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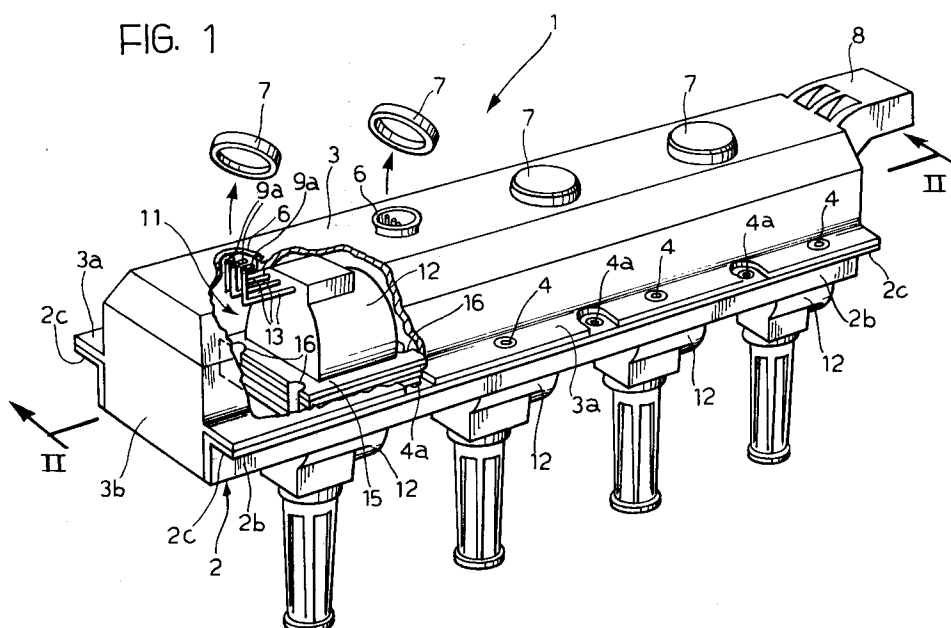
54 A plug-top coil-ignition unit for an internal combustion engine.

⑤⑦ The unit includes:

- n "plug-top" ignition coils (11),
- a metal, channel-shaped support element (2) with a plurality of holes (10) in its base wall (2a), each coil (11) being fixed to the base wall (2a) of the channel-shaped element (2) so as to extend partially through a hole (10) in the

element with its respective appendage (17) for connection to the plug extending beyond the base wall (2a), and

- a cover (3) of electrically insulating material which is connected to the channel-shaped support element (2) and carries conductors (9) connected to the coils (11).



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The present invention relates to a plug-top coil-ignition unit for a multi-cylinder combustion engine.

The ignition unit according to the invention is characterized in that it includes:

a plurality of so-called plug-top ignition coils each including an ignition transformer housed in an insulating casing from which input terminals and at least one output terminal extend at opposite ends, the at least one output terminal being connected to electrical connection means carried by a tubular appendage of insulating material which is connected to the casing of the coil and is adapted to be fitted directly onto a spark plug,

a channel-shaped metal support element the base wall of which has a plurality of holes which are narrower than the widest portions of the coils, each coil being fixed to the base wall of the channel-shaped support element so as to extend partially through an associated hole therein, with its appendage for connection to the plug extending beyond the base wall, and

a cover of electrically-insulating material, which is connected to the channel-shaped support element, has a plurality of holes with removable closure elements, and carries a plurality of conductors which extend between an electrical connector on the cover and the holes, some of the conductors being connected to the input terminals of one of the ignition coils in correspondence with each hole.

Further characteristics and the advantages of the ignition unit according to the invention will become clear from the detailed description which follows with reference to the appended drawings, provided purely by way of non-limiting example, in which:

Figure 1 is a perspective view of a coil ignition unit according to the invention,

Figure 2 is a longitudinal section taken on the line II-II of Figure 1,

Figure 3 is a cross-section taken on the line III-III of Figure 2,

Figure 4 is a plan view of an embodiment of a set of electrical conductors used for supplying the coils and their connection to an external electronic control unit,

Figure 5 is a transparent view of the cover of the ignition unit from above showing the electrical conductors comoulded in the cover,

Figure 6 is a transparent view of the cover from above, showing a set of electrical conductors fixed to the cover, and

Figure 7 is a side view of a connector fixed to the cover of the ignition unit for connecting it to the electronic control unit.

