(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 617 438 A1**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **94104250.9**

(51) Int. Cl.[5]: **H01F 31/00**, H01F 27/02

(22) Date of filing: **18.03.94**

(30) Priority: **24.03.93 IT TO930200**

(43) Date of publication of application:
28.09.94 Bulletin 94/39

(84) Designated Contracting States:
DE ES FR GB SE

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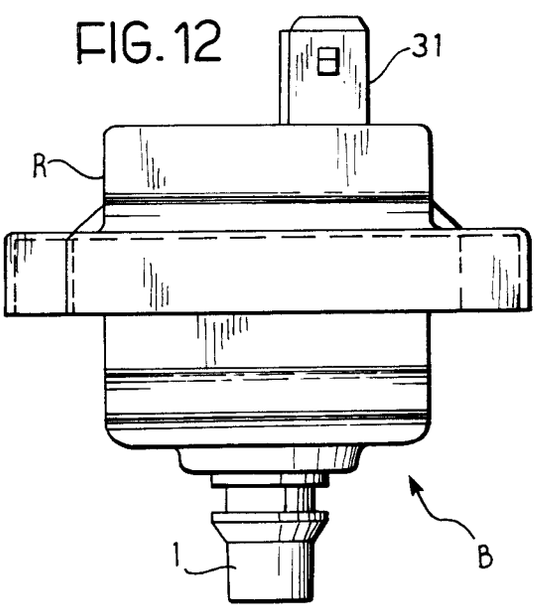
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(54) An ignition coil and a method for the manufacture thereof.

(57) An ignition coil (B) of the "plug-top" type comprises a tank-shaped insulating container (5) in which a primary winding (12c) and a secondary winding (4a) are disposed. The empty spaces in the container (5) are filled with an insulating material which is poured therein in the liquid state and hardened. The container (5), fitted with the magnetic core (7), is then completely covered with resin (R) by moulding. The co-moulding of resin (R) on the completed coil (B) reduces noise and corrosion of the plates of the magnetic core (7).

FIG. 12



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The present invention relates to an ignition coil for use, in particular, in an internal combustion engine having an ignition system with electronic distribution.

More specifically, the invention relates to an ignition coil of the so-called "plug-top" type, that is, the type which is intended to be mounted directly on a respective spark plug and which comprises a substantially tank-shaped insulating container in which coaxial primary and secondary windings are supported, the empty spaces in the container being filled with an electrically insulating material which is poured therein in the liquid state and then hardened, and a magnetic core having at least one arm extending through the primary and secondary windings.

Coils of this type have the disadvantage that they have insufficient protection for the plates of the magnetic cores, since these are disposed outside the container. For this reason, the pack of plates of the magnetic core is subject to corrosion and may have the typical noisiness of magnetic cores of this type.

The object of the present invention is to provide a coil which enables all the problems indicated above to be solved in a satisfactory manner.

According to the present invention, this object is achieved by virtue of an ignition coil, characterized in that the container and the magnetic core are substantially covered by a second insulating material which is applied in the liquid state and then hardened.

An ignition coil formed according to the present invention can pass a salt-fog resistance test (400 hours) and at the same time is less noisy than the coils normally produced.

Moreover, the reduction in components and the manufacturing method of the present invention enable an ignition coil of low cost and complexity to be produced.

Further advantages and characteristics of the present invention will become clear from the following detailed description, given with the aid of the appended drawings, provided by way of non-limiting example, in which:

Figure 1 shows schematically, an element for supporting the coil according to the present invention,

Figure 2 is a sectioned view of the element shown in Figure 1,

Figure 3 shows, in partial section, the primary winding assembly of the coil according to the present invention,

Figure 4 shows, in partial section, the assembly of the two windings of the coil according to the present invention,

Figure 5 is a side view of the assembly shown in Figure 3,

Figure 6 is a partially sectioned view of the assembly of Figure 4 combined with the support element shown in Figures 1 and 2,

Figure 7 is a side view of the assembly shown in Figure 6,

Figure 8 shows the magnetic core of the coil according to the present invention,

Figure 9 shows, in partial section, the assembly of Figure 7, completed by a container and by the magnetic core shown in Figure 8,

Figure 10 is a sectioned view of the assembly shown in Figure 9,

Figures 11 and 12 are two side views of the complete coil according to the present invention, and

Figure 13 shows, schematically and in perspective, an alternative embodiment of the assembly of Figure 4.

