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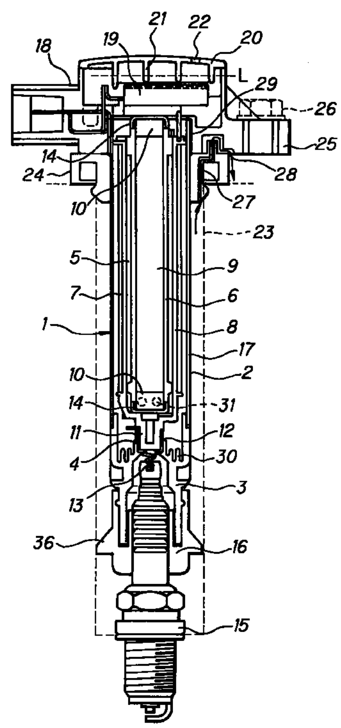
(54) Engine igniting coil device

(57) In an engine igniting coil device of the open-magnetic-circuit type that has a bobbin having a hollow axis having a circular section in which a rod-shape core is inserted, the core is formed of a plurality of iron plates having different widths and laminated to have a substantially circular section and the thus formed core is splitted in the direction perpendicular to the lamination into a plurality of parts in order to increase a space factor of the core in the bobbin's hollow axis having a circular section and to easily accommodate the core in the bobbin's hollow axis having a circular section assuring a high space factor of the core therein and reducing eddy-current core-loss to improve an output factor of a secondary voltage.

FIG. 1



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Description

BACKGROUND OF THE INVENTION

The present invention relates to an open-magnetic-circuit type engine igniting coil device.

Japanese Laid-Open Patent No. 54-63317 discloses an open-magnetic-circuit type engine igniting coil device which comprises a primary coil bobbin having a hollow shaft with a rod-shape core inserted therein and a secondary coil bobbin coaxially laid on the primary coil bobbin and which is characterized in that the primary coil bobbin accommodates thin strips irregularly inserted in tight therein in order to accommodate the core in the primary-coil-bobbin's hollow shaft having a circular section with a high space factor therein for generating a magnetic flux enough to obtain an improved output efficiency of a secondary voltage.

Japanese Laid-Open Patent No. 5-87311 discloses an engine igniting coil device that has a primary coil bobbin with a hollow axis having a circular section in which metal wires having regular hexagonal section are densely inserted.

The above-mentioned prior arts involve the following drawbacks:

The process for irregularly filling thin strips or densely inserting wires having a regular hexagonal section into a coil-bobbin's hollow axis having a circular section for improving a space factor of the core therein is considerably laborious as compared with a process of inserting a previously assembled core into a hollow shaft of a coil bobbin.

SUMMARY OF THE INVENTION

Accordingly, an object of the present invention is to provide an engine igniting coil device which is an open-magnetic-circuit type, wherein a coil bobbin has a hollow shaft having a circular section and accommodating therein a core with a high space factor and said core is a lamination of iron plates having different widths and having a nearly circular cross-section.

Another object of the present invention is to provide an engine igniting coil device that is an open-magnetic-circuit type, wherein a core formed of laminations of iron plates is split into a plurality of parts in a direction perpendicular to the lamination to improve an output efficiency of a secondary voltage by effectively reducing an eddy current core loss.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a sectional front view of an engine igniting coil device embodying the present invention.

Fig. 2 is a sectional side view of a core of the engine igniting coil device shown in Fig. 1.

Fig. 3 is a sectional side view of a cylindrical case of the engine igniting coil device shownin Fig. 1.

Fig. 4 is a plan view showing an internal structure of a low-voltage terminal socket of the engine igniting coil device shown in Fig. 1.

Fig. 5 is a plan view of a low-voltage terminal socket with an igniter mounted thereon.

Fig. 6 is a sectional side view of an example of a split core.

Fig. 7 is a sectional side view of another example of a split core.

Fig. 8 is a graph showing secondary voltage output characteristics of a device with a split core and a device with split core.