The drawings show, by way of example, an ignition unit according to the invention for a four-cylinder internal combustion engine. The unit, generally indicated 1, includes a casing formed by a

channel-shaped support element 2 made of metal and by a cover 3 of electrically-insulating material connected to the support element 2.

In the embodiment shown, the channel-shaped element 2 has a substantially flat base wall 2a and two side walls or panels each of which has a portion 2b which is perpendicular to the base wall and a portion 2c which is bent so as to be horizontal and coplanar with the corresponding portion of the other side wall of the shaped element.

The cover 3 is substantially tank-shaped and its longitudinal side walls have respective coplanar flanges 3a which bear on the portions 2c of the side walls of the channel-shaped element 2.

The end walls of the cover 3 have respective extensions, indicated 3b in Figure 1, which close the ends of the channel-shaped element 2.

As shown by way of (non-limiting) example in Figures 1 and 3, the channel-shaped element 2 and the cover 3 are interconnected by rivets 4 which, in the embodiment illustrated, are constituted by tubular elements which are integral with the appendages or flanges 2c of the channel-shaped element 2 and extend through corresponding holes in the flanges 3a of the cover 3 and are then clenched onto the flanges.

The top wall of the cover 3 has four holes 5 surrounded by respective collars 6 for retaining corresponding removable closure elements 7.

An end appendage of the cover 3, shaped like the body of an electrical connector, is indicated 8.

This appendage may be formed as a separate part, as shown in Figure 7, having appendages or pins 8a which can be upset ultrasonically to fix it to the cover 3.

A plurality of electrical terminals, for example, of the flat pin type, which are not visible in the drawings but are of known type, extend in the connector appendage 8 of the cover 3. Conveniently, these terminals are integral with or at any rate connected to conductors 9 which are incorporated in the top wall of the cover 3 and have projecting ends (indicated 9a in Figures 1 and 2) which extend through the holes 5 in the cover.

The base wall 2a of the channel-shaped element 2 has four holes, indicated 10 in Figure 2.

4 ignition coils, each generally indicated 11 in the drawings, are mounted in the casing formed by the channel-shaped element 2 and the associated cover 3. Each coil is substantially of the type described in British patent application GB-A-2 231 729 in the name of the present Applicant. Each coil includes, in known manner, an insulating casing 12, which houses the primary and secondary windings of an ignition transformer and from which input terminals 13 and an output terminal 14 (only one of which is shown in broken outline in Figure 2) extend at opposite ends.

Each ignition coil 11 includes a magnetic core constituted by a pack of plates 15 which extend substantially around the casing 12.

Each coil 11 and, in particular, its pack of plates 15 is wider than each hole 10 in the base wall of the channel-shaped element 2. Each coil 11 is thus positioned with most of its casing 12 between the channel-shaped element 2 and the cover 3 but with part of its casing extending downwardly through a hole 10 in the channel-shaped element 2.

Adjacent each hole 10, the channel-shaped support element 2 has integral fixing appendages 16 which are turned over onto the pack of plates 15 of the associated ignition coil 11 (see in particular Figures 1 and 2).

The ignition coils 11 are of the so-called plug-top type and are intended to be fitted directly onto respective spark plugs of the internal combustion engine. Accordingly, as described in British patent application GB-A-2 231 729, electrical connecting elements are connected to the output terminal 14 of each coil and are housed in a flexible tubular appendage 17 of electrically insulating material, such as an elastomeric material, connected to the portion of the casing 12 of the coil 11 which projects from the channel-shaped element 2.

The flexible tubular appendages 17 of the coils 11 are intended to be fitted in corresponding recesses in the internal combustion engine and their distal ends are intended to fit onto the ends of the corresponding plugs the central electrodes of which are thus connected to the output terminals 14 of the associated ignition coils 11.

