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54 TELESCOPIC FEED BEAM FOR ROCK DRILL AND METHOD OF MEASURING ROCK DRILL TRAVEL

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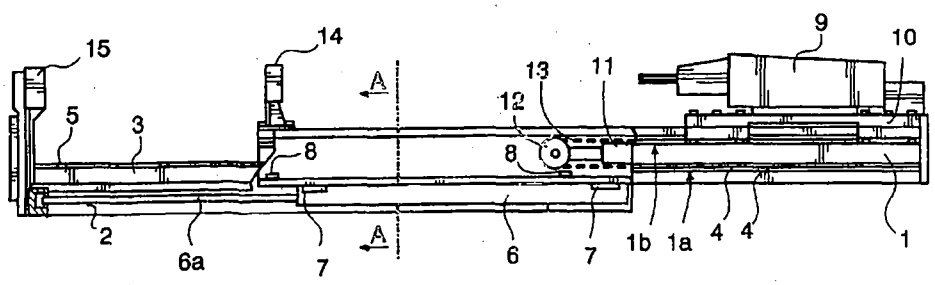
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(54) Title: TELESCOPIC FEED BEAM FOR ROCK DRILL AND METHOD OF MEASURING ROCK DRILL TRAVEL



(57) Abstract: The invention relates to a telescopic feed beam for a rock drill and to a method of measuring a travel length. The pressure surface of a piston (11b) in a feed cylinder (11) of the feed beam is twice as large as the pressure surface of a piston (6b) in a feed extension cylinder (6). Furthermore, the feed beam comprises a flow indicator (19) for measuring the volume flow rate of hydraulic fluid fed and/or discharged, and thereby the travel length.

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TELESCOPIC FEED BEAM FOR ROCK DRILL AND METHOD OF MEASURING ROCK DRILL TRAVEL

BACKGROUND OF THE INVENTION

[0001] The invention relates to a telescopic feed beam for a rock drill, the feed beam comprising a lower beam intended to be coupled to a boom of a rock drilling apparatus, and an upper beam mounted slidingly in its longitudinal direction relative to the lower beam, and a feed extension cylinder coupled to act between the upper beam and the lower beam for moving the upper beam relative to the lower beam, a feed cylinder for moving the rock drill relative to the upper beam, a flexible transfer element, such as a chain or a wire, mounted to be driven by the feed cylinder and coupled to the upper beam and to the rock drill, respectively, or a carriage thereof, such that the rock drill moves a double travel length with respect to the travel length of the feed cylinder or its rod, whereby cylinder spaces in the feed extension cylinder and the feed cylinder, whereto hydraulic fluid is fed via a feed conduit during a feed movement of the rock drill, are interconnected in parallel relative to the feed conduit.

[0002] The invention also relates to a method of measuring the travel length of a rock drill during the use of such a telescopic feed beam for a rock drill, the feed beam comprising a lower beam intended to be coupled to a boom of a rock drilling apparatus, and an upper beam mounted slidingly in its longitudinal direction relative to the lower beam, and a feed extension cylinder coupled to act between the upper beam and the lower beam for moving the upper beam relative to the lower beam, a feed cylinder for moving the rock drill relative to the upper beam, a flexible transfer element, such as a chain or a wire, mounted to be driven by the feed cylinder and coupled to the upper beam and to the rock drill, respectively, or a carriage thereof, such that the rock drill moves a double travel length with respect to the travel length of the feed cylinder or its rod, whereby cylinder spaces in the feed extension cylinder and the feed cylinder, whereto hydraulic fluid is fed via a feed conduit during a feed movement of the rock drill, are interconnected in parallel relative to the feed conduit.

[0003] Telescopic feed beams comprise two beam parts mounted one upon the other or slidably within one another, i.e. a lower beam and an upper beam movable relative thereto. The lower beam is connected or connec-

tible to the boom of a rock drilling apparatus and, during drilling, is pushed against the rock to be drilled by means of the boom and other related equipment. The drilling takes place by moving the upper beam and the rock drill. During drilling, longer holes are drilled in two steps, i.e. the rock drill moves on the upper beam by means of a feed device constituted by a feed cylinder and a wire, and, on the other hand, the upper beam is moved relative to the lower beam with a separate feed extension cylinder in order to utilize the entire feed length of the beam. The problem in known solutions is the measurement of the travel length of the rock drill. The measurement of the total travel length requires that both the length of the reciprocal movement of the beams and the length of the travel of the rock drill on the upper beam can be measured, and that these travel lengths can be combined. The sensoring of such a system and the processing of the measurement science are complex, and it does not operate reliably.

