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(54) **A plug-top coil-ignition unit for an internal combustion engine**

Zündeinheit für eine Brennkraftmaschine

Bobine d'allumage placée sur le haut d'une bougie pour un moteur à combustion interne

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EP-A- 0 340 083 **WO-A-84/00402**
US-A- 4 706 639

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Description

The present invention relates to a coil-ignition unit for a multi-cylinder internal combustion engine comprising 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, and a coil support including a base wall with a plurality of holes each associated with one of the coils, through which holes the appendages for connection to the plugs extend beyond the base wall.

PCT patent application WO-A-84/00402 relates to a coil-ignition unit of the type specified above, in which the support for the coils comprises a metal casing with two side panels fixing the coils and an aluminium top portion carrying an electronic circuit for controlling the coils. The circuit is encapsulated in a plastic body and the input terminals of the coils comprise medium voltage cables connected with the encapsulated circuit. A unit of this type is difficult to assemble.

United States patent US-A-4 706 639 relates to an ignition module comprising a plastic housing and a metallic cover. A plurality of ignition coils are clamped between the housing and the cover. The lower wall of the housing has high voltage conductors embedded therein for connection with tubular members which are adapted to slip onto the spark plugs of the engine. The output terminals of each coil are electrically connected to two spark plug connector members. A module of this type may be subject to drawbacks in the insulation of the embedded conductors.

The object of the present invention is to provide an improved plug-top coil-ignition unit of the above-specified kind.

According to the invention, this object is achieved by means of a coil-ignition unit of the aforesaid type, which is characterized in that

the coil support comprises a channel-shaped metal support element, the holes of which are narrower than the widest portions of the coils, and each coil is fixed to the base wall of the channel-shaped support element so as to extend partially through an associated hole therein, the coil-ignition unit further including:

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, each hole in the cover being associated with a coil and the conductors being connected to the input terminals of the ignition coils at

the associated holes.

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 pre-assembled 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 as defined in the claims.

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 comprising

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 (14) 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, and

a coil support (2) including a base wall (2a) with a plurality of holes (10) each associated with one of the coils (11), through which holes the appendages (17) for connection to the plugs extend beyond the base wall (2a),

characterised in that the coil support comprises a channel-shaped metal support element (2), the holes (10) of the base wall (2a) are narrower than the widest portions of the coils (11), and each coil (11) is fixed to the base wall (2a) of the channel-shaped support element (2) so as to extend partially through an associated hole (10) therein, the coil-ignition unit further including:

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 and the holes (5, 6), each hole (5, 6) in the cover (3) being associated with a coil (11) and the conductors (9) being connected to the input terminals (13) of the ignition coils (11) at the associated holes (5, 6).

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 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.
4. 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).
5. An ignition unit according to Claim 4, characterised in that the conductors (9) are incorporated in the cover (3) and their ends (9) project into the holes (5, 6) therein (3).
6. An ignition unit according to Claim 5, characterised in that the said ends (9) have a bent portion (9a)

and wherein the said holes (5, 5a) in the cover afford access from outside from opposite sides to the said bent portions (9a).

7. An ignition unit according to Claim 6, 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). 5
8. An ignition unit according to any one of Claims 1 to 4, characterised in that the conductors are fixed to the underside or internal surface of the cover (3). 10
9. 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). 15
10. 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. 20
11. 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. 25

Patentansprüche

1. Spulenzündeinheit für einen Mehrzylinder-Verbrennungsmotor, die umfaßt: 35

eine Vielzahl sogenannter Kopfzündspulen (11), die jeweils einen Zündtransformator enthalten, der in einer isolierenden Ummantelung (12) aufgenommen ist, von der aus sich Eingangsanschlüsse (13) und wenigstens ein Ausgangsanschluß (14) an entgegengesetzten Enden erstrecken, wobei der wenigstens eine Ausgangsanschluß (14) mit einer elektrischen Verbindungseinrichtung verbunden ist, die von einer röhrenförmigen Verlängerung (17) aus isolierendem Material getragen wird, die mit der Ummantelung (12) der Spule (11) verbunden ist und direkt auf eine Zündkerze gepaßt wird, und 40

