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CA 2189382 C 2005/04/05

(11)(21) 2 189 382

(12) BREVET CANADIEN
CANADIAN PATENT

(13) C

(22) Date de dépôt/Filing Date: 1996/11/01

(41) Mise à la disp. pub./Open to Public Insp.: 1997/05/03

(45) Date de délivrance/Issue Date: 2005/04/05

(30) Priorité/Priority: 1995/11/02 (195 40 763.6) DE

(51) Cl.Int.^{6}/Int.Cl.^{6} F02F 7/00

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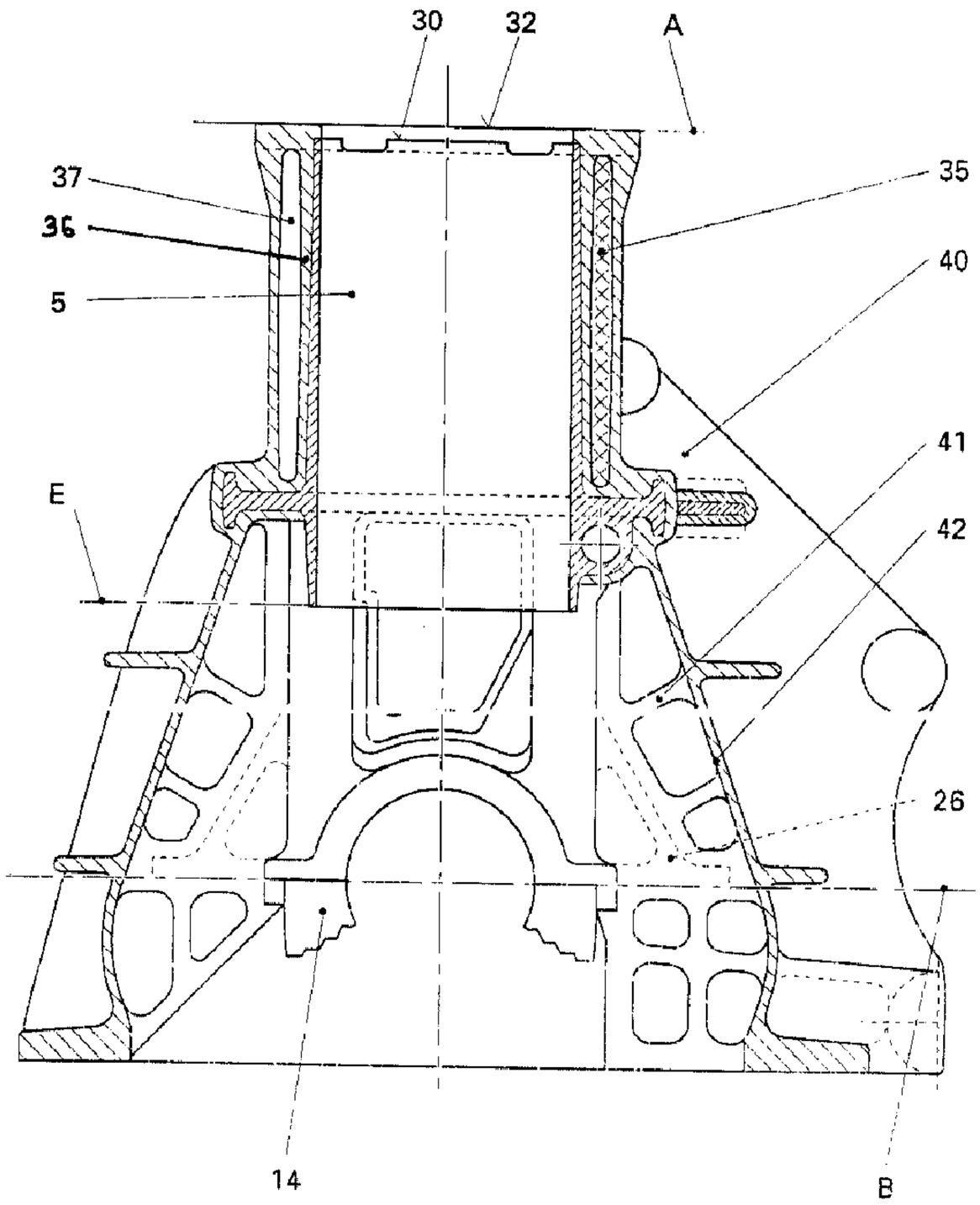
(54) Titre : CARTER POUR MACHINES A COMBUSTION A PISTONS
(54) Title: HOUSING FOR A CYLINDER-OPERATED COMBUSTION-POWERED MACHINE



(57) Abrégé/Abstract:
A housing for a piston-operated, combustion-powered machine includes an internal portion defining one or more cylinders. The internal portion has a deck upon which are formed threaded columns extending toward an upper connection plane. Partitions extend downward from the deck portion to a lower connection plane, and support bearing blocks for a crankshaft. An external

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(57) Abrégé(suite)/Abstract(continued):
portion is cast around the internal portion so as to provide spaces for cooling water and oil. The external portion is made of a different material from that of the internal portion. The internal portion integrally supports the cylinder liners, and hence constitutes a unit therewith.

ABSTRACT OF THE DISCLOSURE

A housing for a piston-operated, combustion-powered machine includes an internal portion defining one or more cylinders. The internal portion has a deck upon which are formed threaded columns extending toward an upper connection plane. Partitions extend downward from the deck portion to a lower connection plane, and support bearing blocks for a crankshaft. An external portion is cast around the internal portion so as to provide spaces for cooling water and oil. The external portion is made of a different material from that of the internal portion. The internal portion integrally supports the cylinder liners, and hence constitutes a unit therewith.

HOUSING FOR A CYLINDER-OPERATED COMBUSTION-POWERED MACHINE

The invention relates to a housing for a combustion-powered machine.

A housing of the relevant type is disclosed in German Patent Document No. DE-34 36 872 C2. This housing, for an in-line combustion-powered machine, incorporates an integral internal portion made of cast iron and common to all cylinders, with a cover-like base. Adjacent to the individual cylinders there are threaded columns extending between an upper connection plane supporting the cylinder head and a lower connection plane containing the longitudinal axis of the crankshaft.

The base disposed between these planes is closer to the lower connection plane and is surrounded, in the longitudinal direction of the combustion-powered machine, by side flanges located between the threaded columns and connected thereto. Between two threaded columns disposed in a transverse plane of the combustion-powered machine there is a partition extending from the base to the lower connection plane, which serves as a bearing support for the crankshaft.

Adjacent to each cylinder, the base supports a circular recess, with separate cylinder liners set into the recesses.

In order to attain a housing of the lightest possible weight, this inner portion is surrounded by a cast outer portion consisting of heat-resistance plastic, with the provision of recesses for carrying cooling water and oil.

From European Patent Document No. EP-0 067 890 A1 it is known to provide a housing for a multi-cylinder combustion-powered machine with side walls made of plastic. The housing is constructed essentially of an integrally formed metallic frame with cylinder liners, crankshaft bearings, a base and an upper closed deck, as well as front end lateral walls. This structure, open along its longitudinal sides, is then closed by way of separately constructed plastic side walls.

Furthermore, it is known from German Patent Document No. DE-43 06 269 A1, to split the housing for a multi-cylinder combustion-powered machine in such a way that an integrally constructed inner portion is screwed to an outer, trough-like housing cover, the inner portion consisting of a base having a circumferential flange on which are formed cylinder liners as well as partitions with crankshaft bearings.

Furthermore, Swiss Patent Document No. CH-428 319 discloses a piston housing made of aluminum, with separately installed cylinder liners, the side walls of which are constructed to include metal plates during the casting of the housing, for the purpose of minimizing noise.

