

25 These members constitute a printing element.

Reference numeral 24 represents a flat plate spring to which the armature 22 is secured and which is deflected by the magnetic flux of the permanent magnet 16. Reference numeral 26 represents a spacer
5 determining the deflection quantity of the plate spring 24, and reference numeral 28 represents a plate-like yoke.

The plate spring 24 carrying the armature 22 is
10 attached onto the annular yoke 18 through the spacer 26. The plate-like yoke 28 comprising the armature 22 freely fitted in a groove formed thereon is secured onto the plate spring 24.

15 Reference numeral 30 represents an attachment frame including dot pins 20 therein, and reference numeral 32 represents a wire guide supporting the movement of the dot pins 20 arranged within the attachment frame 30.

20

The printing state and non-printing state of the conventional dot impact printing head having the above-mentioned structure will now be described.

The non-printing state will be described with
25 reference to Fig. 3. The arrows indicate a main magnetic path of the magnetic flux formed by the

permanent magnet 16.

In this case, the exciting coil 14 is not actuated and hence, the main magnetic path of the permanent magnet 5 16 is formed. This main magnetic path starts from the permanent magnet 16, passes through the annular yoke 18, spacer 26, plate spring 24, plate-like yoke 28, armature 22, plate spring 24, core 12 and base plate 10 and returns to the permanent magnet 16.

10

While this main magnetic path is formed, an attracting force is produced between the armature 22 and core 12, and the plate spring 24 is deflected towards the core 12 by this attracting force against the elastic force 15 of the plate spring 24 per se. The armature 22 is thus attracted to the core 12.

Accordingly, the dot pin 20 secured to the armature 22 is drawn into the attachment frame 30 together with 20 the armature 22 by a distance corresponding to the amount of deflection of the plate spring 24 set by the spacer 26. The dot pin 20 does not project from the top end (not shown) of the attachment frame 30 and therefore no printing operation is performed.

25

The printing state will now be described with

reference to Fig. 4.

The exciting coil 14 is actuated to form a magnetic flux. This magnetic flux erases the main magnetic path
5 of the permanent magnet 16 formed during the non-printing state.

Accordingly, the attracting force between the armature
22 and core 12 is cancelled and the deflection of the
10 plate spring 24 is cancelled by the elastic force thereof, and the dot pin 20 is projected forward together with the armature 22 by a distance corresponding to the of the cancelled deflection.

15 In this state, the dot pin 20 is projected from the top end (not shown) of the attachment frame 30, and the printing operation is carried out.

If the actuation is stopped at an appropriate timing
20 before and after the printing operation, the main magnetic path is formed by the permanent magnet 16 in the manner described above to attract the armature 22 to the core 12 and produce the non-printing state.

25 If the exciting coil 14 is selectively actuated in the above-mentioned manner, the dot pin 20 is driven and

the printing operation is performed.

However, this structure has the following defects.

- 5 Firstly since the permanent magnet 16 is distant from the air gap between the armature 22 and core 12, the magnetic flux of the permanent magnet 16 does not act effectively as the attracting force at this air gap.
- 10 In the second place, if a plurality of exciting coils are simultaneously actuated, since the magnetic flux of the permanent magnet 16 is not circulated into the core 12 adjacent to the permanent magnet 16, there is formed a magnetic flux passing through the air gap
15 outside the permanent magnet 16 as indicated by solid lines in Fig. 4. Furthermore, the magnetic flux of the actuated exciting coils 14 acts on the cores 12 of other non-actuated coils 14, and the magnetic flux of the permanent magnet 16 passing through the non-
20 excited cores 12 is increased.

These unnecessarily formed magnetic fluxes interfere with one another to increase the magnetic resistance of the magnetic path, with the result that the action
25 of the plate spring 24 is made slow and an intended printed letter cannot be obtained, and the driving

current has to be increased.

The present invention provides a dot impact printing head comprising a printing element comprising a dot pin and an armature attached to a plate spring, a
5 permanent magnet forming a main magnetic path for deflecting the plate spring, and an electromagnet mechanism comprising an exciting coil having a core, which forms a magnetic flux erasing the main magnetic
10 path of the permanent magnet for cancelling the deflection of the plate spring, characterised in that the permanent magnet is separated from the electromagnet mechanism through the plate spring and is arranged in the vicinity of the armature, the
15 electromagnet mechanism, such that the armature, the permanent magnet and core are magnetically coupled with one another to form said main magnetic path passing through the core, and the armature and the permanent magnet define a subsidiary magnetic path
20 which does not pass through the core.