In the drawings, parts and elements already described with reference to a previous drawing will be given the same numerical and/or alphabetical symbols. Moreover, in some drawings, the symbols relating to parts or elements described with reference to other drawings have been omitted for greater clarity.

Figures 1 and 2 show a support element 1 which is made of insulating material and is intended to house the bobbins of the windings, and which terminates in a high-tension conduit for connection to a plug. In Figure 2, the high-tension socket 2, a diode 10 with a lead forced into the high-tension socket 2, a seat 10c for a flange of the primary bobbin and two cradle-like supports 10a and 10b for the secondary winding bobbin can be distinguished.

Figure 3 shows the bobbin 3 of the primary winding 12c, this bobbin also being made of insulating material, for example, plastics material. The two ends of the winding 12c are connected to two metal electrical supply terminals 12 and 13 fixed to a flange 14 of the primary bobbin 3. The supply terminals 12 and 13 may be fixed by the hot upsetting of four pins projecting from the flange 14 or of the edges of a seat, also formed on the flange 14. The terminals 12 and 13 also have two regions 12a, 13a (visible in Figure 5) which project from the plastics material of the flange 14 so that the electrical or ultrasound welding to the terminals 12b and 13b of the primary winding 12c can be carried out. Three holes 14a, 14b and 14c (visible in Figure 5) are also formed in the flange 14 and serve for the oriented fitting of the bobbin 4 carrying the secondary winding 4a. A wire for connecting the pack of plates constituting the magnetic core 7 to earth may also be welded to the negative terminal, for example, the terminal 12a.

Figure 4 shows the bobbin 3 of the primary winding 12c on which the bobbin 4 of the secon-

dary winding 4a is fitted. The secondary winding 4a has two electrical terminals 16 and 17; the terminal 16 is fixed to the negative terminal 12 of the primary winding 12c by electrical welding after the three pins 15a, 15b and 15c of the bobbin 4 of the secondary winding 4a have been force-fitted in an oriented manner in the respective holes 14a, 14b and 14c of the flange 14 of the bobbin 3 of the primary winding 12c.

Figure 6 shows the primary and secondary bobbins 3, 4 fitted on the support element 1. The flange 14 of the primary bobbin 3 is force-fitted in the seat 10c of the support element 1 and the flanges 17a and 17b of the secondary bobbin 4 bear on the cradle-like seats 10a and 10b of the support element 1. The remaining free lead of the diode 10 is electrically or ultrasonically welded to the remaining free high-tension terminal 17 of the secondary winding 4a.

Figure 7 is a side view of the assembly of Figure 6 in which the square-sectioned hole 26 for housing the central portion of the magnetic core 7 of the coil can be noted.

Figure 8 shows the magnetic core 7 constituted by two preassembled and substantially "E"-shaped half-packs of plates 24 and 25.

Figures 9 and 10 show the assembly of Figure 7 inserted in a container 5 and subsequently completed by the magnetic core 7.

The container 5 has a circular groove 19 which engages the toroidal portion 18 of the support element 1, and grooves 21a and 21b with horizontal axes which engage homologous toroidal projections 20a and 20b of the primary bobbin 3 (visible in Figure 10). These toroidal portions 18, 20a, 20b and the corresponding grooves 19, 21a, 21b ensure that there is no leakage to the exterior during the pouring of the resin into the container 5, which operation will be described below.

The container 5 and the primary bobbin 3 may also be connected by ultrasound welding. The upper edge 22 of the container 5 reaches the level of the upper edge 23 of the flange 14 of the primary bobbin 3.