einen Spulenträger (12), der eine Bodenwand (2a) mit einer Vielzahl von Löchern (10) enthält, die jeweils zu einer der Spulen (11) gehören, wobei sich durch diese Löcher die Verlängerungen (17) zur Verbindung mit den Zündkerzen über die Bodenwand (2a) hinaus erstrecken, 45

dadurch gekennzeichnet, daß der Spulenträger ein rinnenförmiges Trägerelement (2) aus Metall umfaßt, wobei die Löcher (10) der Bodenwand (2a) kleiner sind als die breitesten Abschnitte der Spulen (11), und jede Spule (11) an der Bodenwand (2a) des rinnenförmigen Trägerelementes (2) so befestigt ist, daß sie sich teilweise durch ein dazugehöriges Loch (10) darin erstreckt, wobei die Spulenzündeinheit weiterhin enthält:

eine Abdeckung (3) aus elektrisch isolierendem Material, die mit dem rinnenförmigen Trägerelement (2) verbunden ist, eine Vielzahl von Löchern (5,6) mit entfernbaren Verschlußelementen (7) aufweist und eine Vielzahl von Leitern (9) trägt, die sich zwischen einem elektrischen Verbinder (8) an der Abdeckung und den Löchern (5, 6) erstrecken, wobei jedes Loch (5, 6) in der Abdeckung (3) zu einer Spule (11) gehört, und die Leiter (9) mit den Eingangsanschlüssen (13) der Zündspulen (11) an den zugehörigen Löchern (5, 6) verbunden sind.

2. Zündspule nach Anspruch 1, **dadurch gekennzeichnet**, daß die Vielzahl von Leitern (9) in einem Stück durch Ausstanzen aus einem Blech oder einem Streifen leitenden Materials, insbesondere Messing, hergestellt wird. 30
3. Zündeinheit nach Anspruch 2, **dadurch gekennzeichnet**, daß die Leiter (9) der Leiterstruktur entsprechende Enden (9b) aufweisen, die sich durch den elektrischen Verbinder (8) hindurch erstrecken, um die Spulen (11) in Funktion betreiben zu können.
4. Zündeinheit nach einem der vorangehenden Ansprüche, **dadurch gekennzeichnet**, daß an jedes Loch (10) angrenzend das rinnenförmige Trägerelement (2) integrale Befestigungsverlängerungen (16) aufweist, die auf die zugehörige Zündspule (11) umgebogen werden.
5. Zündeinheit nach Anspruch 4, **dadurch gekennzeichnet**, daß die Leiter (9) in die Abdeckung (3) integriert sind, und ihre Enden (9) in die Löcher (5, 6) darin (3) vorstehen.
6. Zündeinheit nach Anspruch 5, **dadurch gekennzeichnet**, daß die Enden (9) einen gebogenen Abschnitt (9a) aufweisen, wobei die Löcher (5, 5a) in der Abdeckung Zugang zu den gebogenen Abschnitten (9a) von außen von einander gegenüberliegenden Seiten ermöglichen.
7. Zündeinheit nach Anspruch 6, **dadurch gekennzeichnet**, daß die Endabschnitte (9a) der Leiter (9) so gebogen sind, daß sie im wesentlichen parallel

zu den Achsen der entsprechenden Löcher (5) in der Abdeckung (3) sind.

8. Zündeinheit nach einem der Ansprüche 1 bis 4, **dadurch gekennzeichnet**, daß die Leiter an der Unterseite bzw. der Innenfläche der Abdeckung (3) befestigt sind.

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9. Zündeinheit nach einem der vorangehenden Ansprüche, **dadurch gekennzeichnet**, daß die Eingangsanschlüsse (13) der Zündspulen (11) mit Enden der Leiter (9), die von der Abdeckung (3) getragen werden, durch Schweißen verbunden sind, das durch die Löcher (5, 6) in der Abdeckung (3) hindurch ausgeführt wird.

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10. Zündeinheit nach einem der vorangehenden Ansprüche, **dadurch gekennzeichnet**, daß das rinnenförmige Trägerelement (2) und die Abdeckung (3) durch Nieten (4) oder dergleichen miteinander verbunden sind.

