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(12) # EUROPEAN PATENT SPECIFICATION

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(54) **Horizontal continuous casting mould.**

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Description

The invention deals with a horizontal continuous casting mould according to the features as laid out in the preamble of claim I.

It is well known for a horizontal continuous casting mould to consist of a mould tube, which defines the mould passage, mounted in a housing structure. The housing structure provides liquid cooling for molten metal passed along the mould passage so that the molten metal begins to solidify in the mould passage and for the cross-section of the casting to be determined by the cross-section of the mould passage.

European Patent Application A0071580, upon which the preamble of claim 1 is based, discloses a horizontal continuous casting mould in which a mould tube is replaceably positioned within a housing structure with the longitudinal axis of the mould passage arranged to be substantially horizontal. Outside of the mould tube there is a spacer positioned in the housing structure and a duct is defined between the inside of the spacer and the outside of the mould tube. Liquid coolant is caused to flow along this duct to provide cooling for the mould tube. Clearly, when the mould passage becomes damaged or otherwise needs replacing the mould tube can be readily withdrawn from the housing structure and a replacement tube fitted in its place.

If, however, the cross-section of the desired casting is to be changed, then a different mould tube has to be provided and, if mould tubes of different cross-section are employed in the housing structure with a fixed spacer, then the cross-section of the duct surrounding the mould will vary. It is most important, however, that a predetermined flow of liquid coolant takes place along the duct whatever the size of the mould tube and consequently, if the cross-section of the duct is allowed to change, then the predetermined flow of liquid coolant does not occur.

It is an object of the present invention to provide a horizontal continuous casting mould in which this difficulty is overcome.

According to the present invention, a horizontal continuous casting mould comprises a housing structure; a mould tube defining a mould passage, said tube being removably mounted in the housing structure with the longitudinal axis of the mould passage disposed substantially horizontally; a spacer mounted in the housing structure, said spacer surrounding the mould tube and defining therewith a duct between the outside of the mould tube and the inside of the spacer for the passage of liquid coolant; characterised in that mould tubes of different cross-sections can be installed in the housing structure, the spacer is removably mounted in the housing structure and, for each size of mould tube, there is a different correspondingly spacer such that the cross-section of the duct between the outside of the mould tube and the inside of the spacer remains substantially the same.

By changing the annular spacer each time the size of the mould tube is changed, then the cross-section of the annular duct between the spacer and the mould tube can be kept at the predetermined value and the cooling of the mould tube remains satisfactory.

It is desirable that the longitudinal axis of the mould passage is always in a fixed relation with the longitudinal axis of an opening formed in the housing structure. The longitudinal axis of the mould passage is preferably held coincident with the longitudinal axis of the opening. In this way, the pass-line of the casting produced in the mould is always the same regardless of the cross-section of the casting.

In order that the invention may be more readily understood, it will now be described, by way of example only, with reference to the accompanying drawings, in which:-

Figure 1 is a front view, partly in section, of a continuous casting mould in accordance with the present invention;

Figure 2 is a section on the line 2-2 of Figure 1; and

Figure 3 is an alternative section on the line 2-2 of Figure 1.

A horizontal continuous casting mould has a housing structure 1 which is located in the casting position between the supply tundish for the molten metal and a run-out table for the casting, neither of which are shown.

The housing structure is mainly of fabricated metal plates and it defines a pair of chambers 3, 5 located close to the base of the housing structure. The chambers are defined in part by a cylindrical tube 6 which also defines an opening 7 through the structure, the longitudinal axis of the opening being arranged substantially horizontal. A tube 9 having an outwardly extending flange at one end is mounted within the opening 7. A number of bolts 10 secure the tube 9 to an inwardly extending rib 13 on the tube 6 and thus form an annular enclosure 15. At each end of the structure, a group of holes 17 are provided in the tube 6 and the group of holes at each end are in communication with the respective chambers 3, 5.

An annular spacer in the form of a tube 20 is removably mounted in the opening 7 and defines an opening 23 of reduced cross-section as compared with that of the opening 7. The spacer is conveniently a push fit into the inside of the tube 9. A mould tube 25, conveniently of copper alloy, defines a mould passage 27 of the cross-section of the required casting. One end of the mould tube is sealed into an aperture in an end plate 31 which is removably bolted to one end of the housing structure. The other end of the mould tube has an outwardly extending flange 33 which is bolted to an end plate which, in turn, is removably bolted to the other end of the housing structure.