Fig. 9 shows variations of lamination of a core to be inserted in a hollow axis of a bobbin.

Fig. 10 shows space factors of respective cores shown in Fig. 9 and inserted in a hollow axis of a bobbin.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The preferred embodiments of the present invention will now be described in detail by way of example and with reference to the accompanying drawings.

As shown in Fig. 1, an engine igniting coil device according to the present invention has a coil case 1 composed of a cylindrical case 2 and a case 3 having a small tubular hole 4 in its center portion and fitted in an open end of the case 2 to form a closed end of the coil case 1.

The coil case 1 accommodates an assembly of a coil bobbin 6 with a primary coil 5 having a hollow shaft with a rode-shape core 9 inserted therein and a coil bobbin 8 with a secondary coil 7 coaxially mounted on the coil bobbin 6. The core 9 isprovided ateach end with a permanent magnet 10 for obtaining a large change in magnetic flux with an interrupted primary current.

As shown in Fig. 2, the core 9 is formed in such a manner that iron plates having different widths are laminated to form a nearly circular section and jointed to each other by caulking to form a single body. The caulked portion is indicated with a broken line in Fig. 2.

The core 9 is accommodated in the hollow cylindrical shaft of the primary coil bobbin 6, attaining an increased space factor of the core 9 therein. The coil device can get an increased efficiency of generating magnetic flux and thereby an improved output efficiency of its secondary voltage.

As described above, the core 9 is an integrally caulked lamination of iron plates forming a nearly circular section and can therefore be easily mounted in the coil bobbin 6.

Fig. 9 illustrates variations of laminated cores composed of a plurality of 0.35 mm thick iron plates. In this case, a cross-section area of a hollow shaft is 50.27 mm^2 and a sectional area of a core ⟨a⟩ is 31.99 mm^2. A space factor of the core ⟨a⟩ in the hollow shaft is 63.6%. Similarly, a sectional area of a core ⟨b⟩ is 39.44 mm^2 and a space factor of the core ⟨b⟩ in the hollow shaft is 78.5%. Namely, an increasing ratio of the space factor of the core is 23.3%. A sectional area of a core ⟨c⟩ is

42.56 mm^2 and a space factor of the core ⟨c⟩ in the hollow shaft is 84.7% with an increasing ratio of 7.7%. A sectional area of a core ⟨d⟩ is 44.20 mm^2 and a space factor of the core ⟨d⟩ in the hollow shaft is 87.9% with an increasing ratio of 3.9%. A sectional area of a core ⟨e⟩ is 45.45 mm^2 and a space factor of the core ⟨e⟩ in the hollow shaft is 90.4% with an increasing ratio of 2.8%. A sectional area of a core ⟨f⟩ is 46.27 mm^2 and a space factor of the core ⟨f⟩ in the hollow shaft is 92.0% with an increasing ratio of 1.8%. A sectional area of a core ⟨g⟩ is 46.73 mm^2 and a space factor of the core ⟨g⟩ in the hollow shaft is 93.0% with an increasing ratio of 1.0%. A sectional area of a core ⟨h⟩ is 47.16 mm^2 and a space factor of the core ⟨h⟩ in the hollow shaft is 93.8% with an increasing ratio of 0.9%.

Fig. 10 shows space-factor characteristics of respective cores ⟨a⟩ - ⟨h⟩.

The cores ⟨d⟩ - ⟨h⟩ are suitable to use in practice since increasing ratios of their space factors are small and constant.

According to the present invention, the core 9 formed by laminating a plurality of iron plates is divided in a direction perpendicular to the plate laminating direction.

By dividing the core 9 into small component parts, it becomes possible to reduce an eddy current core loss. As a result, the magnetic flux generating efficiency is increased and the output efficiency of a secondary voltage of the coil device is improved.

Divided core portions 91and 92 are separately laminated and caulked. Caulked portions are indicated with broken lines.