Finally, from German Patent Document No. DE-OS 17 51 919 it is known to provide an integrally constructed cylinder block for a combustion-powered machine, with as-cast crankshaft bearings and integrally cast staybolts for securing the cylinder head, of which the outer shell is made by applying sheet metal or plastic shaped parts.

It is an object of the invention to provide, for a piston operated combustion-powered machine with an internal and an external portion, a housing of the above-described type which, during operation of the combustion-powered machine, is substantially free of deflection and as stiff as possible. Moreover, the housing is light in weight, and is provided with acoustic damping characteristics.

Accordingly, in one aspect of the present invention there is provided a housing for a piston-operated, combustion-powered machine with at least one integral metallic internal portion having cylinders, the internal portion having a deck portion and, formed thereon, threaded columns extending in the direction of an upper connection plane for a cylinder head, wherein partitions adjacent the cylinders extend in a perpendicular plane from said deck portion to a lower connection plane, the partitions having bearing blocks for a crankshaft, and having, cast around the internal portion, an external portion which is cast so as to surround the internal portion and so as to provide spaces for cooling water and oil, the external portion being of a different metal than the internal portion, and cylinder liners integrally formed with, and having the same material as the internal portion.

The important advantages of the invention are to be found in the fact that the internal portion also integrally provides the cylinder liners, thus avoiding the necessity of additional attachment locations. All noise-generating or noise-transmitting components of the internal portion are thus to be made of a material, for example a cast iron material, which provides advantageous damping characteristics.

The other important component of the housing, namely the external portion, can be made of a light metallic material in order to reduce the overall weight of the housing, e.g. from an aluminum or magnesium alloy, and thus display adequate strength to resist the forces and moments passing from the internal portion to the external portion and back; moreover, this construction is particularly appropriate for the operating conditions encountered in a combustion-powered machine, in particular the relatively high temperatures and the impingement of oil or water.

As an alternative, the external portion can achieve light weight by being made from plastic.

Advantageously, the threaded columns are spaced away from the cylinder liners, so that vibrations transferred through piston wall forces to the cylinder liners are not further transferred by the threaded columns. Likewise the vibrations arising in the connecting-rod assembly are kept away from the cylinder liners by means of

the threaded columns, due to the general force flux. Therefore the cylinder liners are protected from the force flux arising from the interchange of force between the cylinder head and the connecting-rod assembly, resulting in a low deflection level which has a positive effect on oil consumption, abrasion and blow-by gases.

In an advantageous embodiment, the threaded columns can extend from the deck all the way to the upper connection plane; alternatively, the threaded columns can be provided in a horizontally separate manner. For this, a portion of the inner component is arranged so as to extend from the deck in the direction of the upper connection plane, and has a length such that a thread can be provided, the second part of the threaded column being provided in the outer portion, and supported by directly abutting the part provided by the internal portion.

In an advantageous embodiment, the threaded columns, regardless of whether they are integral or made up of several parts, can be connected to the deck and the cylinder liners in the region of the deck, using stiffening bridges.

In order to attain an optimally rigid connection between the internal part and the external part, the deck, in a further embodiment, is provided around its outer periphery with a gripping region which is essentially enclosed, during pouring, by the material of the external portion. In order to optimally absorb longitudinal forces applied to the housing, for example by way of an end-located gear box, the gripping region can include a peripheral bead, which in a further embodiment can be arranged intermittently in the manner of teeth. In any case, this cover makes possible an unhindered, uniform force flux for such longitudinal forces, which in turn decreases distortion.

Furthermore, the cover can be provided in its zone between the external peripheral line and the cylinder liners, for the purpose of improved gripping, with openings passing through the material of the external portion.

Aside from the mentioned gripping provision in the region of the deck, this housing, in a further advantageous embodiment, can be provided with comparable gripping regions in its upper or lower connection surfaces. To this end, the bearing blocks for the crankshaft, lying in the region of the lower connecting plane, can have outwardly extending additional gripping regions, which for purposes of stiffening can be connected one after another in the longitudinal direction.

The upper end faces of the integral threaded columns and/or the cylinder liners directed toward the upper connection plane may also include a toothed structure running at right angles to the upper connection plane, for the purpose of improved gripping. When the internal and external portions are brought together, the said end region is fully enclosed in the material of the external portion, so that there will be available, in the region of the upper connection plane, a deck surface of integral material for further working. This is advantageous for the cutting tools to be used, and for the flow of turnings as well as the recycling of such turnings.

Basically, the housing can be arranged either as an open deck or a closed deck housing. Further, the housing can be fabricated using a die-cast molding, an iron mold or a sand mold.

During the process of casting the external portion around the internal portion, a water jacket core can be provided immediately outside the cylinder liners in order to create a cooling water jacket, thus making possible an optimal heat exchange.

Alternatively, the water jacket core can be positioned at a relatively small distance from the cylinder liners, so that the latter can be surrounded by a relatively thin layer of the material of the external portion, so as to create a closed, fluid-tight cavity for cooling water.

Preferably, bearing caps secured to the bearing blocks are made of the same material, preferably cast iron, as the internal portion. This facilitates the cutting of the bearings for the crankshaft, and results in the smallest possible amount of bearing play during operation of the combustion-powered machine. A further stiffening and noise-dampening can be attained by making the bearing caps in the form of an integral bearing bridge extending the length of the housing.

Generally, the invention offers the advantage of providing a low-deflection, rigid housing with very good running and dampening properties, while at the same time having a low weight. Not required is the otherwise commonly encountered expenditure for the additional compression or casting of individual cylinder liners, and the costly working of the cylindrical running surfaces, in connection with so-called light metal motors.

Furthermore, it is indicated that the housing, in the case of an in-line combustion-powered machine or that of a VR-motor with a plurality of cylinders,

includes one internal part, whereas a V-combustion-powered machine can have a particular internal part for each cylinder bank, such parts being captured together by the external portion when the latter is cast.

Further advantages of the invention will be evident from the following example embodiments, referring to the drawings. They show:

In FIG. 1 a plan view of an internal portion of a housing;

In FIG. 2 a side elevation of FIG. 1;

In FIG. 3 a view from below of an internal portion of a housing;

In FIG. 4 a section along the line IV-IV in FIG. 1;

In FIG. 5 a section along the line V-V in FIG. 1 through a housing;

In FIG. 6 a section along the line VI-VI in FIG. 1 through a housing;

In FIG. 7 a section along the line VII-VII in FIG. 1, through a housing;

In FIG. 8 a section through another example embodiment similar to FIG. 4;

and

In FIG. 9 a section through the revised example embodiment, similar to FIG. 5.

A combustion-powered machine has a housing which consists essentially of an internal portion shown generally at 1, and an external portion 2 which is cast around the internal portion.

The combustion-powered machine includes, along a longitudinal central plane L, cylinders 3 and 4 which include cylinder liners 5 and 6.

The internal portion 1 is made in one piece and homogeneously of cast iron, and consists primarily of the cylinder liners 5, 6, a deck portion 7 and threaded columns 8, as well as bearings 9 for a partition 10 which extends in a perpendicular plane Q adjacent the cylinders 3, 4, defining the crankshaft location.

In accordance with FIG. 2, the internal portion 1 extends essentially between an upper connection plane A for a non-illustrated cylinder head, and a lower connecting plane B. It should be pointed out that the expressions used in connection with this invention, such as upper and lower, refer merely to the drawing figures, and do not denote any limitation or restriction in connection with the possible installation position of the housing.

The threaded columns 8 extend from the deck portion 7 to the region of the

upper connection plane A, whereas the partitions 10 extend essentially from the deck portion 7 to the lower connection plane B.

