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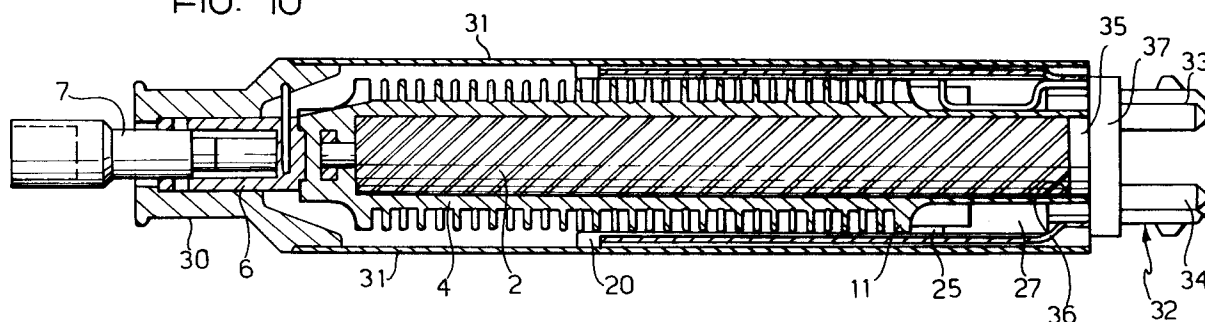
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I-10152 Torino (IT)(54) **Ignition coil with reduced transverse size.**

(57) An ignition coil, of the plug-top type with reduced lateral size, is intended for use in multi-valve engines. The coil comprises a core (2) made of

sheet metal wound in an elongate shape on which the spools (4, 20) of the secondary and primary windings respectively are fitted.

FIG. 10

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The present invention relates to an ignition coil, particularly for a multi-valve internal combustion engine provided with a static distribution ignition system.

As is known in multi-valve engines, which today are increasingly more varied, for example of the type having four valves per cylinder, the space available on the cylinder head is becoming increasingly smaller. This is due to the presence of the greater number of valves per cylinder and the respective mechanisms for actuating the valves themselves.

If it is desired to use single coils, one for each spark plug, mounted directly on the spark plug, of the type generally known as plug-top, the problem then arises of the lack of available space for the aforementioned spark plugs.

The object of the present invention is to produce an ignition coil of reduced lateral size which enables the above disadvantage to be overcome satisfactorily although offering performance which is equal to or greater than the coils of the prior art.

According to the present invention, this object is achieved by virtue of an ignition coil having the characteristics given in the claims following the present description.

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

- Figure 1 is a side view of the core of the coil according to the present invention;
- Figure 2 is an axial view of the core shown in Figure 1;
- Figure 3 is a schematic view, partially in section, of components of the coil according to the present invention, partially assembled;
- Figure 4 is a schematic view, in section, of a component of the coil according to the present invention;
- Figures 5 and 6 are two axial views of the component shown in Figure 4;
- Figure 7 is a schematic view of components of the coil, as shown in Figure 3, not in section;
- Figure 8 is a schematic view, not in section, of the component shown in Figure 4;
- Figure 9 is a view in section of a further component of the coil according to the present invention; and
- Figure 10 is a view, in section, of the complete coil according to the present invention.

With reference to Figures 1 and 2, the coil according to the present invention comprises a core 2 made of ferromagnetic material and having a substantially linear development. The core 2 is, for example, formed of a cylinder with a circular section and made of ferromagnetic material wound

in a spiral, for example sheet metal (0.2 mm thick).

The core 2 is intended to be inserted in a spool 4, shown in Figure 3, for the secondary winding. The secondary spool 4 comprises a plurality of cells 5 which can accommodate the secondary, or high-voltage, winding. The secondary spool 4 is made of insulating material, for example plastics material, with a bush 6 comoulded from electrically conductive material.

The purpose of the bush 6 is to enable the terminals 7 to be connected by the connection to the spark plug (not illustrated) of the internal combustion engine. The terminal 7 is fixed to the bush 6 by means of a pin 13, shown in Figure 7, which engages a slot 14 provided in the terminal 7. This arrangement enables the terminal 7 to slide inside a hole 15 in the bush 6.

