(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 572 812 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
27.03.2013 Bulletin 2013/13

(51) Int Cl.:
B22D 11/04 (2006.01) *B22D 11/055* (2006.01)

(21) Application number: 11182175.7

(22) Date of filing: 21.09.2011

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(71) Applicant: Siemens VAI Metals Technologies GmbH
4031 Linz (AT)

(72) Inventors:
- Das, Subroto Kumar
700052 Kolkata (IN)
- Hrazdera, Gerald
4470 Enns (AT)
- Pal, Amit
700047 Kolkata (IN)
- Poeppl, Johann
4202 Kirchschlag (AT)
- Pühringer, Thomas
4020 Linz (AT)
- Steins, Roger
90409 Nürnberg (DE)
- Thoene, Heinrich
4020 Linz (AT)
- Wimmer, Franz
4752 Riedau (AT)

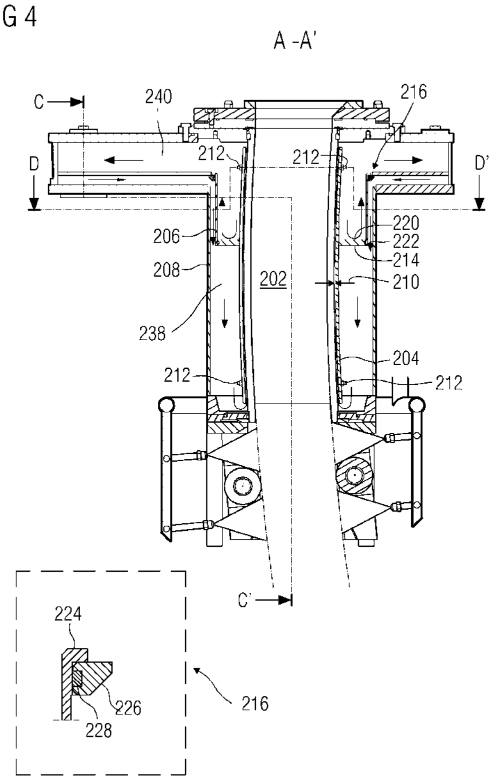
(74) Representative: Maier, Daniel Oliver
Siemens AG
Postfach 22 16 34
80506 München (DE)

Remarks:
Amended claims in accordance with Rule 137(2) EPC.

(54) **Mold assembly for continuous casting**

(57) The present invention provides a mold assembly (100) suitable for use in continuous casting. The mold assembly (100) includes a mold (202) delimiting a mold cavity for flow of molten metal. A cooling jacket (204) surrounds the mold (202) such that a flow gap (210) is formed there between. An intermediate tubular structure (206) surrounds the cooling jacket (204) and is coupled thereto through first coupling means (214). A housing assembly (208) encloses the mold (202) such that an enclosed space is formed between the housing assembly (208) and the mold (202). The intermediate tubular structure (206) and the housing assembly (208) are coupled using second coupling means (216).

FIG 4



EP 2 572 812 A1

Description

[0001] The present invention relates to continuous casting. In particular, the present invention relates to a mold assembly enabling uniform cooling during continuous casting.

[0002] Continuous casting is widely used to produce cast products such as billets, blooms, thick slabs/ingots, thin slabs, strips, and the like.

[0003] During continuous casting, molten metal is poured into an open-ended mold that cools and solidifies a peripheral region of the molten metal to form a metal strand. The metal strand is continuously withdrawn from the bottom of the mold while the molten metal is being continuously poured from the top. At steady state, the solid shell exiting the mold should form a stable metal strand that should have adequate mechanical strength to support the liquid metal core.

[0004] The mold is cooled using a cooling fluid to effect the formation of a solid shell in the peripheral region of the molten metal. The heat transfer from the molten metal at metal-mold interface leads to an initial solidification and subsequent growth of the solid shell against the mold. One of the objectives while designing a mold assembly is to match the rate of heat removal at the surface with the internal supply of heat from the molten metal core such that a surface temperature of the metal strand is reduced monotonically and uniformly along the peripheral region of the molten metal. The quality of the cast metal product and the production rates are directly dependent on the efficiency of the cooling process. Evidently, production of cast metal products of high quality at faster rates can be achieved through increasing the efficiency of the cooling process.

[0005] Non-uniform cooling of the metal strand leads to differential thickness, metallurgical structure and strength of the solid shell in the metal strand. Moreover, non-uniform cooling also results in differential thermal expansion and shrinkage in different regions, which in turn lead to thermal stress and strain inside the solid shell. These undesirable effects often lead to cracks or breakouts in the metal strand.

[0006] Thus, one of the challenges while designing the mold assembly is to ensure efficient and uniform cooling of the metal strand across the peripheral region. It is imperative that the temperature of the mold is effectively regulated to ensure sufficient mechanical strength and stability of the metal strand exiting the mold. Moreover, it is necessary to ensure uniform cooling of the inner surface of the mold along the circumference to effect uniform cooling of the metal strand along the peripheral region.

[0007] In various mold assemblies known in the art, a cooling jacket is attached to the mold. The mold, along with the attached cooling jacket, is placed in housing provided with inlet and outlet ports such that a cooling fluid may be flowed continuously through the space enclosed between the mold and the cooling jacket. The cooling jacket interfaces with the housing to partition the enclosed space into two chambers, which are interconnected through the flow space formed between the mold and the cooling jacket. A suitable sealing means is disposed between an interface of the cooling jacket and the housing to prevent leakage of the cooling fluid from one chamber to another. In addition, the cooling jacket is aligned with respect to the mold to achieve uniform spacing between an outer wall of the mold and an inner wall of the cooling jacket along the circumference such that a uniform temperature is maintained along the circumference of the mold.

[0008] One such assembly is known from the US patent 4,807,691. The patent discloses a mold unit for insertion into a water tank in a machine for continuous casting. The mold unit includes a mold tube, a pair of flanges, and a cooling jacket. The mold tube is resiliently held between the pair of flanges. The cooling jacket surrounds the mold tube such that there is formed a flow space between the cooling jacket and the mold tube. A flange extends radially outwardly from the cooling jacket. A plurality of rods interconnect the flanges in the pair of flanges and the flange extending from the cooling jacket such that the cooling jacket is suitably positioned with respect to the mold tube.

[0009] Various mold assemblies known in the prior art, as exemplified by the aforementioned patent, strive to provide a uniform gap between the mold and the cooling jacket through aligning the cooling jacket to a fixed axis such as the central axis of the mold using spacer bolts and the like. However, the two design objectives - providing a leakage-resistant interface between the cooling jacket and the housing, and ensuring a uniform gap between the mold and the cooling jacket - present an inherent contradiction. As the cooling jacket is adjusted to ensure symmetric alignment with respect to the mold, there is a risk that the interface between the housing and the cooling jacket becomes prone to leakage due to misalignment of the seal disposed therein. Moreover, this approach leads to disturbing lateral and longitudinal forces on the mold. Such forces may undesirably alter geometrical construction of the mold affecting the quality of the cast product formed there-through.

[0010] In light of the foregoing, there is a need for an improved mold assembly suitable for use in continuous casting such that efficient cooling of molten metal is enabled.

[0011] Accordingly, an object of the present invention is to provide a mold assembly suitable for use in continuous casting such that efficient cooling of molten metal is enabled.