The present invention is advantageous in that the magnetic flux of the permanent magnet between the spring and core is more effective. Moreover the above
25 defined arrangement reduces the interference between the excited and unexcited coils. There is further a

reduced leakage of magnetic flux to other portions of the structure.

Embodiments of the invention will now be described, by way of example only, with reference to the remaining accompanying diagrammatic drawings in which:

Fig. 5 is a sectional side view showing a dot impact printing head according to a first embodiment of the present invention;

Fig. 6 is a plan view of the printing head shown in Fig. 5;

Fig. 7 is a sectional side view showing a part of the printing head shown in Fig. 5 in the non-printing state;

Fig. 8 is a sectional side view showing a part of the printing head shown in Fig. 5 in the printing state;

Fig. 9 is a sectional side view showing a part of a dot impact printing head according to a second embodiment of the present invention in the non-printing state; and

Fig. 10 is a sectional side view showing a part of a dot impact printing head according to a third embodiment of the present invention in the non-printing state.

5

Referring first to Figures 5 to 8, reference numeral 34 represents a base plate, and two cores 36 and 38 are radially spaced from another on the base plate 34 for each printing element. These cores are formed of
10 silicon steel or pure iron.

Exciting coils 40 and 42 are attached to the cores 36 and 38, and an electromagnet mechanism is constructed by these exciting coils 40 and 42 having the cores 36
15 and 38.

One end of a dot pin 44 is secured to the end portion of an armature 46, and a printing element is constructed by these members 44 and 46.

20

A plate spring 48 has the armature 46 secured thereto. The plate spring is deflected to drive the dot pin 44. The plate spring is formed of a carbon tool steel or maraging steel. A spacer 50 is arranged to determine
25 the amount of deflection of the plate spring 48. Reference numeral 52 represents an annular yoke.

One set of the dot pin 44, armature 46 and plate spring 48 is attached at the plate spring 48 to the core 38 through the spacer 50 to correspond to one
5 radial electromagnet mechanism, and the annular yoke 52 is arranged on the plate spring 48.

A permanent magnet 54 is secured onto the annular yoke 52. A ferrite type magnet, a rare earth cobalt type
10 magnet or a plastics magnet is used as the permanent magnet 54. The permanent magnet 54 is arranged on the periphery of the armature 46 to surround the armatures 46.

15 A yoke 56 is attached to the permanent magnet 54 and each armature 46 is freely fitted in a groove formed in the yoke 56. An attachment frame 58 including the dot pins 44 there-within is attached onto the yoke 56. Reference numeral 60 represents a wire guide for the
20 dot pins 44 arranged within the attachment frame 58.

A double structure is adopted in which the permanent magnet 54 is arranged in the vicinity of the armature 46 and two electromagnets are arranged for each
25 printing element. The printing and non-printing states in this embodiment will now be described.

When the exciting coils 40 and 42 are not actuated, the magnetic resistance of a loop passing through the cores 36 and 38, seen from the permanent magnet 54, is lower than the magnetic resistance of the plate spring 48. Accordingly, the magnetic flux from the permanent magnet 54 flows mainly as shown in Fig. 7, whereby the armature 46 is attracted to the core 36.

When the exciting coils 40 and 42 are actuated, the magnetic resistance of the loop passing through the cores 36 and 38, seen from the permanent magnet 54, is increased. Accordingly, the magnetic flux from the permanent magnet 54 is going to pass through a path which is easier to pass. This loop is a subsidiary magnetic path shown in Fig. 8. If the plate spring 48 is formed of a magnetic material, the magnetic flux from the permanent magnet 54 flows through the plate spring 48 in larger quantities. If the plate spring 48 is formed of a non-magnetic material, the magnetic flux passes through the air gap.

The magnetic flux passing through the subsidiary magnetic path acts as a force lifting up the armature 46. Accordingly, the operation of releasing the armature 46 is quickened.

The operation of the dot pin will now be described in detail.

- 5 In the non-printing state shown in Fig. 7, the magnetic
flux of the permanent magnet 54 forms main and
subsidiary magnetic paths of the non-printing state
indicated by arrows in Fig. 7. As is seen from Fig.
7, this main path extends to the yoke 56 from the
10 permanent magnet 54, leads to the armature 46 from the
inner wall of the yoke 56, passes through the plate
spring 48, core 36, base plate 34, core 38, spacer 50,
plate spring 48 and annular yoke 52, and returns to
the permanent magnet 54.
- 15 The subsidiary magnetic path extends from the
permanent magnet 54 to the yoke 56, leads to the
armature 46 from the inner wall of the yoke 56 but it
does not pass through the core 36, unlike the main
magnetic path, but extends sideways from the plate
20 spring 48 and returns to the permanent magnet 54
through the annular yoke 52.