BRIEF DESCRIPTION OF THE INVENTION

[0004] The object of the present invention is to provide an arrangement that avoids known drawbacks and achieves as simple and reliable a structure as possible. The feed beam of the invention is characterized in that the pressure surface of a piston in said cylinder space of the feed cylinder is twice as large as the pressure surface of a piston in said cylinder space of the feed extension cylinder, that the feed conduit via which hydraulic fluid is fed to said cylinder spaces during a feed movement of the rock drill comprises a flow indicator for measuring the volume flow rate of the hydraulic fluid fed into said cylinder spaces, and thereby the travel length of the rock drill. The method of the invention is characterized by dimensioning the pressure surface of a piston in said cylinder space of the feed cylinder twice as large as the pressure surface of a piston in said cylinder space of the feed extension cylinder, by measuring the entire volume flow rate of the hydraulic fluid fed into said cylinder spaces and/or discharged therefrom, and thereby the travel length of the rock drill.

[0005] The essential idea of the invention is to dimension the pressure surfaces of the pistons of the transfer and feed cylinders coupled in parallel such that the same amount of hydraulic fluid in the feed direction achieves an equally long travel length between both the upper and the lower beam and the rock drill and the upper beam, respectively. The essential idea of a pre-

ferred embodiment of the invention is to couple a pressure limit switch to the return conduit of one cylinder, allowing the piston of the other cylinder to move freely and first proceed its travel length, after which, when its movement stops and the pressure rises, the piston of the other cylinder starts its movement.

[0006] An advantage of the invention is that it enables simple and reliable measurement of the travel length of the rock drill with one flow indicator even in both travel directions. Furthermore, the advantage of a preferred embodiment of the invention is that it enables the selection of the order in which the movements occur without it anyway affecting the measurement.

BRIEF DESCRIPTION OF THE FIGURES

[0007] The invention is described in detail in the accompanying drawings, in which

Figure 1 is a side view of a telescopic feed beam of the invention with the feed beam partly in section,

Figure 2 is a schematic sectional view of the telescopic feed beam of Figure 1 in its transverse direction along line A – A in Figure 1,

Figure 3 schematically shows a hydraulic coupling of a preferred embodiment of the arrangement according to the invention, and

Figure 4 schematically shows a hydraulic coupling of a second embodiment of the arrangement according to the invention.

DETAILED DESCRIPTION OF THE INVENTION

[0008] Figure 1 shows a telescopic feed beam composed of an upper beam 1 and a lower beam 2. The upper beam 1 and the lower beam 2 are mounted mutually slidingly in their longitudinal direction by means of slide rails 1a at the lower edge of the upper beam 1 and slide members 3 attached to the lower beam. The upper beam 1 is made from e.g. an aluminium alloy by extrusion, its slide surfaces being preferably formed simultaneously. For the slide members, the slide rails are provided with slide surfaces 4, usually steel strips or the like in aluminium beams. The slide members 3, in turn, are most preferably made from aluminium profiles, to which slides are attached in the manner shown in Figure 2, the slides being in contact with the slide surfaces 4. The slide members 3 are attached to the lower beam 2 with bolts 5. At the front end of the lower beam 2, the slide members preferably extend substantially over the entire travel length of the upper beam 1, the slides thus supporting the upper beam over its entire length, while the aluminium profiles stiffen the low lower beam 2 at the

front end. If desired, the slide members 3 may extend over the entire length of the lower beam 2, and slides may be positioned in a desired portion of the aluminium profile. Alternatively, the feed beam may be made from suitable steel, suitable slide surfaces being formed therein in a manner known *per se*.

