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(54) **ROLL BENDING DEVICE FOR ROLLING STANDS**

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DISPOSITIF DE CINTRAGE PAR ROULEAUX POUR CAGES DE LAMINOIR

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Description

[0001] The invention relates to those devices which are applied, in stands for rolling strips or other flat products, to the working rolls, to the backup rolls or to rolls of other types, in order to bend them and to cause them to adopt a deformed configuration which improves the quality of rolling.

[0002] Indeed, in view of the high loads which come into play during this type of rolling (in the order of 2×10^3 - 4×10^3 tons), for limiting the unavoidable deformations to which the working rolls are subject in spite of the reinforcing effect exerted on them by the backup rolls, it is known to pre-bend the rolls with the devices to which the present invention relates.

[0003] Currently-known bending devices consist, in practice, of normal hydraulic jacks which act on the chock supporting the working rolls, along axes perpendicular to the strip to be rolled; the jacks are generally housed in blocks fixed to the uprights of the load-bearing structure of the stand and, as a result of their action, the axis of the working roll is deformed along a curved line which may be concave or convex, according to requirements.

[0004] An example of these bending devices is described in European patent No. 623 401 in the name of SMS- Schloemann Siemag.

[0005] This prior document describes a set of cylinder-piston units intended to bend the working rolls of the rolling stand, which act on the chocks thereof in a combined manner so as to prevent any play between the chocks and the aforementioned units. This eliminates the risk of impacts while setting the bending forces, particularly when these forces are reversed in order to change the direction of bending of the rolls (that is, in order to change from positive deformation to negative deformation of their axes, or vice versa).

[0006] In order to achieve such results, the bending devices considered in this patent are formed basically by pairs of (partial) jaws which can be operated independently in opposite directions and which act on the roll chocks in order to bring about their bending in opposite directions.

[0007] Considering the drawings appended to this prior document, it is not difficult to see that the solution claimed therein is quite bulky as well as functionally limited and complex.

[0008] Indeed, the surfaces of each jaw which act on the roll chocks are formed on respective shaped bodies arranged at the ends of hydraulically-operated rods; this means that, in order to form each jaw, it is necessary to have two separate, differently-shaped bodies acting along respective parallel axes and which move in opposite directions, in order to grip the chock likewise a jaw.

[0009] Although each body related to the upper working roll is combined with one of the lower working roll, thus permitting a reduction in size and a limitation of the number of ducts required to supply the operating fluid,

the fact that the bodies forming a same jaw slide along corresponding separate axes is rather disadvantageous.

[0010] Indeed, the grip of the jaw is clearly unbalanced since its two pressure surfaces operate along respective parallel axes, thus giving rise to a couple that acts on the roll chock gripped by the jaw.

[0011] It is probably for this reason that in the European patent cited above, three shaped bodies forming parts of (two) corresponding jaws are fitted along the sides of the chocks, the intermediate body being operated by a piston and by a rod of larger dimensions so as to be able to exert a force equal to that of the other two bodies, and moving along a thrust axis parallel to those of the other two bodies.

[0012] A solution of this type does in fact compensate for the unbalanced action mentioned above; this is because the body which is interposed between the other two acts on the chock (urging it upwards, or downwards, according to the chock concerned) in the opposite direction to the other two, and the resulting combined effect produces two pairs of equal and opposite forces which thus cancel one another out.

[0013] From this brief description of the prior art, it is not difficult to realise that the bending device to which it relates is certainly not the simplest and most functional.

[0014] In fact it is quite bulky given that, as mentioned, at least three shaped bodies are needed beside each chock and this inevitably requires a certain amount of space; in this connection, it should be pointed out that, in rolling stands, the spaces available for the fitting of the bending devices are not generally very large, since these devices have to be positioned between the uprights of the outer structure and the chocks of the corresponding rolls.

[0015] Moreover, the structural complexity of the known devices also requires a corresponding (large) number of oil-supply ducts, and a certain difficulty in the control of the operation of the bending devices can consequently not be ruled out.

[0016] With regard to this last point, indeed in fact be seen that for a correct control of bending of the working rolls, it is necessary for the movements of the shaped bodies which are combined in pairs and which form the various jaws, to be precise, particularly for the bodies disposed beside the intermediate ones because, otherwise, the gripping action on the chock is not effective. For example, it is possible to imagine what would happen if the two bodies between which an intermediate body is disposed were to move differently from one another.