The present invention is not limited to the above-mentioned core 9 which is made by laminating a plurality of iron plates having different widths to form a nearly circular section and then splitted in the direction perpendicular to the plate laminating direction, and it also proposes a core 9', shown in Fig. 7, which is made of laminations of iron plates forming a square section and splitted in a direction perpendicular to the plate laminating direction. This split laminated core 9' having a square cross-section can effectively improve the flux generating efficiency.

In this case, the core 9' being laminations of iron plates having a square section is divided into 4 divisions in a direction perpendicular to the plate laminating direction. Divided components of the core 9' must have a width of not less than 2.8 mm for caulking. The caulking portions are indicated with a broken line in Fig. 7.

Laminated iron plates may also be jointed together to form a single core by welding or bonding (besides by caulking). In this case, the laminated core may be divided into components having smaller width (than 2.8 mm), which can therefore prevent an eddy current loss more effectively. In the case of laminating a plurality of differently wide iron plates to form a nearly circular section, the plate width restriction may be relaxed.

Fig. 8 shows output characteristics of two cores 9' (i.e., a core composed of 4 split parts and a single solid core, which are similar in structure and mounted in the coil bobbins of the same structure). Namely, two curves indicate changes of secondary voltages of two above-mentioned cores, respectively, as currents in their primary coils change under the same conditions.

In the engine igniting coil device shown in Fig. 1, a high-voltage terminal holder 11 is provided as a center projection formed integrally with the flanged end portion of the secondary coil bobbin 8 and a high-voltage terminal 12 bonded to the holder 11 has a contact 13 attached thereto for providing electrical connection with an ignition plug 15.

An assembly of the primary coil bobbin 6, secondary coil bobbin 8, high-voltage terminal 12 and contact 13 is mounted at a given place and fixed in the coil case 1 in such a manner that a holder portion of the high-voltage terminal 12 is press-fitted in the small hole 4 of the coil case 1 and the contact 13 outwardly projected from the small hole 4.

The coil case 1 with the assembly fixed at the given place therein is filled with melted insulating resin injected through an open-end of the coil case 1 to form a single solid device.

The permanent magnets 10 attached one to each end of the core 9 are covered with damping members 14, respectively, which can prevent intrusion of melted resin into the core 9 and absorb relatively large thermal stress produced in the longitudinal direction of the core 9, thus preventing cracking of the resin layer formed round the core 9.

A space formed between the primary coil bobbin 6 and the secondary coil bobbin 8 is filled with melted resin entered therein through a plurality of holes 18 made in the high-voltage terminal holder 11 of the flanged end portion of the secondary coil bobbin 8. Two bobbins are fixed to each other with the resin layer solidified therebetween.

The case 3 also functions as a connector of an ignition plug 15 and is provided at its top end with a plug rubber 16 for holding the ignition plug 15. When the ignition plug 15 is inserted into the plug rubber 16, a tip of the ignition plug 15 comes into contact with the contact 13, thus making electrical connection of the ignition coil device.

The case 2 made of dielectomagnetic material having a high permeability, e.g., silicone steel, which has an electromagnetic shielding effect and acts as a side core for concentrating a lager portion of magnetic flux produced by the open-magnetic-circuit type core 9 to the case 2, thus preventing loss of the produced magnetic flux by passing a cylinder block of the engine not to cause a drop of a secondary output voltage. The case 2 itself has a thermal radiation effect.

As shown in Fig. 3, the case 2 has a slit 33 to form a gap of 0.5 to 1.5 mm in longitudinal direction and a C-shaped section to minimize an eddy current core loss.

The case 2 is internally covered with an elastic member 17 (e.g., rubber, elastomer) which separates resin layer from the inner wall of the case 2 and absorbs thermal stress of metal, thus preventing the resin layer from cracking.

The case 3 has a plurality of ribs 30 formed between the small hole 4 and the side wall to assure an insulation distance between the high-voltage terminal 12 fitted in the small hole 4 and the case 2.

As shown in Fig. 1, a low-voltage terminal socket 18 is fitted in an upper end of the case 2 and accommodates therein an igniter 19.