This subsidiary magnetic path is formed by the
magnetic flux always generated by the permanent magnet
25 54 in either the printing state or the non-printing
state.

The main magnetic path of the permanent magnet 54 generates an attracting force between the armature 46 and the core 36, and the plate spring 48 is attracted and deflected toward the core 36 by an amount corresponding to the thickness of the spacer 50, against the elastic force of the plate spring 48 per se. Accordingly, the dot pin 44 attached to the armature 46 which moves together with the plate spring 48, is drawn into the attachment frame 58 by a distance corresponding to the amount of deflection of the plate spring 48.

In this case, the top end (not shown) of the dot pin 44 is held within the attachment frame 58 but does not project from the top end portion of the attachment frame 58. Therefore the printing operation is not performed.

The printing state will now be described with reference to Fig. 8.

The exciting coils 40 and 42 are actuated, and a new magnetic flux flowing in the direction opposite to the flow direction of the above-mentioned main magnetic path is applied to the cores 36 and 38. Accordingly,

the magnetic flux of the main magnetic path flowing through the cores 36 and 38 is cancelled. Only the main magnetic path through the cores 36 and 38 is thus erased, but the subsidiary magnetic path is not erased
5 but kept active. If the main magnetic path is thus erased, the deflection of the plate spring 48 is cancelled by its elasticity and the original state is restored. At this point, the armature 46 moves together with the plate spring 48 and projects the dot
10 pin 44 forwards.

The top end of the dot pin 44 is thus projected from the top end portion of the attachment frame 58 by cancellation of the deflection of the plate spring 48,
15 and hence, the printing operation is performed.

This printing state is terminated in the following manner. Actuation of the exciting coils 40 and 42 is stopped at an appropriate timing before and after the
20 completion of the printing operation. Thus the main magnetic path is restored in the cores 36 and 38 and the plate spring 48 is deflected in the above-mentioned manner, whereby the armature 46 is attracted to the core 36 and the top end of the dot pin 44 is
25 drawn into the attachment frame 58 to stop the printing operation.

By thus generating and erasing the main magnetic path by actuating and de-energizing the exciting coils 40 and 42 at an appropriate timing, the dot pin 44 is
5 projected and withdrawn. In this manner, the printing operation is conducted.

A second embodiment of the printing head will now be described with reference to Fig. 9.

10

Explanation of the parts and members explained above with respect to the first embodiment is omitted.

In Fig. 9, reference numeral 62 represents a base
15 plate, and a yoke 64 is integrated and connected with the base plate 62.

In this second embodiment, an electromagnet mechanism as adopted in the conventional dot impact printing
20 head is arranged on the base plate 62, but since the permanent magnet 54 is attached in the same manner as described in the first embodiment, not only the main magnetic path but also the subsidiary magnetic path is formed.

25

A third embodiment of the printing head will now be

described with reference to Fig. 10.

Reference numeral 66 represents an annular yoke having a flange extended inward from the top end portion. A
5 permanent magnet 68 is secured to the lower face of the flange of the annular yoke 66 and a yoke 70 is secured to the lower face of the permanent magnet 68.

In this third embodiment, the permanent magnet 68 is
10 gripped by the annular yoke 66 and the yoke 70 so that the three members are integrated with one another. The spacer 50 is arranged on the core 38 and the annular yoke 66 is secured onto the plate spring 48 arranged on the spacer 50. The permanent magnet 68 is located
15 above the armature 46.

In the third embodiment, as in the first embodiment, two electromagnet mechanisms are arranged for each printing element. Since the permanent magnet 68 is
20 arranged above the armature 46 in the vicinity thereof through the plate spring 48, as in the first embodiment, not only the main magnetic path but also the subsidiary magnetic path passing through the plate spring 48 can be formed. In this structure, the
25 magnetic flux formed by the exciting coils 40 and 42 having the cores 36 and 38, respectively, flows and

turns in the direction opposite to the flow direction of the main magnetic path, and the main magnetic path is erased as in the first embodiment.

5 As is apparent from the foregoing description, the permanent magnet is spatially separated from the electromagnet and there is a gap therebetween. By dint of this feature, the following effects can be attained:

10

The force attracting the armature to the core is in proportion to the amount of the magnetic flux passing through the armature and the core, and the density of the magnetic flux is highest at both the poles of the
15 permanent magnet. Because of these two facts, as the magnetic poles of the permanent magnet are brought close to the gap between the armature and the core, the effective magnetic flux is increased.