The magnetic core 7 is formed by fitting the two preassembled half-packs of plates 24 and 25 together. The central portions 28 of the half-packs 24 and 25 are fitted symmetrically and with slight interference in the seat 26 in the primary bobbin 3. The half-packs 24 and 25 are kept with their ends pressed against each other and are joined in the regions 27 of the outer arms which are in contact by TIG or laser welding. The half-packs 24 and 25 also have two holes 29 and 30 in diagonally opposite positions for the mounting of the coil on the internal combustion engine.

The container 5 is then filled with two-part epoxy resin which, after polymerization, forms a single insulating block which also protects the primary and secondary windings from moisture and other atmospheric agents.

Figures 11 and 12 show the complete coil B constituted by the assembly shown in Figures 9 and 10, covered with resin R (for example, PBT filled with elastomers). The terminals 12 and 13 of the coil B and the points 29 and 30 for attachment to the internal combustion engine are protected by the resin covering R. This covering is formed with the use of a die, the cavity of which follows the external surface of the coil, leaving a space of about 1 mm. Moreover, the die can form the cable terminal 31 for the terminals 12 and 13 which is thus integral with the covering.

Figure 13 shows an alternative embodiment of the assembly of Figures 4 and 5 which has a further high-tension output 32 fixed to a bracket 33 which engages the flange 17a of the bobbin 4 and the flange 14 of the bobbin 3. The high-tension output 32 has a high-tension socket and a diode similar to the high-tension socket 2 and the diode 10 of the support element 1.

Naturally, the principle of the invention remaining the same, the details of construction and forms of embodiment may be varied widely with respect to those described and illustrated, without thereby departing from the scope of the present invention.

Claims

1. An electrical or electronic device, particularly an ignition coil (B) for an internal combustion engine, of the type which is intended to be mounted on a respective spark plug, comprising:

a substantially tank-shaped insulating container (5) in which coaxial primary (12c) and secondary (4a) windings are supported, the empty spaces in the container (5) being filled with a first electrically insulating material which is poured therein in the liquid state and then hardened, and

a magnetic core (7) having at least one arm which extends through the primary (12c) and secondary (4a) windings,

characterized in that the container (5) and the magnetic core (7) are substantially covered by a second insulating material (R) which is applied in the lqiuid state and then hardened.

2. A device according to Claim 1, characterized in that it comprises support means (1) having seats (10a, 10b, 10c) for the mounting of first (3) and second (4) bobbin means on which the primary (12c) and secondary (4a) windings are wound.

3. A device according to Claim 2, characterized in that the support means (1) have a substantially toroidal formation (18) for engaging a corresponding groove (19) formed in the wall of a first hole in the container (5) in order to prevent the first insulating material from leaking to the exterior, a portion of the support means (1) projecting from the container (5) for housing high-tension means (2) for connection to the spark splug.

4. A device according to Claim 3, characterized in that the support means (1) can house electrical rectifier means (10) connected between the secondary winding (4a) and the high-tension connection means (2).

5. A device according to Claim 2, characterized in that the first bobbin means (3) have two substantially toroidal formations (20a, 20b) which, in order to prevent leakages of the first insulating material to the exterior, can engage two corresponding grooves (21a, 21b) formed in correspondence with two second holes (26) in the container (5) to enable the arm to extend through the windings (12c, 4a).

6. A device according to any one of Claims 2 to 5, characterized in that the support means (1) and the first bobbin means (3) are fitted in the container (5) by ultrasound welding.

7. A device according to Claim 2, characterized in that the first bobbin means (3) has seats (14a, 14b, 14c) which can be engaged by respective projections (15a, 15b, 15c) of the second bobbin means (4) in a manner such that the bobbin means (3, 4) can be assembled only in the correct position.

8. A device according to any one of the preceding claims, characterized in that it comprises electrical connection means (12, 13) and in that the ends (12b, 13b) of the primary winding (12c) are welded directly to the electrical connection means (12a, 13a) by ultrasound welding.

9. A device according to Claim 1, characterized in that it comprises an electrical conductor connected to the magnetic core (7) for connecting the magnetic core (7) to earth.

10. A device according to any one of the preceding claims, characterized in that the secondary winding (4a) has a first terminal (16) connected to first connection means (2) and a second terminal (17) connected to second, high-tension, connection means having respective substantially tubular means (1, 32) of insulating material.