[0009] A feed extension cylinder 6 is provided below the upper beam 1, the cylinder pipe of the feed extension cylinder being attached to the lower surface of the upper beam 1. The feed extension cylinder 6 is preferably fixed to the upper beam 1 rigidly and immovably, unable to turn relative thereto. A piston rod 6a of the feed extension cylinder 6, in turn, is attached at its one end to the front end of the lower beam 2. The feed extension cylinder 6 may be attached e.g. by flanges 7 fastened to the cylinder pipe of the feed extension cylinder 6 and bolts 8 driven into it through the bottom plate of the upper beam 1. Naturally, the fastening may be carried by any other manner known *per se*. Figure 1 also shows a rock drill 9 intended to move along the upper beam, and a rock drill carriage 10 mounted in a manner known *per se* slidably along second slide rails 1b provided at the upper edge of the upper beam 1. For the displacement of the rock drill 9 and the carriage 10, a feed cylinder 11 is provided within the upper beam 1, and an idler wheel 12 is coupled to the cylinder pipe of the feed cylinder. A feed wire 13, in turn, coupled to both the beam 1 and the drill carriage 10, passes around the idler wheel 12. Such a feed cylinder/wire structure is generally well known *per se*, and will therefore not be described more closely herein. By the feed of medium into the feed cylinder 11, its piston rod 11a is expelled, and the cylinder pipe moves towards the front end of the upper beam, thus pushing the feed wire 13 ahead of it by means of the idler wheel, and so the rock drill 9 and the carriage 10 move on at a speed twice as high as that of the piston rod 11a and the idler wheel 12, respectively. Correspondingly, when the piston of the feed cylinder is retracted, the rock drill moves to the rear portion of the upper beam 1 in a manner known *per se*. The figure also shows a travelling centralizer 14 provided for a drill rod at the front end of the upper beam 1, and a front centralizer 15 at the front end of the lower beam 2. Such centralizers are fully known *per se*, and are not essential to the present invention, wherefore they will not be described more closely.

[0010] Figure 2 is a sectional view of the feed beam structure of Figure 1 along line A - A. It shows how the lower beam 2 is composed of vertical side portions 2a and a transverse bottom plate 2b positioned between the side portions. A chute-like space 2c is defined between the sides and the bottom

plate, wherein the feed extension cylinder 6 is located below the upper beam 1. The upper edge of the cylinder pipe of the feed extension cylinder 6 is provided with a fixing flange 7, which fixes it at its both ends immovably relative to the upper beam 1. In this way, the feed extension cylinder 6 and its piston rod 6a remain protected at all times between the upper beam 1 and the lower beam 2. The profiles 3, having slides 16 inside thereof, are attached by means of the bolts 5 to the edge flanges 2d provided at the edge of the sides of the lower beam 2. The slides 16, in turn, are in contact with the slide surfaces 4 of the slide rails 1a of the upper beam 1, so that the upper beam and the lower beam slide in close contact with each other.

[0011] Figure 3 is a schematic diagram of a hydraulic coupling suitable for implementing the invention. It schematically shows the upper beam 1 and the lower beam 2, which are able to move relative to one another in their longitudinal direction. The feed extension cylinder 6 is coupled to the upper beam 1 with a flange or the like 7 such that the cylinder 6 is immovable relative to the upper beam 1 in its longitudinal direction, its piston rod 6a being coupled at its end to the lower beam 2 immovably in its longitudinal direction. Correspondingly, the piston rod 11a of the feed cylinder 11 is coupled to the upper beam 1 immovably in its longitudinal direction. Hydraulic fluid feed and return conduits 17 and 18 are coupled to the feed extension and feed cylinders in such a manner that their cylinder spaces 6c and 11c, and 6d and 11d, respectively are parallel relative to the conduits 17 and 18, respectively. The feed conduit 17 along which hydraulic fluid is fed into the cylinders during a feed movement, such as drilling, is provided with a flow indicator 19, which may be an entire indicator or a mere flow sensor issuing a signal proportional to the flow rate and most preferably being able to measure the flow rate of the hydraulic fluid in both directions. The conduit 17 is further coupled to the cylinder space 6c on the side of the piston rod 6a of the piston 6b of the feed extension cylinder and, correspondingly, to the cylinder space 11c relative to the piston 11d of the feed cylinder 11. During a return movement, the return conduit 18 employed for the feed of hydraulic feed is, in turn, coupled to the second cylinder space 6d of the feed extension cylinder 6 and to the second hydraulic fluid space 11d of the feed cylinder 11. During a feed movement, when hydraulic fluid is being fed to the conduit 17, hydraulic fluid is discharged from the cylinder spaces 6d and 11d via the conduit 18, and, correspondingly, during a return movement, when hydraulic fluid is being fed to the conduit 18, hydraulic fluid is discharged from the cylinder spaces 6c and 11c

through the flow indicator 19 via the conduit 17.