This hole 15 is provided with a spring 16 such that the terminal 7 is urged in the direction of the spark plug and its cup-shaped seat 17 is always in contact with the positive terminal of the spark plug. This arrangement is particularly useful in applications in which there are different measurements between the terminals of the coil and of the spark plug. The measuring interval, to which the coil according to the present invention can be correctly applied, is determined by the axial dimension of the slot 14.

The secondary spool 4 has an axial cavity 8 which can accommodate the core 2, terminating in a surface 9 at right angles to the axis of the spool 4 itself against which the core 2 abuts when inserted. The primary spool 20, shown in Figures 4, 5, 6 and 8, is force-fitted on a cylindrical upper outer portion 10 of the secondary spool 4. A flange 11, also provided on the secondary spool 4, has the function of providing a shoulder for conferring a specific desired axial position on the primary spool 20.

The primary spool 20, which is also made of insulating material, can accommodate the primary, or low-voltage, winding. The shape of the latter is substantially that of a tube with a bore such that it can be fitted, as stated above, on the secondary spool 4. It will be appreciated that the outer surface 21 of the primary spool 20 can accommodate the primary winding of the coil.

The two ends of the outer surface 21 of the primary spool 20 have respective radial projections 22, 23, the function of which is to act as a shoulder for the primary winding. In contrast, the internal surface 24 of the primary spool 20 has radial projections 25 which, when the primary spool 20 is mounted on the secondary spool 4, cooperate by means of a surface 26, such that they abut the flange 11 of the secondary spool 4. In this way, as stated above, a predetermined axial position relative to the secondary spool 4 is imparted to the primary spool 20.

On the primary spool 20 are further provided projections 27 of a size such that their surfaces 28 facing the axis have a slight interference, with an end portion 10 of the secondary spool 4, when the primary spool 20 has been mounted on the secondary spool 4.

The coil is further provided with a hood 30, shown in Figure 10, made of insulating plastics material and having the following functions:

- to insulate the area surrounding the high voltage bush 6;
- to define the size of the coil on the side facing the spark plug;
- to close one side of a container 31.

The container 31, shown in Figures 9 and 10 and made of insulating plastics material, completes the coil and defines the radial size of the coil itself. Further, the container 31, cooperating with the hood 30, forms a casing which can contain impregnating resin.

Once the coil is assembled, liquid impregnating resin is cast in the coil and is subsequently polymerised, rendering it solid.

It will be appreciated that the coil is provided with electrical connectors. In fact it comprises a low voltage connector 32, having electrical supply terminals 33, 34, the positive terminal 33 of which is connected to a positive terminal of the primary winding, and the negative terminal 34 of which is connected to the negative terminals of the primary winding and the secondary winding.

A portion 35 of the low voltage connector 32 is disposed so as to enable the low voltage connector 32 to be centred on the cavity 8 in the secondary spool 4. Furthermore, the portion 35 of this connector is shaped such that its end surface 36 adheres to the core 2. In contrast, a portion 37 of the low voltage connector 32 is shaped such that it has external size which is smaller than the bore of the container 31 (at least 4 mm), such that the impregnating resin can be cast.

The coil produced in this way has lateral size which is very compact and enables it to be used in engines in which the available space is limited although it is cheap and simple to produce.

Naturally, the principle of the invention remaining the same, the features of embodiments and details of description may vary widely with respect to what has been described and illustrated, without departing from the scope of the present invention.

Claims

1. An ignition coil, intended to be mounted directly on a spark plug, characterized in that it comprises in operative combinations:
 - a core (2) conducting electromagnetic flux;

- a first spool (4), carrying a low voltage winding, and carrying the core (2) in an internal axial cavity (8);
- a second spool (20), carrying a high voltage winding, intended to be fitted on the first spool (4);
- connection means (6, 7) which are associated with the first spool (4) and can connect a terminal of the high voltage winding to the spark plug; the first spool (4) being provided with the flange (11) at a first end, remote from the connection means (6, 7), and the second spool (20) being provided on its internal surface (24) with radial projections (25) which define abutment surfaces (26) which can cooperate with the flange (11) so as to determine a relative axial assembly position between the first spool (4) and the second spool (20).