In Figure 2, the end portions of the spark plugs have been shown in broken outline in the condition of use, in which the flexible tubular appendages 17 of the ignition coils are fitted thereon.

The input terminals 13 of each coil 11 are bent upwardly and are welded in order, for example by resistance welding, to the corresponding ends 9a of the conductors 9 which are incorporated in the top wall of the cover 3.

In use, the connector 8 is connected to the outputs of an ignition control unit which can drive the ignition coils 11 selectively by means of the conductors incorporated in the cover 3.

The base wall 2a of the channel-shaped element 2 conveniently has further holes, indicated 18 in Figure 2, for the passage of members of the internal combustion engine.

The flanges 2c of the channel-shaped element 2 have holes 4a in which the members for fixing the ignition unit to the internal combustion engine can be inserted.

The ignition coils 11 and their associated connecting appendages 17 are conveniently produced as preassembled units.

The entire unit described above can thus be

assembled extremely quickly, easily, and above all, completely automatically, for example by means of electronically-controlled assembly machines. In fact, as can easily be seen, the assembly involves first of all the positioning of the coils 11 in the holes in the base wall of the channel-shaped support element 2 and the turning-over of the appendages 16 of the channel-shaped element to anchor the coils 11 and the cover 3 and the channel-shaped support element 2 are then riveted together. The input terminals 13 of the coils 11 can be welded to the corresponding ends 9a of the conductors carried by the cover 3 through the holes 5 in the top wall of the cover 3. Upon completion of the welding, the holes in the top of the cover 3 are closed by the fitting of the removable closure elements or plugs 7.

The extremely simple structure of the ignition unit described above also facilitates operations, when the need arises, to check the functioning of the ignition coils after a certain period of use.

The channel-shaped element 2 and the conductors 9 of the cover together form a screen against radio interference generated by the coils in operation.

In the foregoing description and in the appended drawings, the conductors carried by the cover 3 are constituted by metal members incorporated in its top wall. In a variant, however, the conductors could be constituted by pre-blanked and bent metal elements fitted on the underside of the top wall of the cover 3 and retained thereon by conventional retaining members such as engagement teeth or appendages integral with the wall which are upset over the conductor members, etc.

Figure 4 shows in plan, by way of example, a conductor structure formed by blanking for incorporation (co-moulding) in the cover 3. The structure includes the conductors 9 with respective appendages 9a for connection to the coils and ends 9b which are intended to extend through the connector 8 shown in Figures 2 and 7. The structure shown in Figure 4 also has bridges 9c which connect the various conductors 9 and hold the structure together until it has been incorporated in the cover 3, after which the bridges are removed so that the conductors 9 are electrically separated.

Figure 5 is a transparent view of the cover 3 from above showing the conductor structure 9 incorporated therein. In particular, Figure 5 shows the terminals 9a and 9b of the conductors 9 and the bridges 9c which are accessible through the holes 5 and 5a from both sides of the cover 3 so that the bridges can be cut off and removed. The terminals 9a are shown in broken outline in their initial positions, in which they are coplanar with the conductors 9; after the conductor structure has been incorporated in the cover, the terminals 9a are bent so

as to be substantially parallel to the axes of the holes 5 for subsequent connection to the terminals of the coils.

Figure 6 shows an embodiment of the cover 3 in which a conductor structure similar to that shown in Figure 4 is anchored by the upsetting (for example, by ultrasound) of pins or appendages which are integral with the cover and are inserted through corresponding holes in the conductors 9. The upset appendages are indicated 3g in Figure 6.

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

In particular, the invention is not limited to the number and arrangement of coils shown in the drawings but these may differ according to the number of cylinders in the combustion engine for which the ignition unit is intended.