11. A device according to Claim 1, characterized in that the first insulating material is a two-part epoxy resin.

12. A device according to Claim 1, characterized in that the second insulating material is a plastics resin (R).

13. A device according to Claim 12, characterized in that the plastics resin (R) is PBT filled with elastomers.

14. A device according to Claim 1, characterized in that the magnetic core (7) is constituted by plates of ferromagnetic material.

15. A device according to claim 14, characterized in that the plates are disposed in two substantially "E"-shaped packs (24, 25) having two holes (29, 30) for enabling the device to be fixed in its final position of use.

16. A method of manufacturing a device of the type described in any one of Claims 1 to 15, comprising the steps of:

- winding the primary (12c) and secondary (4a) windings on the first (3) and second (4) bobbin means,
- fitting the electrical connection means (12, 13) on the first bobbin means (3) by the hot upsetting of projections on a flange (14) of the first bobbin means (3),
- welding the ends (12b, 13b) of the primary winding (12c) to the electrical connection means (12a, 13a),
- fitting the first (3) and second (4) bobbin means together,
- connecting the support means (1) to the high-tension connection means (2) and the electrical rectifier means (10),
- fitting the support means (1) and the bobbin means (3, 4) together,
- welding the ends (16, 17) of the secondary winding (4a),
- fitting the magnetic core (7) in the container (5), welding the two packs (24, 25) of plates together by TIG or laser welding,
- pouring the first insulating material into the container (5) and then hardening it,
- covering the device (B) with the second insulating material (R) by moulding, the moulding also being able simultaneously to form substantially tubular protection

and connection means (31) for the electrical connection means.

17. A method according to Claim 16, characterized in that the step in which the ends (16, 17) of the secondary winding (4a) are welded consists of the welding of a first end (16) of the secondary winding (4a) to one of the electrical connection means (12) and of a second end (17) to the electrical rectifier means (10).

18. A method according to Claim 16, characterized in that the step in which the ends (16, 17) of the secondary winding (4a) are welded consists of the welding of a first end (16) of the secondary winding (4a) to the electrical rectifier means (10) and of a second end (17) to electrical rectifier means disposed in the second high-tension connection means (32).