The cylinder liners 5 extend in their lower region as far as a plane E lying between the deck portion 7 and the lower connection plane B.

The threaded columns 8 have receiving portions 11 as well as threads 12 for non-illustrated threaded members securing a cylinder head to the housing.

To either side of the bearing seat 9, in each partition 10, there is a threaded bore 13 for the securement of crankshaft bearing caps 14 which are made of the same cast iron material as the internal portion 1.

Threads 12 and threaded bores 13 can be aligned with each other axially, in order to improve the force flux; alternatively one can use a tie rod extending from the bearing caps 14 to the cylinder head.

An integral component of the internal portion 1, adjacent the deck portion 7, is a main oil channel 15 extending in the longitudinal direction, from which, for example, extend perpendicular channels 16 for feeding the bearings 9.

In order to attain a rigid connection, stiffening bridges 17 are cast between the threaded columns 8 and the cylinder liners 5,6 in the region of the deck portion 7. In the transverse plane Q lying between the cylinder 3 and 4, the partition 10 extends above the deck portion 7 in the direction of the upper connecting plane A, in such a way as to provide a cooling water passage 18.

In order to achieve a positive grip between the external portion and the internal portion in the transverse and longitudinal directions of the housing, the deck portion 7 includes a gripping region 20 around its external periphery, which is to a large extent enclosed by the external portion 2.

The gripping region 20 includes a lip 21 which, seen in cross-section, extends to both sides of the deck portion 7 and runs around the periphery of the deck portion 7, the lip having a dovetail form 22 as can be seen in Figure 2.

In order to increase the gripping effect, the deck portion 7, in accordance with FIG. 1, has openings 23 which are provided at the time of the casting of the external portion 2.

As a variation of the form of the deck portion 7 shown in the figures, the deck portion can be brought closer to the cylinder liners 5,6 or to the threaded columns 8,

and to that extent the less plate-like in form, as shown for example in FIG. 1.

A further gripping region 24 is provided in the bearing block 25 of the bearing 9, in the form of braces 26 provided with an opening. As shown on the right half of FIG. 3, the braces can be connected with one another by means of cast bridges 27 extending in the longitudinal direction of the housing.

In order to provide a good grip in the region of the upper attachment plane A, the cylinder liners 5,6 are provided with a tooth formation 28 involving as-cast recesses 29 in their ends 30 directed toward the plane A.

An identical grip can be provided for the corresponding ends 31 of the threaded columns 8.

These ends 30, 31 are completely enclosed by the material of the outer portion during casting, in accordance with FIGS. 5 and 6, so as to produce a deck surface 32 of uniform material which is directed toward the cylinder head.

During the casting of the outer portion around the inner portion 1, a water jacket core 35 can be provided at close spacing to the cylinder liners 5, 6, in such a way that the core is surrounded by a similarly thin layer 36.

As an alternative, the water jacket core 35 can be provided directly against the cylinder liners 5, 6.

In order to provide a uniform cooling to the periphery of the cylinder liners 5, 6, a water jacket 37 can be introduced between the threaded channels 8 and the cylinder liners 5, 6, this being attainable, according to FIG. 6, by providing the threaded columns 8 with flattened regions 38.

A complete housing, consisting of the internal portion 1 and the external portion 2, can be best seen in FIG. 5, in which a transmission case 40, constructed integrally with the external portion 2, is provided for connecting a gear unit to the housing. Gripping regions 20 and braces 26 are surrounded by the material of the external portion, and, for the further stiffening of the entire housing, ribs 41 are provided, the ribs having openings and being in the region of the partition 10 and the bearings 9.

FIG. 5 makes it likewise clear how the deck portion 7 and the external partitions 42 of the external portion 2 define a space for the passage of oil in the region of the connecting rod assembly, whereas above the deck portion 7 there are

spaces for cooling water in the form of the water jacket 37.

FIGS. 8 and 9 show an embodiment which has been altered in connection with the construction of the threaded columns. In this alternative, the threaded columns 8 are split, such that a lower portion is constructed as a threaded boss 81 integral with the internal portion 1, while an upper part is constructed as a support 82 defining the receiving portion 11, and belonging to the external portion 2.

In the threaded bosses 81 are provided threads 12 which are engaged by the bolts of the cylinder head.

The threaded bosses 81 and the supports 82 form a shoulder-like abutment 83, providing a direct, unhindered force flow.

The latter embodiment, in the case of an open-deck construction, offers improved conditions for the casting of material around the cylinder liners 5, 6.

Furthermore, these figures show a further gripping region 84 in the transverse planes which illustrate the bearing blocks 25.

What is claimed is:

1. A housing for a piston-operated, combustion-powered machine with at least one integral metallic internal portion having cylinders, the internal portion having a deck portion and, formed thereon, threaded columns extending in the direction of an upper connection plane for a cylinder head, wherein partitions adjacent the cylinders extend in a perpendicular plane from said deck portion to a lower connection plane, the partitions having bearing blocks for a crankshaft, and having, cast around the internal portion, an external portion which is cast so as to surround the internal portion and so as to provide spaces for cooling water and oil, the external portion being of a different metal than the internal portion, and cylinder liners integrally formed with, and having the same material as the internal portion.

2. A housing according to claim 1, wherein said cylinder liners extend between the upper connection plane and a plane lying between the deck portion and the lower connection plane.

3. A housing according to claim 1 or 2, wherein between the threaded columns and the cylinder liners, in the region of the deck portion there are provided cast stiffening bridges.

4. A housing according to claim 1, wherein the deck portion has, around its periphery, a gripping region which is surrounded to a large extent by a corresponding region of the external portion when the latter is cast.

5. A housing according to claim 4, wherein outwardly extending additional gripping regions are provided on the bearing blocks.

6. A housing according to claim 4 or 5, wherein a surrounding lip extends at least intermittently around the periphery.

7. A housing according to any one of claims 4 to 6, wherein the periphery

has, at least intermittently, a dovetail form.

8. A housing according to any one of claims 4 to 7, wherein the deck portion has, in the gripping region, openings extending through the external portion.

9. A housing according to claim 5, wherein the additional gripping regions are connected to each other by a cast bridge extending in the longitudinal direction of the housing.

10. A housing according to claim 1, wherein forward surfaces of the internal portion directed toward the upper connection plane are surrounded by the external portion when the latter is cast, so as to create a deck surface which is directed toward the cylinder head and is of unitary material.

11. A housing according to claim 10, wherein at least one of the forward surfaces has a dovetail formation perpendicular to the upper connection plane.

12. A housing according to claim 1, wherein during casting of the external portion around the internal portion, a water jacket core is positioned immediately against the cylinder liners.

13. A housing according to claim 1, wherein during casting of the external portion around the internal portion, a water jacket core is located at a small spacing away from the cylinder liners.

14. A housing according to claim 1, wherein bearings of the crankshaft have bearing caps of which threaded fasteners provided on both sides of an intermediate longitudinal plane of the housing are located in alignment with the threaded columns.

15. A housing according to claim 1 or 14, wherein bearings of the crankshaft have bearing caps which are connected with each other in the direction of an

intermediate longitudinal plane in the manner of a bridge, wherein the caps are of the same material as the internal portion.

16. A housing according to claim 1, wherein the threaded columns extend from the deck portion to the region of the upper connection plane.

17. A housing according to claim 1, wherein the threaded columns are split in such away that one portion is formed as a threaded boss on the internal portion and a further portion is formed as a support on the external portion.