20 Furthermore, when the armature is released, the magnetic flux of the permanent magnet and the magnetic flux of the electromagnet form different loops, and if these loops are closed in the magnetic circuits thereof, leakage of fluxes to the adjacent magnetic
25 circuits is hardly caused.

Moreover, the permanent magnet is arranged in the vicinity of the armature, and in the first and third embodiments, two exciting coils are arranged for each printing element. By dint of these features, the
5 following effects can be attained:

In the first embodiment, the attracting force acting between the armature and the core is effectively increased by the permanent magnet arranged in the
10 vicinity of the armature, as compared with the attracting force produced in the conventional dot impact printing head. Accordingly, the non-printing state can be maintained more precisely and the size of the permanent magnet can be reduced.

15

When the two exciting coils are actuated, the generated magnetic flux flows in the opposite direction to the flow direction of the magnetic flux in the main magnetic path and erases the magnetic flux
20 of the main magnetic path. Accordingly, mutual interference between these actuated exciting coils and adjacent non-actuated exciting coils is drastically reduced. Therefore, defects of the conventional techniques such as reduction of the printing pressure
25 and increase of the driving current, can be greatly moderated.

Moreover, since it is sufficient if the main magnetic path is erased only in the core and base plate, the magnetic flux of the permanent magnet forms a flow in
5 a subsidiary magnetic path, and unnecessary leakage of the magnetic flux into other portions of the structure is effectively controlled. Accordingly, cancellation of the main magnetic path at the printing step can be performed more effectively than in the conventional
10 dot impact printing head.

Attraction of the armature to the core and release of the armature from the core, that is, deflection of the plate spring and release of the plate spring, can be
15 performed more precisely than in the conventional dot impact printing head, not only in the case where only one dot is driven but also in the case where a plurality of dots are simultaneously driven. Therefore correct printing can be performed even if
20 the printing speed is high.

In the second embodiment, one exciting coil is arranged for each printing element as in the conventional dot impact printing head. Therefore, the
25 dot impact printing head of this second embodiment is used when a certain amount of mutual interference

between electromagnet mechanisms can be tolerated. Also in this second embodiment, a subsidiary magnetic path is formed as in the first embodiment and the advantages of the formation of this subsidiary magnetic path can similarly be attained. Furthermore, the base plate and annular yoke can be formed integrally from a metal plate. Therefore, a dot impact printing head having a simple structure can be provided at a low cost.

10

In the third embodiment, the permanent magnet is located at a position different from the position of the permanent magnet in the first embodiment. That is, in the third embodiment, the permanent magnet is located above the armature. However, the third embodiment is not different from the first embodiment in the basic structure for forming the main magnetic path and the subsidiary magnetic path. Therefore, the above-mentioned effects attained in the first embodiment are similarly attained in the third embodiment.

When the described dot impact printing heads are applied to Chinese letter output dot printers having many dot pins, for example, 16 to 20 dot pins, for which high quality printing is required, great

advantages can be attained.

If the described dot impact printing heads are linearly developed, the printing head can
5 advantageously be applied to a dot line printer.

CLAIMS

1. A dot impact printing head comprising a printing
element (44,46) comprising a dot pin (44) and an
5 armature (46) attached to a plate spring (48), a
permanent magnet (54,68) forming a main magnetic path
for deflecting the plate spring (48), and an
electromagnet mechanism (36,38,40,42) comprising an
exciting coil (40,42) having a core (36,38) which
10 forms a magnetic flux erasing the main magnetic path
of the permanent magnet for cancelling the deflection
of the plate spring (48), characterised in that the
permanent magnet (54,68) is separated from the
electromagnet mechanism through the plate spring (48)
15 and is arranged in the vicinity of the armature (46),
such that the armature (46), the permanent magnet
(54,68) and core (36,38) are magnetically coupled with
one another to form said main magnetic path passing
through the core (36,38) and the armature (46) and the
20 permanent magnet (54,68) define a subsidiary magnetic
path which does not pass through the core (36,38).

2. A dot impact printing head as claimed in claim 1,
characterised in that a plurality of printing elements
25 (44,46), each having a dot pin (44), are provided and
the electromagnet mechanism comprises two cores

(36,38) and exciting coils (40,42) for each printing element (44,46).