[0012] In addition to the idler wheel 12, Figure 3 also shows a second idler wheel 12a located at one end of the feed cylinder 11. A flexible transfer member, such as a wire or chain 13, passes around both feed wheels 12 and 12a and is attached with a fastener 13a to the upper beam 1 and, correspondingly, with a fastener 13b to the carriage 10 of the rock drill or, alternatively, directly to the rock drill 9 in a manner known *per se*. When the feed cylinder 11 is displaced relative to the upper beam 1, it pushes the chain or wire 13 ahead of it, and by the action of a closed loop, the fastener 1b moves double the distance relative to the travel length of the cylinder 11 in the same travel direction, moving the rock drill the same distance.

[0013] The feed extension cylinder 6 and feed cylinder 11 are dimensioned such that the pressure surface of the piston 11b facing the cylinder space 11c of the feed cylinder 11 is twice the pressure surface facing the cylinder space 6c of the piston 6b of the feed extension cylinder 6. A given unit volume of hydraulic fluid fed into the cylinder space 6c of the feed extension cylinder 6 makes the upper beam 1 move a given distance relative to the lower beam 2. Correspondingly, the same amount of hydraulic fluid, fed to the cylinder space 11c of the feed cylinder 11, makes the feed cylinder 11 move half of this distance relative to the upper carriage 1. Since the movement provided by the feed cylinder 11 for the rock drill 9 is twice as long as its own travel length, the result is that, given this unit volume of hydraulic fluid, the rock drill 9 moves an equal distance relative to the upper beam 1 as the upper beam 1 would move relative to the lower beam 2 by the action of an amount of hydraulic fluid fed to the feed extension cylinder 6. As a result of this, a given amount of hydraulic fluid always corresponds to a given travel length of the rock drill in the feed direction irrespective of whether the hydraulic fluid flows only to one cylinder or partly to both. The flow rates of the hydraulic fluid discharged from the cylinder spaces 11d and 6d via the hydraulic fluid conduit 18 may significantly deviate from each other, but it has no effect on the situation between the cylinder spaces 6c and 11c. In this way, only one flow indicator 19 can be used for a simple and reliable measurement of the amount of hydraulic fluid used for a feed movement and, consequently, of the length of the feed movement of the rock drill.

[0014] When the rock drill is displaced in the opposite direction in a return movement, the rock drill is on the one hand displaced along the upper beam 1 as the hydraulic fluid moves the feed cylinder 11 to the right relative to

the piston 11b in the situation shown in Figure 3, whereby the total length of the feed cylinder 11 and its piston rod 11a shortens. Correspondingly, the upper beam 1 is displaced relative to the lower beam 2 outwards from it such that the total length of the feed beams increases as the hydraulic fluid pushes the feed extension cylinder 6 relative to its piston 6b such that their total length increases. In this situation, the hydraulic fluid flows from the cylinder spaces 6c and 11c through the flow indicator 19 in the opposite direction and out through the conduit 17. Even in this situation, the travel length of the rock drill in the return direction relative to the lower beam 2 is directly proportional to the volume flow rate of the hydraulic fluid flowing through the flow indicator 19, and thus the length of the return movement of the rock drill can also reliably be measured by measuring this flow rate. In this way, the entire travel length of the rock drill can be reliably measured in both directions by means of only one flow indicator, provided the pressure surfaces of the pistons of the feed extension cylinder 6 and the feed cylinder 11 of the feed mechanism are selected such that their ratio is essentially the ratio of one to two.