2. A coil according to Claim 1, characterized in that the internal surface (24) of the second spool (20) is provided with further projections (27) intended to cooperate, by means of their internal surfaces (28), with the end portions (10) of the first end of the first spool (4) such that the second spool (20) fits on the first spool (4).
3. A coil according to Claim 2, characterized in that the first spool (4) has an outer surface shaped in the manner of a plurality of cells (5) intended to accommodate the high voltage winding.
4. A coil according to Claim 3, characterized in that the second spool (20) is provided on its outer surface (21) with projections (22, 23) disposed at both ends of the second spool (20) and intended to form shoulders for the low voltage winding.
5. A coil according to Claim 4, characterized in that the connection means (6, 7) comprise a bush (6) made of electrically conductive material and comoulded with the first spool (4).
6. A coil according to Claim 5, characterized in that the connection means (6, 7) comprise a high voltage terminal (7) intended to come into contact with a connection terminal of the spark plug, the terminal having a substantially cup-shaped concave contact seat (17) and being movably associated with the bush (6).

7. A coil according to Claim 6, characterized in that the high voltage terminal (7) can slide in the bush (6) such that it can be adapted to systems having different measurements. 5
8. A coil according to Claim 7, characterized in that it comprises resilient means (16), operatively interposed between the bush (6) and the high voltage terminal (7), such that it urges the terminal (7) towards the spark plug in order to provide an optimum electrical contact. 10
9. A coil according to Claim 8, characterized in that the resilient means comprise a helical spring (16). 15
10. A coil according to Claim 9, characterized in that the high voltage terminal (7) is provided with an elongate aperture (14) in which is intended to be inserted a pin (13), provided in the bush (6), the elongate aperture (14) and pin (13) being arranged so as to define the axial movement of the high voltage terminal (7) relative to the bush (6). 20 25
11. A coil according to Claim 10, characterized in that size, in the axial direction, of the elongate aperture (14) determines the length of travel of the high voltage terminal (7). 30
12. A coil according to any one of the preceding claims, characterized in that it comprises a substantially tubular container (31) which can be fitted on the second spool (20). 35
13. A coil according to Claim 12, characterized in that it comprises a hood (30) which can be fitted on a second end, turned towards the spark plug, and about the bush (6). 40
14. A coil according to Claim 13, characterized in that the container (31) and the hood (30) together form a casing which can enable an insulating material, cast in the liquid phase and subsequently solidified, to be introduced thereinto. 45 50
15. A coil according to any one of the preceding claims, characterized in that it comprises low voltage connection means (32) inserted in the first end of the first spool (4). 55
16. A coil according to Claim 15, characterized in that the core (2) is cylindrical and consists of a wound sheet of ferromag-

netic material.