FIG. 1

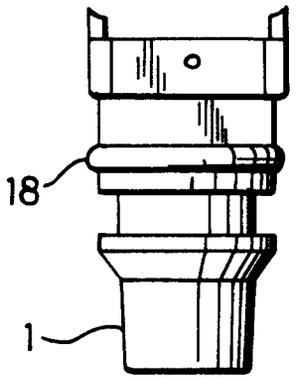


FIG. 2

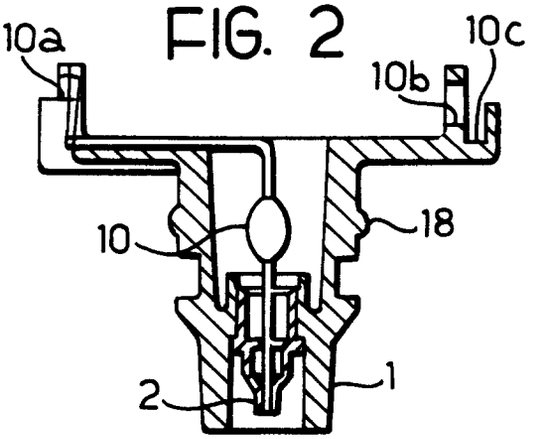


FIG. 3

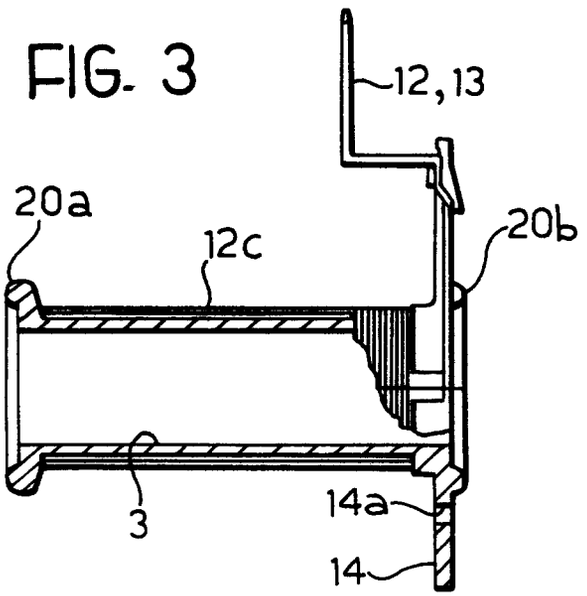


FIG. 4

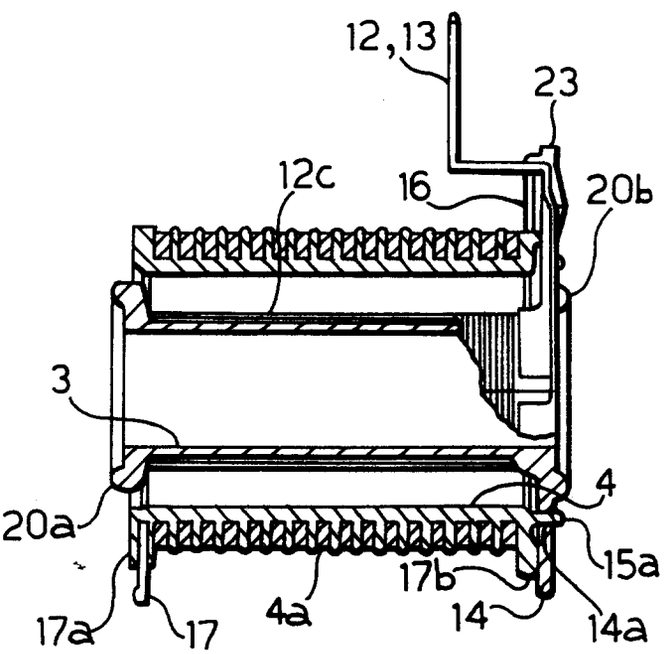