The low-voltage-terminal socket 18 is fitted on an outwardly bent portion 29 of the elastic member 17 provided on the inside wall of the case 2 to assure a high sealing quality.

Fig. 4 shows an internal structure of the low-voltage-terminal socket holder 18 with the removed cap 20. Fig. 5 shows the low-voltage-terminal socket holder 18 with an igniter 19 mounted therein.

Melted resin is poured into the low-voltage terminal socket 18 with the removed cap to a level L (Fig. 1), then a cap 20 is placed thereon with its ribs 21 immersed in the liquid resin. The cap 20 has an air vent hole 22.

The cap 20 has a plurality of the ribs 21 that serve as a cushion for dispersing thermal stress to the resin layer, thus preventing cracking of the resin layer on the igniter 19.

As shown in Fig. 1, the case 2 under the low-voltage-terminal socket holder 18 is provided with a rubber seal 24 that is used when the coil case 1 is mounted in cylinder bore 23 made in a cylinder head portion of an engine.

With the coil case 1 embedded in the cylinder bore 23, this ignition coil device is secured at its flange 25 to the cylinder head with a bolt 26 through the flange 25 integrally formed with the holder 18.

To prevent air pressure from increasing by heat in the embedded portion of the coil case 1 in the cylinder bore 23, air vent holes 27 and 28 communicating with each other are provided between the rubber seal 24 and the low-voltage-terminal socket 18. The flow of air is indicated by an arrow in Fig. 1.

A plug rubber 16 has a flange 36 formed at its circumference. This flange 36 has the same diameter as the diameter of the cylinder bore 23 and serves as a guide for inserting the coil case 1 into the cylinder bore 23 to assure the reliable connection with the ignition plug 15. The engine vibration transmitted through the ignition plug 15 to the coil case 1 is absorbed by the flange 23. The vibration applied to electrical connections between the contact 13 and the ignition plug 15 can be suppressed. The durability of the device is thus improved.

As described above, the present invention provides an engine igniting coil device that has the following improvements:

In an open-magnetic circuit type engine igniting coil device according to the present invention, a rod-shape core inserted in a hollow shaft of an ignition coil bobbin is made of laminations of different in width iron plates forming a nearly circular cross-section of the core and, therefore, can attain an increased space factor in the hollow shaft of the bobbin, thus effectively increasing the output efficiency of the secondary voltage of the ignition coil device. The core is separately manufactured as a unit part that is easy to mount in the hollow shaft of the coil bobbin. This is desirable for mass production of the proposed ignition coil devices for engines.

The ignition coil device also can use a split core that is formed of laminations of iron plates and is further split into a plurality of parts in a direction perpendicular to the plate laminating direction and which can therefore reduce an eddy current core loss effectively to improve an output efficiency of the second voltage of the ignition coil device.

In an engine igniting coil device of the open-magnetic-circuit type that has a bobbin having a hollow axis having a circular section in which a rod-shape core is inserted, the core is formed of a plurality of iron plates having different widths and laminated to have a substantially circular section and the thus formed core is splitted in the direction perpendicular to the lamination into a plurality of parts in order to increase a space factor of the core in the bobbin's hollow axis having a circular section and to easily accommodate the core in the bobbin's hollow axis having a circular section assuring a high space factor of the core therein and reducing eddy-current core-loss to improve an output factor of a secondary voltage.

Claims

1. An engine igniting coil device which is an open-magnetic-circuit type ignition coil device having a coil bobbin with a hollow shaft having a circular section, said hollow shaft accommodating a rode-shape core which is formed of a plurality of iron plates having different widths and laminated on each other to form a substantially circular section of the core.

2. An engine igniting coil device which is an open-magnetic-circuit type ignition coil device having a coil bobbin with a hollow shaft having a circular section, said hollow shaft accommodating a rode-shape core which is formed of a lamination of iron plates and is split into a plurality of parts in a direction perpendicular to the iron plate laminating direction.