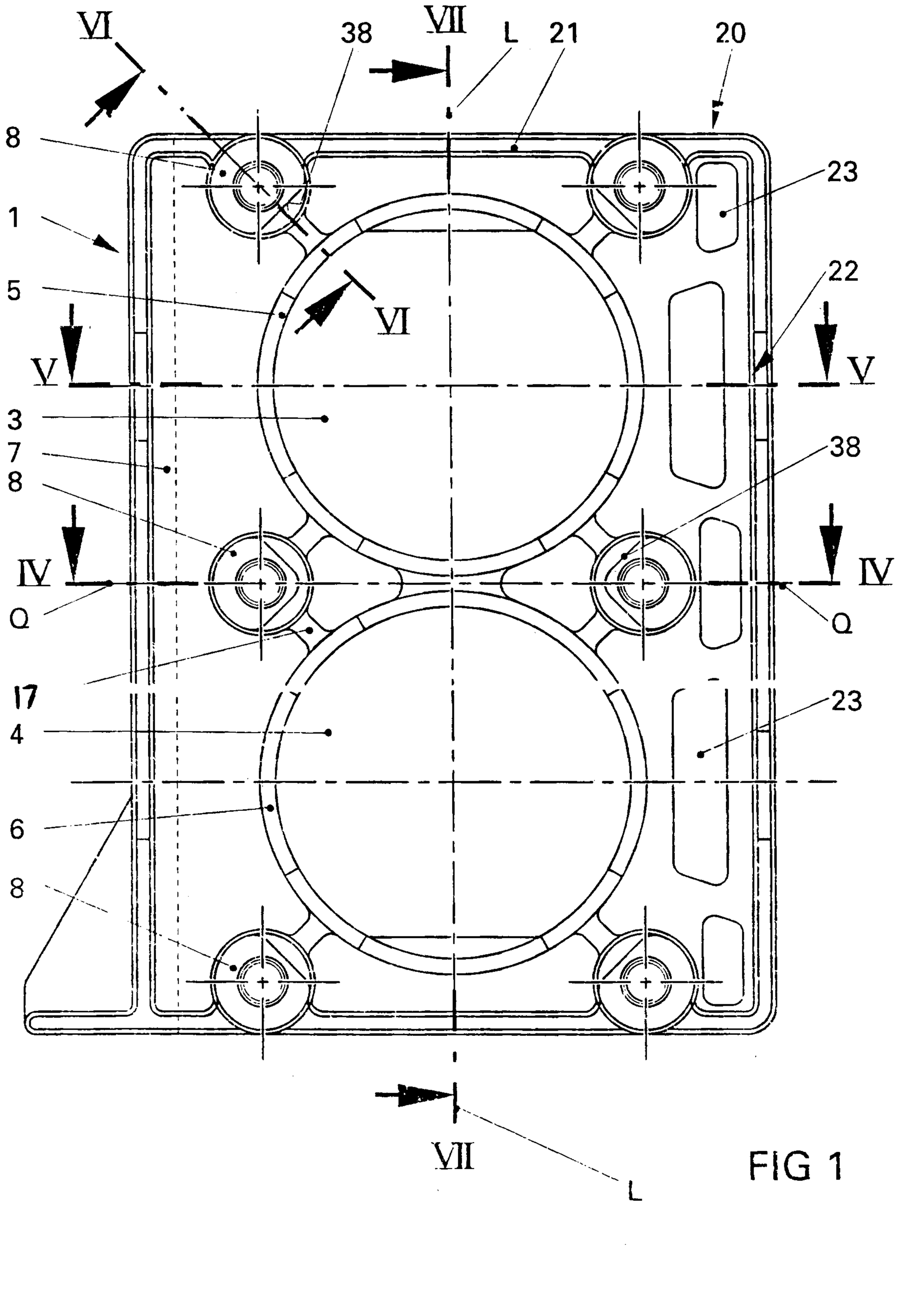


FIG 1

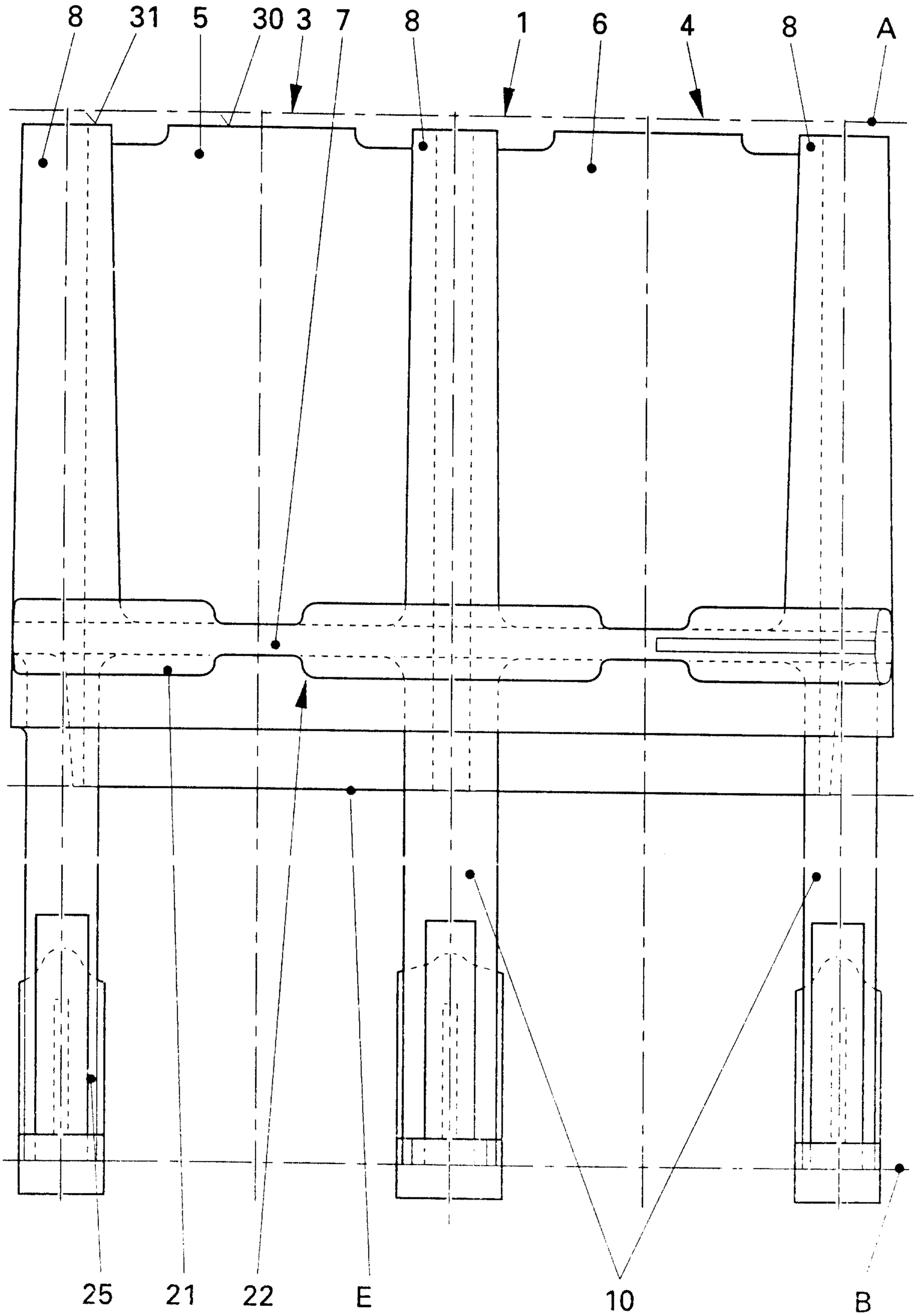