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11. Zündeinheit nach einem der vorangehenden Ansprüche, **dadurch gekennzeichnet**, daß das rinnenförmige Trägerelement (2) eine zweite Vielzahl von Löchern (18) für den Durchtritt von Elementen des Verbrennungsmotors aufweist.

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Revendications

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1. Ensemble de bobines d'allumage pour moteur à combustion interne à plusieurs cylindres, comportant :

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plusieurs bobines d'allumage (11) dites sur le haut d'une bougie, comportant chacune un transformateur d'allumage reçu dans un boîtier isolant (12), à partir duquel des bornes d'entrée (13) et au moins une borne de sortie (14) s'étendent au niveau des extrémités opposées, la au moins une borne de sortie (14) étant reliée à des moyens de liaison électrique supportés par un prolongement tubulaire (17) constitué de matériau isolant qui est relié au boîtier (12) de la bobine (11) et est adapté pour être agencé directement sur une bougie, et un support de bobines (2) comportant une paroi de base (2a) ayant plusieurs trous (10) associés chacun avec une des bobines (11), trous à travers lesquels les prolongements (17) de liaison aux bougies s'étendent au-delà de la paroi de base (2a), caractérisé en ce que le support de bobines comporte un élément de support (2) métallique en forme de canal, les trous (10) de la paroi de base (2a) sont plus étroits que les parties les plus larges des bobines (11), et chaque bobine

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(11) est fixée sur la paroi de base (2a) de l'élément de support (2) en forme de canal de manière à s'étendre partiellement à travers un trou associé (10) situé dans celle-ci, l'ensemble de bobines d'allumage comportant en outre : un couvercle (3) constitué de matériau électriquement isolant, qui est relié à l'élément de support (2) en forme de canal, comporte plusieurs trous (5, 6) munis d'éléments de fermeture amovible (7) et supporte plusieurs conducteurs (9) qui s'étendent entre un connecteur électrique (8) situé sur le couvercle et les trous (5, 6), chaque trou (5, 6) du couvercle (3) étant associé à une bobine (11) et les conducteurs (9) étant reliés aux bornes d'entrée (13) des bobines d'allumage (11) au niveau des trous associés (5, 6).

2. Bobine d'allumage selon la revendication 1, caractérisée en ce que les plusieurs conducteurs (9) sont formés en une seule pièce par une ébauche réalisée à partir d'une feuille ou d'une bande de matériau conducteur, en particulier du laiton.

3. Ensemble d'allumage selon la revendication 2, caractérisé en ce que les conducteurs (9) de la structure conductrice ont des extrémités respectives (9b) qui s'étendent à travers le connecteur électrique (8) pour permettre aux bobines (11) d'être actionnées en utilisation.

4. Ensemble d'allumage selon l'une quelconque des revendications précédentes, caractérisé en ce que l'élément de support (2) en forme de canal comporte des prolongements d'ancrage venus de matière (16), adjacents à chaque trou (10), qui sont retournés sur la bobine d'allumage associée (11).

5. Ensemble d'allumage selon la revendication 4, caractérisé en ce que les conducteurs (9) sont incorporés dans le couvercle (3) et leurs extrémités (9) font saillie à l'intérieur des trous (5, 6) agencés dans celui-ci (3).

6. Ensemble d'allumage selon la revendication 5, caractérisé en ce que lesdites extrémités (9) ont une partie incurvée (9a) et dans lequel lesdits trous (5, 5a) du couvercle permettent l'accès à partir de l'extérieur, à partir de côtés opposés, auxdites parties incurvées (9a).

7. Ensemble d'allumage selon la revendication 6, caractérisé en ce que les parties d'extrémité (9a) des conducteurs (9) sont incurvées de manière à être pratiquement parallèles aux axes des trous correspondants (5) du couvercle (3).

8. Ensemble d'allumage selon l'une quelconque des

revendications 1 à 4, caractérisé en ce que les conducteurs sont fixés sur le côté inférieur, ou surface intérieure du couvercle (3).