[0015] Figure 4 schematically shows a preferred embodiment of the invention. Its operation and structure are otherwise similar to that of the embodiment shown in Figure 3, but a preferred additional feature has been added thereto, by means of which the movement of the feed beams 1 and 2, and that of the rock drill can be controlled in the desired order. As regards the functioning of the drilling and the quality of the drilling, it is usually advantageous to first move the feed beams relative to each other as short as possible and only after that start to move the rock drill along the upper beam 1. In this embodiment, a pressure limit switch or valve 20 is coupled to the conduit leading to the feed-time return conduit 18 from the cylinder space 11d of the feed cylinder 11. The operation of the pressure limit switch or valve 20 is such that, during a feed movement, the counterpressure of the hydraulic fluid tending to be discharged from the cylinder space 11d is higher than from the cylinder space 6d of the feed extension cylinder 6 coupled directly to the conduit 18. This being the case, the hydraulic fluid to be fed can more easily enter the feed extension cylinder 6, thus pushing the upper beam 1 relative to the lower beam 2. When the upper beam has moved along its entire travel length, it stops and the flow of hydraulic fluid from the cylinder space 6d stops. As a result of this, the pressure of the hydraulic fluid in the conduit 17 and the cylinder space 11c, but also in the cylinder space 11d, rises, until it exceeds the limit value set in the pressure limit switch 20. The hy-

draulic fluid then starts to flow to the conduit 18 via the pressure limit switch 20 and further out, whereby the rock drill is displaced relative to the upper beam 1 in the manner described above.

[0016] Figure 4 further shows a non-return valve 21, through which the hydraulic fluid flows past the pressure limit switch 20 to the cylinder space 11d during a return movement. This being the case, there is generally no need to choose which of them moves first, since it has no effect on the drilling result. Naturally, when a decision is to be made regarding which displacement movement occurs first, the pressure limit switch can be coupled in the opposite direction in the manner shown in Figure 4 from the conduit 18 either to the feed cylinder 11 or to the feed extension cylinder 6.

[0017] In the above description and drawings, the invention was described only by way of example, and it is in no way restricted thereto. The feed mechanism of the rock drill can be, not only a feed cylinder/wire mechanism, but also some other feed cylinder mechanism, although the cylinder/wire structure is advantageous in use.

CLAIMS

1. A telescopic feed beam for a rock drill, the feed beam comprising a lower beam (2) intended to be coupled to a boom of a rock drilling apparatus, and an upper beam (1) mounted slidingly in its longitudinal direction relative to the lower beam (2), and a feed extension cylinder (6) coupled to act between the upper beam (1) and the lower beam (2) for moving the upper beam (1) relative to the lower beam (2), a feed cylinder (11) for moving the rock drill (9) relative to the upper beam (1), a flexible transfer element, such as a chain or a wire, mounted to be driven by the feed cylinder (11) and coupled to the upper beam (1) and to the rock drill (9), respectively, or a carriage (10) thereof, such that the rock drill (9) moves a double travel length with respect to the travel length of the feed cylinder (11) or its rod (11a), whereby cylinder spaces (6b, 11b) in the feed extension cylinder (6) and the feed cylinder (11), whereto hydraulic fluid is fed via a feed conduit (17) during a feed movement of the rock drill (9), are interconnected in parallel relative to the feed conduit (17), **characterized** in that the pressure surface of a piston (11b) in said cylinder space (11c) of the feed cylinder (11) is twice as large as the pressure surface of a piston (6b) in said cylinder space (6c) of the feed extension cylinder (6), that the feed conduit (17) via which hydraulic fluid is fed to said cylinder spaces (6c, 11c) during a feed movement of the rock drill (9) comprises a flow indicator (19) for measuring the volume flow rate of the hydraulic fluid fed into said cylinder spaces (6c, 11c) and/or discharged therefrom, and thereby the travel length of the rock drill.

2. A feed beam as claimed in claim 1, **characterized** in that second cylinder spaces (6d, 11d) of the feed cylinder (11) and the feed extension cylinder (6) of the rock drill are interconnected in parallel relative to a return conduit (18) for hydraulic fluid.

3. A feed beam as claimed in claim 2, **characterized** in that in a conduit leading from the second cylinder space (11d) of the feed cylinder (11) to the return conduit (18) is provided a pressure limit switch or valve (20), which enables hydraulic fluid flow from said cylinder space (11d) to the return conduit (18) only when the pressure of the hydraulic fluid in the cylinder space (11d) exceeds a preset pressure value, and that the second cylinder space (6d) of the feed extension cylinder (6) is coupled to the return conduit (18) without a pressure limit switch or valve.

4. A feed beam as claimed in claim 3, **characterized** in that parallel to the pressure limit switch or valve (20) is coupled a non-return valve (21) enabling a hydraulic fluid flow from the return conduit (18) to said cylinder space (11d) of the feed cylinder (11) past the pressure limit switch (20).