In the correct position of the mould tube, the longitudinal axis of the mould passage is coincident with the longitudinal axis of the opening 7.

The outer surface of the mould tube is spaced

apart from the spacer 20 which surrounds it to form a duct 28 between them.

The housing structure provides cooling for the molten metal passed through the mould tube. To this end, liquid coolant, usually water, is supplied to the chamber 3 from where it flows out through the openings 17 at the adjacent end of the structure into contact with the outer surface of the mould tube and the spacer. Some of the water passes along the duct 28, along the length of the outside of the mould tube and through further openings 17 at the opposite end of the structure into the chamber 5, from where it flows to drain. There is, therefore, a continuous flow of cooling water in contact with the outer surface of the mould tube. In addition, some of the cooling water which is supplied to the chamber 3 passes through openings in the flange 11 and into the enclosure 15 and out from the enclosure through a further outlet port 35.

It is most desirable that a predetermined flow of liquid coolant along the duct 28 takes place whatever the size of the mould tube. To this end, therefore, it is necessary to keep the cross-section of the duct 28 at a predetermined value. For each mould tube, therefore, an appropriately sized annular spacer is always provided so that the two together define a duct of the predetermined cross-section.

Figure 3 shows an alternative form of the continuous casting mould in which a casting of a much smaller cross-section than that shown in Figures 1 and 2 is required. To this end. the annular spacer and the mould tube shown in Figures 1 and 2 are removed with the end plates 31, 34. A new spacer 41 is pushed into the tube 9 and a second mould tube 43 is located in the opening through the housing structure and held in position by new end plates 45, 47. The longitudinal axis of the mould tube is still coincident with the longitudinal axis of the opening provided by the housing structure. The cooling means provided in the housing remain and a large part of the water from the chamber flows along the duct 28 and into the chamber 5. It will be noticed that the cross-section of the duct in the arrangement of Figure 3 is substantially as the cross-section of the duct in the arrangements of Figures 1 and 2.

It is important that the lowest part of all the castings produced in the mould remains level with the upper surfaces of the rolls of the roller table and, to this end, the mould can be raised or lowered with respect to the roller table.

The horizontal continuous casting mould of this invention may incorporate electro-magnetic stirring of the molten metal passed through the mould tube. In horizontal continuous casting, the solidifying casting is withdrawn from the mould tube using a push-pull cycle withdrawal pattern and this may bring about a surface defect on the produced casting, known as a cold shut crack, a witness mark or a ghost line. By causing the molten metal in the mould tube to be stirred as part of it is solidified, the surface defects referred to above can be reduced. To this end, electric coils, indicated by the broken line in Figure 2, can be positioned in the enclosure 15. The spacer 20 is of magnetically transparent material. When these coils are energised with alternating current, the material can be caused to give either linear or rotational stirring of the liquid core in the mould tube. Alternatively, differential stirring intensity can be applied along the length of the horizontal mould in order to effect the solidification rate of the skin at any point.

Claims.

1. A horizontal continuous casting mould comprising a housing structure (1);

a mould tube (25) defining a mould passage (27), said tube being removably mounted in the housing structure with the longitudinal axis of the mould passage disposed substantially horizontally;

a spacer (20) mounted in the housing structure, said spacer surrounding the mould tube and defining therewith a duct (28) between the outside of the mould tube and the inside of the spacer for the passage of liquid coolant;

characterised in that mould tubes (25, 43) of different cross-sections can be installed in the housing structure (1), the spacer (20, 41) is removably mounted in the housing structure (1) and, for each size of mould tube, there is a different correspondingly sized spacer such that the cross-section of the duct (28) between the outside of the mould tube and the inside of the spacer remains substantially the same.

2. A horizontal continuous casting mould as claimed in claim 1, characterised in that the mould tube is supported by a pair of end plates (31, 34) removably secured to the housing structure (1).

