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(54) STRIP CASTING APPARATUS

BANDGIESSVORRICHTUNG

DISPOSITIF DE COUL E EN BANDES

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EP 1 173 301 B9

Description

TECHNICAL FIELD

[0001] This invention relates to the casting of metal strip. It has particular but not exclusive application to the casting of ferrous metal strip.

[0002] It is known to cast metal strip by continuous casting in a twin roll caster. Molten metal is introduced between a pair of contra-rotated horizontal casting rolls which are cooled so that metal shells solidify on the moving roll surfaces and are brought together at the nip between them to produce a solidified strip product delivered downwardly from the nip between the rolls. The term "nip" is used herein to refer to the general region at which the rolls are closest together. The molten metal may be poured from a ladle into a smaller vessel or series of smaller vessels from which it flows through a metal delivery nozzle located above the nip so as to direct it into the nip between the rolls, so forming a casting pool of molten metal supported on the casting surfaces of the rolls immediately above the nip. This casting pool may be confined between side plates or dams held in sliding engagement with the ends of the rolls.

[0003] Although twin roll casting has been applied with some success to non-ferrous metals which solidify rapidly on cooling, there have been problems in applying the technique to the casting of ferrous metals which have high solidification temperatures and tend to produce defects caused by uneven solidification at the chilled casting surfaces of the rolls. One particular problem arises due to the formation of pieces of solid metal known as "skulls" in the vicinity of the pool confining side plates. These problems are exacerbated when efforts are made to reduce the superheat of the incoming molten metal. The rate of heat loss from the melt pool is greatest near the side plates due primarily to additional conductive heat transfer through the side plates to the roll ends. This high rate of local heat loss is reflected in the tendency to form "skulls" of solid metal in this region which can grow to a considerable size and fall between the rolls causing defects in the strip generally known as "snake eggs". It is therefore very important to maintain constant pool conditions in the region of the side plates. In particular, the setting of the gaps between the nozzle ends and the inner faces of the side plates is critically important.

[0004] We have determined that significant flow changes are brought about by variation in the position in the ends of the delivery nozzle relative to the side plates which may be brought about by inaccurate location of the delivery nozzle during set up and by subsequent movement of the nozzle ends due to thermal expansion during casting. This problem remains even if the nozzle is designed specifically to provide an increased flow of metal to the "triple point" regions (ie. where the side dams and casting rolls meet in the meniscus regions of the casting pool) to increase the heat input to these regions of the pool. Examples of such nozzles may be seen in United States Patents 4,694,887, 5,221,511 and our earlier Australian Patent Application 35218/97 and Au 35219/17 based on Provisional Application PO2367, and GB 2317132.

[0005] Although triple point pouring has been effective to reduce the formation of skulls in the triple point regions of the pool it has not been possible completely to eliminate the problem because the generation of defects is remarkably sensitive to even minor variations in the flow of metal into the triple point regions of the pool and movements of the nozzle ends due to thermal expansion during casting can be sufficient to cause defects. As the gap between the nozzle end and the side plate is reduced the downwardly inclined flow of metal from the triple point pouring passages in the ends of the nozzle impinges higher on the side plates. This can lead to the formation of skulls with subsequent snake egg defects or in extreme cases can cause the poured metal to surge upwardly in the reduced gap between the nozzle ends and side plates to spill over the upper edges of the side plates. This problem is addressed by the present invention

DISCLOSURE OF THE INVENTION

[0006] According to the invention there is provided apparatus for casting metal strip including

a pair of parallel casting rolls forming a nip between them,

an elongate metal delivery nozzle formed in a plurality of discrete elongate pieces disposed along the nip,

nozzle support means supporting the nozzle pieces such that the nozzle extends above and along the nip between the casting rolls for delivery of molten metal into the nip whereby to form a casting pool of molten metal supported above the nip,

a pair of pool confinement plates at the ends of the nip,

plate biasing means to bias the pool confinement plates against end surfaces of the rolls so that the plates move inwardly of the rolls to accommodate wear of the plates, and

nozzle end shifter means to shift the nozzle pieces defining the outer nozzle ends on the support means with inward movements matching the inward movements of said side plates to maintain a constant distance between the side plates and the nozzle ends.

[0007] Preferably, the nozzle end shifter means comprises a pair of moveable structures disposed one at each end of the casting roll assembly, moving means to move those structures longitudinally of the rolls, nozzle attachment means attaching the moveable structures to the two nozzle end pieces defining the outer nozzle ends so that those two nozzle pieces are moved with the movable structures, and control means responsive to inward advances of the side plates relative to the outer ends of the rolls to cause the moving means to move the moveable structures inwardly and so shift said two nozzle pieces with matching inward movements.

[0008] The plate biasing means may comprise a pair of generally horizontally acting thrusters actuable to ap-

ply opposing inward closure forces to the pool confinement plates and said moveable structures may provide abutments against which the thrusters react to apply the inward closure forces to the plates.

[0009] The moveable structures may comprise a pair of carriages which carry the thrusters and which are moveable toward and away from another to enable the spacing between them to be adjusted so that the carriages can be preset before a casting operation to suit the width of the casting rolls.

[0010] The moveable structures may include carriage drive means acting between outer end parts of the moveable structures and the carriages to move the carriages toward and away from one another.

[0011] The carriage drive means may comprise a pair of fluid operable cylinder units connected one to each of the carriages and to outer end parts of said moveable structures.

[0012] The moving means may act on the outer end parts of the moveable structures.

[0013] The moving means may comprise a pair of jacks connected to the outer end parts of the moveable structures. Those jacks may be electrically driven screw operated jacks.

[0014] The control means may be responsive to motion of the plate biasing means which produces inward movements of the pool confinement plates. The control means may, for example, include transducers in the plate thrusters to produce control signals indicative of movement of the thrusters and plates and connected in a control circuit with the moving means such that the moving means causes corresponding movements of the moveable structures and therefore said two nozzle pieces.

[0015] Alternatively the control means may include inspection means to observe the position of the pool confinement plates and to provide control signals dependant on observed changes in the position of those plates.

[0016] The moving means may be independently operable to adjust the initial setting of said two nozzle pieces relative to the plates.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] In order that the invention may be more fully explained, one particular embodiment will be described in some detail with reference to the accompanying drawings in which:

Figure 1 is a vertical cross section through a strip caster constructed in accordance with the present invention;

Figures 2A and 2B join on the line A-A to form a longitudinal cross section through important parts of the caster;

Figure 3 is a side elevation of parts of the caster which provide support for a metal delivery nozzle;

Figure 4 is a plan view of the components shown in Figure 3;

Figure 5 is a side elevation of a one half segment of the metal delivery nozzle;

Figure 6 is a plan view of the nozzle segment shown in Figure 5;

Figure 7 is a longitudinal cross-section through the delivery nozzle segment;

Figure 8 is an enlarged vertical cross section through components at one end of the caster; and

Figure 9 is a transverse cross section through the components shown in Figure 8.

DETAILED DESCRIPTION OF THE PREFERED EMODIMENT

[0018] The illustrated caster comprises a main machine frame 11 which supports a casting roll module in the form of a cassette 13 which can be moved into an operative position in the caster as a unit but can readily be removed when the rolls are to be replaced. Cassette 13 carries a pair of parallel casting rolls 16 to which molten metal is supplied during a casting operation from a ladle (not shown) via a tundish 17, distributor 18 and delivery nozzle 19 to create a casting pool 68. Casting rolls 16 are water cooled so that shells solidify on the moving roll surfaces and are brought together at the nip between them to produce a solidified strip product 20 at the roll outlet. This product may be fed to a standard coiler.

