



NEW EUROPEAN PATENT SPECIFICATION

Date of publication of the new patent specification : **20.01.93 Bulletin 93/03**

Int. Cl.⁵ : **B22D 11/04**

Application number : **85301854.7**

Date of filing : **18.03.85**

Horizontal continuous casting mould.

Priority : **19.03.84 GB 8407072**

Date of publication of application :
25.09.85 Bulletin 85/39

Publication of the grant of the patent :
27.07.88 Bulletin 88/30

Mention of the opposition decision :
20.01.93 Bulletin 93/03

Designated Contracting States :
AT BE CH DE FR GB IT LI LU NL SE

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DE-A- 2 628 293
GB-A- 1 525 036
US-A- 3 321 008
US-A- 3 730 257
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EP 0 155 836 B2

Description

The invention deals with a horizontal continuous casting mould according to the features laid out in the preamble of claim 1.

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.

British Patent Specification No. 1525036 discloses a vertical continuous casting mould in which liquid coolant is circulated through an annular duct between a mould tube and a spacer surrounding the mould tube. The mould tube and the spacer are located between pole pieces of an electro-magnetic inductor for stirring molten metal passed along the mould tube. The electro-magnetic inductor is contained within the same path as the duct and, after passing through the duct, the liquid coolant flows around and cools the electromagnetic inductor.

The mould tube and the spacer are replaced together so that, if a change is made to the cross-section of the mould tube, a corresponding change is made to the spacer so that the cross-section of the duct between the spacer and the mould tube remains substantially the same.

It is not always necessary to employ electromagnetic stirring during a casting operation but, by mounting the mould tube and the spacer between pole pieces of an electromagnetic inductor, the stirrer has to be provided in the mould. Thus, the complexity of the mould and hence its cost are excessive if electromagnetic stirring is not required.

EP-A-0071580, upon which the preamble of claim 1 is based, discloses a horizontal continuous casting mould having a housing structure, a mould tube defining a mould passage, the tube being removably mounted in the housing structure with the longitudinal axis of the mould passage disposed substantially horizontal; a spacer mounted in the housing structure and surrounding the mould tube and defining therewith a duct between the outside of the mould tube and in the inside of the spacer; means define a path including the duct for the passage of cooling liquid and means within the housing structure defining an annular enclosure surrounding the mould tube.

This document discloses the possibility of replacing a damaged mould tube with another mould tube of the same size but not with one of a different size. Although an annular enclosure is provided surrounding the mould tube, this enclosure forms part of the same path for cooling liquid which includes the duct and there is no provision for electromagnetic stirring.

It is an object of the present invention to provide

a horizontal continuous casting mould which is more versatile than the known moulds.

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 horizontal; a spacer mounted in the housing structure and surrounding the mould tube and defining therewith a duct between the outside of the mould tube and the inside of the spacer; means defining a path including said duct for the passage of cooling liquid; means within the housing structure defining an annular enclosure surrounding the mould tube; characterised in that means define a path including said enclosure for the passage of cooling liquid, said paths having a common inlet and separate outlets for the cooling liquid; and that the spacer is removably mounted in a tube which forms the inner wall of said annular enclosure and for each size of mould tube a different correspondingly sized spacer is employed such that the cross-section of the duct remains substantially the same.

In accordance with one embodiment of the invention, the housing defines a pair of chambers and liquid coolant is forced from one of the chambers along both of said paths and the coolant passing through said duct returns to the other of said chambers.

If desired, the enclosure may contain a coil for electro-magnetic stirring of molten metal passed along the mould passage.