3. A horizontal continuous casting mould as claimed in claim 1 or 2, characterised in that the housing structure defines a pair of chambers (35) which are in communication with respective ends of the duct (28) and liquid coolant is forced from one chamber along the duct to the other chamber.

4. A horizontal continuous casting mould as claimed in claim 1, 2, or 3, characterised in that the housing structure defines an annular enclosure (15) outside of and surrounding the spacer, said enclosure containing a coil for electro-magnetic stirring of molten metal passed along the mould passage.

5. A horizontal continuous casting mould as claimed in claim 4, characterised in that provision is made for passing liquid coolant through said enclosure (15).

Patentansprüche

1. Gießform zum Horizontalstranggießen, mit einer Gehäusestruktur (1);

einem Formrohr (25), welches einen Formkanal (27) definiert und auswechselbar so an der Gehäusestruktur angebracht ist, daß die Längsachse des Formkanals im wesentlichen horizontal liegt;

einem in der Gehäusestruktur angeordneten Abstandsteil (20), welches Abstandsteil das Formrohr umgibt und zusammen mit diesem einen

Kanal (28) zum Durchtritt flüssigen Kühlmittels zwischen der Außenseite des Formrohres und der Innenseite des Abstandsteil definiert;

dadurch gekennzeichnet, daß Formrohre (25, 43) unterschiedlichen Querschnitts in der Gehäusestruktur (1) installiert werden können. daß das Abstandsteil (20, 41) auswechselbar in der Gehäusestruktur (1) angeordnet ist und daß für jede Formrohrgröße ein verschiedenes entsprechend bemessenes Abstandsteil vorgesehen ist, so daß der Querschnitt des Kanals (28) zwischen der Außenseite des Formrohres und der Innenseite des Abstands teils im wesentlich gleich bleibt.

2. Gießform zum Horizontalstranggießen nach Anspruch 1, dadurch gekennzeichnet, daß das Formrohr von einem Paar Stirnplatten (31, 34) getragen wird, die auswechselbar an der Gehäusestruktur (1) befestigt sind.

3. Gießform zum Horizontalstranggießen nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß die Gehäusestruktur ein Paar Kammern (35) definiert, welche mit jeweiligen Enden des Kanals (28) kommunizieren, und daß flüssiges Kühlmittel aus einer Kammer entlang dem Kanal zu der anderen Kammer geleitet wird.

4. Gießform zum Horizontalstranggießen nach Anspruch 1, 2 oder 3, dadurch gekennzeichnet, daß die Gehäusestruktur einen außerhalb des Abstandsteil befindlichen und dieses umgebenden Ringraum (15) definiert, welcher eine Spule zum elektromagnetischen Rühren von geschmolzenem Metall enthält, das entlang dem Formkanal geführt wird.

5. Gießform zum Horizontalstranggießen nach Anspruch 4, dadurch gekennzeichnet, daß Vorrichtungen zur Hindurchführung von flüssigem Kühlmittel durch den Ringraum vorgesehen sind.

Revendications

I. Moule pour la coulée continue horizontale de métaux et autres qui comprend une enveloppe (1):

un moule en forme de tube ou tubulaire (25) définissant un canal (27), ledit moule étant monté de façon amovible dans ladite enveloppe de manière que l'axe longitudinal de son canal soit pratiquement horizontal;

une cale d'espacement (20) montée dans ladite enveloppe, ladite cale entourant ledit moule tubulaire et définissant avec lui un conduit (28) s'étendant entre la face extérieure dudit moule et la face intérieure de ladite cale d'espacement pour la circulation d'un réfrigérant liquide;

caractérisé en ce que des moules en forme de tube (25, 43) ayant différentes sections peuvent être installés dans l'enveloppe (1), la cale d'espacement (20, 41) étant montée de façon amovible dans l'enveloppe (1), et en ce que, pour chaque taille de moule tubulaire est prévue une cale d'espacement ayant des dimensions différentes calculées pour que la section du conduit (28) compris entre la face extérieure du moule tubulaire et la face intérieure de la cale reste pratiquement la même;

2. Moule pour la coulée continue horizontale selon la revendication 1, caractérisé en ce que le moule tubulaire est supporté par deux plaques d'extrémité (31, 34) fixées de façon amovible à l'enveloppe (1).