[0019] Casting rolls 16 are contra-rotated through drive shafts from an electric motor (not shown) connected to a transmission mounted on the main machine frame. The drive shafts can be disconnected from the transmission when the cassette is to be removed. Rolls 16 have copper peripheral walls formed with a series of longitudinally extending and circumferentially spaced water cooling passages supplied with cooling water through the roll ends from water supply ducts in the roll drive shafts which are connected to water supply hoses through rotary glands. The roll may typically be about 500 mm diameter and up to 2000 mm long in order to produce strip product approximately the width of the rolls.

[0020] The ladle is of entirely conventional construction and is supported on a rotating turret whence it can be brought into position over the tundish 17 to fill the tundish. The tundish may be fitted with a sliding gate valve 47 actuable by a servo cylinder to allow molten metal to flow from the tundish 17 through the valve 47 and refractory shroud 48 into the distributor 18.

[0021] The distributor 18 is formed as a wide dish made of a refractory material such as magnesium oxide (MgO). One side of the distributor 18 receives molten metal from the tundish 17 and the other side of the distributor 18 is provided with a series of longitudinally spaced metal outlet openings. The lower part of the distributor 18 carries mounting brackets 53 for mounting the distributor onto the main caster frame 11 when it is installed in its operative position.

[0022] Delivery nozzle 19 is made of two discrete elongate pieces 19A formed as identical nozzle half segments

of a refractory material such as alumina graphite. The pieces are supported so as to be disposed in end to end relationship with a gap 50 between them.

[0023] The construction of the nozzle pieces 19A is illustrated in Figures 4 to 6. Each nozzle piece is of generally trough formation so that the nozzle 19 defines an upwardly opening inlet trough 61 to receive molten metal flowing downwardly from the openings 52 of the distributor. Trough 61 is formed between nozzle side walls 62 and end walls 70 and may be considered to be transversely partitioned between its ends by the two flat end walls 80 of the nozzle pieces 19A which are spaced apart to form the gap 50. The bottom of the trough is closed by a horizontal bottom floor 63 which meets the trough side walls 62 at chamfered bottom corners 81. The nozzle is provided at these bottom corners with a series of side openings in the form of longitudinally spaced elongate slots 64 arranged at regular longitudinal spacing along the nozzle. Slots 64 are positioned to provide for egress of molten metal from the trough at the level of the trough floor 63. The trough floor is provided adjacent the slots with recesses 83 which slope outwardly and downwardly from the centre of the floor toward the slots and the slots continue as extensions of the recesses 83 to slot outlets 64 disposed in the chamfered bottom corners 81 of the nozzle beneath the level of the upper floor surface 85.

[0024] The outer ends of the nozzle segments are provided with triple point pouring end formations denoted generally as 87 extending outwardly beyond the nozzle end wall 70. Each end formation 87 defines a small open topped reservoir 88 to receive molten metal from the distributor, this reservoir being separated from the main trough of the nozzle by the end wall 70. The upper end 89 of end wall 70 is lower than the upper edges of the trough and the outer parts of the reservoir 88 and can serve as a weir to allow back flow of molten metal into the main nozzle trough from the reservoir 88 if the reservoir is over filled, as will be more fully explained below.

[0025] Reservoir 88 is shaped as a shallow dish having a flat floor 91, inner and side faces 92, 93 and a curved upright outer face 94. Although side faces 92, 93 are shown as inclined to the vertical they may be formed to stand straight up from the floor 91 so as to be essentially vertical. A pair of triple point pouring passages 95 extend laterally outwardly from reservoir 88 just above the level of the floor 91 to connect with triple point pouring outlets 96 in the undersides of the nozzle end formations 87, the outlets 96 being angled downwardly and inwardly to deliver molten metal into the triple point regions of the casting pool.

[0026] Molten metal falls from the outlet openings 52 of the distributor in a series of free-falling vertical streams 65 into the bottom part of the nozzle trough 61. Molten metal flows from this reservoir out through the side openings 64 to form a casting pool 68 supported above the nip 69 between the casting rolls 16.

[0027] The pool is confined at the ends of the rolls by a pair of side closure plates 56 which are held against stepped ends of the rolls when the roll cassette is in its operative position. Side closure plates 56 are made of a strong refractory material, for example boron nitride, and have scalloped side edges to match the curvature of the stepped ends of the rolls. The side plates are mounted in plate holders 82 which are movable by actuation of a pair of thrusters 83 to bring the side plates into engagement with the stepped ends of the casting rolls to form end closures for the molten pool of metal formed on the casting rolls during a casting operation.

[0028] Removable roll cassette 13 may be constructed in the manner described in our Australian Patent Application 84244/98 so that the casting rolls 16 can be set up and the nip between them adjusted before the cassette is installed in position in the caster. Details of the cassette construction, which are fully described in Patent Application 84244/98, form no part of the present invention and need no further description in this context.

[0029] The pool confining side plates 56 and thrusters 83 are mounted on a pair of carriages denoted generally as 101 disposed one at each end of the roll assembly and moveable toward and away from one another to enable the spacing between them to be adjusted. The carriages can thus be preset before a casting operation to suit the width of the casting rolls and to allow quick roll changes for differing strip widths. Carriages 101 are hung from linear tracks 102 on the under side of a fixed rectangular plate frame 103 which is mounted on the main machine frame by clamps 104 so as to extend horizontally above the casting rolls and to extend beyond them at the two ends of the caster. Rectangular plate frame 103 is disposed beneath the metal distributor vessel 18 and has a central rectangular opening 105 to receive the metal delivery nozzle 19. The mid part of frame 103 is provided with inwardly projecting delivery nozzle supports 106 to engage upper flanges at the inner ends of the two delivery nozzle half pieces 19A and 19B, whereas the outer ends of the delivery nozzle pieces are supported on nozzle support pins 107 mounted on the inner ends of the two carriages 101 so as to project inwardly of the rectangular fixed frame opening 105 but to be moveable in and out with the carriages 101.

[0030] Side plates in holders 82 are pivotally connected to the thrusters 83 so that the side plates can tilt about the pivot connections and the thrusters apply opposing forces through the pivots. The pivot connections are provided in such a way that each side plate can rock longitudinally of the rolls by pivoting movement about a horizontal pivot axis transverse to the rolls and can rock laterally of the rolls by pivoting movement about a vertical pivot axis perpendicular to the horizontal pivot axis, the pivoting movement of the plates being confined to movements about those two specific axes so that planar rotation of the plates is prevented.

[0031] Side plate holders 82 are pivotally connected by a horizontal pivot pins 126 and a pair of vertical pivot pins 128 to a thruster body 129 at the end of a thruster rod 130 of the respective thruster 83. Thruster rod 130

is supported by a pair of linear bearings 120 on a track 140 on the carriage. The vertical pivot pins 128 are fixed to thruster body 129 and fit into elongate slots in the plate holder. The slots are elongate in the direction longitudinal to the thruster 83 to leave small clearance gaps about the pivot pins 128 which permit limited rocking movement of the plate holder about horizontal pin 121 longitudinally of the rolls.

[0032] Horizontal pivot pin 126 is also mounted on the thruster body 129 and engages an internally convex bearing in the plate holder so that the plate holder 125 can rock laterally of the casting rolls about the vertical axis defined by the pivot pins 128. The degree to which the plate holder is free to rock in this manner may be limited by engagement with stops on the thruster body 129.

[0033] The horizontal pivot pins 126 are located at such a height above the level of the nip between the casting rolls that the effect of the outward pressure on the side plates due to the molten metal in the casting pool is such as to rotationally bias the side plates about the pivots in such directions that their bottom ends are biased inwardly so as to produce increased sealing pressure at the bottom of the casting pool. The arrangement permits tilting of the side plates so as to accommodate deformation of the casting roll end surfaces due to thermal expansion during casting and at the same time maintains a biasing action which increases the sealing forces at the bottom of the pool so as to counter-act the increased ferrostatic pressure at the bottom of the pool where there is accordingly the greatest tendency for leakage.