FIG 2

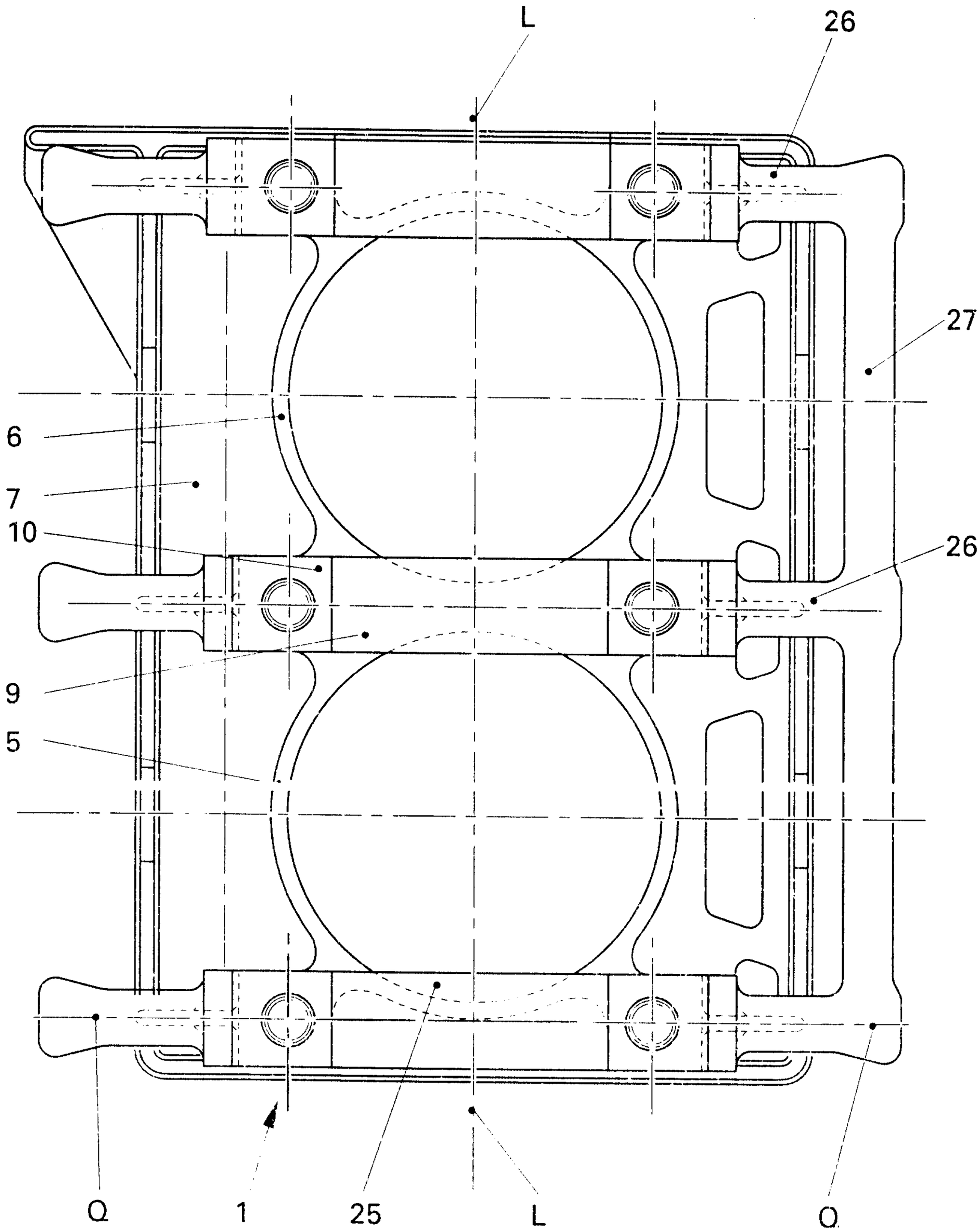


FIG 3

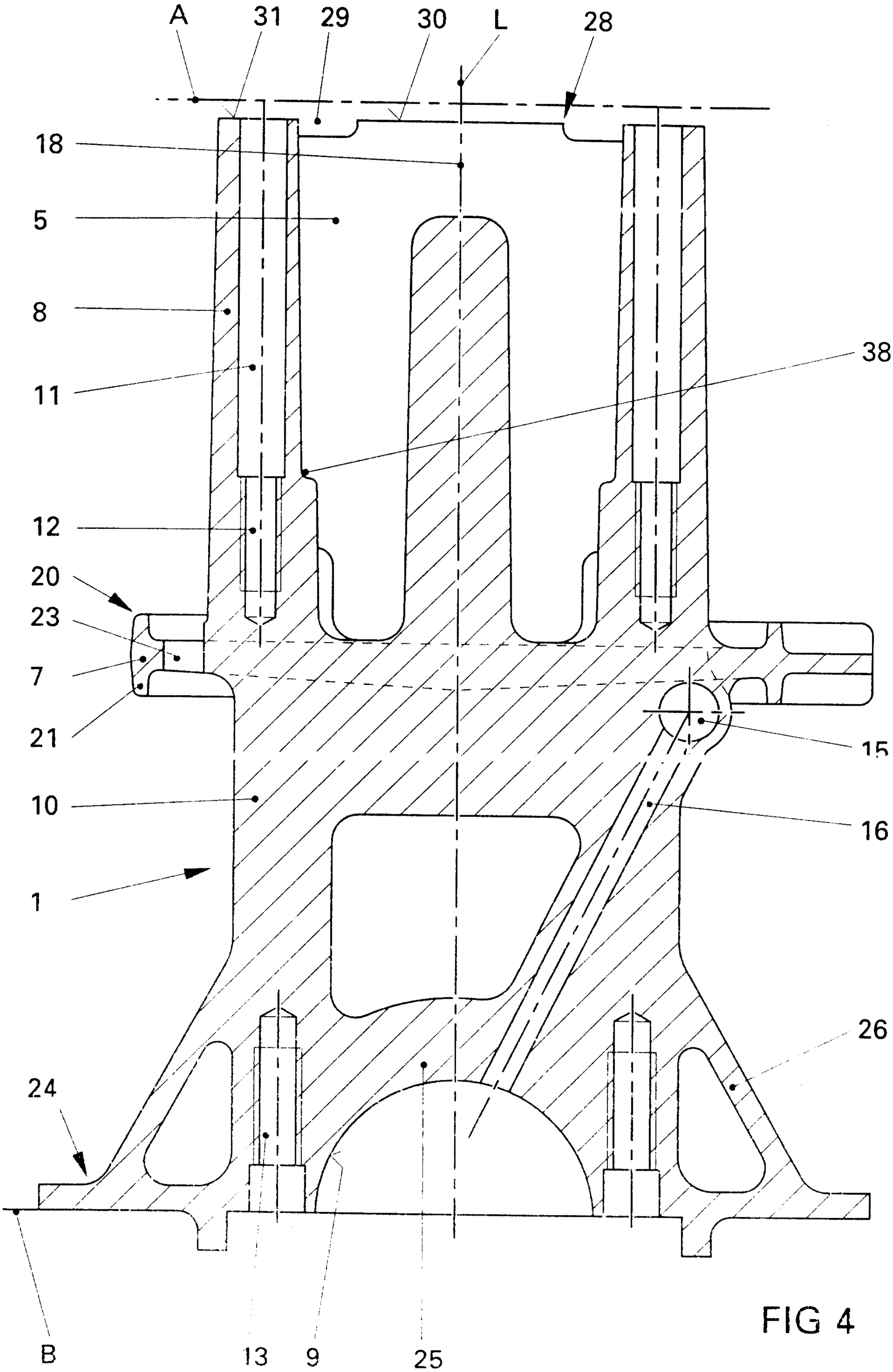