[0017] The object of the present invention is therefore to provide a device for bending the rolls of a rolling stand, having structural and functional characteristics such as to overcome the problems encountered in the prior art considered above.

[0018] This object is achieved by a device characterized as indicated in the following claims.

[0019] For a better understanding of the invention, a description is now given of a preferred but not exclusive embodiment thereof, illustrated in the appended drawings, wherein:

Figure 1 shows a side view of a rolling stand in which the bending devices according to the invention are fitted, with a portion removed for clarity; Figure 2 is an enlarged, partially-sectioned view of a portion of Figure 1, showing a device of the invention.

[0020] Referring to these drawings, the first figure shows a stand for rolling strips or other flat products, in which a pair of opposed working rolls 1 and 2 are reinforced, respectively, by backup rolls 3 and 4.

[0021] The working rolls 1, 2 and the backup rolls 3, 4 are borne by corresponding chocks 9, 10 and 11, 12, mounted in the structure 7 in known manner; the bending devices 20 of the present invention act on the chocks 9 and 10 of the working rolls.

[0022] Before these devices are considered in detail, to complete the description of the stand of Figure 1, it needs only be added that it also contains actuators 13, 14 acting on the chocks 11, 12 of the backup rolls 3, 4 in order to regulate the interaxial spacing between the working rolls 1 and 2, likewise known in the art.

[0023] With reference now to Figure 2, the latter shows in detail one of the bending devices 20 present in the above-mentioned stand; since these devices are identical, only one of them will be described below, the description being intended also to apply (*mutatis mutandis*) to the others.

[0024] Before proceeding with the description, it should merely be stated that for each chock 9, 10 of the working rolls 1, 2, there are two devices 20 that are arranged one on each side, in opposed positions.

[0025] Each device 20 consists of a block 21 fixed to one of the uprights of the structure of the stand and provided with a cylindrical cavity 22; this cavity is in communication, by means of ducts 23, 24 and 25 extending through the block 21, with a pump, not shown in the drawings, for supplying an operating fluid. The cavity 22 is bounded at the top by a sealing ring 26.

[0026] A first piston 30 fixed to a rod 31, is slidable in the cavity 22, the rod being disposed centrally along the axis of the cavity with its end 31a remote from the piston 30 projecting beyond the sealing ring 26.

[0027] In addition, a second piston 32 and a sleeve 33 fixed thereto are mounted coaxially for sliding relative to the rod 31; the second piston 32 also slides in a similar manner to the first one along the walls of the cavity 22, whereas the opposite end of the sleeve 33 projects beyond the ring 26 which provides a seal against leakage of oil from the cavity 22 towards the exterior.

[0028] It can thus be seen that the pistons 30 and 32 divide the cavity 22 into an upper annular chamber 22a, a cylindrical chamber 22b, and an intermediate chamber

22c, which respectively communicate with the ducts 23, 25 and 24.

[0029] A hook 35 arranged adjacent to an appendage 9a of the chock 9 of the working roll 1, extends from the projecting end of the sleeve 33; more particularly, the appendage 9a is fitted between the projecting end 31a of the rod 31 and the upper portion of the hook 35 (with reference to Figure 2).

[0030] Finally, as can be seen from the drawings, small blocks 38 and 39 are advantageously positioned between the surfaces which move relative to one another such as, for example, the hook 35 and the block 21, or the block 21 and the chock 9, to facilitate sliding.

[0031] The operation of the bending device according to the invention can be understood from the foregoing description.

[0032] Indeed it can be easily seen that the pistons 30 and 32 are moved upwards or downwards according to requirements, by the supply of oil or another fluid under pressure to the cavity 22 through the ducts 23, 24 and 25.

[0033] In particular, when an upward bend, that is, a positive bend as it is conventionally referred to by experts in the art, of the upper working roll 1 is required, the rod 31 has to be raised and oil is therefore supplied at the bottom into the cylindrical chamber 22b through the duct 25 so as to move the piston 30 upwards.

[0034] As a result, the projecting end 31a of the rod 31 urges the appendage 9a of the chocks upwards, whilst the hook 35 at this stage exerts a small (balancing) force produced by the supply of oil to the annular chamber 22a at low pressure, to ensure it maintains contact with the appendage 9a from the upper side thereof; also hook 35 is therefore moved in the direction (upward) of the bending force produced, in this case, by the piston 30.