[0034] Appropriate positioning of the pivots will depend on the diameter of the casting rolls, the height of the casting pool and thickness of the strip being cast. The manner in which correct positioning of the pivots can be determined is fully described in our Australian Patent 693256 and United States Patent 5,588,479.

[0035] Carriages 101 can be moved along the linear tracks 102 on frame 103 by operation of a pair of fluid operated carriage positioning cylinder units 141, which may be pneumatically or hydraulically operated, fixed to the outer ends of carriages 101 and to a pair of electrically operated screw jacks 152 mounted on the machine frame. Cylinder units 141 have two fixed positions so that they can set the carriages in two alternative positions for two different cast strip widths. The setting of the carriages in this way then automatically sets the plate holders in appropriate positions so as to be brought into engagement and firmly pressed against the ends of the casting rolls by operation of the thrusters 83. At the same time, the setting of the carriages moves the outer delivery nozzle support pins 107 into positions to support outer ends of the core nozzle 19 appropriate to the width of the strip to be cast, since the relative positioning of the core nozzle supports and the plate holders is maintained.

[0036] Carriages 101 also carry inner bridges 143 which seal against the outer ends of the distribution vessel 18 via seals 144. The bridges 143 are located directly above the side plate holders 82 and will thus fit against the outer ends of the distribution vessel of appropriate width chosen for the size of the strip to be cast thereby to provide a sealed enclosure above the casting pool to enable casting in an inert atmosphere. One or both bridges 143 may also serve as camera supports to support casting pool observation cameras to monitor the condition of the casting pool during casting.

[0037] With the above construction movement of the carriages is effective to set not only the position of the side dams appropriate to the width of the strip to be cast, but also automatically positions the bridges 143 with the casting pool seals 144 and the casting pool observation cameras without the need for individual adjustment or setting of any of these components.

[0038] During casting the core nozzle pieces 19A undergo very significant thermal expansion through contact with the molten steel at temperatures of the order of 1570°C or more. In a typical installation each nozzle piece 19A may for example be about 650cm long and the thermal expansion may produce a change in length of up to 12mm. The gap between the core nozzle ends and the side dams will usually be of the order of 15mm to produce effective triple point pouring of molten metal across the side dams. Accordingly the thermal expansion of the nozzle is very significant and can lead to a severe reduction in the gap between the nozzle ends and the side dams, causing the molten metal leaving the triple point pouring passages 95 to impinge on the upper parts of the side dams above the casting pool leading to the formation of skulls and in extreme cases spilling of metal over the upper edges of the side dams. Moreover the side plates wear only at their margins which engage the end faces of the rolls. The inner parts of the side plates between these margins remain unworn and as wear of the plates continues they are projected inwardly from the ends of the rolls so decreasing the effective gap between the side plates and the nozzle ends. The present invention enables both of these problems to be overcome by incorporating the thruster carriages 101 and carriage setting cylinder units 141 as parts of two moveable structures denoted generally as 150 which are connected to the outer ends of the two nozzle pieces 19A by pins 151 and which can be moved bodily in and\out by the operation of a pair of screw jacks 152. With this arrangement the carriages 101 are incorporated with the carriage drive cylinders 141 in the moveable structures 150 which can be moved by operation of jacks 152 to move the two nozzle segments. Pins 151 are located at the outer ends of the nozzle pieces 19A so the locations of the nozzle ends are accurately determined by the positions of moveable structures 150. This enables the outer ends of the nozzle segments to be accurately set in position relative to the side plates prior to a casting operation. Moreover during a casting operation the screw jacks can be operated so as to move the nozzle segments inwardly to match inward advance of the side plates as they wear so as very accurately to maintain the initially set gap between the noz-

zle ends and the side plates. The positioning of the nozzle ends is not significantly affected by thermal expansion of the nozzle because the ends are located through pins 51 and the nozzle pieces will expand inwardly.

[0039] Screw jacks 152 may be operated by electric motors connected into a control circuit receiving control signals determined by measurement of the gap variation or by some means which measures advance of the side plates. For example the thruster cylinders 83 may incorporate linear velocity displacement transducers to respond to the extension of the thrusters to provide signals indicative of inward movement of the side plates and connected in the control circuit with position encoders (rotary) on the screw jacks to determine the positions of the nozzle ends. Alternatively small water cooled video cameras may be installed on the bridges 143 to directly observe the gaps between the side plates and the nozzle ends and to produce control signals to be fed to the position encoders on the screw jacks. With either arrangement it is possible to achieve very precise control of the gap between the inner faces of the side plates and the outer ends of the nozzle. Moreover the gaps can be accurately set by independent operation of the screw jacks prior to casting.

Claims

1. Apparatus for casting metal strip including
a pair of parallel casting rolls (16) forming a nip between them,
an elongate metal delivery nozzle (19) formed in a plurality of discrete elongate pieces (19A) disposed along the nip,
nozzle support means (106, 107) supporting the nozzle pieces such that the nozzle (19) extends above and along the nip between the casting rolls (16) for delivery of molten metal into the nip whereby to form a casting pool (68) of molten metal supported above the nip,
a pair of pool confinement plates (56) at the ends of the nip,
plate biasing means (83) to bias the pool confinement plates (56) against end surfaces of the rolls (16) so that the plates (56) move inwardly of the rolls (16) to accommodate wear of the plates (56), and
nozzle end shifter means (150, 152) to shift the nozzle pieces (19A) defining the outer nozzle ends on the support means (106, 107) with inward movements matching the inward movements of said side plates (56) to maintain a constant distance between the side plates (56) and the nozzle ends.

2. Apparatus as claimed in claim 1, wherein the nozzle end shifter means comprises a pair of moveable structures (150) disposed one at each end of the casting roll assembly, moving means (152) to move those structures longitudinally of the rolls, nozzle attachment means (151) attaching the moveable structures to the two nozzle end pieces (19A) defining the outer nozzle ends so that those two nozzle pieces (19A) are moved with the movable structures (150), and control means responsive to inward advances of the side plates (56) relative to the outer ends of the rolls (16) to cause the moving means (152) to move the moveable structures (150) inwardly and so shift said two nozzle pieces (19A) with matching inward movements.

3. Apparatus as claimed in claim 2, wherein the plate biasing means (83) comprises a pair of generally horizontally acting thrusters actuable to apply opposing inward closure forces to the pool confinement plates (56) and said moveable structures (150) provide abutments against which the thrusters (83) react to apply the inward closure forced to the side plates (56).

4. Apparatus as claimed in claim 3, wherein the moveable structures (150) comprise a pair of carriages (101) which carry the thrusters (83) and which are moveable toward and away from another to enable the spacing between them to be adjusted so that the carriages (101) can be preset before a casting operation to suit the width of the casting rolls (16).

5. Apparatus as claimed in claim 4, wherein the moveable structures (150) include carriage drive means (141) acting between outer end parts of the moveable structures (150) and the carriages (101) to move the carriages toward and away from one another.

6. Apparatus as claimed in claim 5, wherein the carriage drive means (141) comprises a pair of fluid operable cylinder units connected one to each of the carriages (101) and to outer end parts of said moveable structures (150).

7. Apparatus as claimed in any one of claims 2 to 6, wherein the moving means (152) acts on outer end parts of the moveable structures.

8. Apparatus as claimed in claim 7, wherein the moving means (152) comprises a pair of jacks connected to the outer end parts of the moveable structures (150).