[0012] The object of the present invention is achieved by a mold assembly according to claim 1. Further embodiments of the present invention are addressed in the dependent claims.

[0013] In accordance with the object of the present invention, a mold assembly suitable for use in continuous casting is provided. The mold assembly includes a mold, a cooling jacket, an intermediate tubular structure, and a housing assembly.

[0014] The mold delimits a mold cavity for flow of molten metal. The cooling jacket surrounds the mold such that a flow gap is formed between the mold and the cooling jacket. At least one of the mold and the cooling jacket is provided with adjusting means for adjusting a dimension of the flow gap between the mold and the cooling jacket along a radial direction. The intermediate tubular structure surrounds the cooling jacket and is coupled thereto through first coupling means disposed therein for coupling the cooling jacket and the intermediate tubular structure. The housing assembly encloses the mold such that an enclosed space is formed between the housing assembly and the mold. The cooling jacket and the intermediate tubular structure are disposed within the enclosed space. The housing assembly is coupled to the intermediate tubular structure through second coupling means disposed therein for coupling the intermediate tubular structure and the housing assembly.

[0015] The mold assembly of the present invention facilitates improved alignment between the mold and the cooling jacket to ensure uniform flow gap along a circumference of the mold. The uniform flow gap facilitates efficient heat transfer from the incipient metal strand inside the mold towards the outside, and thereby advantageously eliminates thermal stress and strain inside the solid shell of the resulting metal strand; and hence, mitigates the risk of cracks or break-outs in the resulting metal strand exiting the mold. Further, owing to the inventive design of the mold assembly in accordance with the present invention, an alignment of the mold and the cooling jacket to ensure uniform flow gap along a circumference of the mold neither leads to undesirable mechanical forces on the mold nor renders an interface between the cooling jacket and the intermediate tubular structure and an interface between the intermediate tubular structure and the housing assembly, susceptible to leakage.

[0016] In accordance with an embodiment of the present invention, the first coupling means include a coupling flange extending outwards from the cooling jacket. This technical feature provides the first coupling means for coupling the cooling jacket and the intermediate tubular structure.

[0017] In accordance with another embodiment of the present invention, the second coupling means couple the intermediate tubular structure to the housing assembly in a non-rigid manner. In accordance with an embodiment of the present invention, the second coupling means include an engaging flange extending outwards from the intermediate tubular structure and a supporting structure formed in the housing assembly such that the engaging flange rests on the supporting structure in a non-rigid manner. These technical features ensure that any undesirable mechanical forces on the mold due to alignment of the mold and the cooling jacket are minimized.

[0018] In accordance with another embodiment of the present invention, the mold assembly includes first and second sealing means. The first sealing means provide a leakage-resistant coupling between the cooling jacket and the intermediate tubular structure. The second sealing means provide a leakage-resistant coupling between the intermediate tubular structure and the housing assembly. This technical feature ensures that formation of any undesirable flow path of a cooling fluid is avoided.

[0019] In accordance with still another embodiment of the present invention, the mold assembly includes third coupling means for coupling the cooling jacket to the housing assembly. In accordance with yet another embodiment of the present invention, the third coupling means are such that the cooling jacket is displaceable with respect to the mold along a longitudinal direction. These technical features ensure enhanced flexibility in positioning the cooling jacket with respect to the mold along a longitudinal direction.

[0020] In accordance with another embodiment of the present invention, the cooling jacket, the first coupling means, the intermediate tubular structure and the second coupling means partition the enclosed space into an inlet chamber and an outlet chamber such that the inlet chamber and the outlet chamber are interconnected through the flow gap. In accordance with an embodiment of the present invention, a cooling fluid flows from the inlet chamber to the outlet chamber through the flow gap. These technical features facilitate establishing a flow path for flow of a cooling fluid through the mold assembly for effectively extracting heat from the molten metal flowing through the mold.

[0021] The present invention is further described hereinafter with reference to illustrated embodiments shown in the accompanying drawings, in which:

FIG 1 illustrates a first perspective view of a mold assembly in accordance with an embodiment of the present invention,

FIG 2 illustrates a second perspective view of the mold assembly in accordance with an embodiment of the present invention,

FIG 3 illustrates a top view of the mold assembly in accordance with an embodiment of the present invention,

FIG 4 illustrates a first longitudinal sectional view of the mold assembly in accordance with an embodiment of the present invention,

FIG 5 illustrates a second longitudinal sectional view of the mold assembly in accordance with an embodiment of the present invention,

FIG 6 illustrates a third longitudinal sectional view of the mold assembly in accordance with an embodiment of the present invention, and

FIG 7 illustrates a transverse sectional view of the mold assembly in accordance with an embodiment of the present invention.

[0022] Various embodiments are described with reference to the drawings, wherein like reference numerals are used to refer to like elements throughout. In the following description, for purpose of explanation, numerous specific details are set forth in order to provide a thorough understanding of one or more embodiments. It may be evident that such embodiments may be practiced without these specific details.

[0023] During continuous casting, molten metal flows from a ladle into a small intermediate vessel known as a tundish. The molten metal then flows from the tundish through a submerged nozzle according to the position of a stopper-rod or a slide-gate or an open-pour nozzle, to enter a mold assembly. The mold assembly includes a mold, which is an open-ended tubular structure, which is cooled using a cooling fluid circulated through various elements of the mold assembly surrounding the mold. The peripheral region of the molten metal loses heat to the cooled walls of the mold to form a metal strand with a thin solid shell. A drive rolls assembly located below the mold assembly continuously withdraws the metal strand out of the mold assembly. At steady state, the metal strand exiting the mold should have adequate mechanical strength to support the liquid metal core. The mold assembly should be efficiently cooled to satisfy this requirement.

[0024] The present invention provides an improved mold assembly suitable for use in continuous casting as described above.

[0025] Referring now to the drawings, FIG 1 and FIG 2 illustrate a first perspective view and a second perspective view respectively of the mold assembly 100 in accordance with an embodiment of the present invention.

[0026] The mold assembly 100 includes an inlet 102, outlet 104, inlet 106 and outlet 108. FIG 1 also illustrates metal strand 110 exiting the mold assembly 100.

[0027] The molten metal enters the mold assembly 100 through the inlet 102. A peripheral region of the molten metal gets cooled in the mold assembly 100 such that a metal strand 110 with a molten core and a solid shell is formed. The metal strand 110 exits the mold assembly 100 from the outlet 104.

[0028] The mold assembly 100 is cooled by circulating a cooling fluid through an enclosed space inside the mold assembly 100. The cooling fluid enters the mold assembly 100 through the inlet 106 and exits the mold assembly 100 from the outlet 108.

[0029] It should be noted that the term "metal", as used herein, is intended to refer to any material, such as pure metals and any alloys thereof such as steel and so on, and the like, that is suitable for forming a cast product such as billets, blooms, thick slabs/ingots, thin slabs, strips, and the like.

[0030] FIG 3 illustrates a top view of the mold assembly 100 in accordance with an embodiment of the present invention. FIGS 4 and 5 will illustrate longitudinal sectional views of the mold assembly 100 along A-A' and B-B' shown in FIG 3.