[0035] Conversely, if a negative bend is to be applied to the upper working roll 1, starting from the situation just described, it suffices to adjust the pressures inside the chambers 22a, 22b, progressively increasing the value in one and proportionally reducing it in the other.

[0036] As a result of this, the second piston 32 is urged downwards whilst the sleeve 33 fixed thereto slides relative to the rod 31 and the movement thereof is therefore transmitted to the hook 35 which thus exerts a downward force on the appendage 9a of the chock 9, so as to bring about the desired negative bending. At this stage, the rod 31 applies a slight upward (balancing) force to the appendage 9a in order to keep itself in contact therewith, as described above for the hook 35.

[0037] It should be noted that oil is supplied into the intermediate chamber 22c through the duct 24 for releasing the chock when the rolls of the stand are changed.

In this connection it may be stated that from a functional point of view, the bending device according to the invention in practice acts as a clamp which grips the appendage 9a for raising and lowering it, as required. The ele-

ments which act on the appendage, that is, the hook 35 and the rod 31, advantageously remain in contact therewith even when the direction of the bending imparted to the rolls is reversed, thus avoiding the risk of damaging impacts during the operation of the device.

[0038] In the light of the foregoing, it can thus be appreciated that the invention fully achieves the object initially set.

[0039] Indeed it is not difficult to understand that in the device of the invention, the elements which serve to "grip" the chock of the roll to be bent (that is, the hook 35 and the projecting end of the rod 31) and which correspond to those which form the jaws in European patent No. 623 401, move along the same axis, that is to say, the axis of the cylindrical chamber 22, of the rod 31, and of the sleeve 33, this axis being common to all of these elements.

[0040] The resulting action is consequently balanced, that is, without pairs of forces which are out of alignment as in the prior art, owing to the fact that the pressure surfaces of the jaws act along parallel axes.

[0041] By virtue of this effect it is thus possible to produce a more compact bending device, since it is not necessary to split it into several parts in order to balance its effect, as is the case of the European patent mentioned.

[0042] In this connection, the advantageous effect of the coaxial coupling between the rod 31 and the sleeve 33, which enables the dimensions achieved by the invention to be reduced to the minimum, should be emphasised.

[0043] Moreover, this solution is particularly favourable because it simplifies the device structurally, given that only one cavity is now required for housing two pistons which move the members for gripping the chock (the hook 35 and the rod 31); naturally, the aspects connected with the operation of the device, that is, the number of ducts necessary for supplying the operating fluid and its control system are also advantageously reduced.

[0044] As a further advantage of the invention, the functional flexibility of the device considered herein should also be stressed; indeed, although in Figure 2 the bending device associated with the chock 9 of the upper roll 1 is independent of the bending device of the lower roll 2, (the cavity and the first piston of the latter are only partially visible and indicated 22' and 30', respectively), they could quite clearly be combined so as to render their operation symmetrical with respect to a horizontal median line, thereby achieving a symmetrical bending of the upper and lower rolls.

[0045] For this purpose, it would suffice to supply the cavities 22 and 22' with the same fluid, for example, by interconnecting the respective supply ducts (as shown in broken outline for the duct 25 in Figure 2).

[0046] In other words, it can be concluded that by virtue of its simplicity, the device of the invention can be formed either independently, that is, with each device structurally and functionally separate from the others

present in the rolling stand, or in an interconnected manner, as just explained.

[0047] Naturally, variants of the invention with respect to the embodiment thereof described above should not be excluded.

[0048] By way of example, it is indeed not difficult to imagine that if the shape of the roll chocks and hence also that of the appendage were changed, the elements which exert the thrust action on the chock, such as, for example, the hook 35, would also have to undergo adaptive modifications.

[0049] Moreover the possibility of the devices considered herein being used, not only in conventional rolling stands as in the above-described embodiment, but also in those of the so-called "crossing" type, that is, in which the rolls have a particular crossed arrangement, should not be excluded.

[0050] However, in these stands it would be appropriate to use a configuration wherein the devices for bending the lower working roll are separated from those of the upper roll, on account of the angular relative movements taking place between them; in such circumstances, it would therefore be necessary to have separate respective blocks 21 with cylindrical cavities 22 in order to be able to operate freely on each roll.

[0051] It should also be pointed out that, although in the embodiment described herein the bending devices are applied only to the working rolls 1 and 2, they may, however, also be used in connection with the backup rolls and, more generally, with the various rolls present in stands for rolling strips and the like.