9. Apparatus as claimed in claim 8, wherein the jacks (152) are electrically driven screw operated jacks.

10. Apparatus as claimed in any one of claims 1 to 6, wherein the control means is responsive to motion of the plate biasing means (83) which produces inward movements of the side plates (56).

11. Apparatus as claimed in any one of claims 3 to 5, wherein the control means includes transducers in

the plate thrusters (83) to produce control signals indicative of movement of the thrusters (83) and the plates (56) and connected in a control circuit with the moving means (152) such that the moving means (152) causes corresponding movements of the moveable structures (150) and therefore said two nozzle pieces (19A).

12. Apparatus as claimed in any one of claims 1 to 6, wherein the control means includes inspection means to observe the position of the pool confinement plates (56) and to provide control signals dependant on observed changes in the position of those plates.

13. Apparatus as claimed in any one of claims 2 to 6 wherein the moving means (152) is independently operable to adjust the initial setting of said two nozzle pieces (19A) relative to the side plates (56).

Patentansprüche

1. Vorrichtung zum Gießen eines Metallbands, die umfasst:

ein Paar von parallelen Gießwalzen, die einen Spalt dazwischen bilden,
eine langgestreckte Metallzuführungsdüse, gebildet in einer Mehrzahl von diskreten, langgestreckten Teilen, angeordnet entlang des Spalts,
eine Düsenträgereinrichtung, die die Düsenteile so trägt, dass sich die Düse oberhalb und entlang des Spalts zwischen den Gießwalzen zum Zuführen von geschmolzenem Metall in den Spalt erstreckt, um dadurch einen Gießsumpf aus geschmolzenem Metall, getragen oberhalb des Spalts, zu bilden,
ein Paar von einen Sumpf eingrenzenden Platten an den Enden des Spalts,
eine Plattenvorspanneinrichtung, um die Sumpfeingrenzungsplatten gegen die Endflächen der Walzen so vorzuspannen, dass sich die Platten nach innen von den Walzen bewegen, um eine Abnutzung der Platten anzupassen, und
eine Düsenende-Verschiebungseinrichtung, um die Düsenteile, die die äußeren Düsenenden definieren, an der Trägereinrichtung mit nach innen gerichteten Bewegungen zu verschieben, die die nach innen gerichteten Bewegungen der Seitenplatten anpassen, um einen Abstand zwischen den Seitenplatten und den Düsenenden beizubehalten.

2. Vorrichtung nach Anspruch 1, wobei die Düsenende-Verschiebungseinrichtung ein Paar von bewegbaren Strukturen, angeordnet eine an jedem Ende der Gießwalzenanordnung, eine Bewegungseinrichtung, um diese Strukturen längs der Walzen zu bewegen, eine Düsenbefestigungseinrichtung, die die bewegbaren Strukturen mit den zwei Düsenendteilen, die äußeren Düsenenden definierend, befestigt, so dass diese zwei Düsenteile mit den bewegbaren Strukturen bewegt werden, und eine Steuereinrichtung, die auf ein sich nach innen gerichtetes Vorschieben der Seitenplatten relativ zu den äußeren Enden der Walzen anspricht, um zu bewirken, dass die Bewegungseinrichtung die bewegbaren Strukturen nach innen bewegt und um so die zwei Düsenteile mit dazu passenden, nach innen gerichteten Bewegungen zu verschieben, aufweist.

3. Vorrichtung nach Anspruch 2, wobei die Plattenvorspanneinrichtung ein Paar von im Wesentlichen horizontal wirkenden Schubeinrichtungen, betätigbar so, um nach innen gerichtete Schließkräfte auf die Sumpfeingrenzungsplatten aufzubringen, aufweist, und wobei die bewegbaren Strukturen Anschläge vorsehen, gegen die die Schubeinrichtungen wirken, um die nach innen gerichtete Schließung der Seitenplatten zu erwirken.

4. Vorrichtung nach Anspruch 3, wobei die bewegbaren Strukturen ein Paar von Schlitten aufweisen, die die Schubeinrichtungen tragen und die zueinander hin und voneinander weg bewegbar sind, um zu ermöglichen, dass die Beabstandung dazwischen so eingestellt werden kann, dass die Schlitten vor einem Gießvorgang so vorab eingestellt werden können, um die Breite der Gießwalzen anzupassen.

5. Vorrichtung nach Anspruch 4, wobei die bewegbaren Strukturen Schlittenantriebseinrichtungen umfassen, die zwischen äußeren Endteilen der bewegbaren Strukturen und den Schlitten wirken, um die Schlitten zueinander hin und voneinander weg zu bewegen.

6. Vorrichtung nach Anspruch 5, wobei die Schlittenantriebseinrichtung ein Paar von mittels Fluid betätigbarer Zylindereinheiten, verbunden jeweils eine mit den Schlitten und mit den äußeren Endteilen der bewegbaren Strukturen, aufweist.

7. Vorrichtung nach einem der Ansprüche 2 bis 6, wobei die Bewegungseinrichtung auf äußere Endteile der bewegbaren Strukturen einwirkt.

8. Vorrichtung nach Anspruch 7, wobei die Bewegungseinrichtung ein Paar von Hülsen, verbunden mit den äußeren Endteilen der bewegbaren Strukturen, aufweist.

9. Vorrichtung nach Anspruch 8, wobei die Hülsen elek-

trisch mittels Spindel betriebene Hülsen sind.

10. Vorrichtung nach einem der Ansprüche 1 bis 6, wobei die Steuereinrichtung auf eine Bewegung der Plattenvorspanneinrichtung anspricht, was nach innen gerichtete Bewegungen der Seitenplatten hervorruft.

11. Vorrichtung nach einem der Ansprüche 3 bis 5, wobei die Steuereinrichtung Wandler in den Plattenschubeinrichtungen umfasst, um Steuersignale zu erzeugen, die für eine Bewegung der Schubeinrichtungen und der Platten indikativ sind und die in einer Steuerschaltung mit der Bewegungseinrichtung so verbunden sind, dass die Bewegungseinrichtung entsprechende Bewegungen der bewegbaren Strukturen und deshalb der zwei Düsenteile bewirkt.

12. Vorrichtung nach einem der Ansprüche 1 bis 6, wobei die Steuereinrichtung eine Beobachtungseinrichtung umfasst, um die Position der Sumpfeingrenzungsplatten zu beobachten und um Steuersignale, abhängig von den beobachteten Änderungen in der Position dieser Platten, bereitzustellen.

13. Vorrichtung nach einem der Ansprüche 2 bis 6, wobei die Bewegungseinrichtung unabhängig so betrieben werden kann, um die Anfangseinstellung der zwei Düsenteile relativ zu den Seitenplatten einzustellen.

Revendications

1. Dispositif de coulée de métal en bande comprenant :

une paire de rouleaux de laminage parallèles (16) définissant une zone de pincement entre eux,
une buse allongée (19) de distribution de métal constituée d'une pluralité d'éléments allongés individuels (19A) disposés le long de la zone de pincement,
des moyens de support de buse (106, 107) supportant les éléments de buse de sorte que la buse (19) s'étende au-dessus et le long de la zone de pincement définie entre les rouleaux de laminage (16) pour distribuer du métal en fusion dans la zone de pincement de façon à former un bain de coulée (68) de métal en fusion supporté au-dessus de la zone de pincement,
une paire de plaques de confinement de bain (56) aux extrémités de la zone de pincement,
des moyens de sollicitation des plaques (83) pour rappeler les plaques de confinement de bain (56) contre des surfaces d'extrémité des rouleaux (16) de sorte que les plaques (56) se déplacent vers l'intérieur des rouleaux (16) pour compenser l'usure des plaques (56), et
des moyens de déplacement d'extrémité de buse (150, 152) pour déplacer les éléments de buse (19A) qui définissent les extrémités de buse extérieures sur les moyens de support (106, 107) avec des mouvements vers l'intérieur en correspondance aux mouvements vers l'intérieur desdites plaques latérales (56) de façon à maintenir une distance entre lesdites plaques (56) et les extrémités de buse.