[0031] FIGS 4 and 5 illustrate longitudinal sectional views of the mold assembly 100 respectively along A-A' and B-B' shown in FIG 3. Similarly, FIG 6 illustrates a longitudinal sectional view of the mold assembly 100 along C-C' shown in FIG 4.

[0032] The mold assembly 100 includes a mold 202, a cooling jacket 204, an intermediate tubular structure 206, and a housing assembly 208.

[0033] The mold 202 is an open-ended tubular structure which delimits a mold cavity. The mold cavity defines a longitudinal casting direction along which molten metal flows during continuous casting.

[0034] The mold 202 shown in FIGS 4 through 6 has a curved development suitable for curved apron casting set-up. Further, the mold 202 has a substantially square cross-section. However, in various alternative embodiments of the present invention, the mold 202 may be straight and may have any desired cross-section in accordance with a desired cross-section of the cast product.

[0035] The cooling jacket 204 has a cross-sectional shape that corresponds to the cross-sectional shape of the mold 202. The cooling jacket 204 has such dimensions that the cooling jacket 204 surrounds the mold 202 such that a flow gap 210 is formed between the mold 202 and the cooling jacket 204.

[0036] In various embodiments of the present invention, various structural elements, such as baffles and the like, may be disposed on an inner surface of the cooling jacket 204 to facilitate uniform distribution of the cooling fluid. Such structural elements are well-known in the art and are not being described in detail for the sake of brevity.

[0037] The cooling jacket 204 is coupled to the housing assembly 208 through third coupling means 218. The housing assembly 208 includes a top covering flange 230 with such cross-section and dimensions that is suitable for receiving the top portion of the mold 202. The top covering flange 230 is provided with a pair of brackets 232 symmetrically disposed on either side of a central axis 'X' of the mold 202. The cooling jacket 204 is provided with lugs 234 on diametrically opposite sides such that the cooling jacket 204 may be coupled to the brackets 232. Each bracket 232 includes a through-hole elongated along a longitudinal direction. The cooling jacket 204 is coupled to the brackets 232 through use of fasteners 236. As the through-hole is elongated along the longitudinal direction, the cooling jacket 204 may be displaced with respect to the mold 202 and suitably positioned along a longitudinal direction. It should be noted that the third coupling means 218 are such that the cooling jacket 204 is suspended from the housing assembly 208. In other words, the third coupling means 218 permit movement of the cooling jacket 204 in any direction along a transverse plane orthogonal to planes A-A' and B-B'.

[0038] At least one of the mold 202 and the cooling jacket 204 is attached to adjusting means 212 that enable adjustment of a dimension of the flow gap 210 along a radial direction with respect to central axis 'X'. In one exemplary embodiment, the adjusting means 212 include one or more spacer bolts disposed along the circumference of the cooling jacket 204 is a suitable manner.

[0039] The intermediate tubular structure 206 surrounds the cooling jacket 204. At least one of the cooling jacket 204 and the intermediate tubular structure 206 are provided with a first coupling means 214. In accordance with an embodiment of the present invention, the first coupling means 214 include a coupling flange 220. The coupling flange 220 extends outwards from the cooling jacket 204. In an alternative embodiment of the present invention, the first coupling means 214 include a coupling flange extending inwards from the intermediate tubular structure 206. The first coupling means 214 further include a first sealing means 222. The first sealing means 222 is disposed at an interface of the coupling flange 220 and the intermediate tubular structure 206 to ensure that the corresponding interface is leakage-resistant. In an exemplary embodiment of the present invention, the first sealing means 222 include an o-ring.

[0040] The region where the first coupling means 214 are disposed relative to longitudinal dimensions of the cooling jacket 204 and the intermediate tubular structure 206 will determine the relative longitudinal position of the cooling jacket 204 and the intermediate tubular structure 206.

[0041] The housing assembly 208 surrounds the intermediate tubular structure 206. At least one of the intermediate tubular structure 206 and the housing assembly 208 are provided with a second coupling means 216 for coupling thereof. In an exemplary embodiment of the present invention, the intermediate tubular structure 206 is provided with an engaging flange 224 and the housing assembly 208 is provided with a supporting structure 226. The engaging flange 224 rests on the supporting structure 226. The second coupling means 216, as described above, provides a non-rigid coupling between the intermediate tubular structure 206 and the housing assembly 208. This facilitates minimizing any undesirable mechanical forces on the mold 202. Further, a second sealing means 228 is disposed at an interface of the intermediate tubular structure 206 and the housing assembly 208. In an exemplary embodiment of the present invention, the second sealing means 228 includes an o-ring.

[0042] The housing assembly 208 encloses the mold 202. The housing assembly 208 includes openings formed in a top portion and a bottom portion with such cross-section and dimensions that it is suitable for receiving top and bottom portions of the mold 202 respectively. The mold 202 is rigidly attached to the housing assembly 208 through additional flanges and bolts arrangement and a sealing means.

[0043] The mold 202 and the housing assembly 208 form an enclosed space. The enclosed space includes the cooling jacket 204 and the intermediate tubular structure 206. The cooling jacket 204 and the intermediate tubular structure 206, along with the first and the second coupling means 214 and 216, form a leakage-resistant partition that splits the enclosed space into an inlet chamber 238 and an outlet chamber 240. The inlet and the outlet chambers 238 and 240 are interconnected through the flow gap 210.

[0044] The cooling fluid enters the inlet chamber 238 through the inlet 106 under pressurized condition. The cooling fluid subsequently flows through the flow gap 210 in a direction substantially counter to a direction of flow of molten metal in the mold 202. The cooling fluid exits the flow gap 210 to enter into the outlet chamber 240 and eventually, is removed from the enclosed space through the outlet 108. The flow of cooling fluid through the enclosed space is indicated through arrows marked in FIGS 4 through 6.

[0045] FIG 7 illustrates a transverse sectional view of the mold assembly 100 along D-D' shown in FIG 4. In particular, FIG 7 is intended to illustrate the flow gap 210 and the adjusting means 212 disposed along a circumference of the mold 202. Various other elements of the mold assembly 100 shown in FIG 7 have already been described in detail in conjunction with the foregoing figures.

[0046] The mold assembly of the present invention facilitates improved alignment between the mold and the cooling jacket to ensure uniform flow gap along a circumference of the mold.

[0047] The uniform flow gap facilitates efficient heat transfer from the incipient metal strand inside the mold towards the outside, thereby advantageously eliminating thermal stress and strain inside the solid shell of the resulting metal strand; and hence, mitigating the risk of cracks or break-outs in the resulting metal strand after exit from the mold.

[0048] As explained in the foregoing description, the cooling jacket in the mold assembly of the present invention may be adjusted not only in a transverse direction (i.e. in a plane perpendicular the casting direction) but also in a longitudinal plane. Hence, the mold assembly enables a fully-floating design of the cooling jacket attached to the mold such that the flexibility for adjusting the cooling jacket with respect to the mold is increased manifold.

[0049] The mold assembly in accordance with the present invention provides a cooling jacket that interfaces with the housing assembly through an intermediate tubular structure. The intermediate tubular structure through its coupling to the cooling jacket on one side and the housing assembly on the other side, partitions the enclosed space between the mold and the housing assembly into an inlet chamber and an outlet chamber, which are interconnected through the flow gap formed between the cooling jacket and the mold.