FIG 4

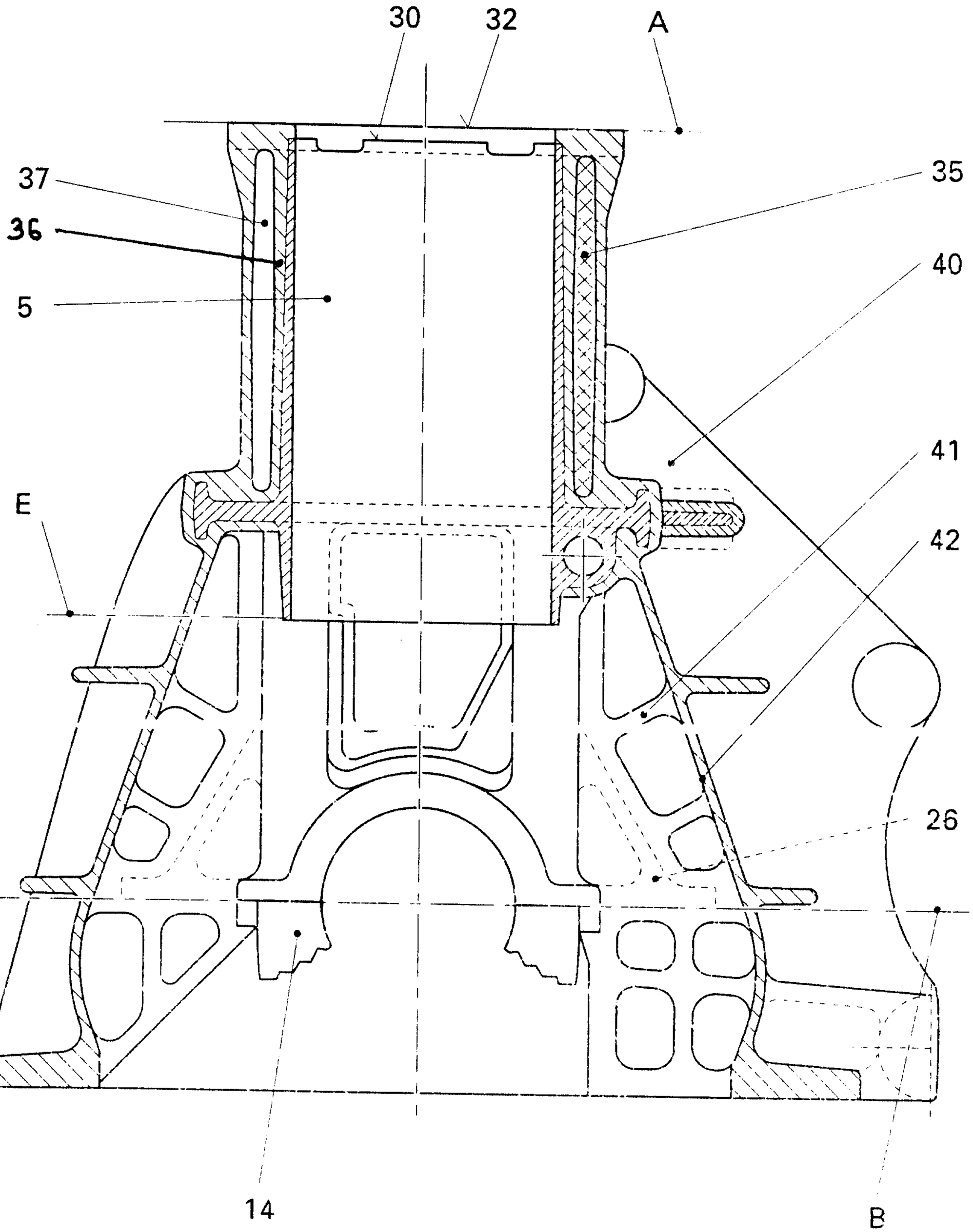
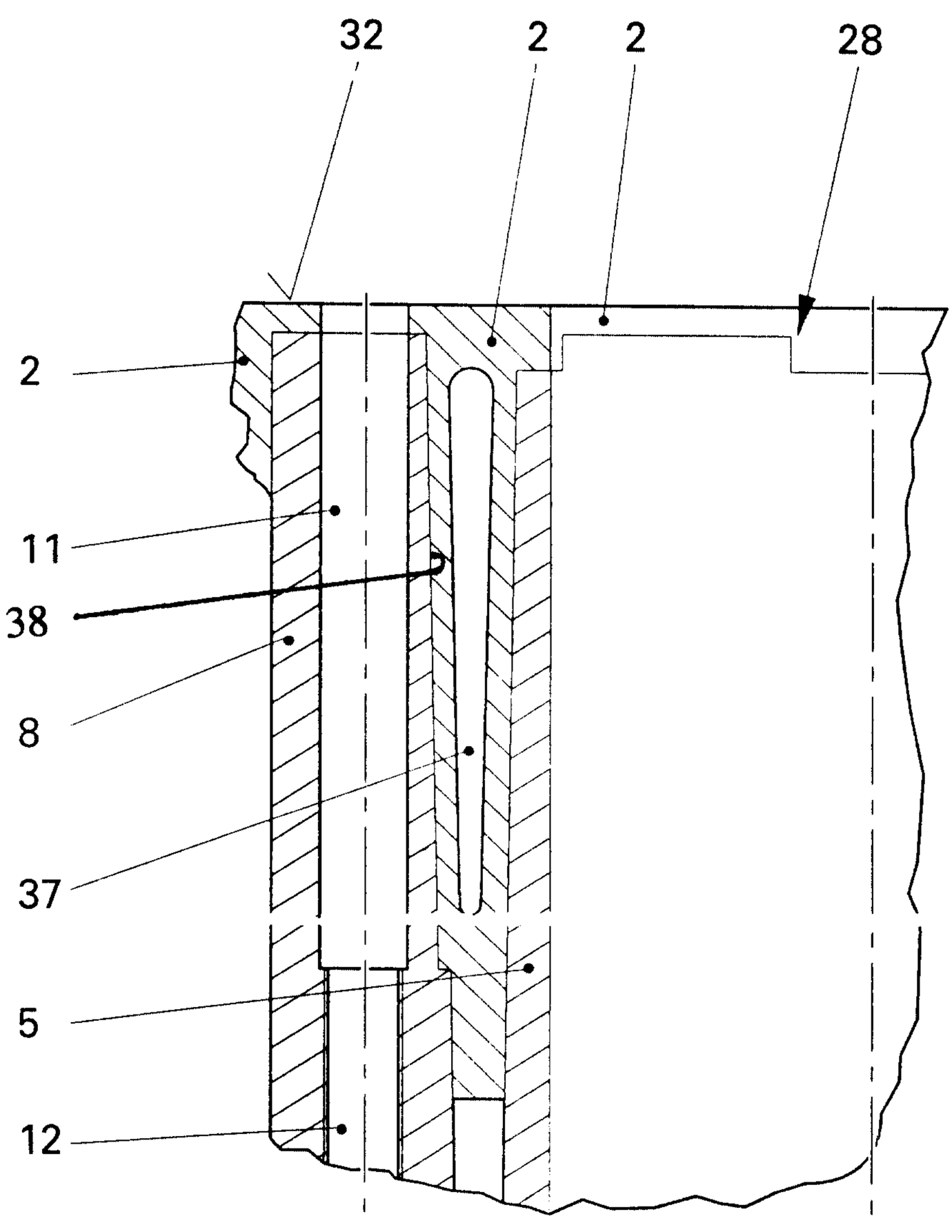