Claims

1. A coil-ignition unit for a multi-cylinder internal combustion engine, characterised in that it includes:

a plurality of so-called plug-top ignition coils (11) each including an ignition transformer housed in an insulating casing (12), from which input terminals (13) and at least one output terminal (14) extend at opposite ends, the at least one output terminal being connected to electrical connection means carried by a tubular appendage (17) of insulating material which is connected to the casing (12) of the coil (11) and is adapted to be fitted directly onto a spark plug,

a channel-shaped metal support element (2) the base wall (2a) of which has a plurality of holes (10) which are narrower than the widest portions of the coils (11), each coil (11) being fixed to the base wall (2a) of the channel-shaped support element (2) so as to extend partially through an associated hole (10) therein, with its appendage (17) for connection to the plug extending beyond the base wall (2a), and

a cover (3) of electrically-insulating material, which is connected to the channel-shaped support element (2), has a plurality of holes (5, 6) with removable closure elements (7), and carries a plurality of conductors (9) which extend between an electrical connector (8) on the cover (3) and the holes (5, 6), some of the con-

ductors (9) being connected to the input terminals (13) of one of the ignition coils (11) in correspondence with each hole.

2. An ignition coil according to Claim 1, characterised in that the plurality of conductors (9) is formed in one piece by blanking from a sheet or strip of conductive material, particularly brass.
3. An ignition unit according to Claim 2, characterised in that the plurality of conductors (9) is formed by a structure (Fig. 4) in which the conductors are interconnected by bridges (9c) integral therewith, the bridges (9c) being removed after the structure has been mounted in the cover (3).
4. An ignition unit according to Claim 2 or Claim 3, characterised in that the conductors (9) of the conductor structure have respective ends (9b) which extend through the electrical connector (8) to enable the coils (11) to be operated in use.
5. An ignition unit according to any one of the preceding claims, characterised in that, adjacent each hole (10), the channel-shaped support element (2) has integral anchoring appendages (16) which are turned over onto the associated ignition coil (11).
6. An ignition unit according to Claim 5, characterised in that the conductors (9) are incorporated in the cover (3) and their ends (9) project into the holes (5, 6) therein (3).
7. An ignition unit according to Claim 6, characterised in that the cover (3) has holes (5, 5a) for affording access from outside from opposite sides so that the bridges (9c) can be cut off and the portions (9a) of the conductors (9) can be bent.
8. An ignition unit according to Claim 7, characterised in that the end portions (9a) of the conductors (9) are bent so as to be substantially parallel to the axes of the corresponding holes (5) in the cover (3).
9. An ignition unit according to any one of Claims 1 to 5, characterised in that the conductors are fixed to the underside or internal surface of the cover (3).
10. An ignition unit according to any one of the preceding claims, characterised in that the input terminals (13) of the ignition coils (11) are

connected to ends of the conductors (9) carried by the cover (3) by welding which is effected through the holes (5, 6) in the cover (3).

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- 11.** An ignition unit according to any one of the preceding claims, characterised in that the channel-shaped element (2) and the set of conductors (9) together form a screen against radio interference generated by the coils (11) in operation.

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- 12.** An ignition unit according to any one of the preceding claims, characterised in that the channel-shaped support element (2) and the cover (3) are interconnected by rivets (4) or the like.

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- 13.** An ignition unit according to any one of the preceding claims, characterised in that the channel-shaped support element (2) has a second plurality of holes (18) for the passage of members of the internal combustion engine.