[0050] Owing to the inventive design of the mold assembly in accordance with the present invention, an alignment of the mold and the cooling jacket to ensure uniform flow gap along a circumference of the mold does not lead to any undesirable mechanical forces on the mold. Furthermore, owing to the inventive design of the mold assembly in accordance with the present invention, an alignment of the mold and the cooling jacket does not render an interface between the cooling jacket and the intermediate tubular structure and an interface between the intermediate tubular structure and the housing assembly, susceptible to leakage.

[0051] While the present invention has been described in detail with reference to certain embodiments, it should be appreciated that the present invention is not limited to those embodiments. In view of the present disclosure, many modifications and variations would present themselves, to those of skill in the art without departing from the scope and spirit of this invention. The scope of the present invention is, therefore, indicated by the following claims rather than by the foregoing description. All changes, modifications, and variations coming within the meaning and range of equivalency of the claims are to be considered within their scope.

Claims

1. A mold assembly (100) suitable for use in continuous casting, the mold assembly (100) comprising:

- a mold (202), the mold (202) delimiting a mold cavity for flow of molten metal,
- a cooling jacket (204), the cooling jacket (204) surrounding the mold (202) such that a flow gap (210) is formed between the mold (202) and the cooling jacket (204), wherein at least one of the mold (202) and the cooling jacket (204) is provided with adjusting means (212) for adjusting a dimension of the flow gap (210) between the mold (202) and the cooling jacket (204) along a radial direction,
- an intermediate tubular structure (206), the intermediate tubular structure (206) surrounding the cooling jacket (204) and coupled thereto through first coupling means (214) disposed therein for coupling the cooling jacket (204) and the intermediate tubular structure (206), and
- a housing assembly (208), the housing assembly (208) enclosing the mold (202) such that an enclosed space is formed between the housing assembly (208) and the mold (202), wherein the cooling jacket (204) and the intermediate tubular structure (206) are disposed within the enclosed space, and wherein the housing assembly (208) is coupled to the intermediate tubular structure (206) through second coupling means (216) disposed therein for coupling the intermediate tubular structure (206) and the housing assembly (208).

2. The mold assembly (100) according to claim 1, the first coupling means (214) comprise a coupling flange (220) extending outwards from the cooling jacket (204).

3. The mold assembly (100) according to claim 1 or 2, wherein the second coupling means (216) couple the intermediate tubular structure (206) to the housing assembly (208) in a non-rigid manner.

4. The mold assembly (100) according to any of claims 1 to 3, wherein the second coupling means (216) comprise an engaging flange (224) extending outward from the intermediate tubular structure (206) and a supporting structure (226) formed in the housing assembly (208) such that the engaging flange (224) rests on the supporting structure (226) in a non-rigid manner.

5. The mold assembly (100) according to any of claims 1 to 4 further comprising first sealing means (222) for providing a leakage-resistant coupling between the cooling jacket (204) and the intermediate tubular structure (206), and second sealing means (228) for providing a leakage-resistant coupling between the intermediate tubular structure (206) and the housing assembly (208).

6. The mold assembly (100) according to any of claims 1 to 5 further comprising third coupling means (218) for coupling the cooling jacket (204) to the housing assembly (208).

7. The mold assembly (100) according to claim 6, wherein the third coupling means (218) are such that the cooling jacket (204) is displaceable with respect to the mold (202) along a longitudinal direction.

8. The mold assembly (100) according to any of claims 1 to 7, wherein the cooling jacket (204), the first coupling means (214), the intermediate tubular structure (206) and the second coupling means (216) partition the enclosed space into an inlet chamber (238) and an outlet chamber (240) such that the inlet chamber (238) and the outlet chamber (240) are interconnected through the flow gap (210).

9. The mold assembly (100) according to claim 8, wherein a cooling fluid flows from the inlet chamber (238) to the outlet chamber (240) through the flow gap (210).

Amended claims in accordance with Rule 137(2) EPC.

1. A mold assembly (100) suitable for use in continuous casting, the mold assembly (100) comprising:

- a mold (202), the mold (202) delimiting a mold cavity for flow of molten metal along a longitudinal direction,
- a cooling jacket (204), the cooling jacket (204) surrounding the mold (202) such that a flow gap (210) is formed between the mold (202) and the cooling jacket (204), wherein at least one of the mold (202) and the cooling jacket (204) is provided with adjusting means (212) for adjusting a dimension of the flow gap (210) between the mold (202) and the cooling jacket (204) along a radial direction,
- an intermediate tubular structure (206), the intermediate tubular structure (206) surrounding the cooling jacket (204) and coupled thereto through first coupling means (214) disposed therein for coupling the cooling jacket (204) and the intermediate tubular structure (206), and
- a housing assembly (208), the housing assembly (208) enclosing the mold (202) such that an enclosed space is formed between the housing assembly (208) and the mold (202), wherein the cooling jacket (204) and the intermediate tubular structure (206) are disposed within the enclosed space such that the housing assembly (208) surrounds the intermediate tubular structure (206), and wherein the housing assembly (208) is coupled to the intermediate tubular structure (206) through second coupling means (216) disposed therein for coupling the intermediate tubular structure (206) and the housing assembly (208).

2. The mold assembly (100) according to claim 1, the first coupling means (214) comprise a coupling flange (220) extending outwards from the cooling jacket (204).

3. The mold assembly (100) according to claim 1 or 2, wherein the second coupling means (216) couple the intermediate tubular structure (206) to the housing assembly (208) in a non-rigid manner.

4. The mold assembly (100) according to any of claims 1 to 3, wherein the second coupling means (216) comprise an engaging flange (224) extending outward from the intermediate tubular structure (206) and a supporting structure (226) formed in the housing assembly (208) such that the engaging flange (224) rests on the supporting structure (226) in a non-rigid manner.

5. The mold assembly (100) according to any of claims 1 to 4 further comprising first sealing means (222) for providing a leakage-resistant coupling between the cooling jacket (204) and the intermediate tubular structure (206), and second sealing means (228) for providing a leakage-resistant coupling between the intermediate tubular structure (206) and the housing assembly (208).

6. The mold assembly (100) according to any of claims 1 to 5 further comprising third coupling means (218) adapted for suspending the cooling jacket (204) from the housing assembly (208) and permitting movement of the cooling jacket (204) in any direction along a transverse plane, the transverse plane being orthogonal to the longitudinal direction.

7. The mold assembly (100) according to claim 6, wherein the third coupling means (218) are further adapted for displacing the cooling jacket (204) with respect to the mold (202) and suitably positioning along the longitudinal direction.

8. The mold assembly (100) according to any of claims 1 to 7, wherein the cooling jacket (204), the first coupling means (214), the intermediate tubular structure (206) and the second coupling means (216) partition the enclosed space into an inlet chamber (238) and an outlet chamber (240) such that the inlet chamber (238) and the outlet chamber (240) are interconnected through the flow gap (210).

9. The mold assembly (100) according to claim 8, wherein a cooling fluid flows from the inlet chamber (238) to the outlet chamber (240) through the flow gap (210).