Claims

1. Bending device for rolls (1, 2, 3, 4) of rolling stands, comprising:

a first thrust element (31) which acts on a chock (9, 10, 11, 12) of a roll to be bent and which is operated by a first piston (30) slidable in a cylindrical cavity (22),

- a second thrust element (35) which acts on the same chock, in the opposite direction to the first element, and which is operated by a second piston (32) slidable in a cylindrical cavity (22),

characterized in that the thrust elements are connected to the respective operating pistons, respectively, by a rod (31) and by a sleeve (33) which are coupled slidingly with one another.

2. A bending device according to Claim 1, wherein the operating pistons (30, 32) of the thrust elements (31, 35) are slidable inside the same cylindrical cavity (22).

3. A bending device according to either claim 1 or claim 2, wherein the first thrust element comprises an end (31a) of the rod (31) opposed to the first piston (30), which end projects from the cylindrical cavity (22).

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4. A bending device according to any of claims 1 to 3, wherein the second thrust element comprises a hook (35) extending from the end of the sleeve (33) opposed, to the second piston (32), which end projects from the cylindrical cavity (22).

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5. A rolling stand comprising one or more devices (20) for bending rolls (1, 2) according to any of the preceding claims.

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Patentansprüche

1. Biegevorrichtung für Rollen (1, 2, 3, 4) einer Walzanlage mit:

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- einem ersten Druckelement (31), welches auf eine Führung (9, 10, 11, 12) einer zu biegenden Rolle einwirkt und welches mittels eines ersten Kolbens (30) betätigbar ist, der in einer zylindrischen Aufnahme (22) gleitend angeordnet ist,

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- einem zweiten Druckelement (35), welches auf die Führung (9, 10, 11, 12) in der entgegengesetzten Richtung wie das erste Druckelement (31) einwirkt, und welches mittels eines zweiten Kolbens (32) betätigbar ist, der in einer zylindrischen Aufnahme (22) gleitend angeordnet ist,

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dadurch gekennzeichnet, daß die Druckelemente (31, 35) mit den jeweils zugehörigen betätigenden Kolben (30, 32) mittels einer Stange (31) beziehungsweise einer Hülse (33) verbunden sind und die Stange (31) mit der Hülse (33) ineinander gleitend miteinander verbunden sind.

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2. Biegevorrichtung nach Anspruch 1, **dadurch gekennzeichnet, daß** die beiden die Druckelemente (31, 35) betätigenden Kolben (30, 32) in der gleichen zylindrischen Aufnahme (22) angeordnet sind.

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3. Biegevorrichtung nach Anspruch 1 oder 2, **dadurch gekennzeichnet, daß** das erste Druckelement (31) als das Ende (31a) der Stange (31) ausgebildet ist, welche dem ersten Kolben (30) gegenüber steht, wobei das Ende (31a) aus der zylindrischen Aufnahme (22) herausragt.

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4. Biegevorrichtung nach einem der Ansprüche 1 bis

3, **dadurch gekennzeichnet, daß** das zweite Druckelement (35) einen Haken aufweist, der sich von dem Ende der Hülse (33) erstreckt, welches dem zweiten Kolben (32) gegenüberliegt und aus der zylindrischen Aufnahme (22) herausragt.

5. Walzanlage mit einer oder mehreren Vorrichtungen (20) zum Biegen von Rollen (1, 2) nach einem der vorhergehenden Ansprüche.

Revendications

1. Dispositif pour incurver des rouleaux (1, 2, 3, 4) de colonnes de cage de laminoir, comportant

un premier élément de poussée (31) qui agit sur une empoise (9, 10, 11, 12) d'un rouleau devant être incurvé, et qui est actionné par un premier piston (30) pouvant coulisser dans une cavité cylindrique (22),

un second élément de poussée (35) qui agit sur la même empoise, dans la direction opposée à celle du premier élément, et qui est actionné par un second piston (32) pouvant coulisser dans une cavité cylindrique (22),

caractérisé en ce que les éléments de poussée sont connectés aux pistons d'actionnement respectifs, respectivement par l'intermédiaire d'une tige (31) et d'un manchon (33) qui sont accouplés de manière coulissante l'un avec l'autre.