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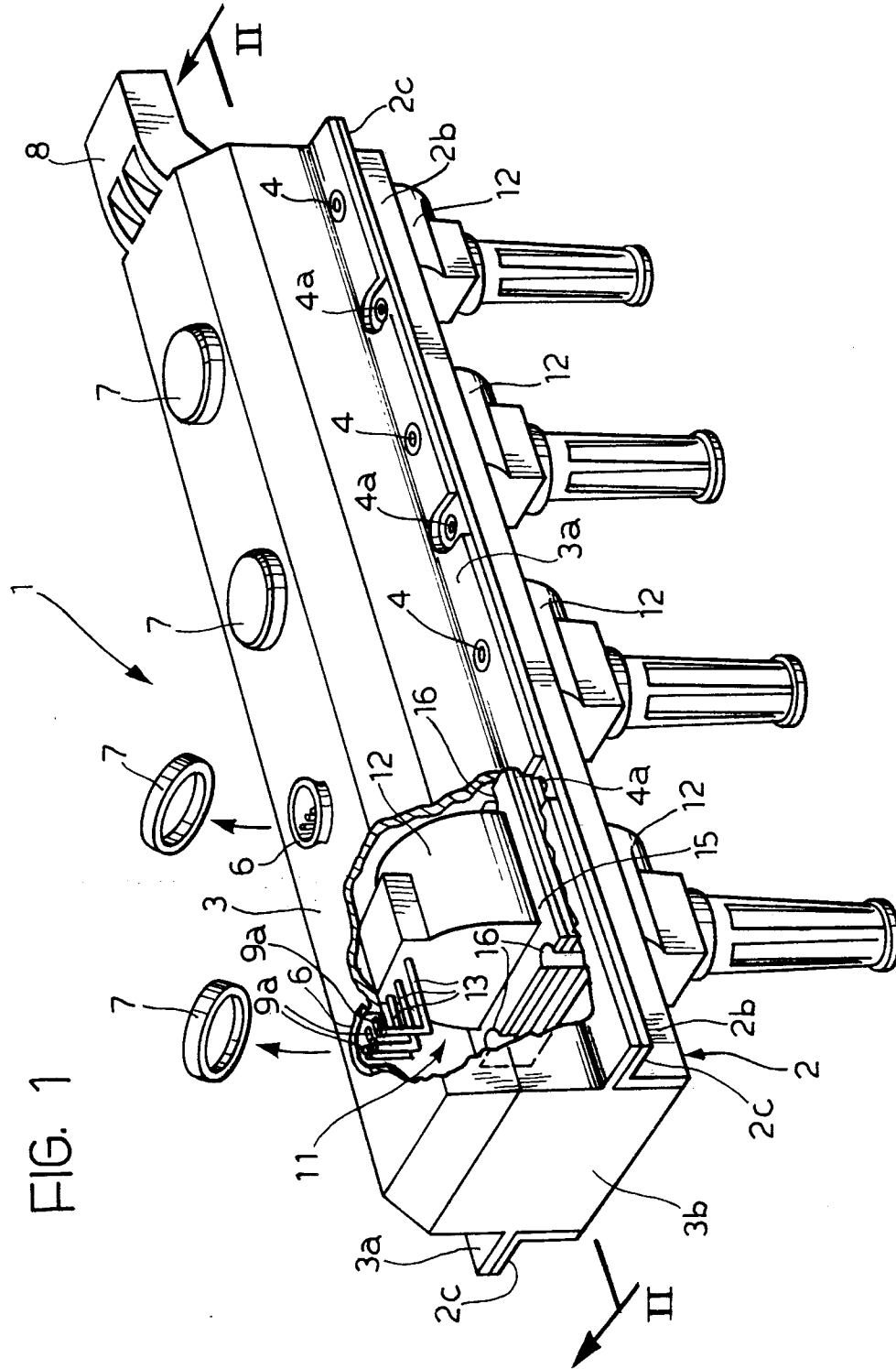