FIG 1

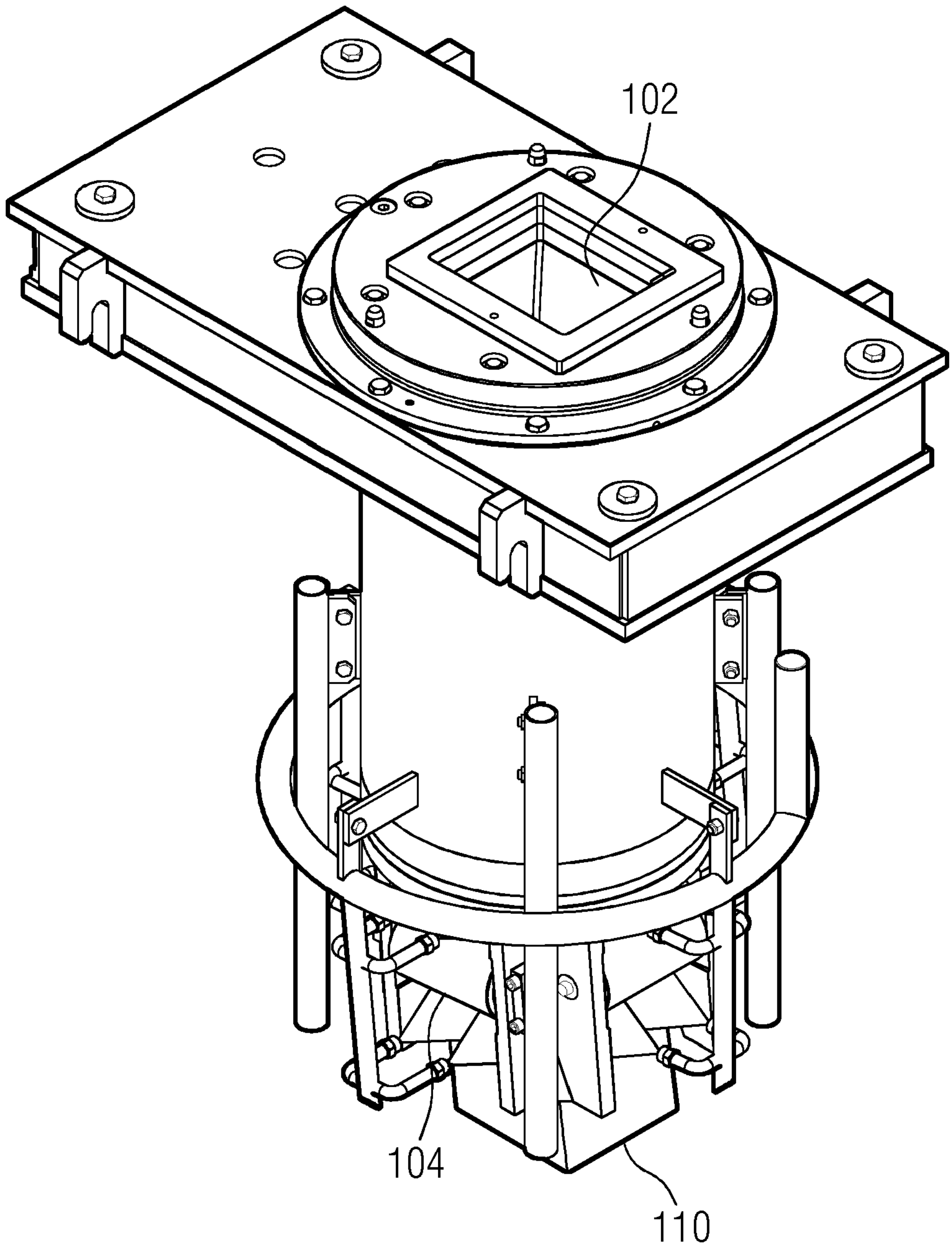


FIG 2

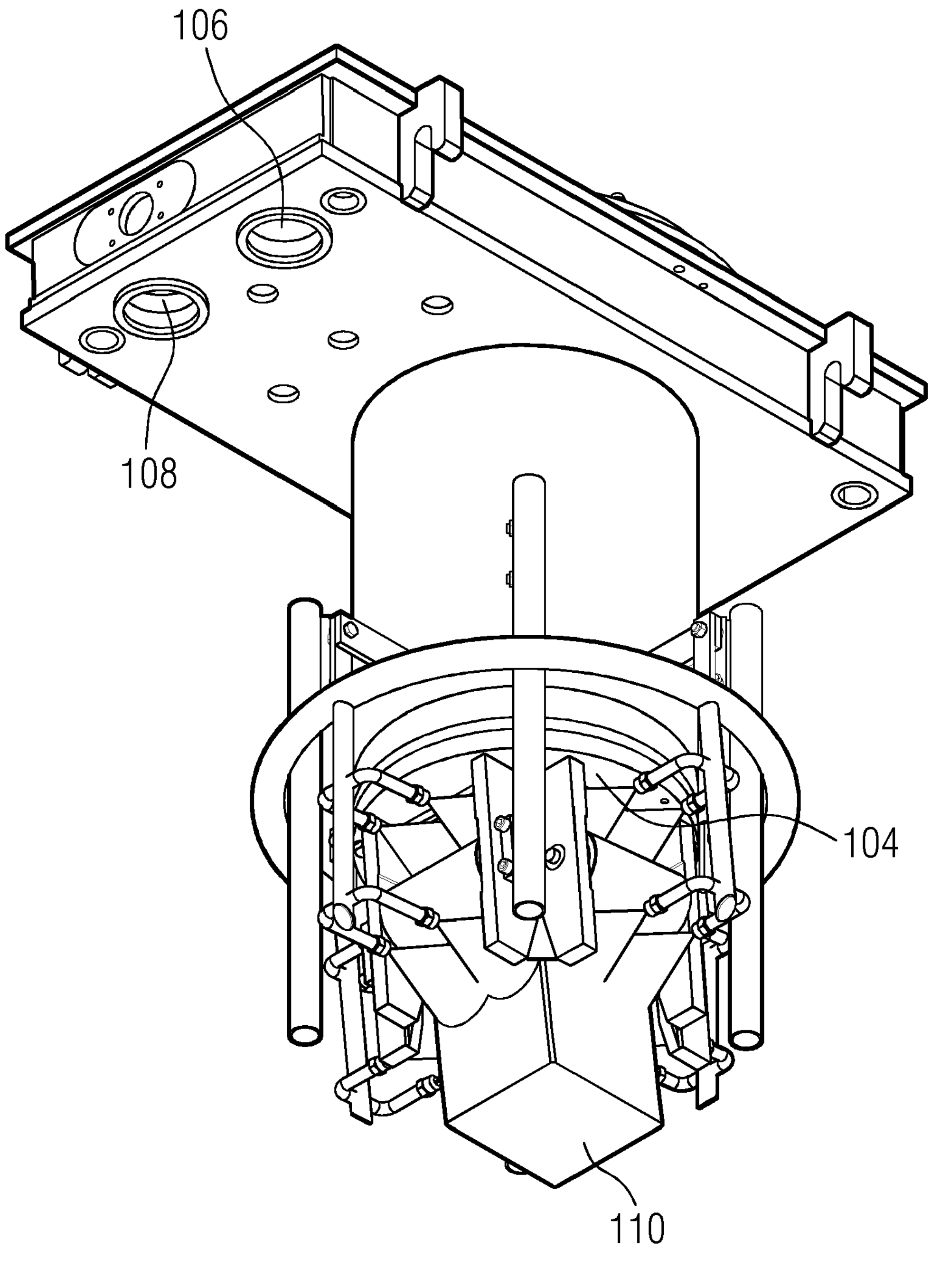


FIG 3

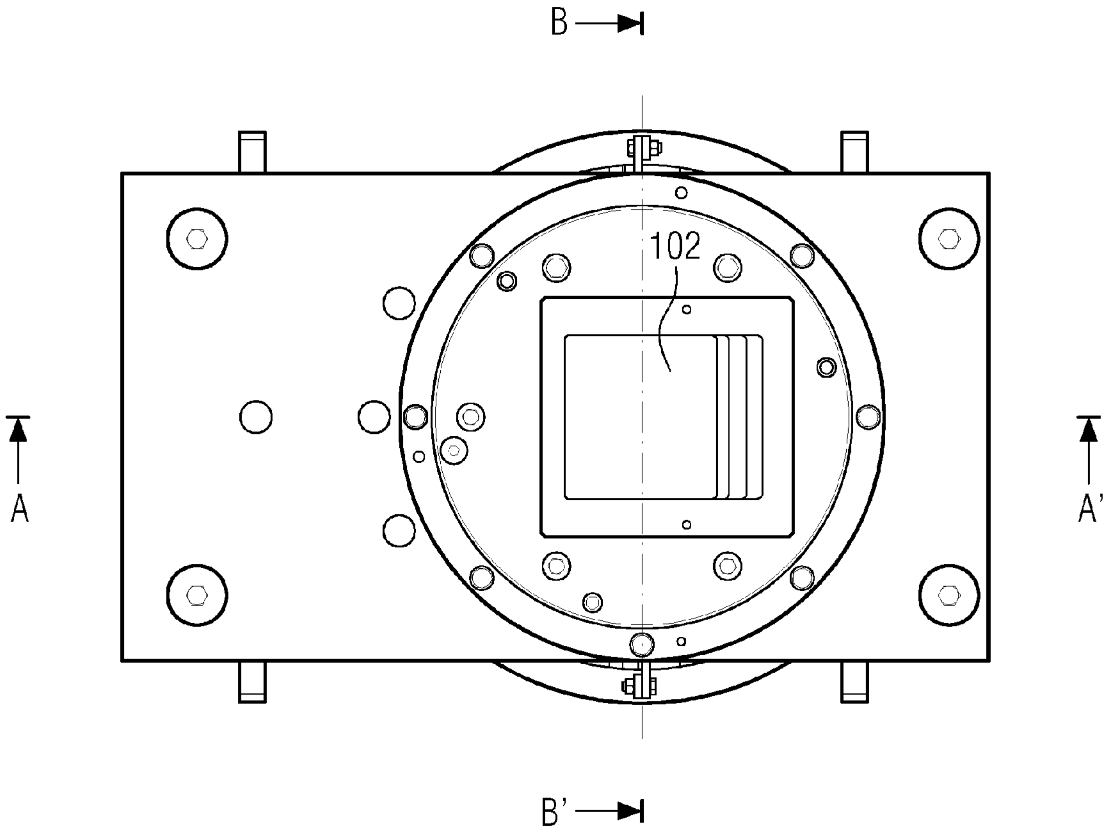