FIG. 5

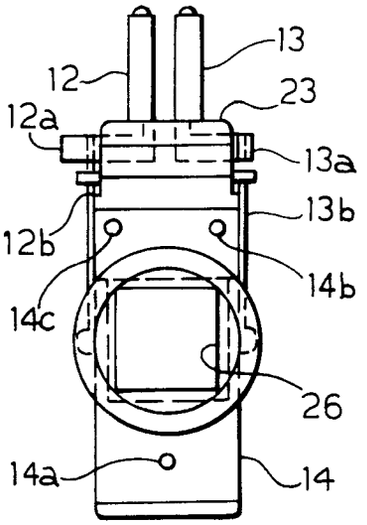


FIG. 6

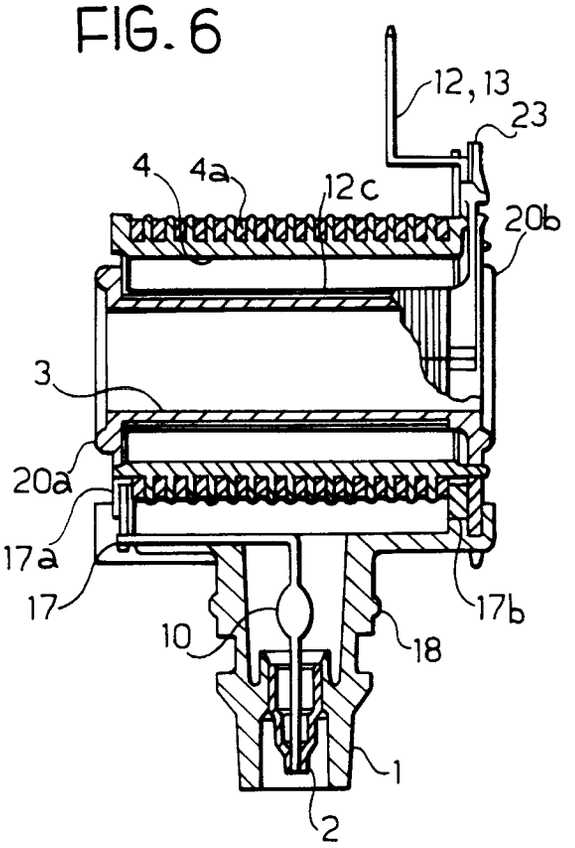


FIG. 7

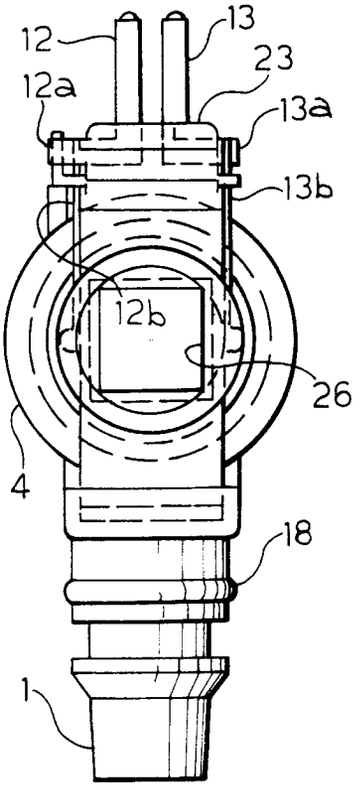


FIG. 8

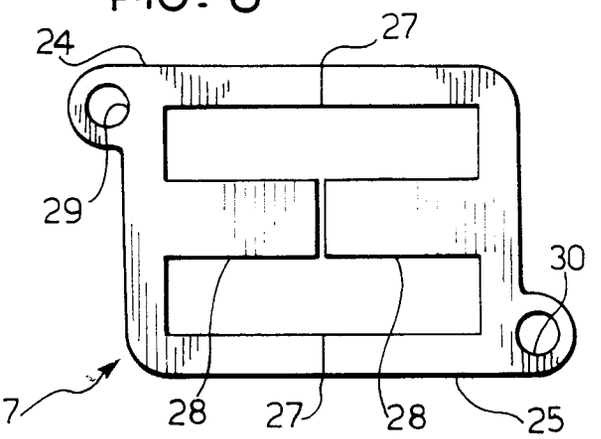