FIG. 1

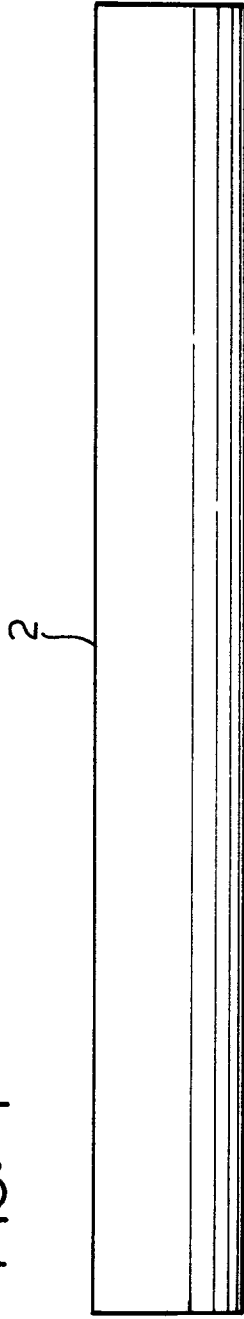


FIG. 2

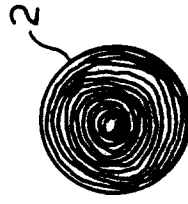


FIG. 3

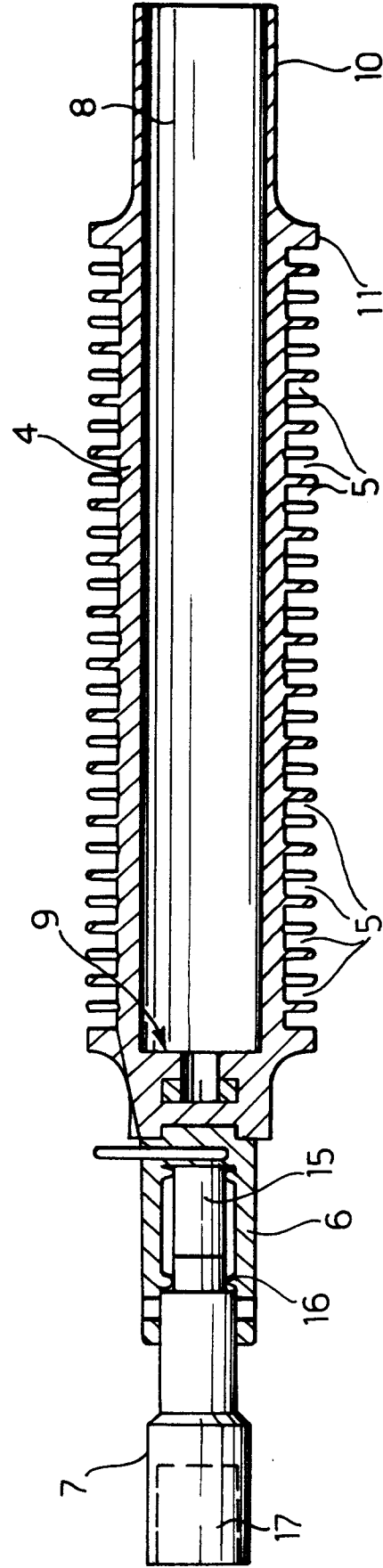


FIG. 5

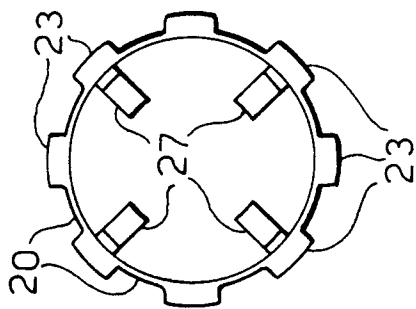


FIG. 4

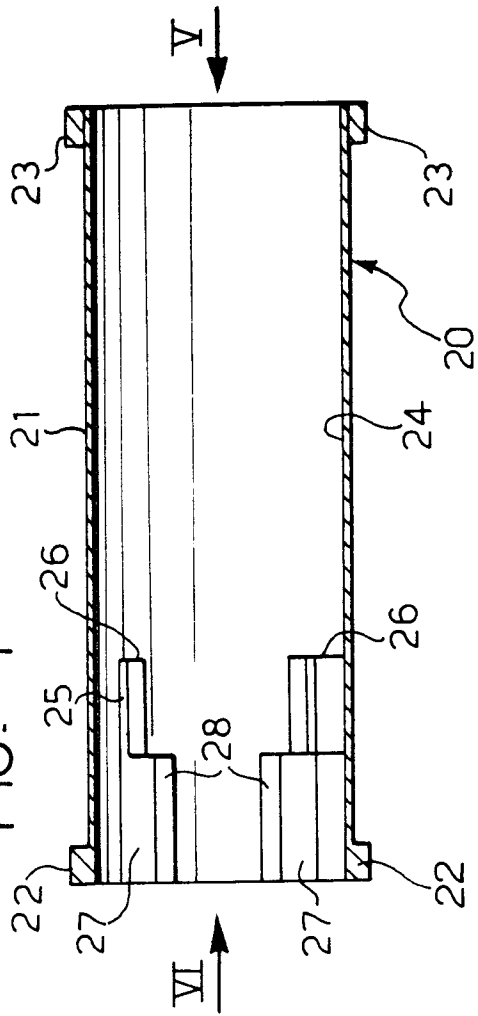


FIG. 6

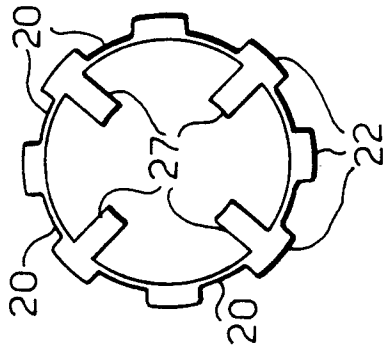


FIG. 7

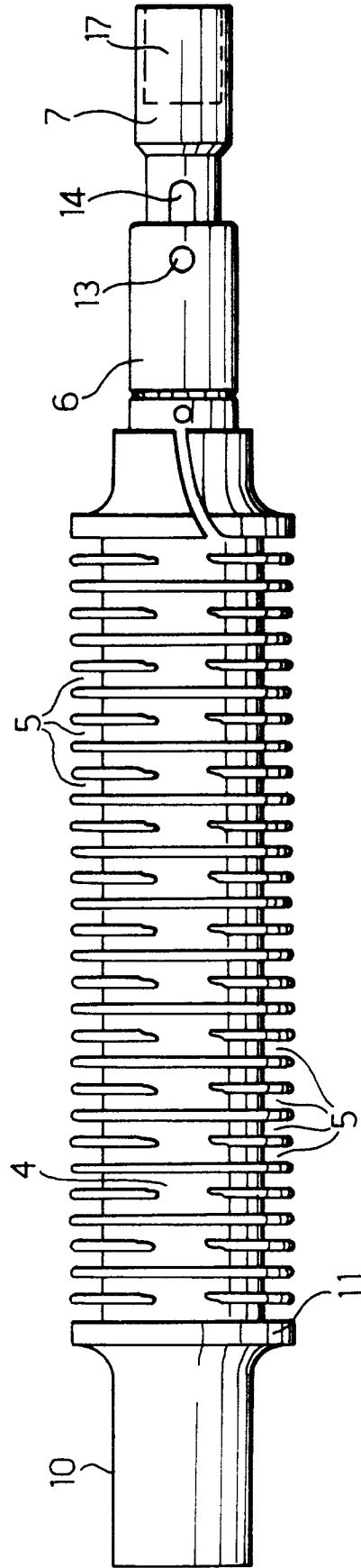


FIG. 8

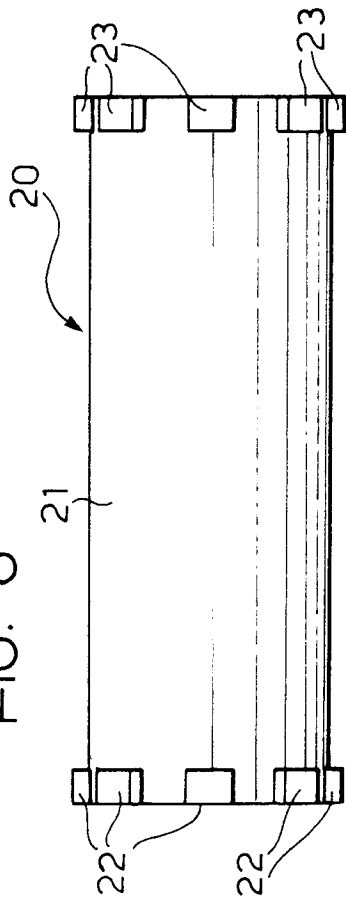


FIG. 9

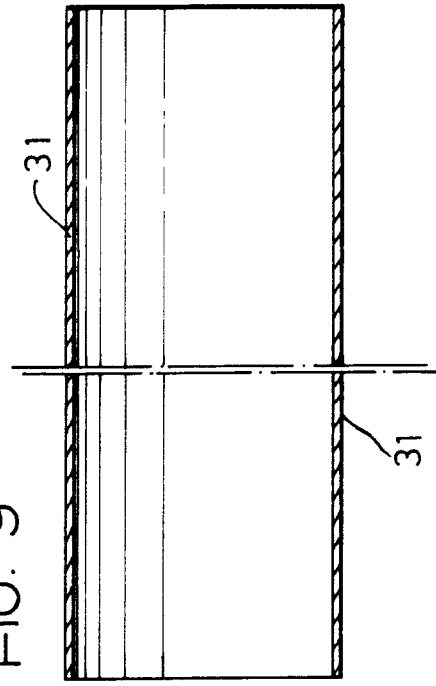
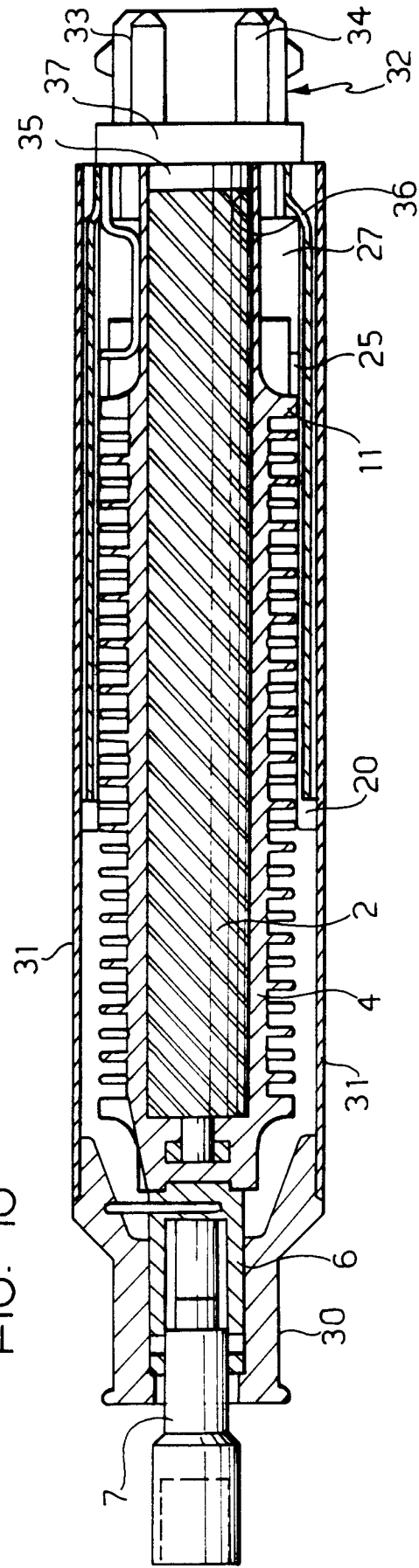


FIG. 10