2. Dispositif d'incurvation selon la revendication 1, dans lequel les pistons d'actionnement (30, 32) des éléments de poussée (31, 35) peuvent coulisser à l'intérieur de la même cavité cylindrique (22).

3. Dispositif d'incurvation selon la revendication 1 ou la revendication 2, dans lequel le premier élément de poussée comporte une première extrémité (31a) de la tige (31) opposée au premier piston (30), extrémité qui fait saillie à partir de la cavité cylindrique (22).

4. Dispositif d'incurvation selon l'une quelconque des revendications 1 à 3, dans lequel le second élément de poussée comporte un crochet (35) s'étendant à partir de l'extrémité du manchon (33) opposée au second piston (32), extrémité qui fait saillie à partir de la cavité cylindrique.

5. Colonne de cage de laminoir comportant un ou plusieurs dispositifs (20) pour incurver des rouleaux (1,2) selon l'une quelconque des revendications précédentes.

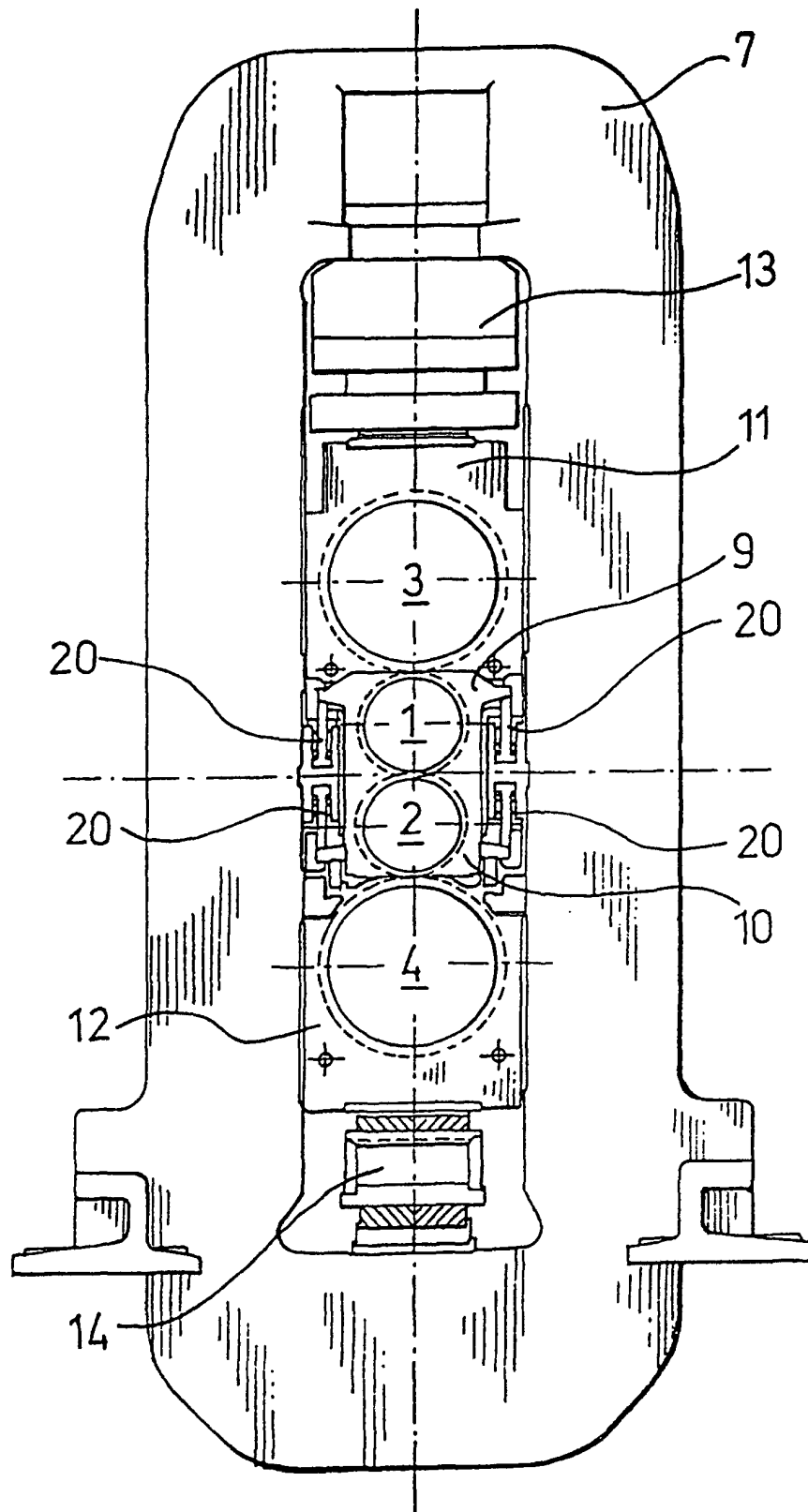


FIG.1

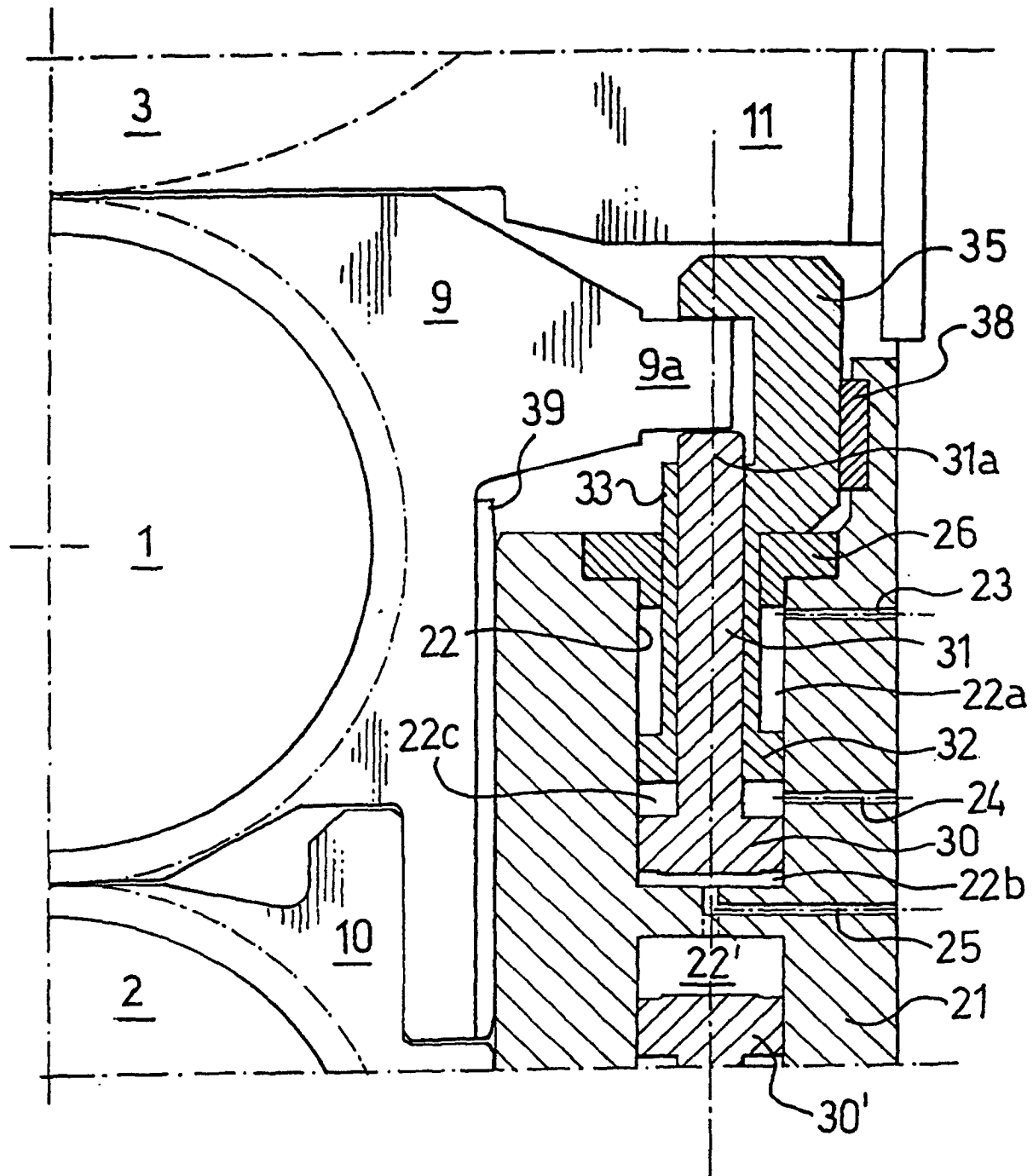


FIG. 2