2. Dispositif selon la revendication 1, dans lequel les moyens de déplacement d'extrémité de buse comprennent une paire de structures mobiles (150) disposées chacune à une extrémité de l'ensemble de rouleaux de laminage, des moyens de déplacement (152) pour déplacer ces structures le long des rouleaux, des moyens de support de buse (151) fixant les structures mobiles aux deux éléments d'extrémité de buse (19A) définissant les extrémités de buse extérieures de sorte que lesdits deux éléments de buse (19A) sont déplacés solidairement des structures mobiles (150), et des moyens de commande répondant aux avances des plaques latérales (56) vers l'intérieur par rapport aux extrémités extérieures des rouleaux (16) pour faire en sorte que les moyens de déplacement (152) déplacent les structures mobiles (150) vers l'intérieur et ainsi fassent se déplacer lesdits deux éléments de buse (19A) selon des mouvements vers l'intérieur identiques.

3. Dispositif selon la revendication 2, dans lequel les moyens de sollicitation des plaque (83) comprennent une paire de poussoirs à action sensiblement horizontale actionnables pour exercer en opposition des forces de fermeture vers l'intérieur sur les plaques de confinement de bain (56), et lesdites structures mobiles (150) forment des butées contre lesquelles les poussoirs (83) réagissent pour appliquer les forces de fermeture vers l'intérieur sur les plaques latérales (56).

4. Dispositif selon la revendication 3, dans lequel les structures mobiles (150) comprennent une paire de chariots (101) qui supportent les poussoirs (83) et qui sont déplaçables de façon à les rapprocher et à les éloigner l'un de l'autre afin de permettre le réglage de l'intervalle les séparant, de sorte que les chariots (101) peuvent être préréglés avant une opération de coulée pour s'adapter à la largeur des rouleaux de laminage (16).

5. Dispositif selon la revendication 4, dans lequel les structures mobiles (150) comprennent des moyens d'entraînement de chariot (141) agissant entre des parties d'extrémité extérieures des structures mobiles (150) et les chariots (101) de façon à faire se rapprocher et s'éloigner les chariots l'un de l'autre.

6. Dispositif selon la revendication 5, dans lequel les moyens d'entraînement de chariot (141) comprennent une paire de vérins à actionnement hydraulique, chacun relié à l'un des chariots (101) et à des parties d'extrémité extérieures desdites structures mobiles (150).

7. Dispositif selon l'une quelconque des revendications 2 à 6, dans lequel les moyens de déplacement (152) agissent sur des parties d'extrémité extérieures des structures mobiles.

8. Dispositif selon la revendication 7, dans lequel les moyens de déplacement (152) comprennent une paire de vérins reliés aux parties d'extrémité extérieures des structures mobiles (150).

9. Dispositif selon la revendication 8, dans lequel les vérins (152) sont des vérins à vis à commande électrique.

10. Dispositif selon l'une quelconque des revendications 1 à 6, dans lequel les moyens de commande répondent au déplacement des moyens de sollicitation des plaques (83) qui entraînent des mouvements desdites plaques (56) vers l'intérieur.

11. Dispositif selon l'une quelconque des revendications 3 à 5, dans lequel les moyens de commande comprennent des convertisseurs situés dans les poussoirs de plaques (83) afin de générer des signaux de commande indicatifs du mouvement des poussoirs (83) et des plaques (56), et qui sont reliés à un circuit de commande avec les moyens de déplacement (152), de sorte que les moyens de déplacement (152) entraînent des déplacements correspondants des structures mobiles (150) et, par conséquent, desdits deux éléments de buse (19A).

12. Dispositif selon l'une quelconque des revendications 1 à 6, dans lequel les moyens de commande comprennent un dispositif d'inspection pour observer la position des plaques de confinement de bain (56) et pour générer des signaux de commande qui sont fonction des changements de position observés pour lesdites plaques.

13. Dispositif selon l'une quelconque des revendications 2 à 6, dans lequel les moyens de déplacement (152) sont actionnables de manière indépendante pour ajuster le réglage initial desdits deux éléments de buse (19A) par rapport aux plaques latérales (56).

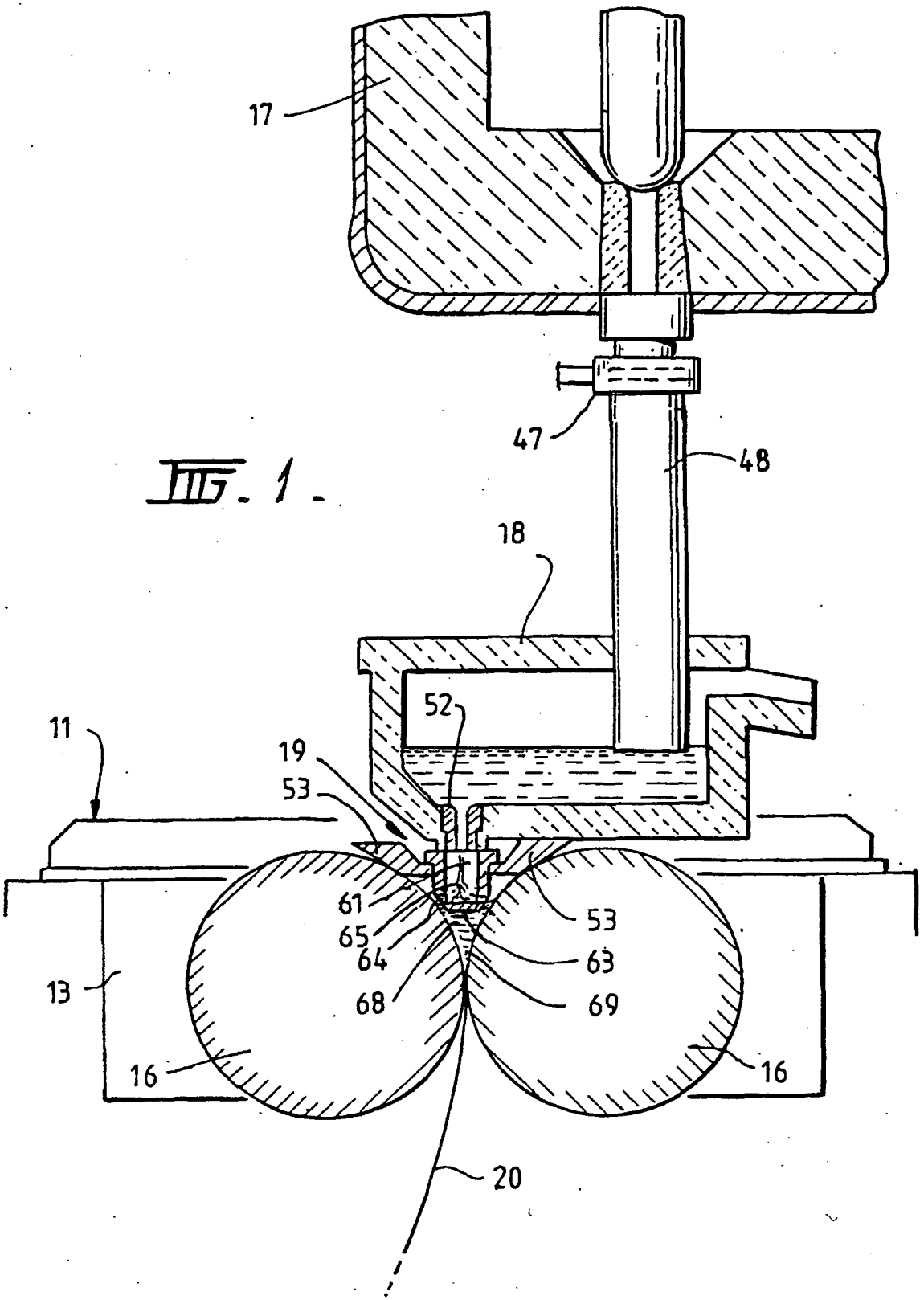


FIG. 1.