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, 43) defining a mould passage (27), said tube being removably mounted in the housing structure with the longitudinal axis of the mould passage disposed substantially horizontal; a spacer (20, 41) mounted in the housing structure and surrounding the mould tube and defining therewith a duct (28) between the outside of the mould tube and the inside of the spacer; means defining a path including said duct (28) for the passage of cooling liquid; means within the housing structure defining an annular enclosure (15) surrounding the mould tube (25, 43); characterised in that means define a path including said enclosure (15) for the passage of cooling liquid, said paths having a common inlet and separate outlets for the cooling liquid; and that the spacer (20, 41) is removably mounted in a tube (9) which forms the inner wall of said annular enclosure (15) and for each size of mould tube a different correspondingly sized spacer is employed such that the cross-section of the duct (28) 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 defines a pair of chambers (3, 5), and liquid coolant is forced from one of the chambers along both of said paths and the coolant passing through said duct returns to the other of said chambers.
4. A horizontal continuous casting mould as claimed in claim 1, 2 or 3, characterised in that said enclosure contains a coil for electro-magnetic stirring of molten metal passed along the mould passage.

Patentansprüche

1. Gießform zum Horizontalstranggießen, mit einer Gehäusestruktur (1); einem Formrohr (25, 43), welches einen Formkanal (27) bildet und auswechselbar in der Gehäusestruktur angebracht ist, wobei die Längsachse des Formkanals im wesentlichen horizontal liegt; einem in der Gehäusestruktur befestigten Abstandsteil (20, 41), welches das Formrohr umgibt und zusammen mit diesem einen Kanal (28) zwischen der Außenseite des Formrohres und der Innenseite des Abstandsteils definiert; Mitteln, die einen den Kanal (28) enthaltenden Weg zum Durchleiten von flüssigem Kühlmittel bilden; Mitteln innerhalb der Gehäusestruktur, die einen Ringraum (15) bilden, der das Formrohr (25, 43) umgibt; dadurch gekennzeichnet, daß Mittel einen den Ringraum (15) enthaltenden Weg zum Durchleiten von flüssigem Kühlmittel bilden, wobei die Wege einen gemeinsamen Einlaß und separate Auslässe für die Kühlflüssigkeit haben; und daß das Abstandsteil (20, 41) auswechselbar in einem Rohr (9) angebracht ist, welches die Innenwand des Ringraumes (15) bildet und für jede Größe von Formrohr ein anderes, entsprechend bemessenes Abstandsteil verwendet wird, so daß der Querschnitt des Kanals (28) im wesentlichen 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 (3, 5) bildet und flüssiges Kühlmittel aus einer Kammer

entlang der beiden Wege gedrückt wird und das durch den Kanal fließende Kühlmittel zu der anderen Kammer zurückkehrt.

4. Gießform zum Horizontalstranggießen nach Anspruch 1, 2 oder 3, dadurch gekennzeichnet, daß der Ringraum eine Spule zum elektromagnetischen Rühren von geschmolzenem Metall enthält, das entlang dem Formkanal geführt wird.

Revendications

1. Lingotière pour la coulée continue horizontale comprend une structure d'enveloppe (1); un moule tubulaire (25, 43) définissant un passage (27), ledit moule tubulaire étant monté de façon amovible dans la structure d'enveloppe avec son axe longitudinal pratiquement horizontal; une pièce d'espacement montée dans la structure d'enveloppe, qui entoure le moule tubulaire et définit avec elle un conduit (28) s'étendant entre la face extérieure du moule tubulaire et la face intérieure de la pièce d'espacement; des moyens définissant un trajet incluant ledit conduit (28) pour la circulation d'un liquide de refroidissement; des moyens délimitant, à l'intérieur de la structure d'enveloppe, une enceinte annulaire (15) entourant ledit moule tubulaire (25, 43), caractérisée par des moyens qui définissent un trajet incluant ladite enceinte de circulation du liquide de refroidissement (15), ledit trajet ayant une entrée commune et des sorties séparées pour ledit liquide de refroidissement; et ce que la pièce d'espacement (20, 41) est montée de façon amovible dans un tube (9) qui forme la paroi intérieure de ladite enceinte annulaire (15) et en ce que, pour chaque dimension de moule tubulaire est utilisée une pièce d'espacement ayant des dimensions différentes correspondantes de sorte que la section du conduit (28) reste pratiquement le même.
2. Lingotière pour la coulée continue horizontale selon la revendication 1, caractérisée en ce que le moule tubulaire est supporté par deux plaques d'extrémité (31, 34) fixées, de façon amovible, sur la structure d'enveloppe (1).
3. Lingotière pour la coulée continue horizontale selon la revendication 1 ou 2, caractérisée en ce que l'enveloppe délimite deux chambres (3, 5) et en ce qu'un liquide de refroidissement est forcé de circuler de l'une desdites chambres, le long des deux trajets mentionnés, le réfrigérant traversant ledit conduit retournant par l'autre desdites chambres.
4. Lingotière pour la coulée continue horizontale; tel

que spécifiée dans les revendications 1, 2 ou 3, caractérisée en ce que ladite enceinte contient un enroulement assurant une agitation électromagnétique du métal en fusion circulant le long du passage du moule.