9. Ensemble d'allumage selon l'une quelconque des revendications précédentes, caractérisé en ce que les bornes d'entrée (13) des bobines d'allumage (11) sont reliées aux extrémités des conducteurs (9) supportés par le couvercle (3) par une soudure qui est effectuée à travers les trous (5, 6) du couvercle (3). 5 10
10. Ensemble d'allumage selon l'une quelconque des revendications précédentes, caractérisé en ce que l'élément de support (2) en forme de canal et le couvercle (3) sont reliés mutuellement par des rivets (4) ou analogue. 15
11. Ensemble d'allumage selon l'une quelconque des revendications précédentes, caractérisé en ce que l'élément de support (2) en forme de canal a plusieurs seconds trous (18) destinés au passage d'éléments du moteur à combustion interne. 20

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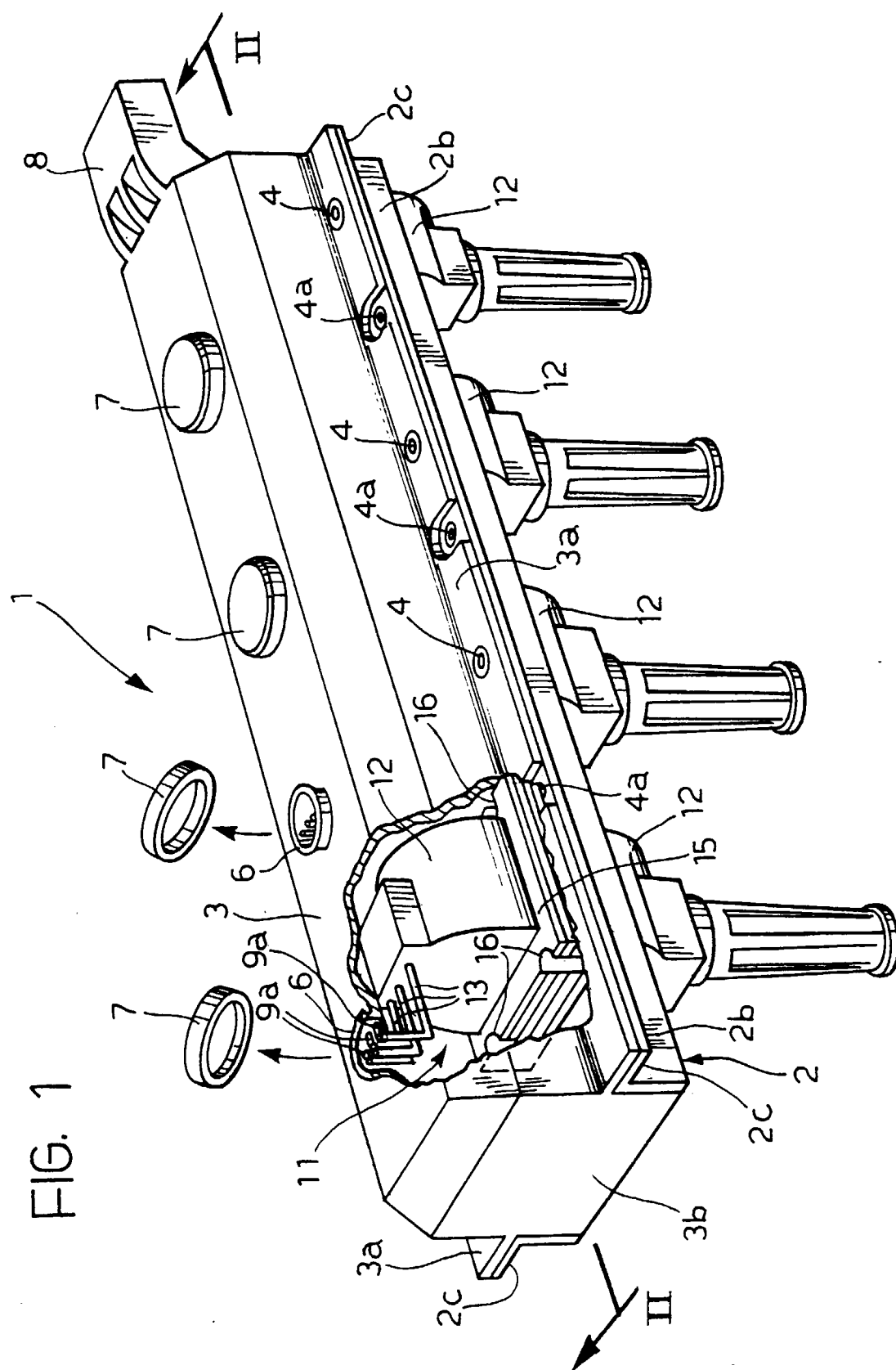
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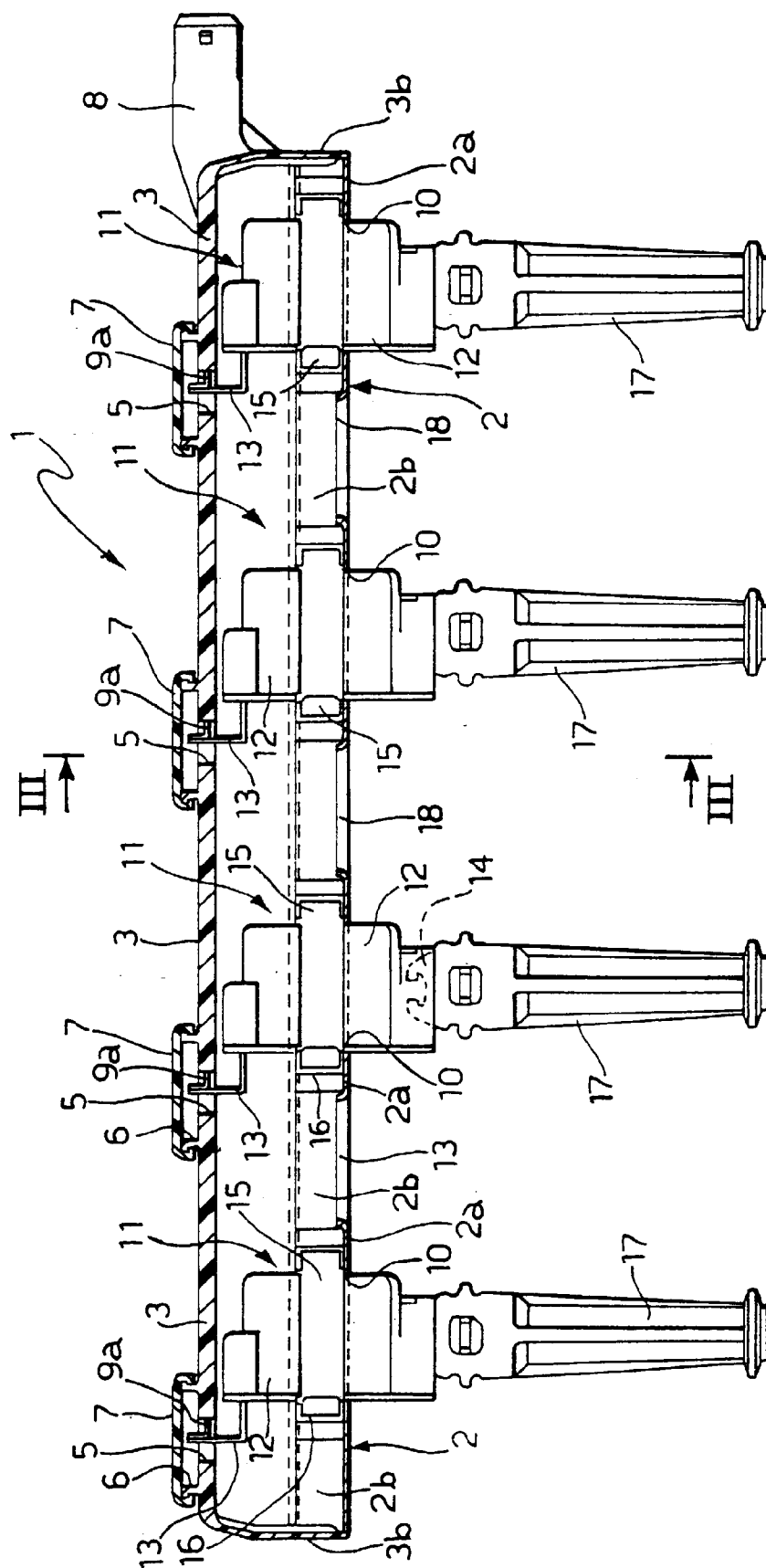


Fig. 2

FIG. 3