FIG. 9

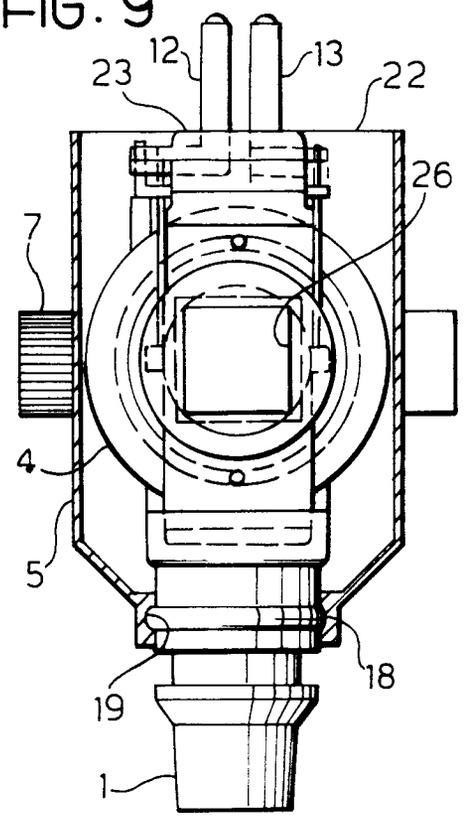


FIG. 10

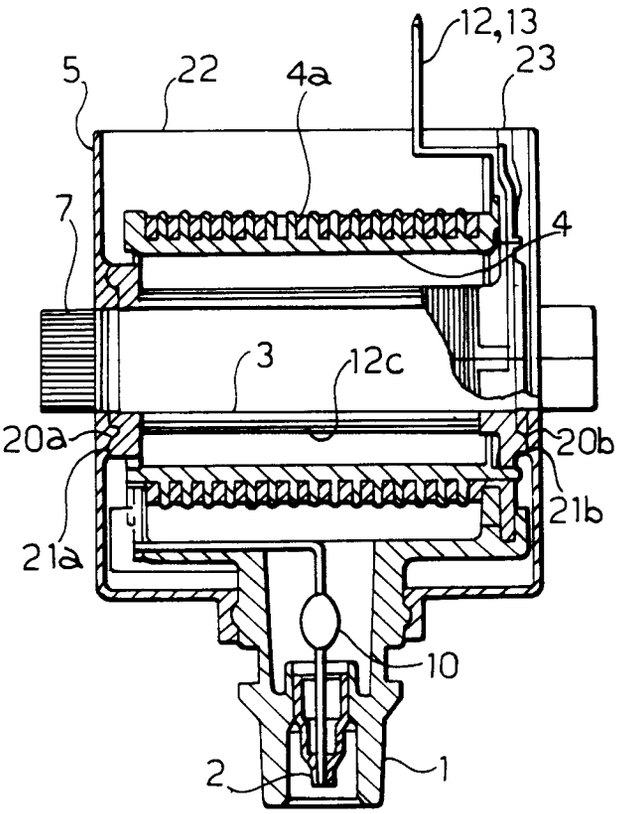


FIG. 11

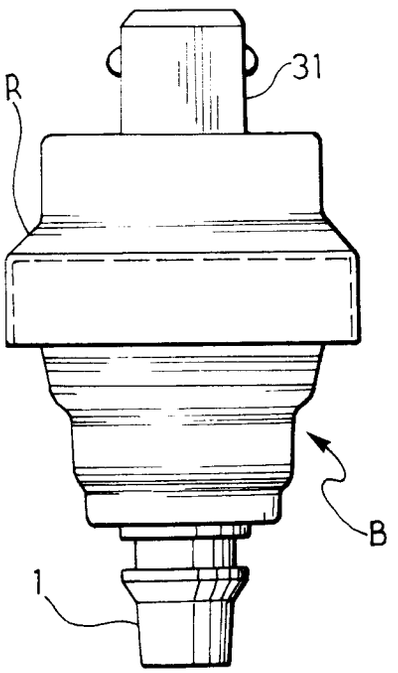
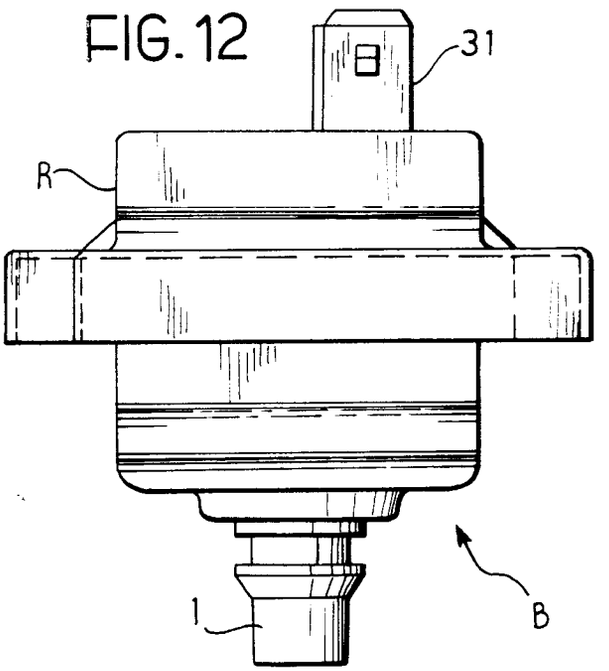