3. A dot impact printing head as claimed in claim 1
5 or 2, characterised in that the subsidiary magnetic path passes through the plate spring (48).

4. A dot impact printing head comprising a plurality of dot pins (44) each mounted to an armature (46), a
10 respective plate spring (48) carrying each armature (46), an electromagnet (36,38,40,42) and a permanent magnet (54,68) associated with each pin (44), arranged so that when the electromagnet (36,38,40,42) is not actuated a main magnetic path is defined through the
15 permanent magnet (54,68) plate spring (48) armature (46 and electromagnet core (36,38) so as to draw the plate spring (48) towards the core (36) retracting the dot pin (44) carried thereby, characterised in that the permanent magnet (54,68) is disposed on the
20 opposite side of the plate spring (48) to its associated electromagnet (36,38,40,42).

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FIG. 1

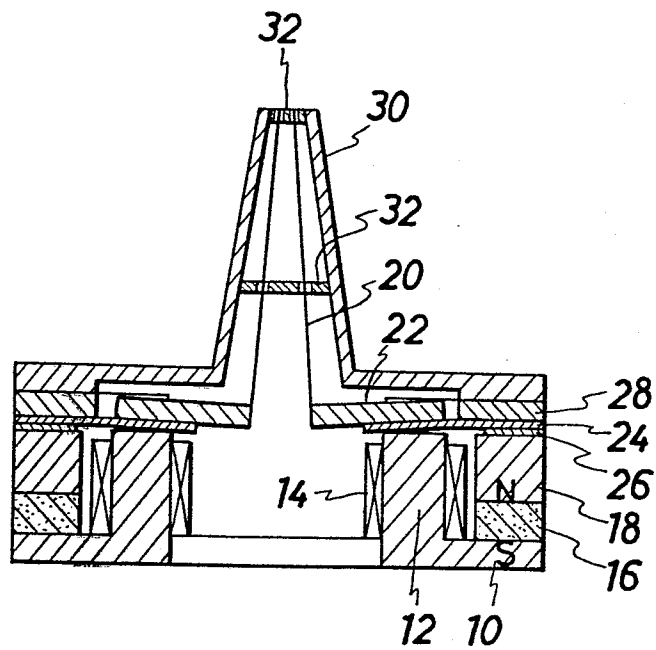


FIG. 2

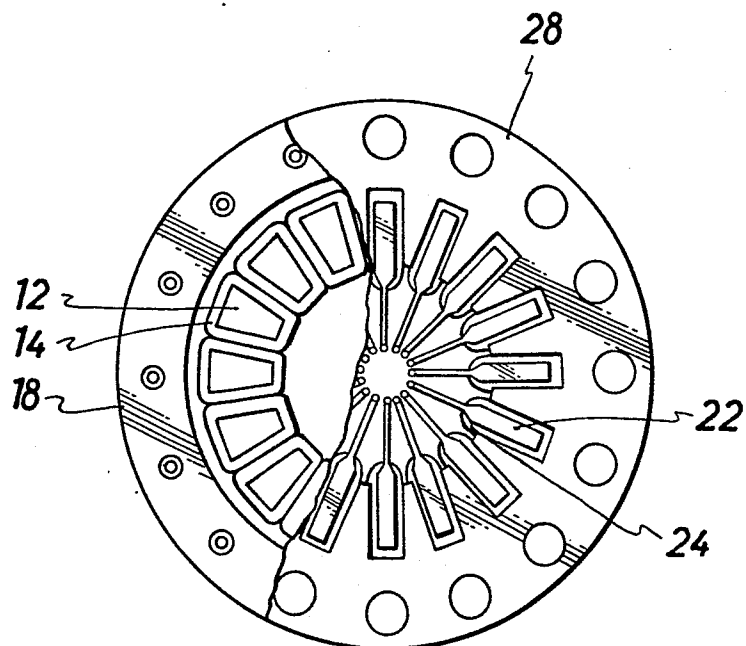


FIG. 3

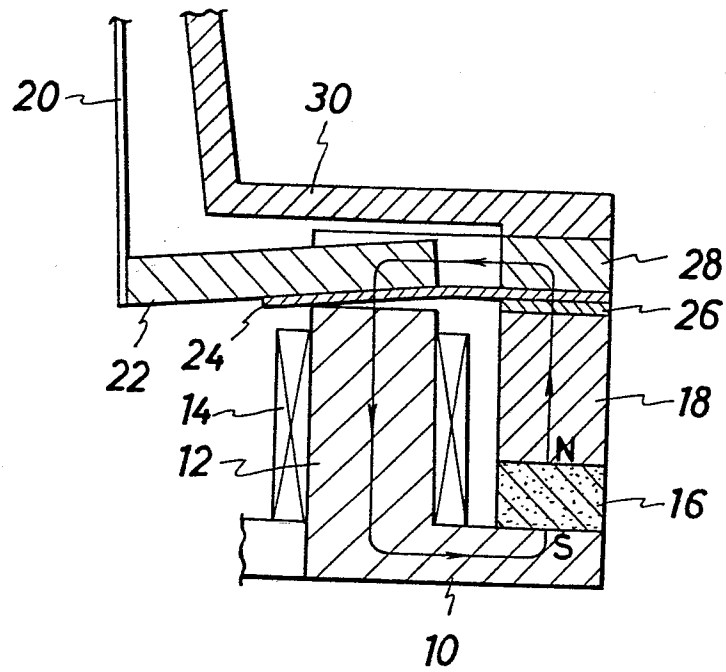


FIG. 4

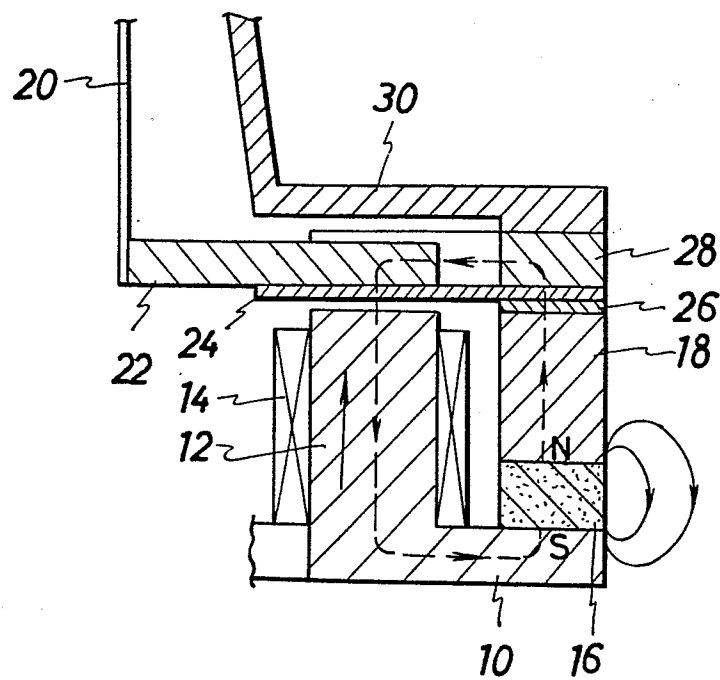


FIG. 5

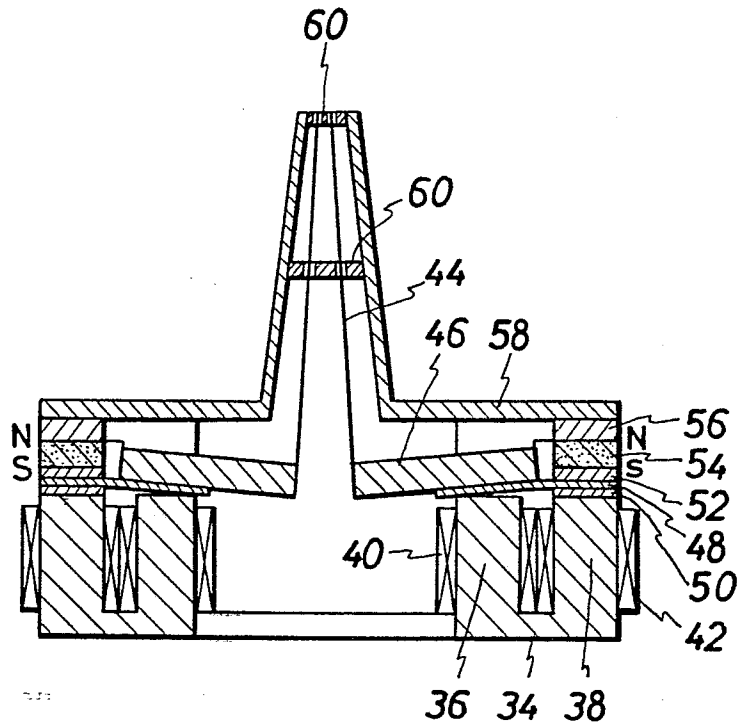


FIG. 6

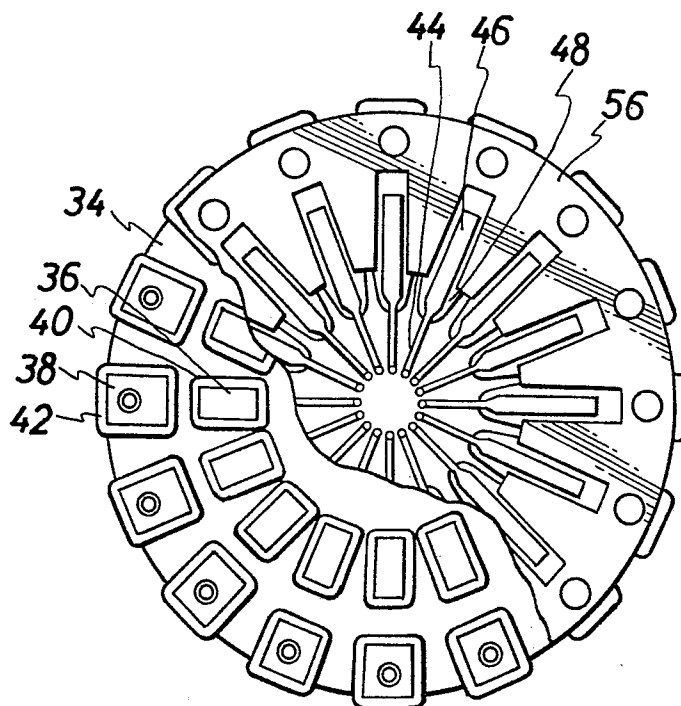


FIG. 7

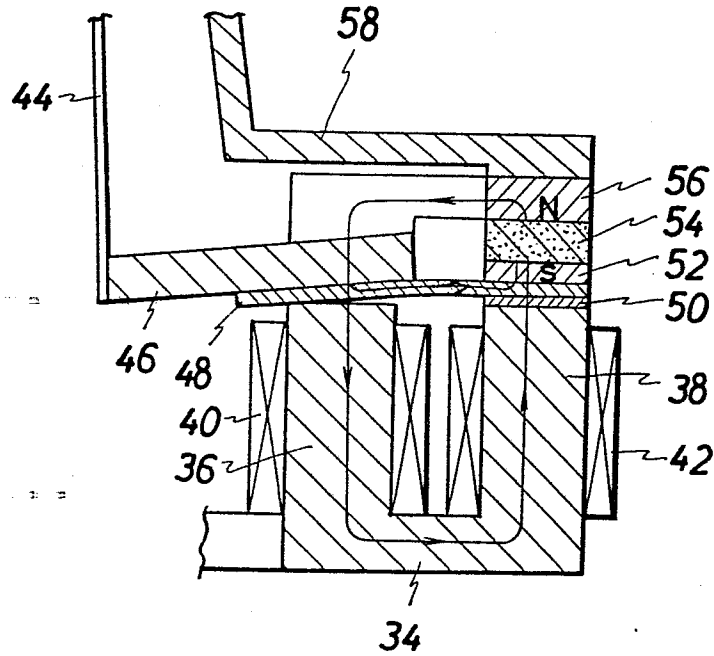
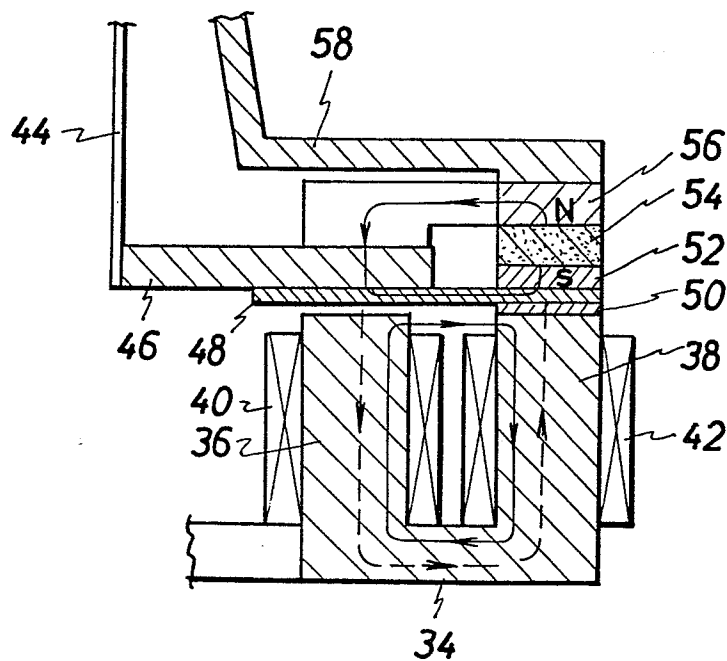