3. Moule pour la coulée continue horizontale selon la revendication 1 ou 2, caractérisé en ce que l'enveloppe délimite deux chambres (35) qui communiquent avec les extrémités respectives du conduit (28), et en ce qu'un réfrigérant liquide est refoulé de l'une des chambres, le long du conduit, jusqu'à l'autre chambre;

4. Moule pour la coulée continue horizontale selon l'une quelconque des revendications 1, 2 ou 3, caractérisé en ce qu'enveloppe délimite une enceinte annulaire (15) s'étendant à l'extérieur de ladite cale d'espacement et entourant celle-ci, ladite enceinte contenant une bobine produisant une agitation électromagnétique du métal en fusion circulant le long du canal du moule.

5. Moule pour la coulée continue horizontale selon la revendication 4, caractérisé par les moyens pour faire passer le réfrigérant liquide dans ladite enceinte (15).

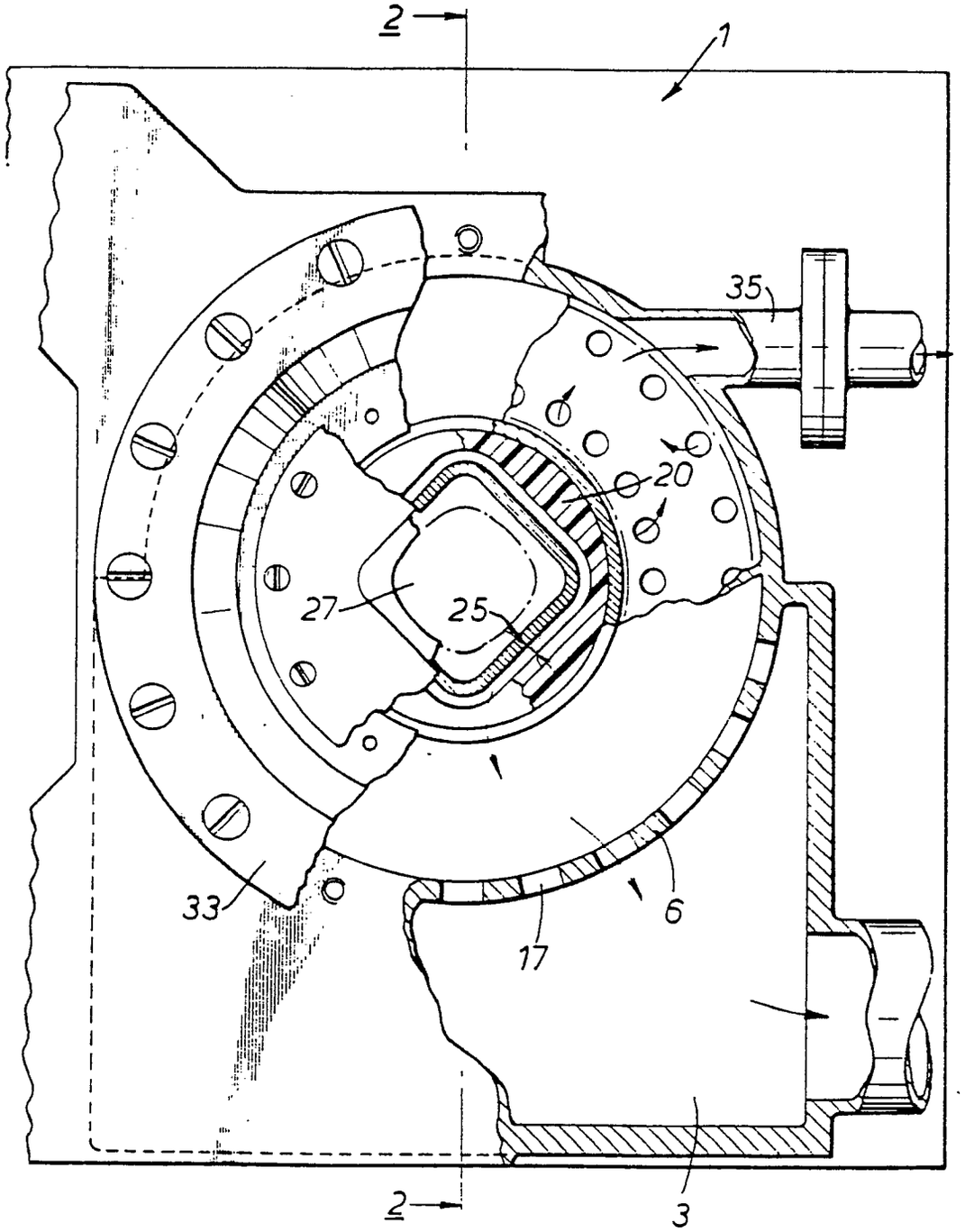

FIG. 1.