3. An engine igniting coil device as defined in claim 1, characterized in that the core formed of a plurality of iron plates having different widths and laminated on each other to form a substantially circular section is divided into a plurality of parts.

4. An engine igniting coil device as defined in claim 1, characterized in that the core formed of a plurality of iron plates having different widths and laminated on each other to form a square section is divided

into a plurality of parts.

FIG. 1

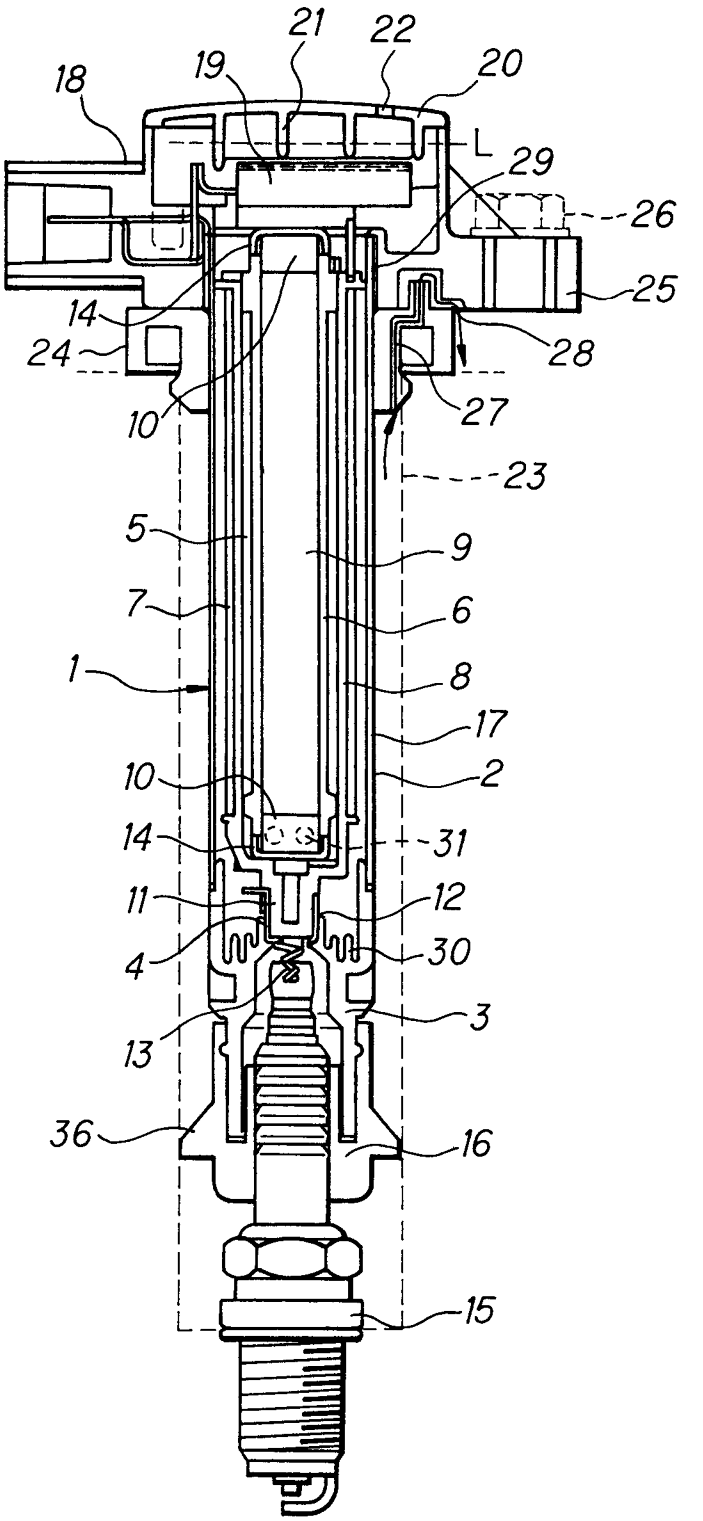
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FIG.2