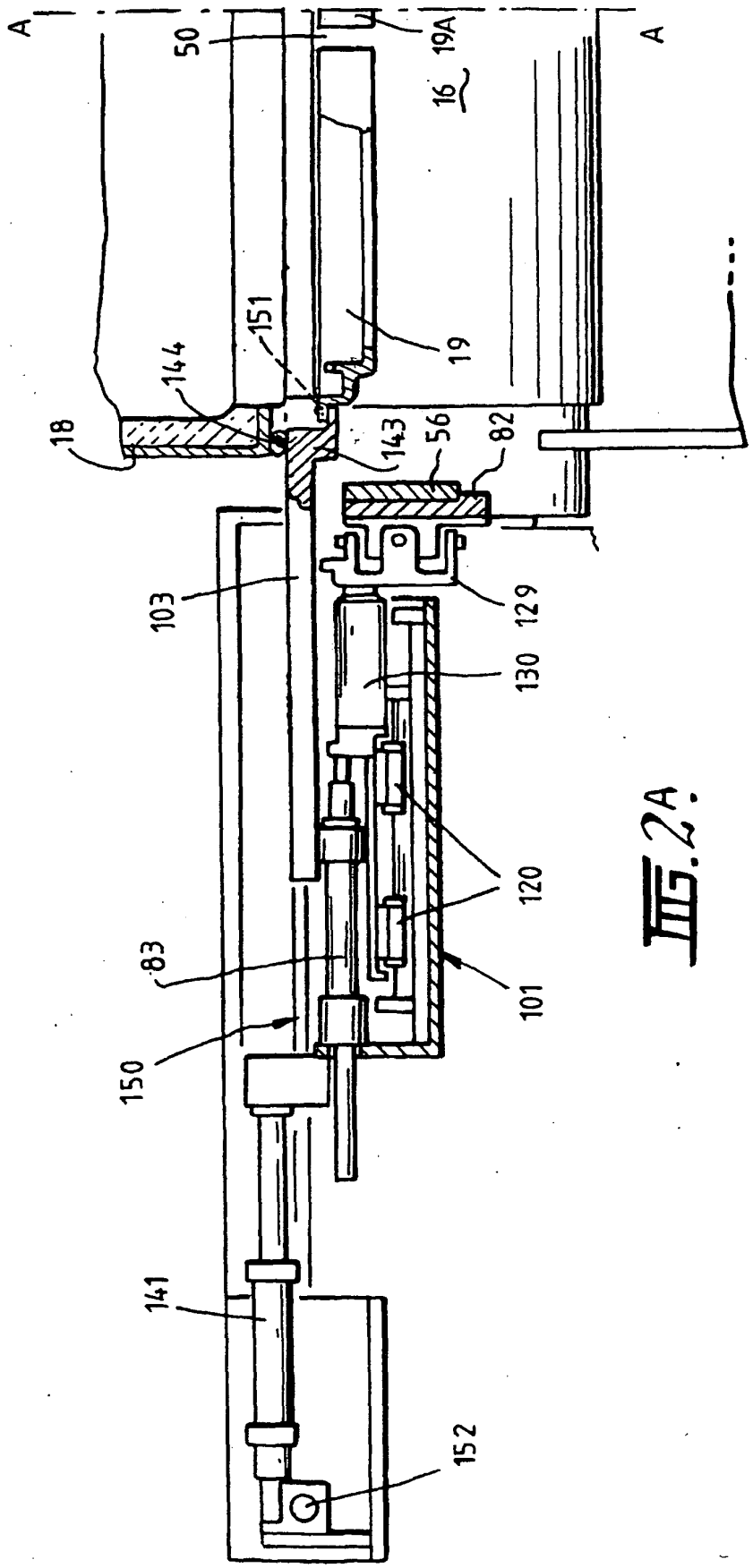

A
50
19A
16
A
151
144
19
18
143
56
82
103
129
130
120
83
101
150
141
152

FIG. 2A