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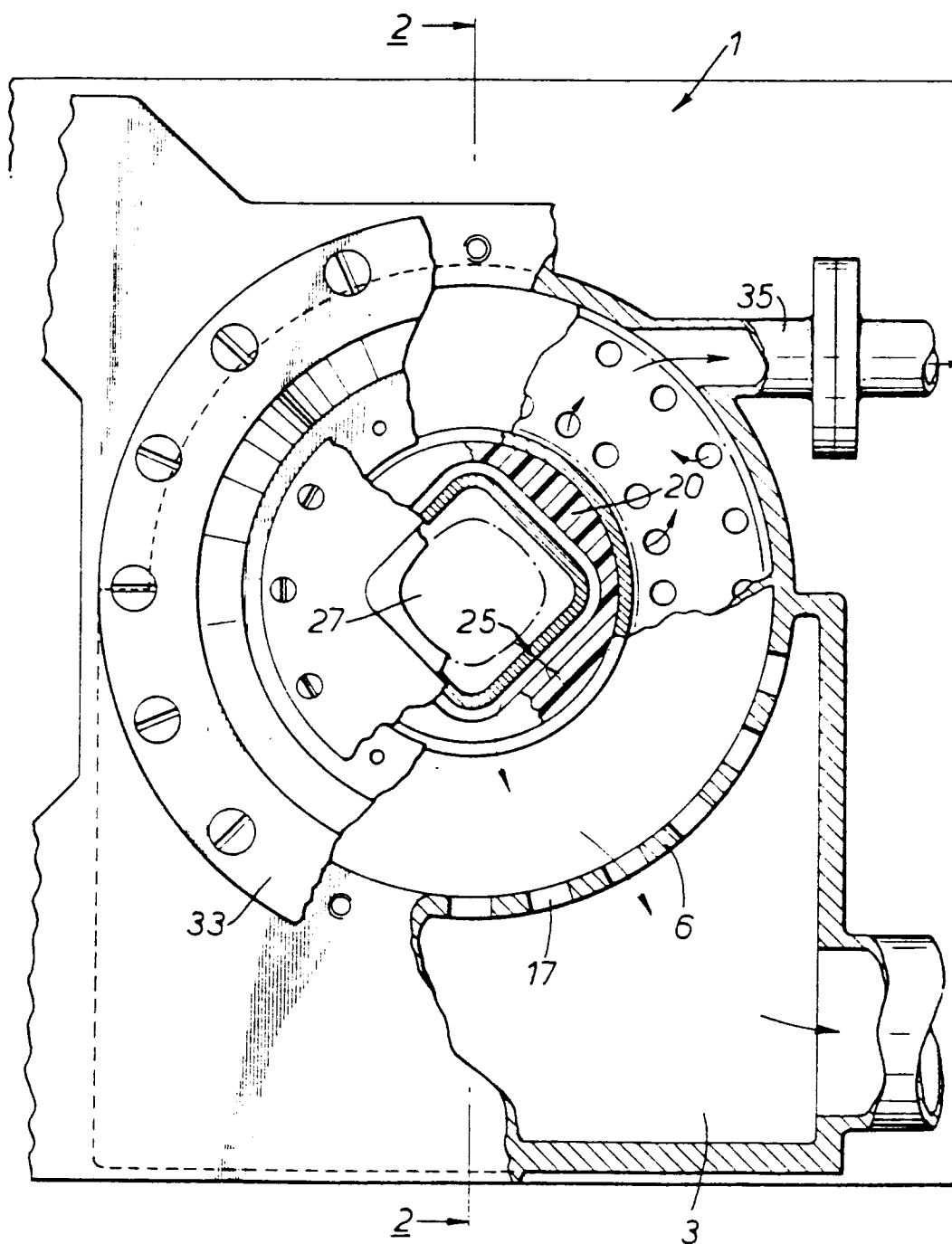


Fig. 1.