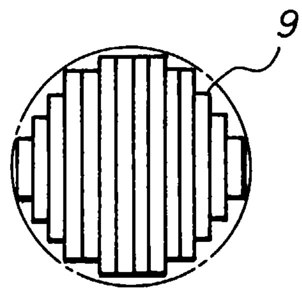

FIG.3

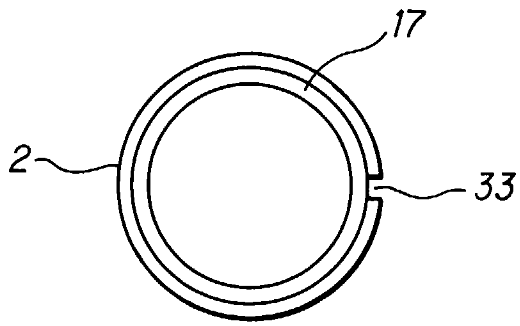

FIG.4

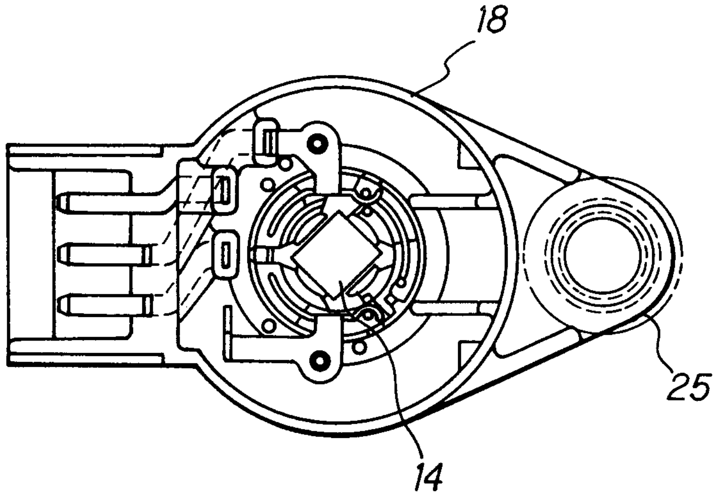

FIG.5

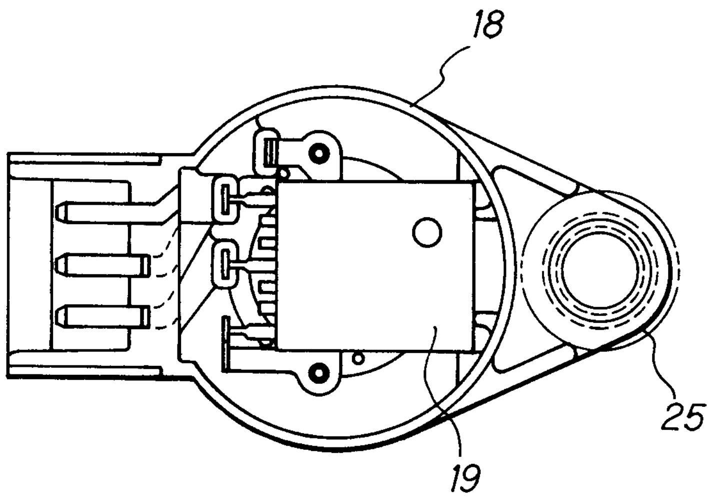

FIG.6

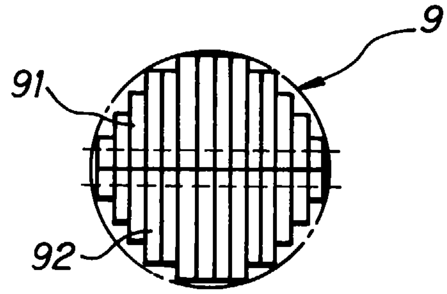

FIG.7

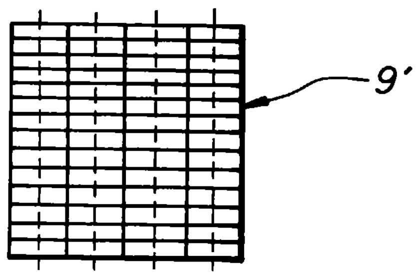

FIG.8

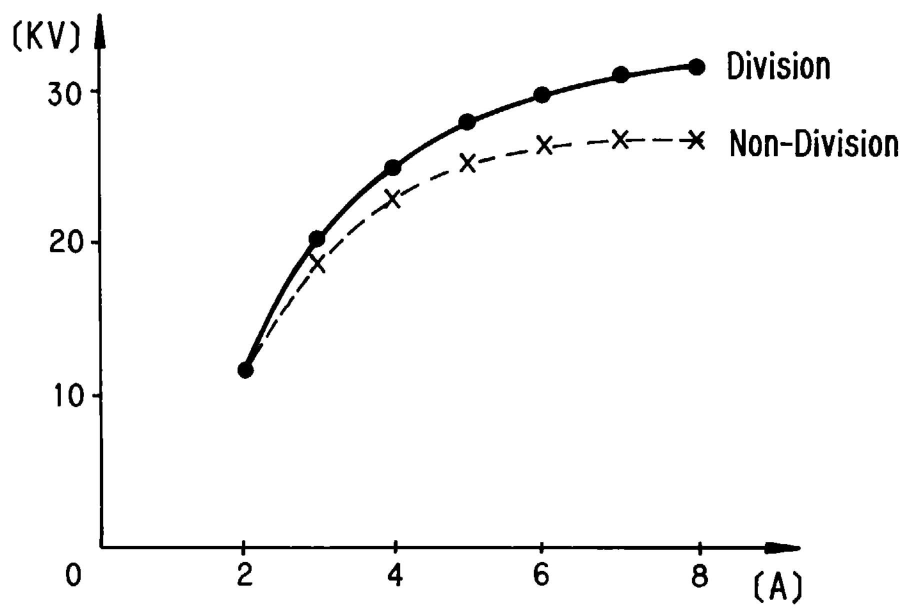

FIG.9

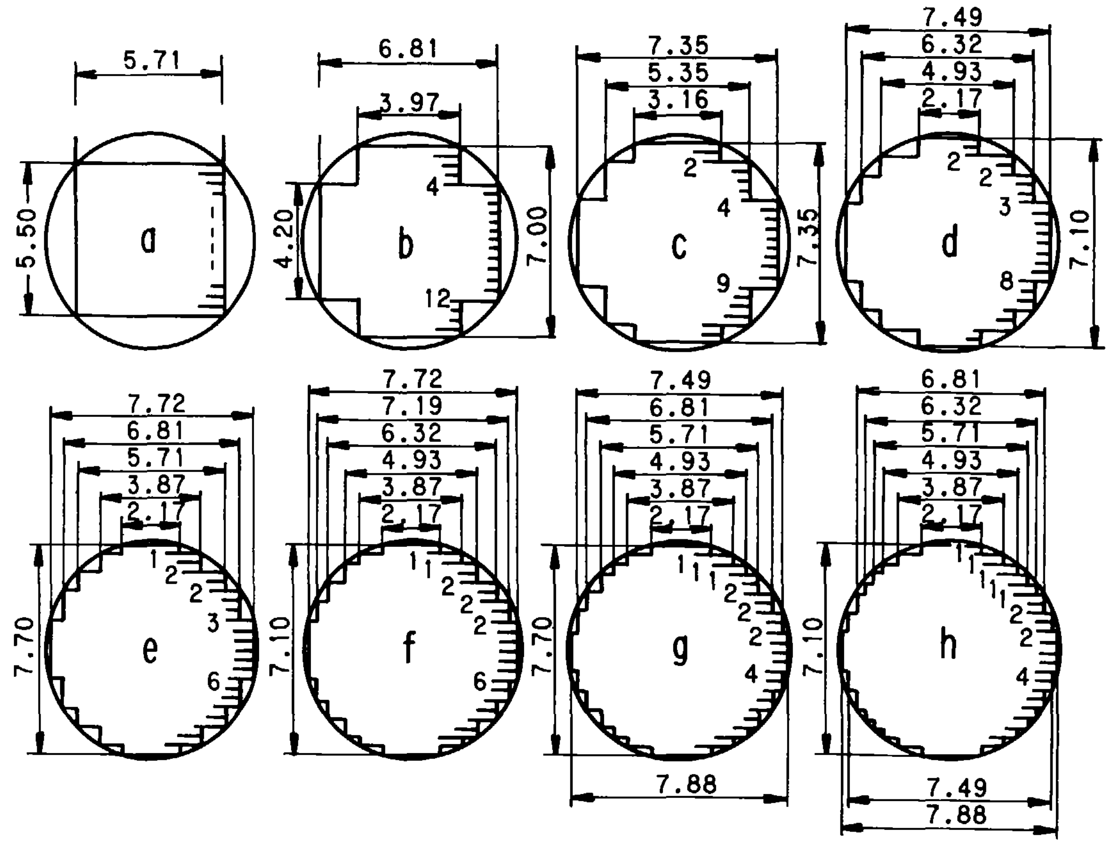