FIG. 2

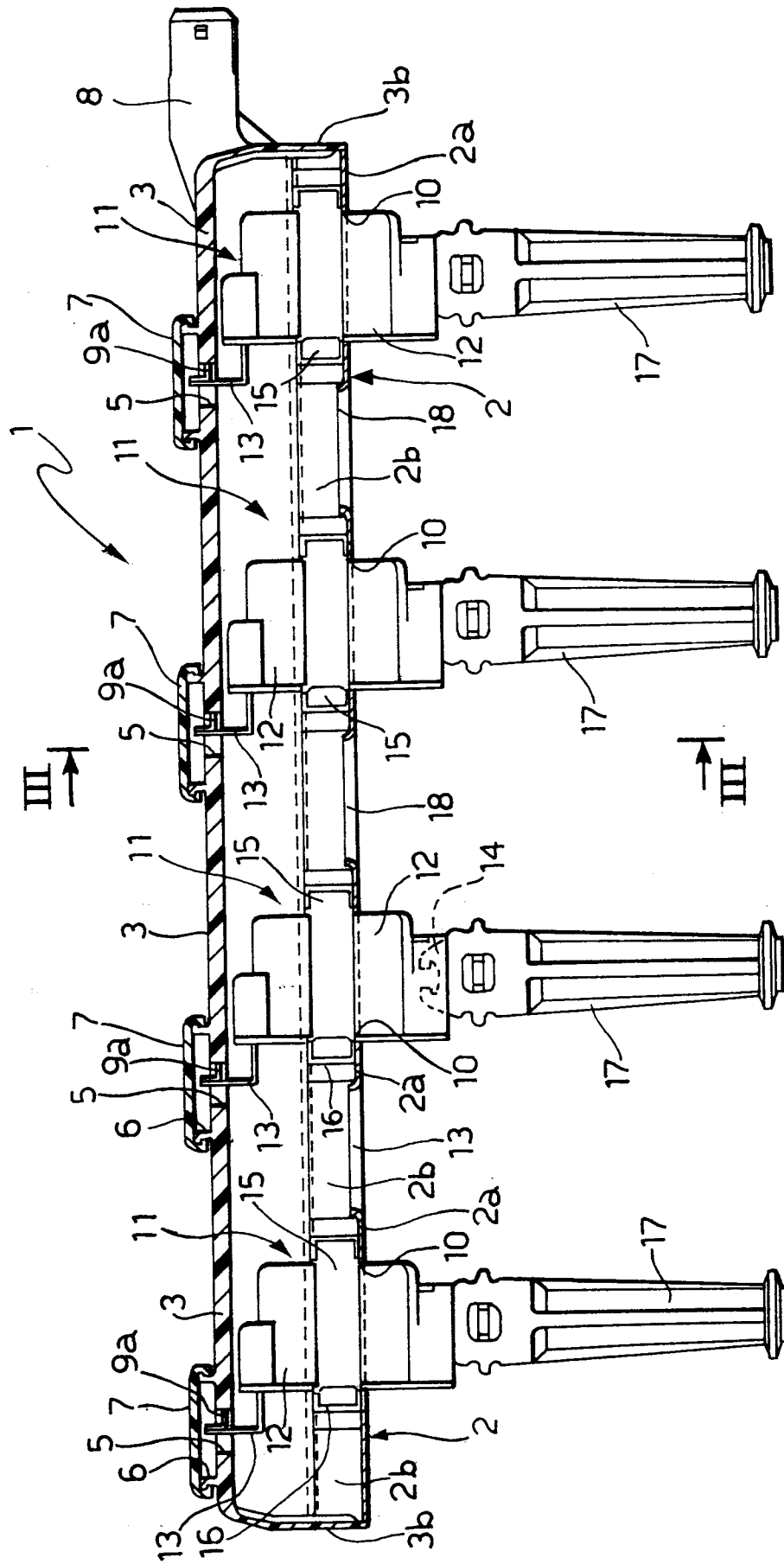


FIG. 3

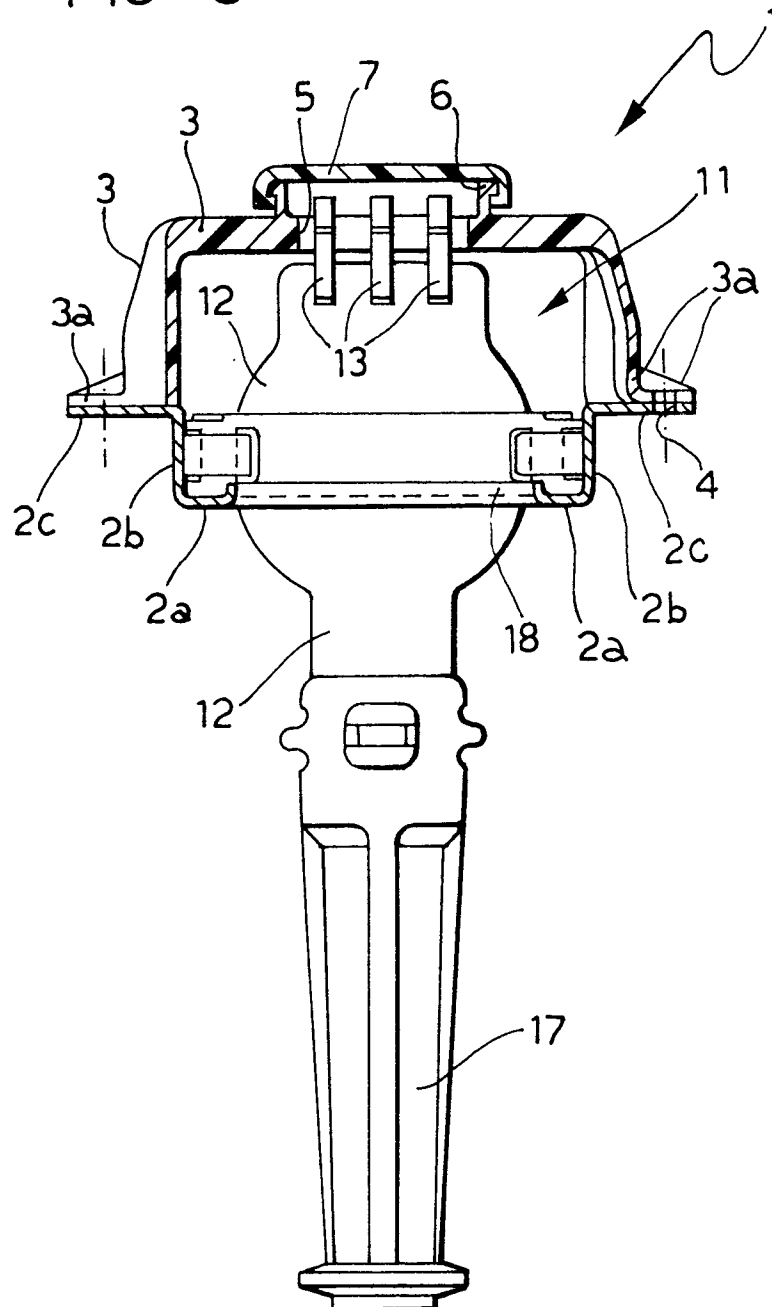