FIG 4

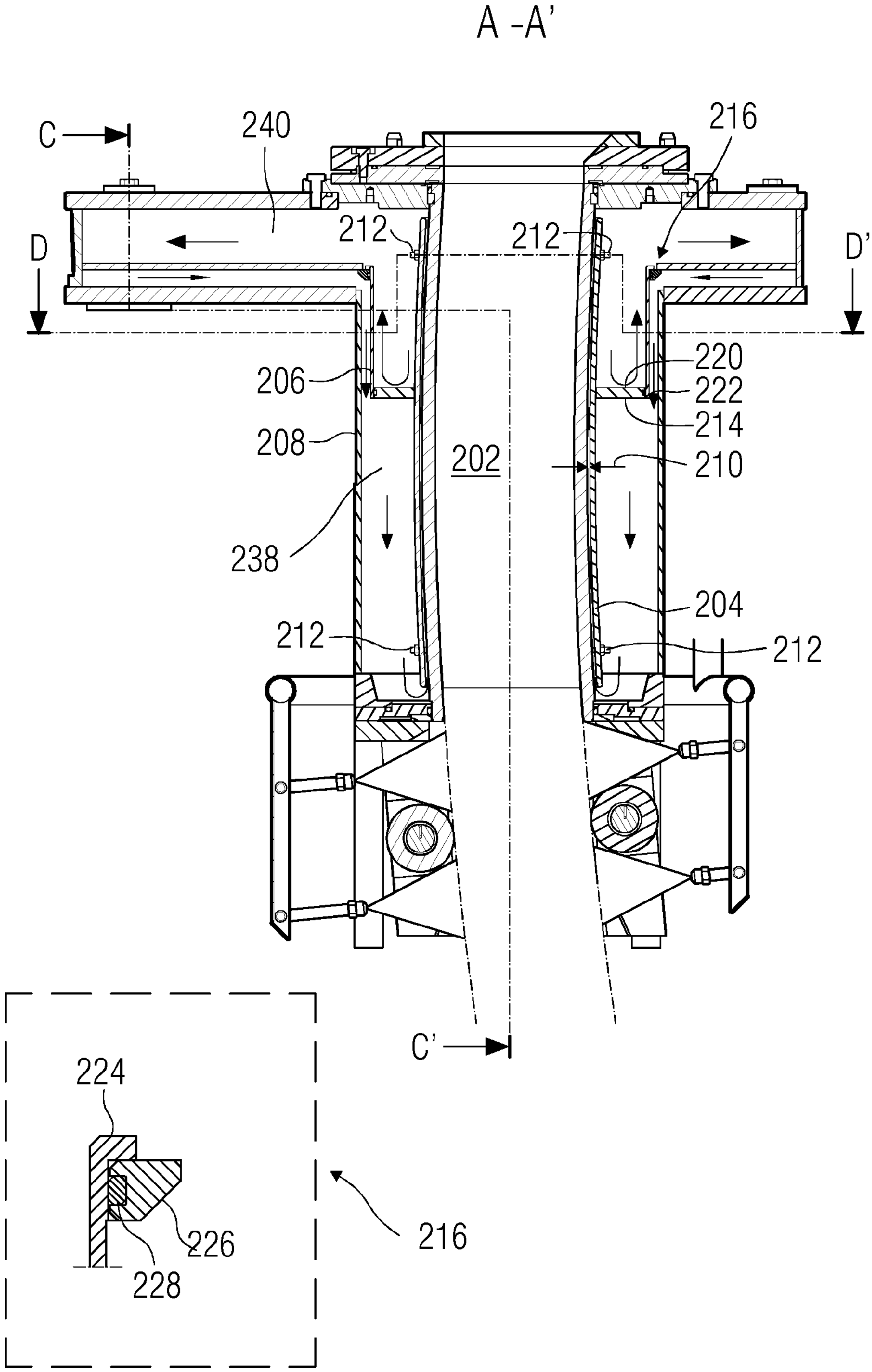

A -A'
C
240
216
212
212
D
D'
206
220
222
214
208
202
210
238
204
212
212
C'
224
226
228