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EUROPEAN SEARCH REPORT

Application Number
EP 94 11 0339

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.6)
A	US-A-4 514 712 (MCDUGAL) * column 9, line 50 - column 12, line 61; figures 11-18 * ---	1,3-6, 12-15	H01T13/44 F02P13/00 H01F38/12
A	EP-A-0 508 374 (NIPPONDENSO CO LTD) * column 3, line 21 - column 3, line 15; figures 1,2 * ---	1,3,5,6, 8,9, 12-14	
A	WO-A-85 00930 (JOHANSSON) * page 3, line 20 - page 5, line 27; figure 3 * ---	1,3, 12-15	
A	EP-A-0 224 452 (MAGNETI MARELLI S.P.A.) * page 5, line 12 - page 6, line 14; figures 2,3 * ---	1,12-16	
A	GB-A-2 199 193 (NIPPONDENSO CO LTD) * figure 6 * ---	1	TECHNICAL FIELDS SEARCHED (Int.Cl.6)
A	DE-A-39 20 080 (AUDI AG) * column 3, line 19 - line 54; figure 2 * ---	6-9	H01F H01T F02P
A	WO-A-86 04480 (CATERPILLAR INC.) * abstract; figures 2,3 * ---	6-9	
A	EP-A-0 297 487 (TDK CORPORATION) -----		
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 8 November 1994	Examiner Michels, J
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			