FIG. 4

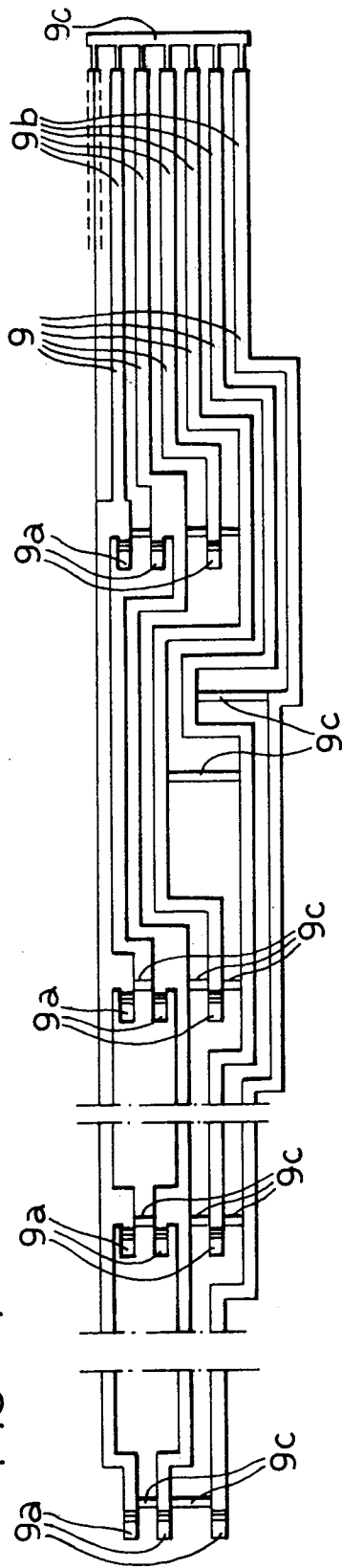


FIG. 5