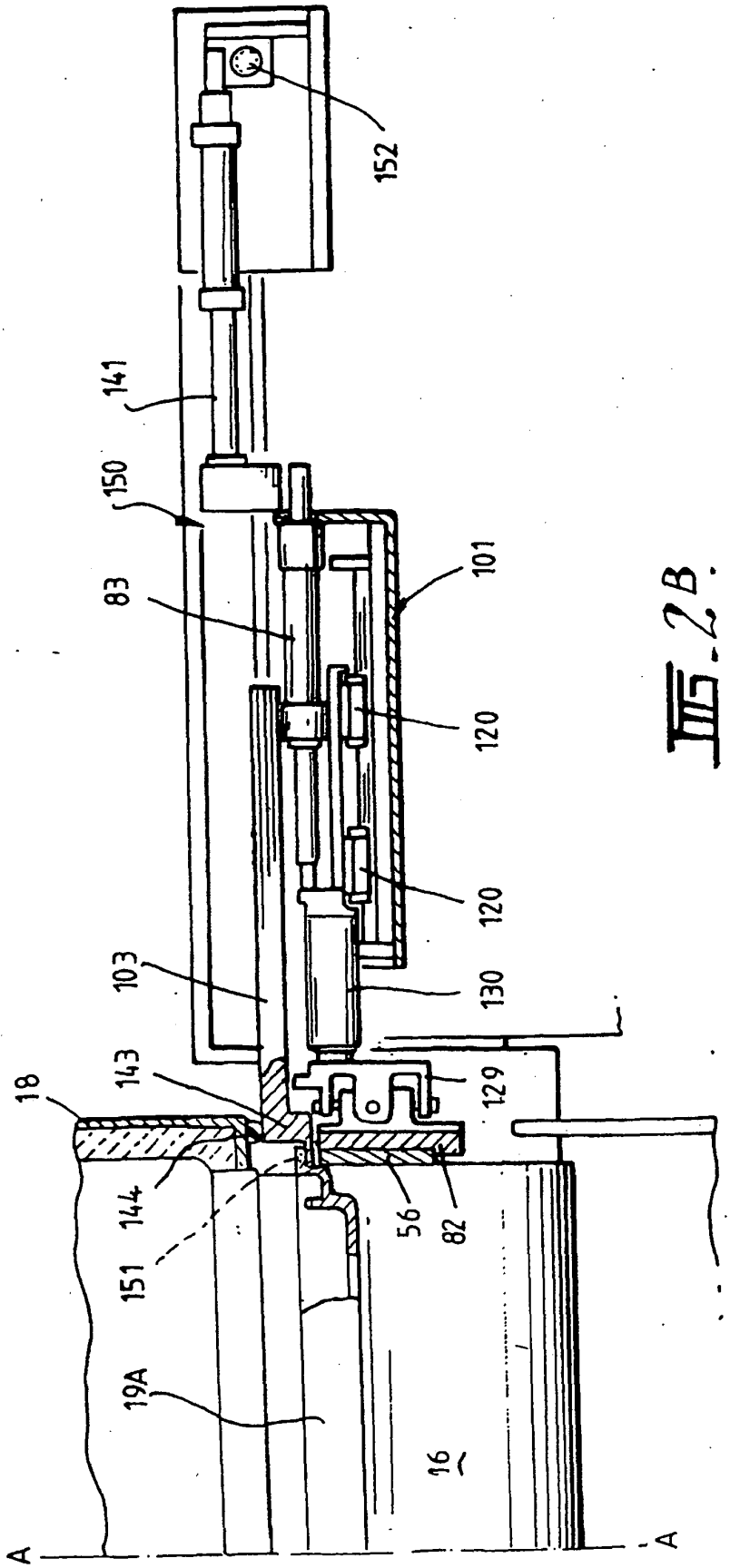
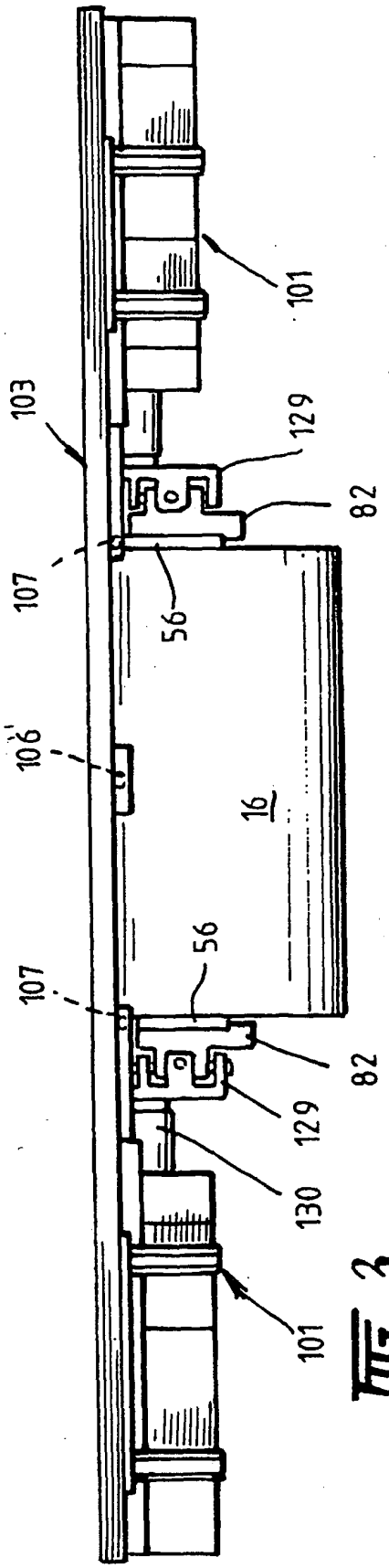
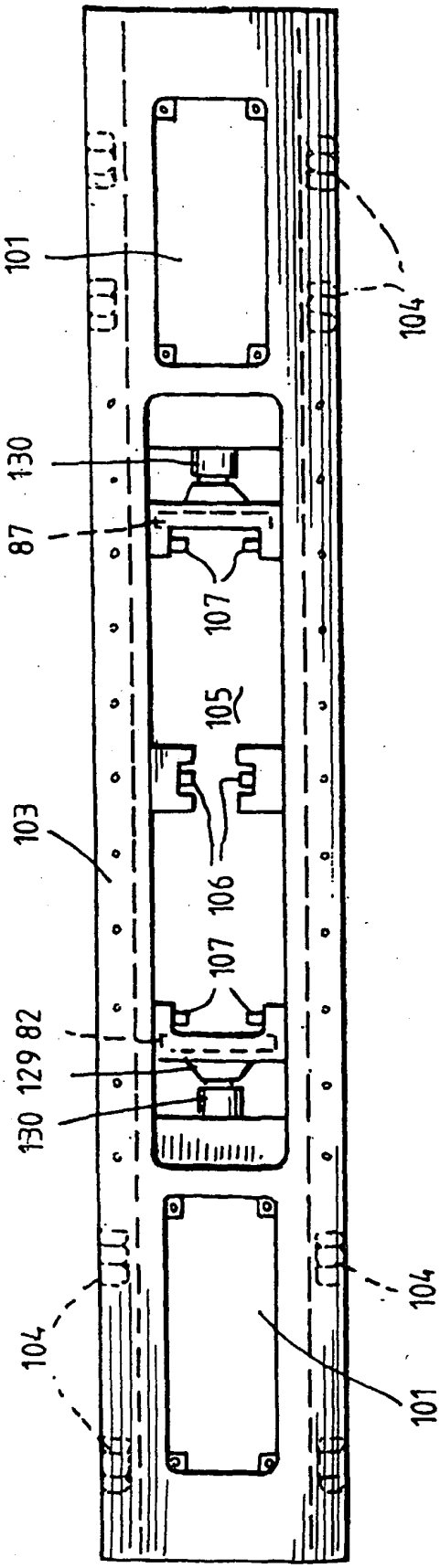