FIG. 8



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FIG. 9

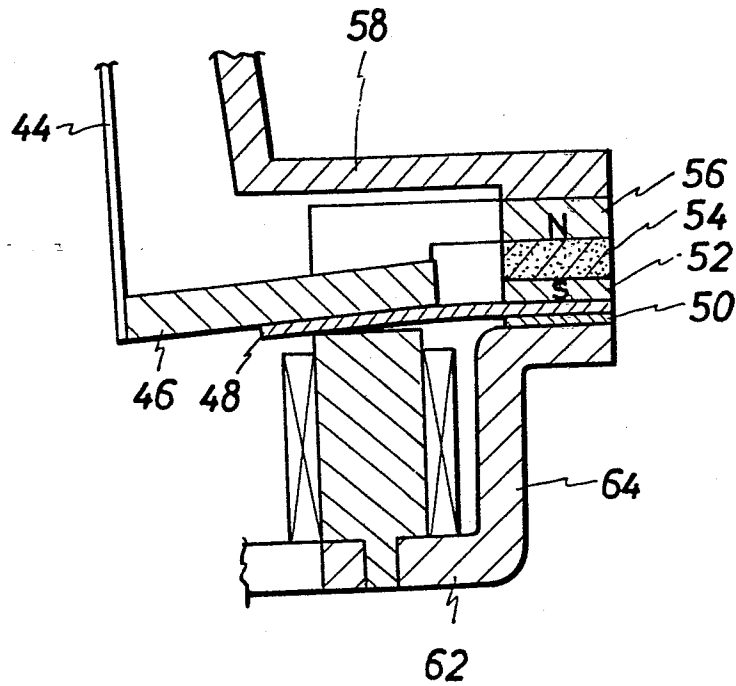
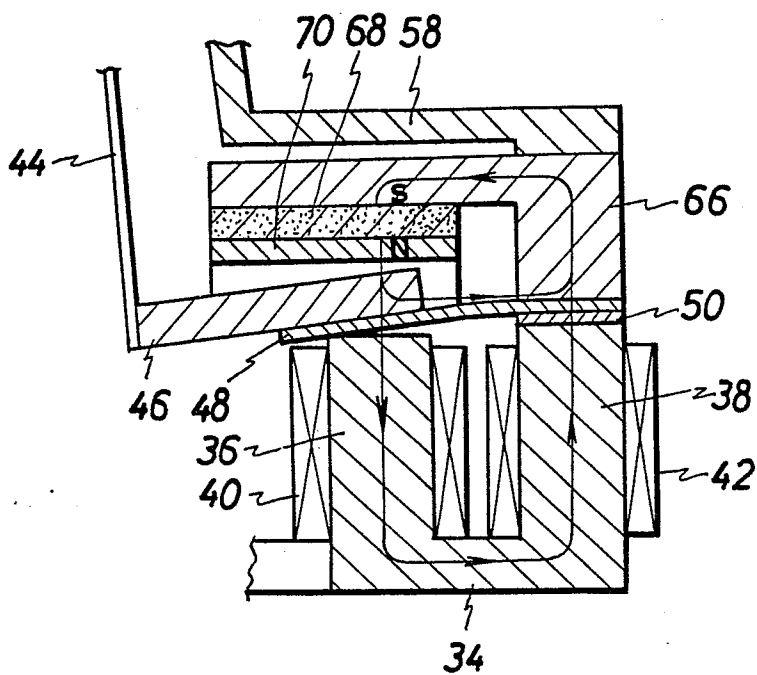


FIG.10





DOCUMENTS CONSIDERED TO BE RELEVANT			EP 84301068.7
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)
P,A	DE - A1 - 3 139 502 (MANNESMANN AG) * Fig. 1; page 7, lines 24-36 * --	1,4	B 41 J 3/10
A	DE - A1 - 3 110 798 (OKI ELECTRIC IND.) * Claims; Fig. 3 * --	1,4	
P,A	US - A - 4 411 538 (ASANO) * Totality * ----	1,4	
			TECHNICAL FIELDS SEARCHED (Int. Cl. 3)
			B 41 J 3/00 B 41 J 7/00 G 06 K 15/00
The present search report has been drawn up for all claims			
Place of search VIENNA		Date of completion of the search 04-05-1984	Examiner WITTMANN
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			