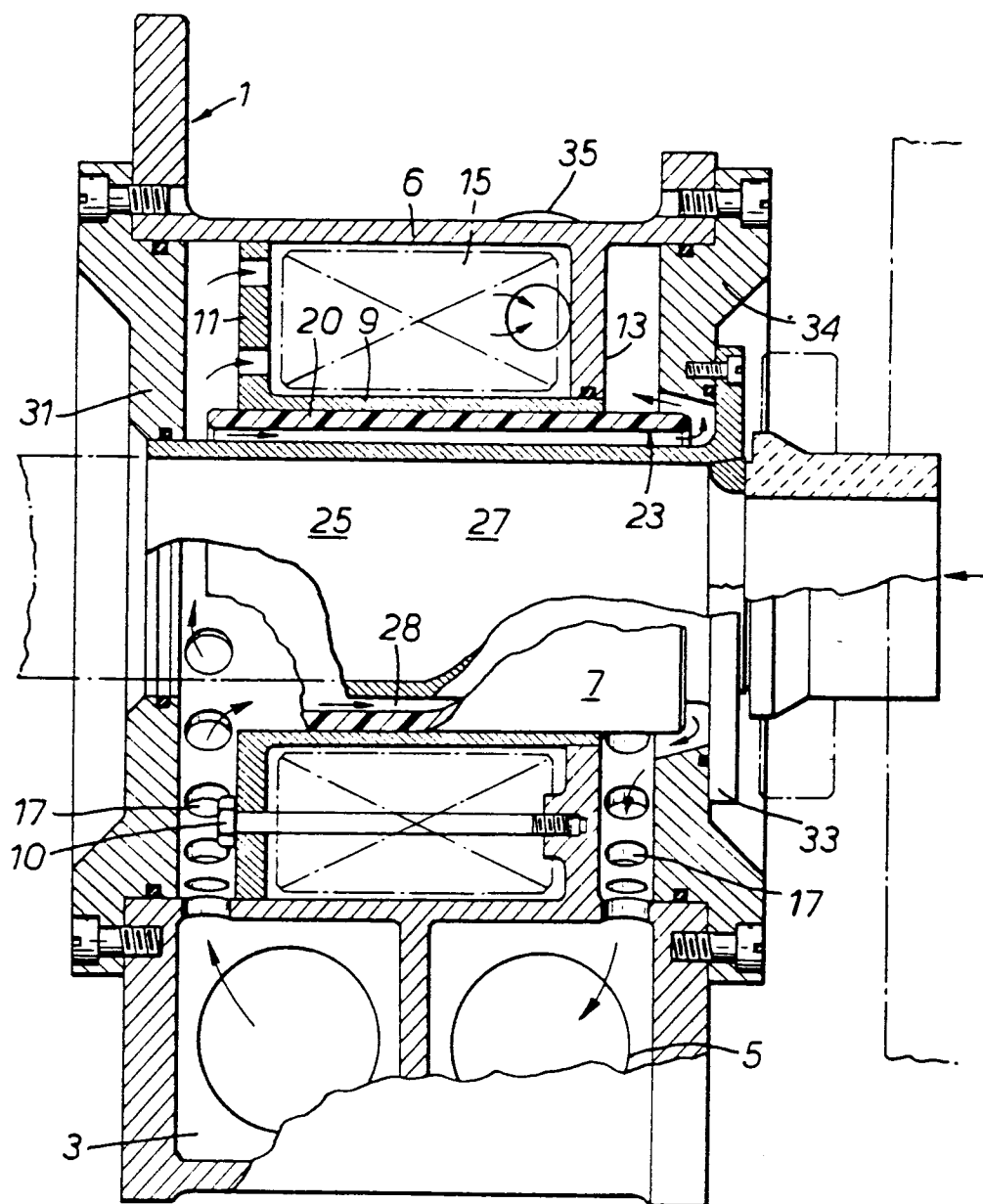


FIG. 2.