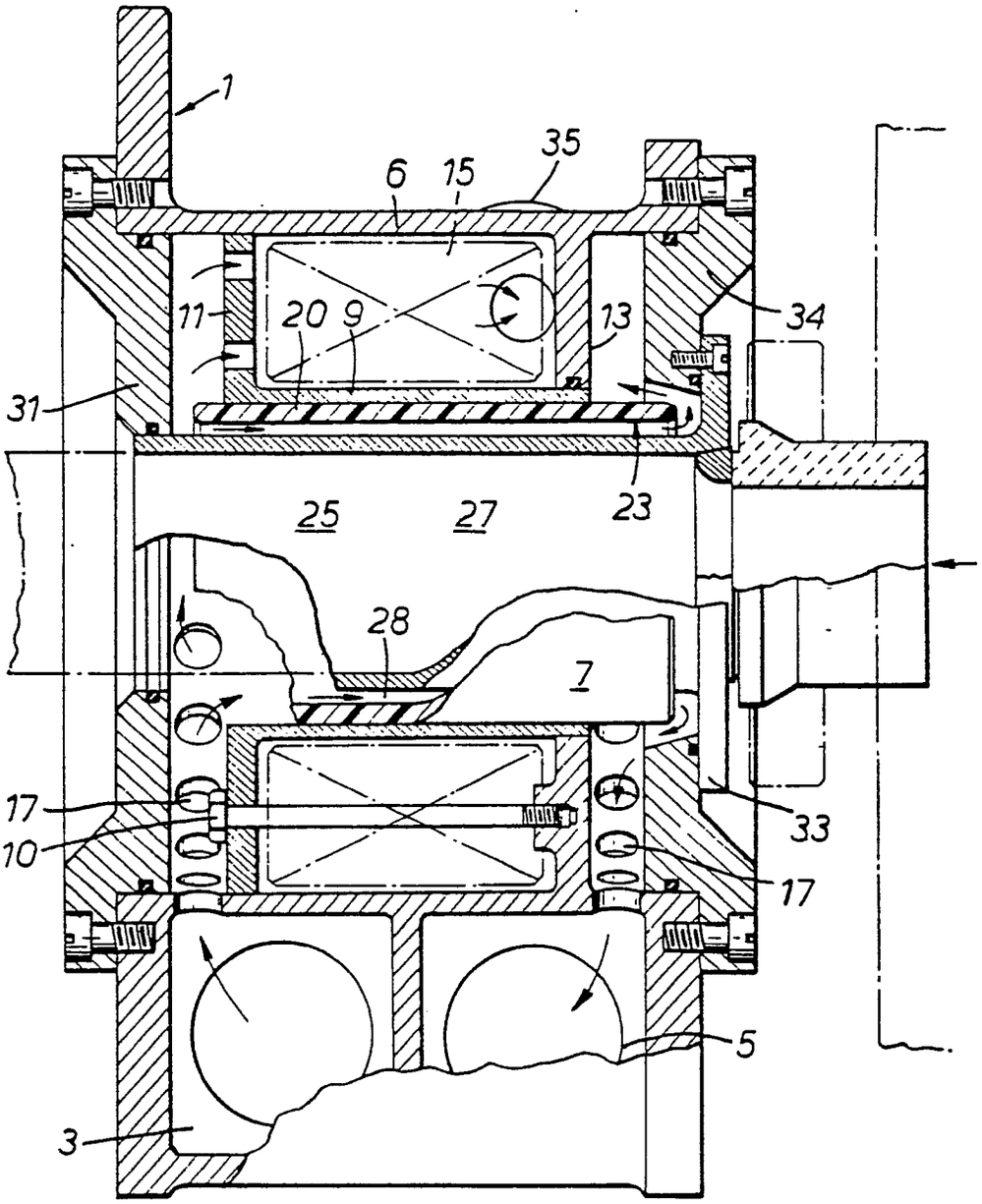

FIG. 2.