216

FIG 5

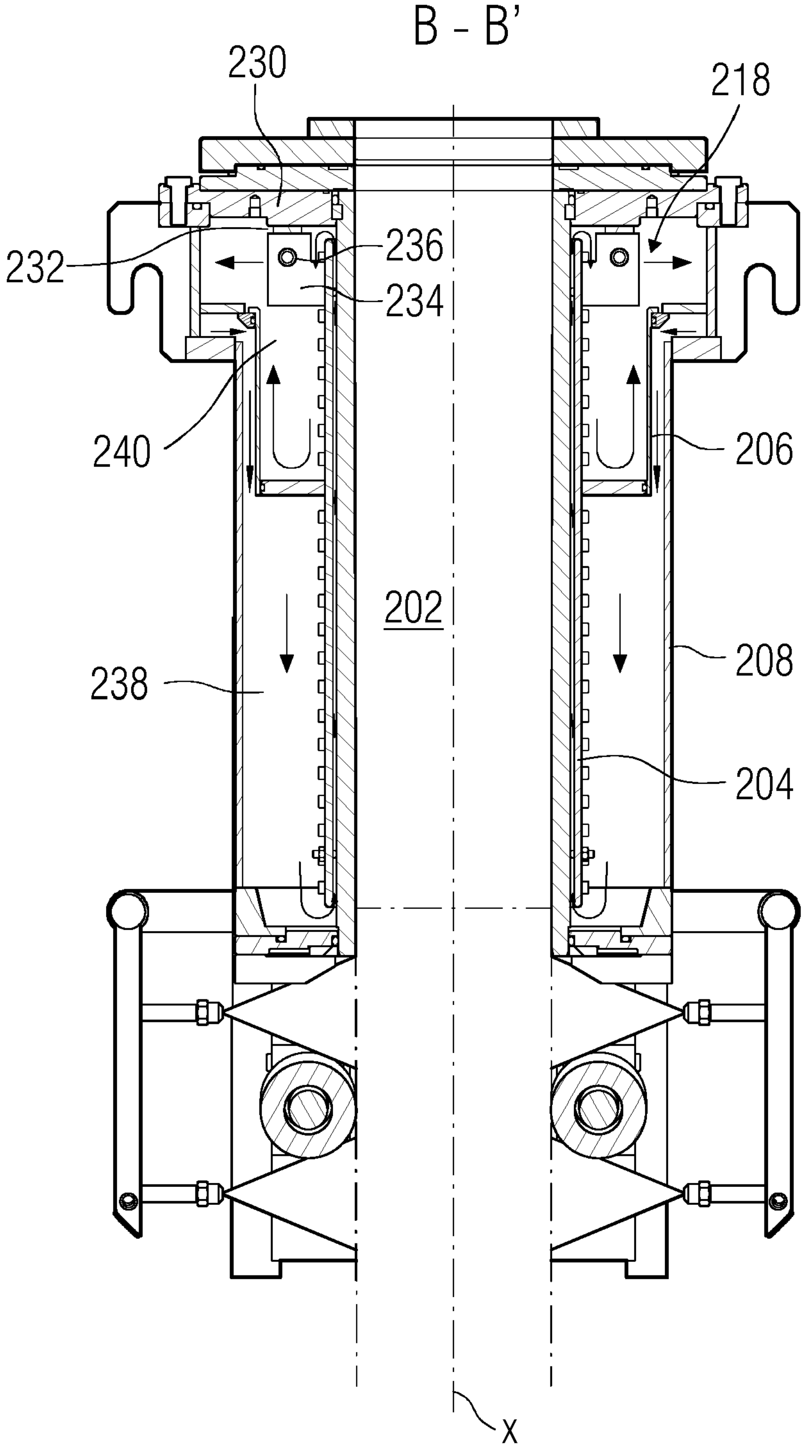


FIG 6

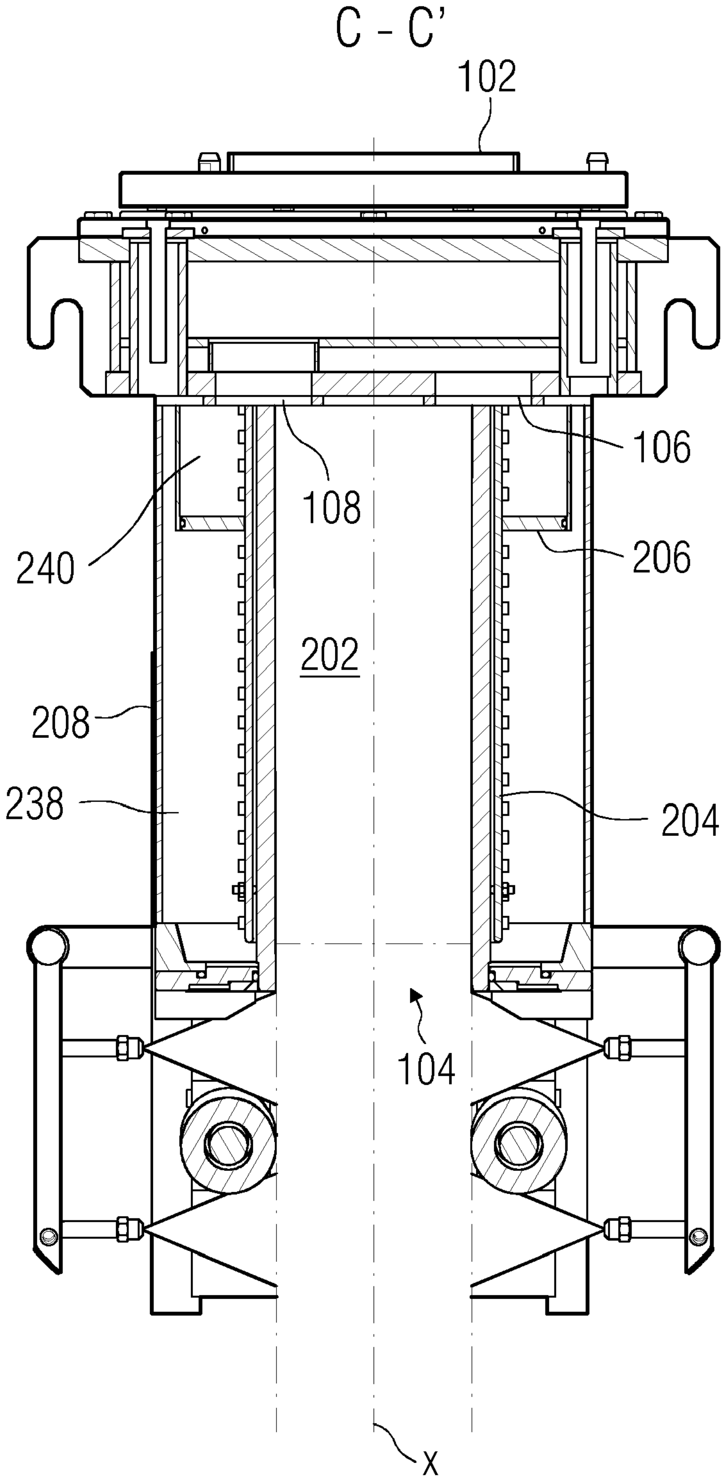
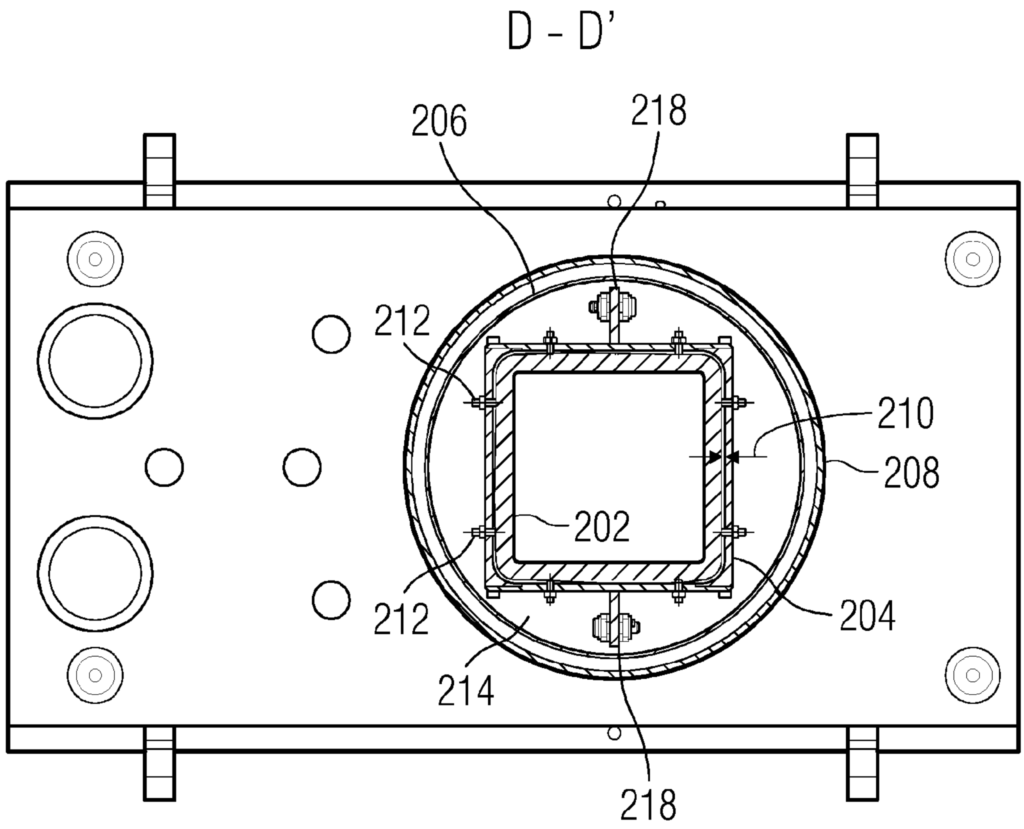