152
141
150
83
101
120
120
103
130
143
129
18
144
151
56
82
19A
16
A
A

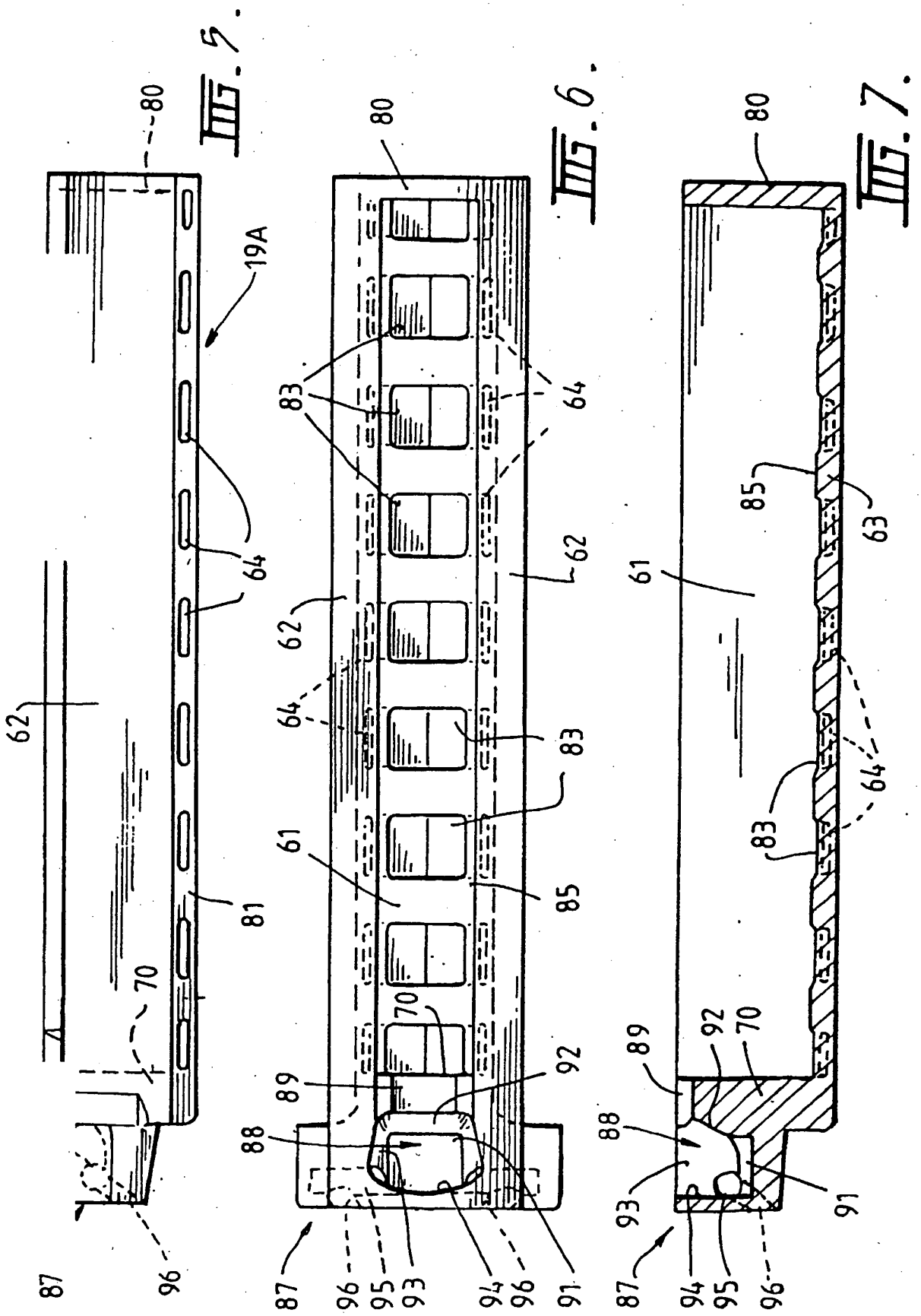
FIG. 2B

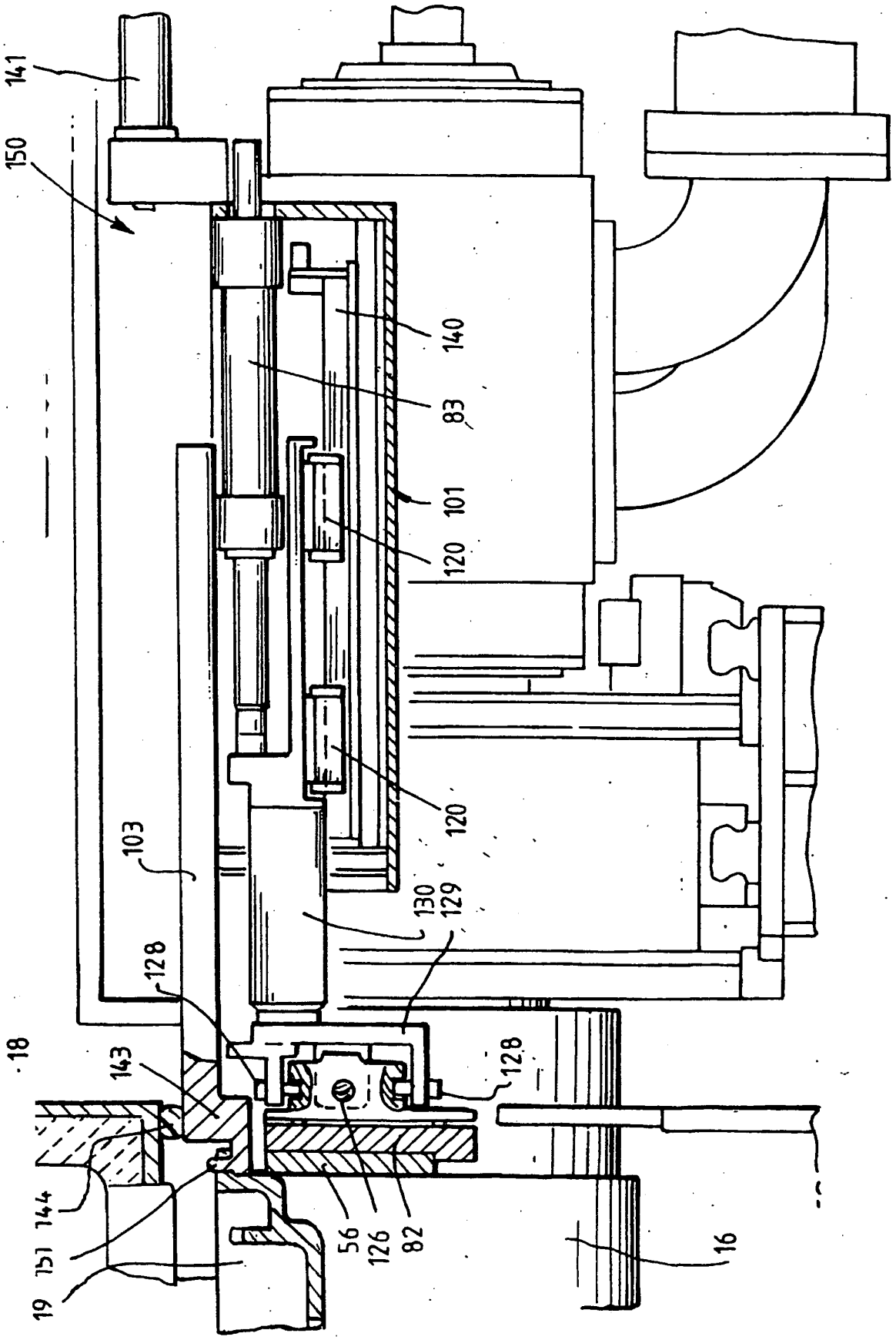

101
103
129
82
107
56
106
16
56
107
82
129
130
101

Фиг. 3.


101
104
130
87
107
105
103
106
107
82
129
130
104
104
101

Фиг. 4.


80
19A
64
62
70
81
87
96
Фиг. 5.
80
83
64
62
64
61
85
83
70
92
89
88
87
96
95
93
94
96
91
Фиг. 6.
80
85
63
61
64
83
89
92
70
88
93
91
87
94
95
96
Фиг. 7.


141
150
140
83
101
120
120
103
130
129
128
18
143
128
144
151
19
56
126
82
16

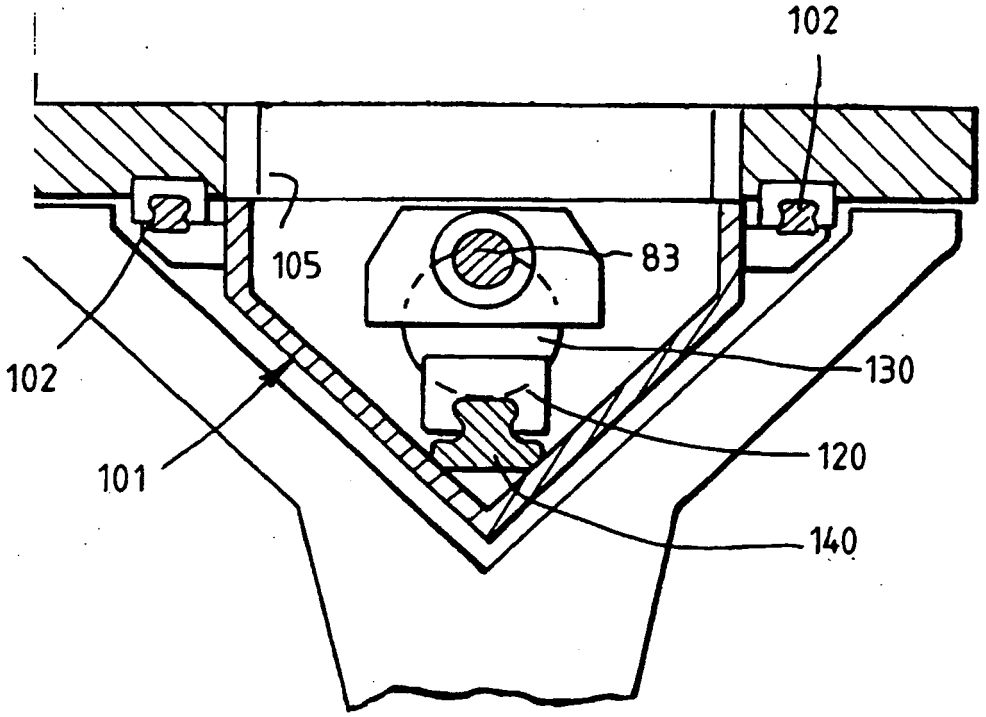


FIG. 9