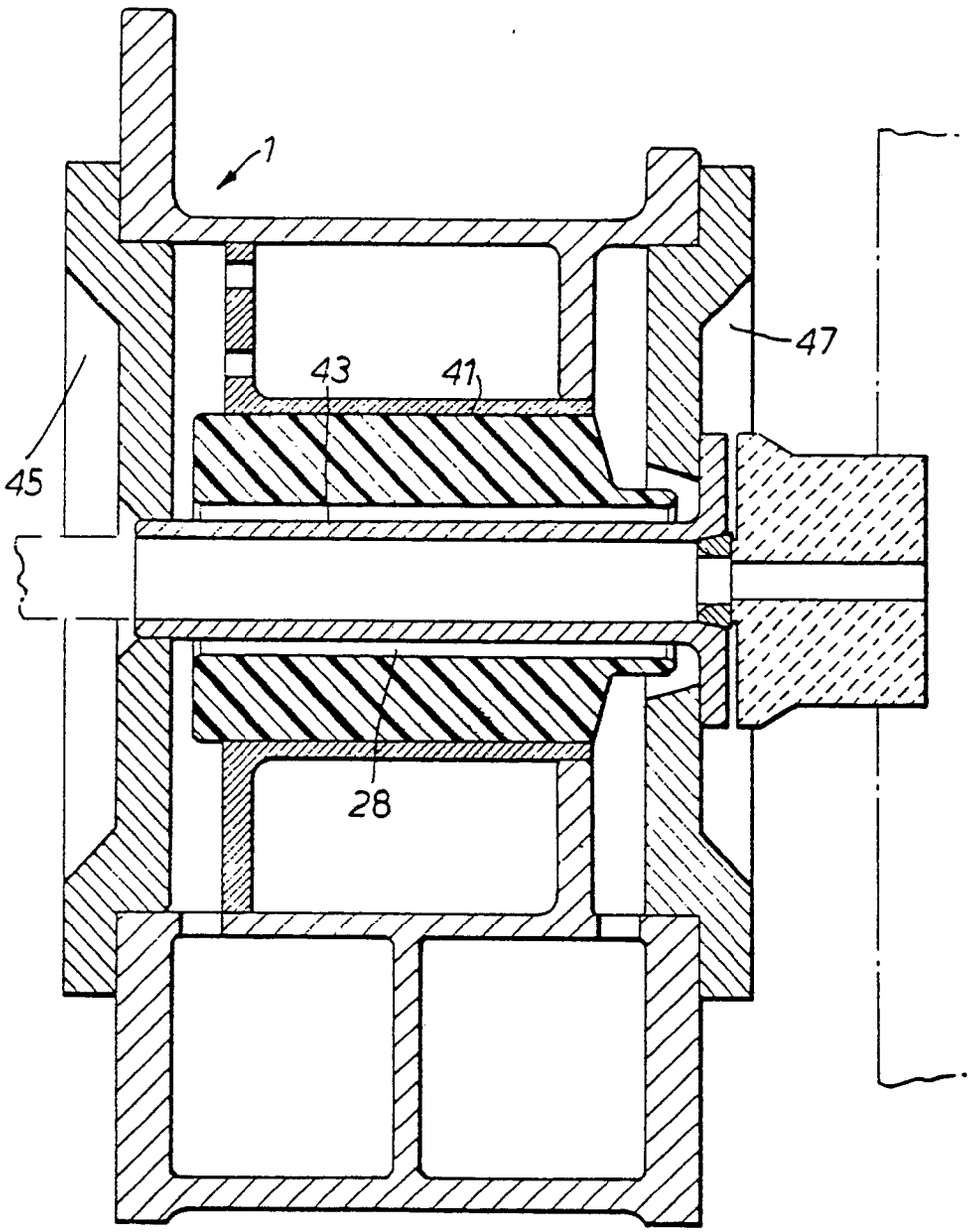

FIG. 3.