FIG 7



Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 11 18 2175

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X A	DE 32 07 149 C1 (MANNESMANN AG) 7 July 1983 (1983-07-07) * column 2, line 10 - column 4, line 30 * * figures 1,2 *	1-6,8,9 7	INV. B22D11/04 B22D11/055
X	EP 0 263 779 A2 (MANNESMANN AG [DE]) 13 April 1988 (1988-04-13) * column 2, line 9 - column 6, line 56 * * figures 1,2 *	1-3,8,9	
X	US 3 527 287 A (HUBER HORST) 8 September 1970 (1970-09-08) * column 2, line 4 - column 4, line 68 * * figure 1 *	1,2,8,9	
X	DE 24 48 275 A1 (SIDERURGIE FSE INST RECH) 24 April 1975 (1975-04-24) * page 4 - page 15 * * figure 1 *	1,2,8,9	
X	GB 954 330 A (BOEHLER & CO AG GEB) 2 April 1964 (1964-04-02) * page 1, line 75 - page 2, line 83 * * figures 1,2 *	1,2,8,9	TECHNICAL FIELDS SEARCHED (IPC) B22D
X	FR 2 442 092 A1 (ROTELEC SA ROTELEC SA [FR]) 20 June 1980 (1980-06-20) * page 2, line 6 - page 3, line 41 * * figure 1 *	1,2,8,9	
X	WO 2007/096420 A2 (DANIELI OFF MECC [IT]; POLONI ALFREDO [IT]; DE LUCA ANDREA [IT]; ANSOL) 30 August 2007 (2007-08-30) * figures 1-4 * * page 2, line 10 - page 6, line 31 * -/--	1,8,9	

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	1 February 2012	Zimmermann, Frank

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 11 18 2175

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	DE 10 31 936 B (EISENWERKE GELSENKIRCHEN AG) 12 June 1958 (1958-06-12) * column 1, line 32 - column 2, line 44 * * figure 1 * -----	1,8,9	
A	DE 29 14 385 A1 (SIDERURGIE FSE INST RECH) 25 October 1979 (1979-10-25) * the whole document * -----	1-9	
			TECHNICAL FIELDS SEARCHED (IPC)

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	1 February 2012	Zimmermann, Frank

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons
....
& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 11 18 2175

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

01-02-2012

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 3207149 C1	07-07-1983	DE 3207149 C1	07-07-1983
		ES 8308732 A1	16-12-1983
		FR 2522290 A1	02-09-1983
		GB 2115328 A	07-09-1983
		IT 1160485 B	11-03-1987
		JP 59016755 U	01-02-1984
		JP 61006980 Y2	03-03-1986
		US 4807691 A	28-02-1989
EP 0263779 A2	13-04-1988	EP 0263779 A2	13-04-1988
		US 4714103 A	22-12-1987
US 3527287 A	08-09-1970	NONE	
DE 2448275 A1	24-04-1975	BE 821110 A1	16-04-1975
		DE 2448275 A1	24-04-1975
		FR 2248103 A1	16-05-1975
		GB 1466008 A	02-03-1977
		IT 1022350 B	20-03-1978
		JP 999884 C	30-05-1980
		JP 50067723 A	06-06-1975
		JP 53008535 B	29-03-1978
		US 3941183 A	02-03-1976
GB 954330 A	02-04-1964	NONE	
FR 2442092 A1	20-06-1980	NONE	
WO 2007096420 A2	30-08-2007	BR PI0708268 A2	24-05-2011
		CA 2637628 A1	30-08-2007
		CN 101389427 A	18-03-2009
		EP 2004348 A2	24-12-2008
		US 2009014147 A1	15-01-2009
		WO 2007096420 A2	30-08-2007
DE 1031936 B	12-06-1958	NONE	
DE 2914385 A1	25-10-1979	BE 875331 A1	05-10-1979
		CH 630274 A5	15-06-1982
		DE 2914385 A1	25-10-1979
		FR 2423285 A1	16-11-1979
		GB 2020212 A	14-11-1979
		IT 1115168 B	03-02-1986
		JP 1248948 C	25-01-1985
		JP 54139833 A	30-10-1979
		JP 59023900 B	05-06-1984

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 11 18 2175

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

01-02-2012

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
		LU 81160 A1	07-11-1979
		US 4299267 A	10-11-1981

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US 4807691 A **[0008]**