FIG 5



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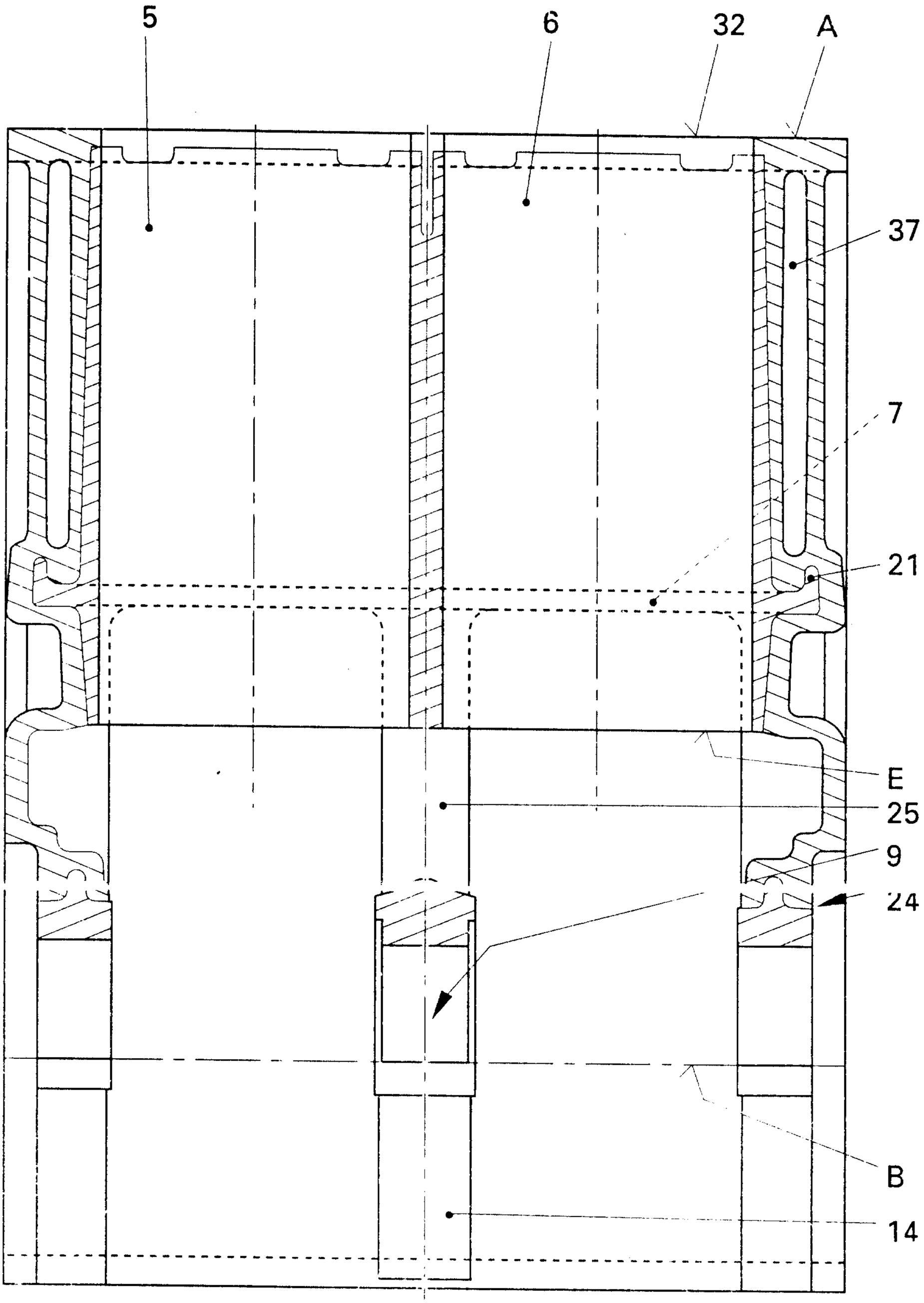