5. A method of measuring the travel length of a rock drill during the use of such a telescopic feed beam for a rock drill, the feed beam comprising a lower beam (2) intended to be coupled to a boom of a rock drilling apparatus, and an upper beam (1) mounted slidingly in its longitudinal direction relative to the lower beam (2), and a feed extension cylinder (6) coupled to act between the upper beam (1) and the lower beam (2) for moving the upper beam (1) relative to the lower beam (2), a feed cylinder (11) for moving the rock drill (9) relative to the upper beam (1), a flexible transfer element, such as a chain or a wire, mounted to be driven by the feed cylinder (11) and coupled to the upper beam (1) and to the rock drill (9), respectively, or a carriage (10) thereof, such that the rock drill (9) moves a double travel length with respect to the travel length of the feed cylinder (11) or its rod (11a), whereby cylinder spaces (6b, 11b) in the feed extension cylinder (6) and the feed cylinder (11), whereto hydraulic fluid is fed via a feed conduit (17) during a feed movement of the rock drill (9), are interconnected in parallel relative to the feed conduit (17), **characterized** by dimensioning the pressure surface of a piston (11b) in said cylinder space (11c) of the feed cylinder (11) twice as large as the pressure surface of a piston (6b) in said cylinder space (6c) of the feed extension cylinder (6), by measuring the entire volume flow rate of the hydraulic fluid fed into said cylinder spaces (6c, 11c) and/or discharged therefrom, and thereby the travel length of the rock drill.

6. A method as claimed in claim 5, **characterized** by measuring the volume flow rate of the hydraulic fluid by means of a flow indicator (19) mounted in the feed conduit (17), hydraulic fluid being fed to said cylinder spaces (6c, 11c) via said indicator during a feed movement of the rock drill (9).