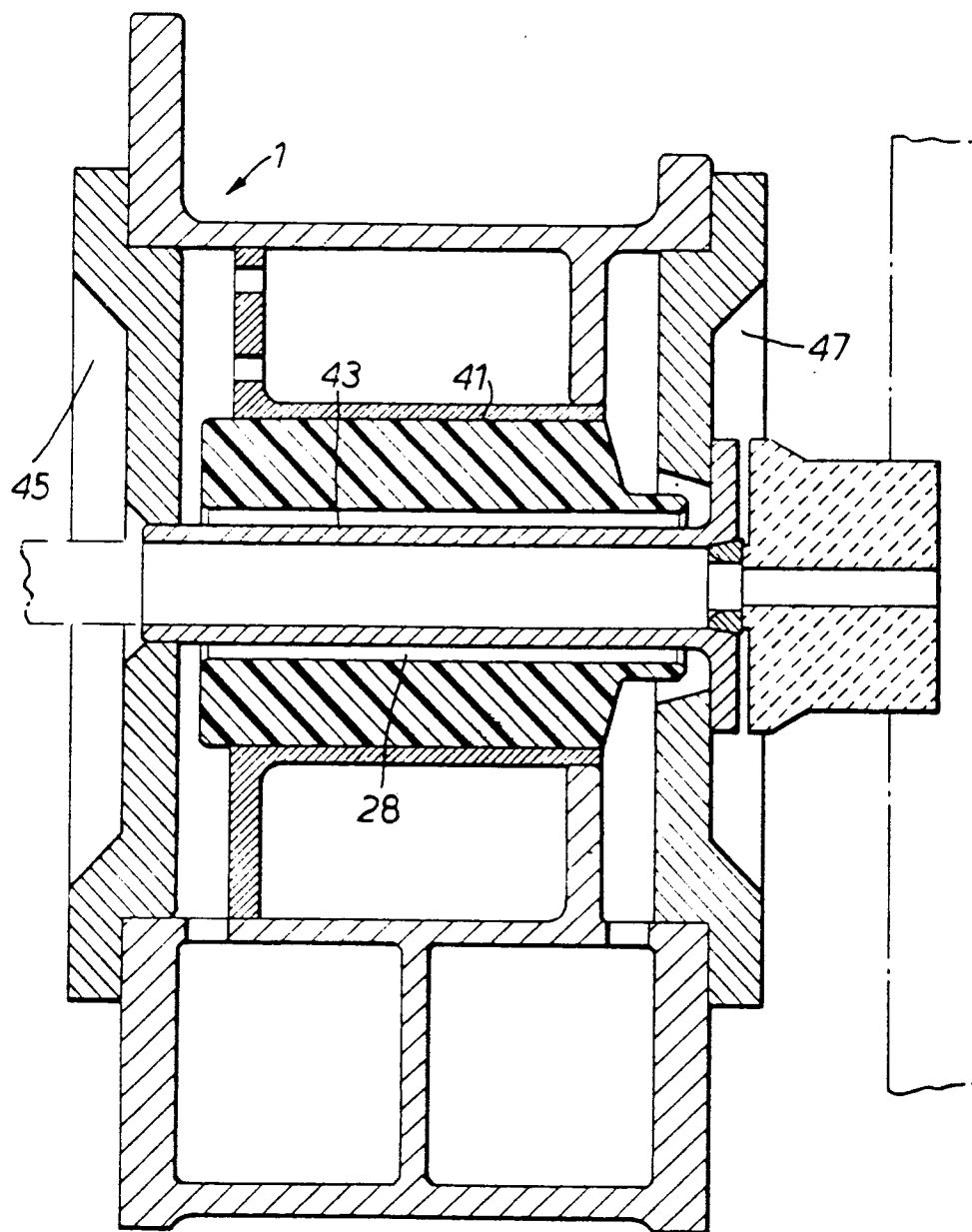


FIG. 3.