FIG 7

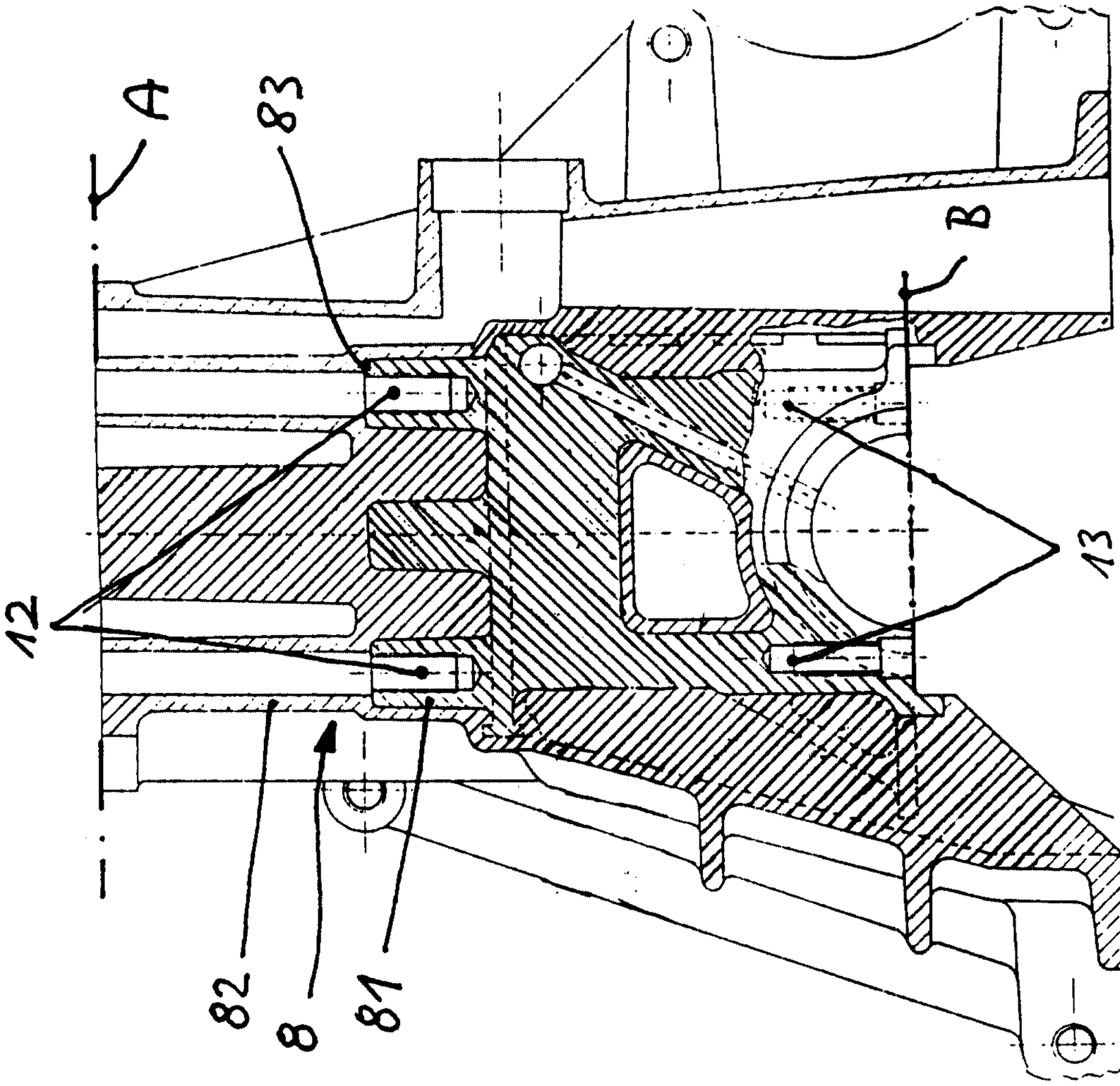


FIG 9

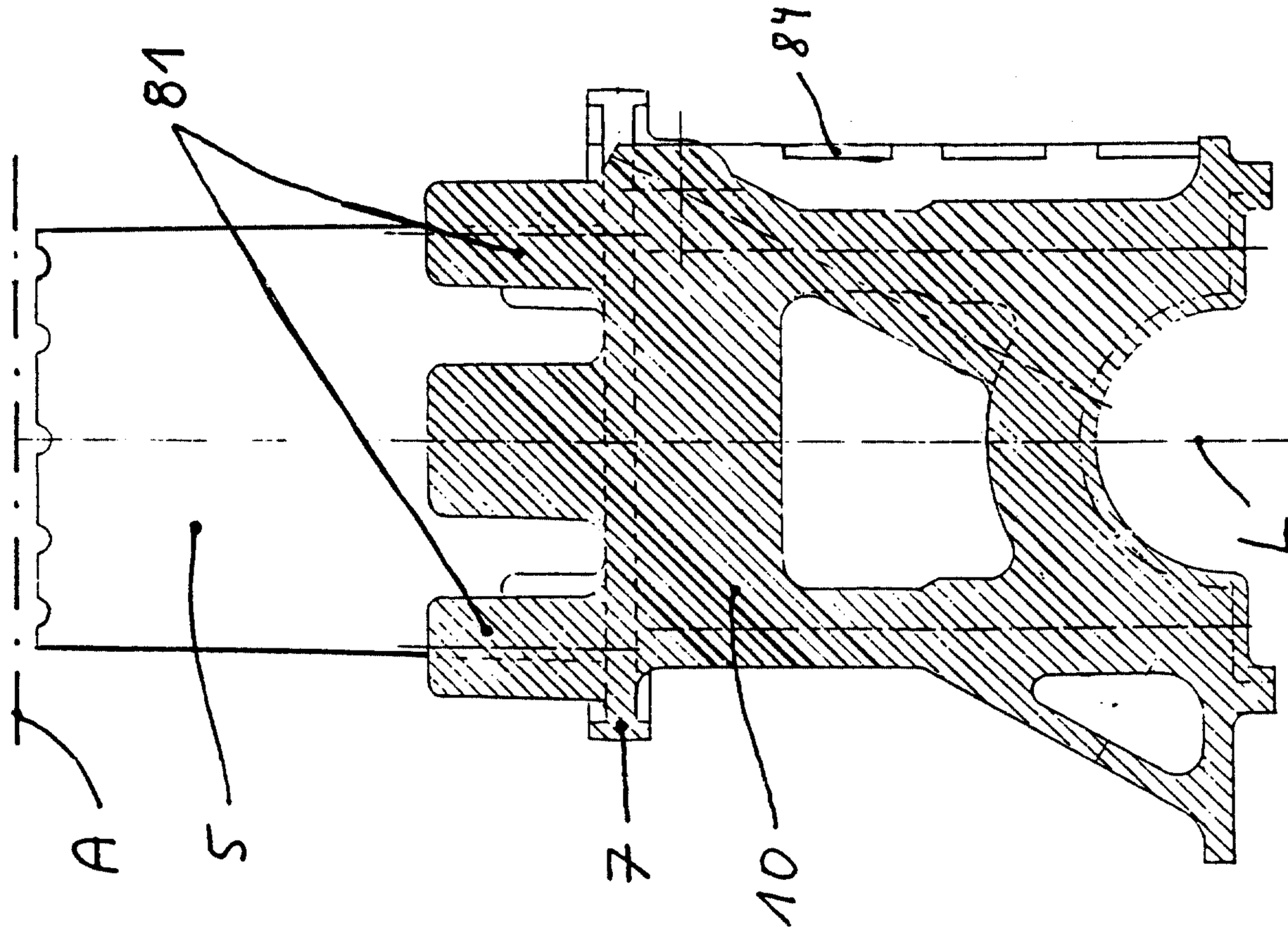
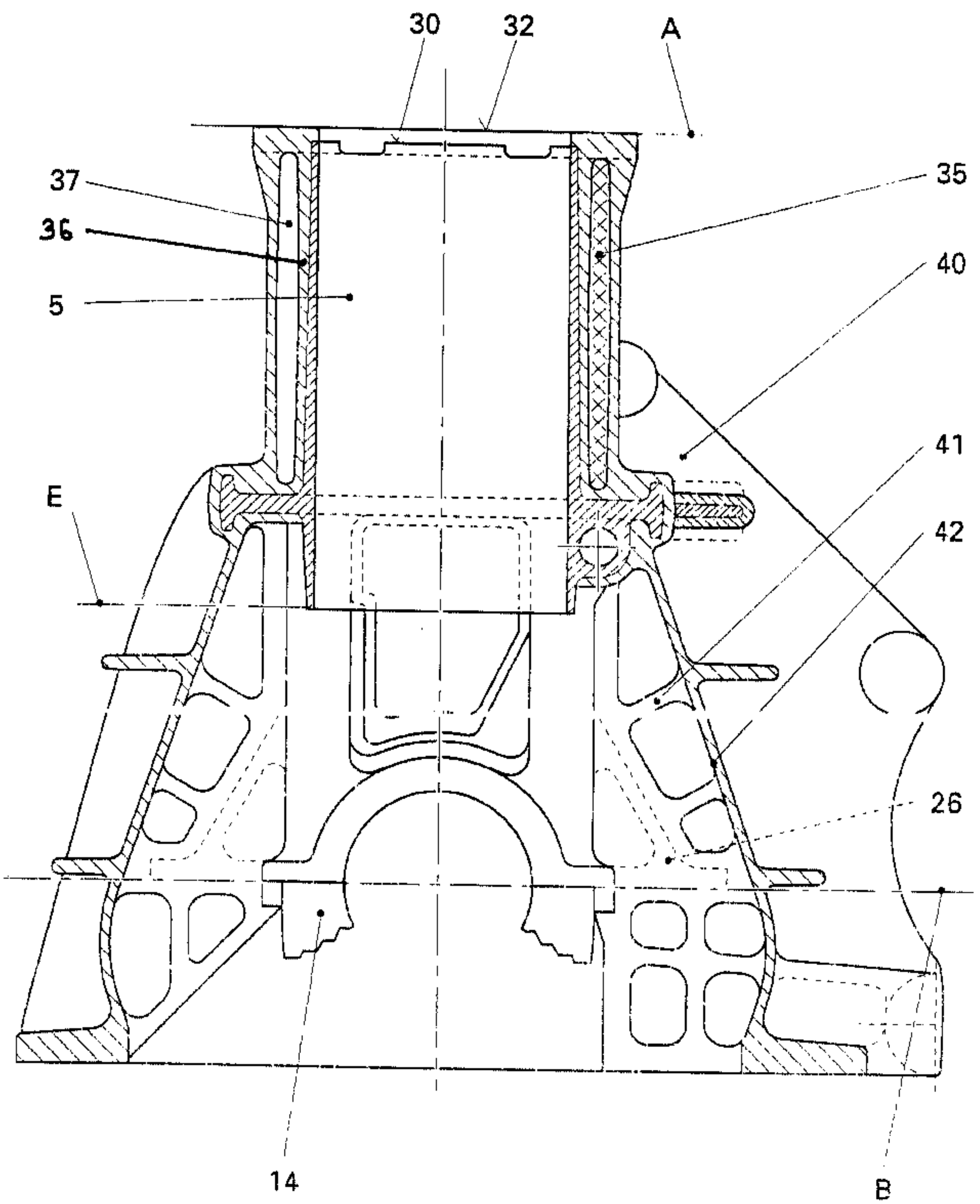


FIG 8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