FIG. 12



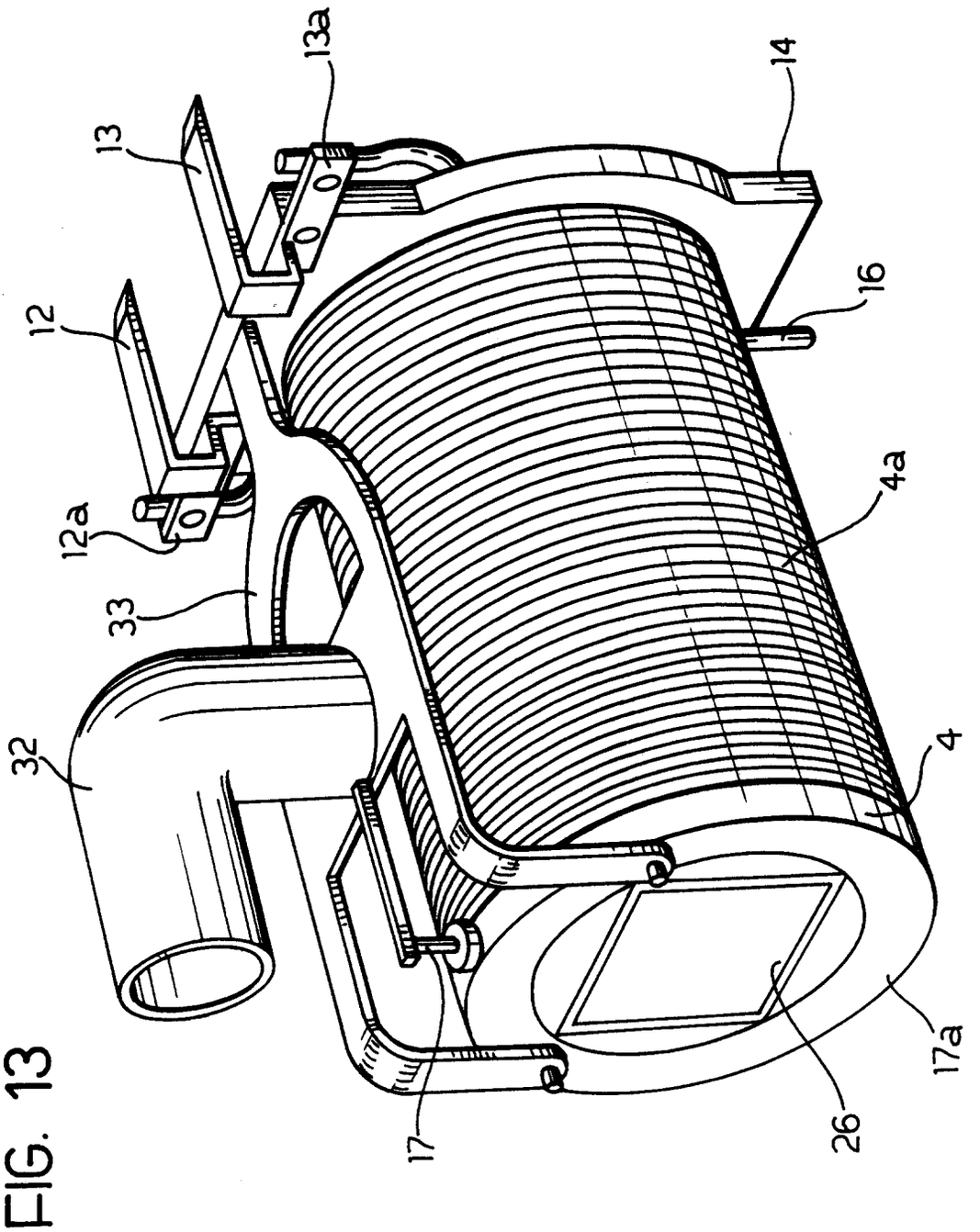


FIG. 13

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EUROPEAN SEARCH REPORT

Application Number
EP 94 10 4250

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)
Y	EP-A-0 230 811 (DUCELLIER) * column 4, line 46 - column 5, line 5; figures 1,5 *	1	H01F31/00 H01F27/02
A		11,12, 14,16	

Y	DE-U-91 14 575 (INDUSTRIE MAGNETI MARELLI) * the whole document *	1	
A		2-4,14, 16,18	

A	PATENT ABSTRACTS OF JAPAN vol. 9, no. 56 (E-302) (1779) 12 March 1985 & JP-A-59 195 811 (NIPPON DENSO) 7 November 1984 * abstract *	1,9,14, 15	

TECHNICAL FIELDS SEARCHED (Int.Cl.5)

H01F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	4 July 1994	Marti Almeda, R

CATEGORY OF CITED DOCUMENTS

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