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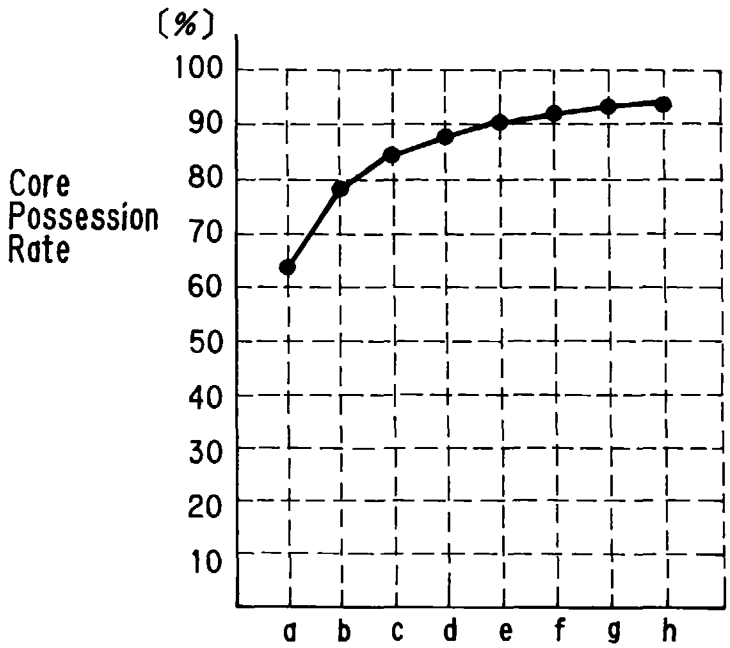
FIG.10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EUROPEAN SEARCH REPORT

Application Number
EP 96 12 0613

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)
X	GB 2 130 806 A (BOSCH GMBH ROBERT) 6 June 1984	1	H01T13/44 H01F38/12
Y	* page 1, line 31 - line 79; figure 2 *	2	
Y	US 3 137 832 A (GENERAL ELECTRIC CIE) 16 June 1964	2	
A	* column 8, line 42 - line 73; figure 14 *	3	
A	US 2 632 132 A (DELANO) 17 March 1953 * figure 4 *	4	
P,X	EP 0 716 436 A (NIPPONDENSO) 12 June 1996 * the whole document *	1	
A	DE 27 45 990 A (BOSCH GMBH ROBERT) 19 April 1979		
D,A	& JP 05 463 317 A		

TECHNICAL FIELDS SEARCHED (Int.Cl.6)
H01T
H01F
F02P

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	20 March 1997	Bijn, E

CATEGORY OF CITED DOCUMENTS

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