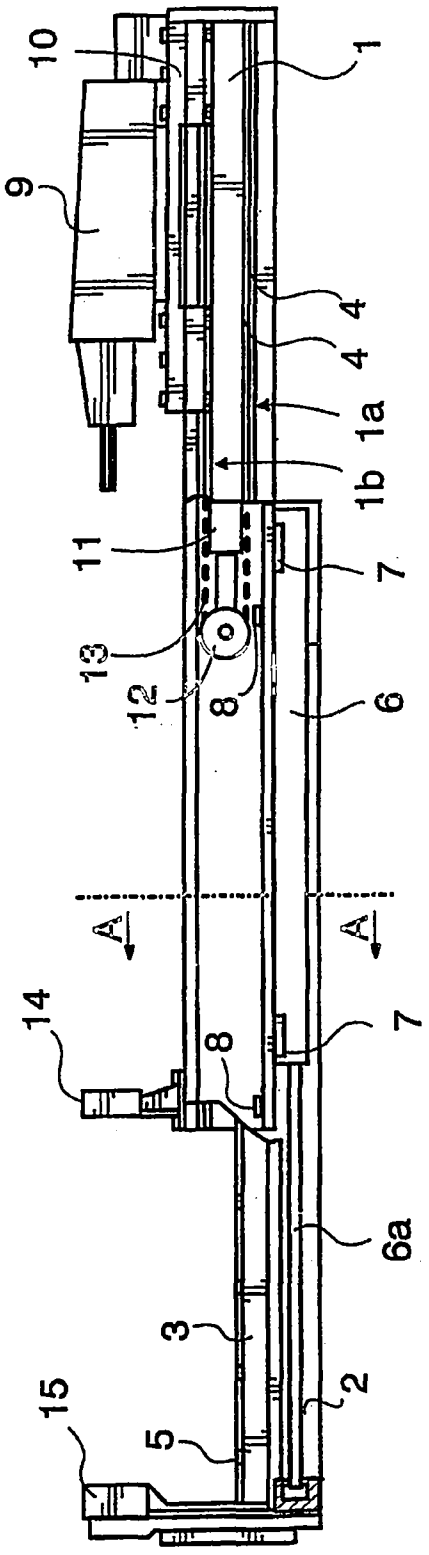


FIG. 1

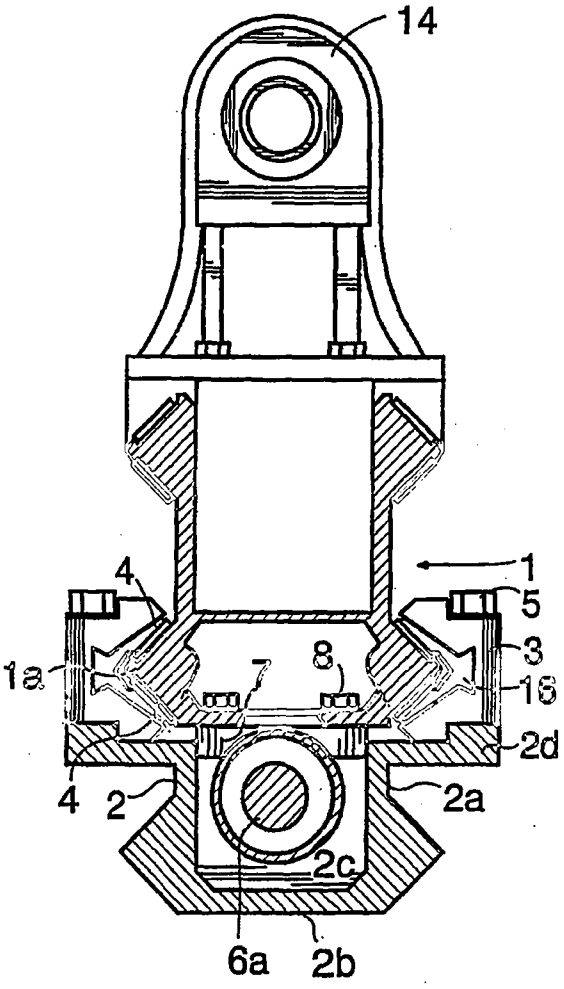


FIG. 2

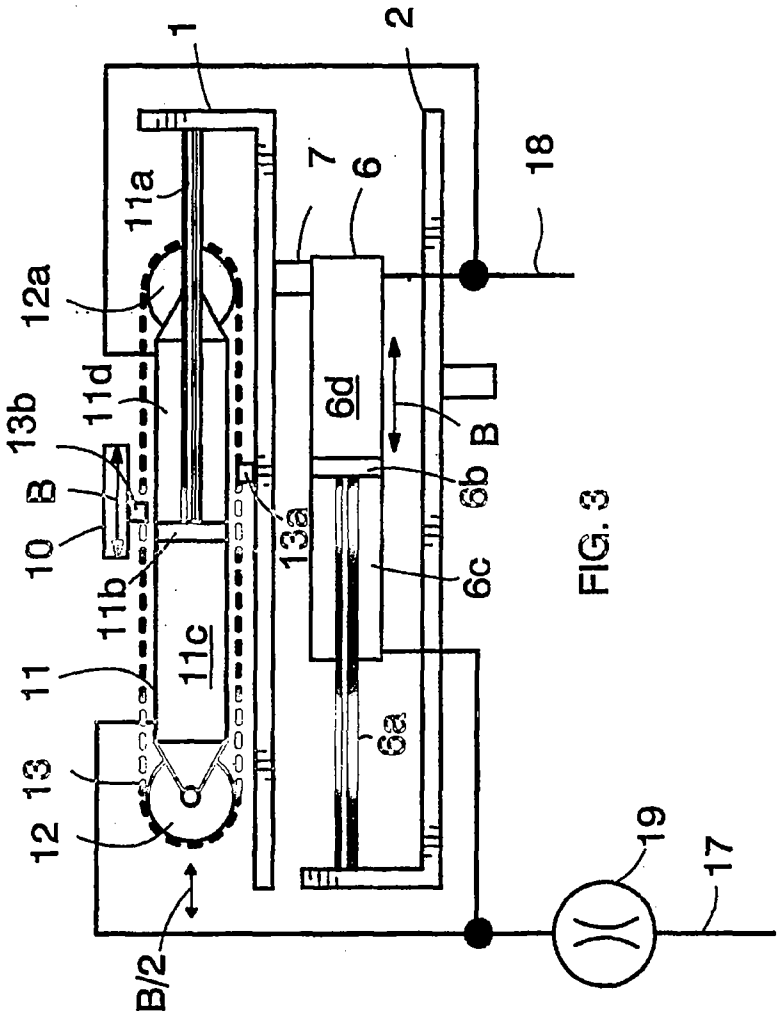

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FIG. 3

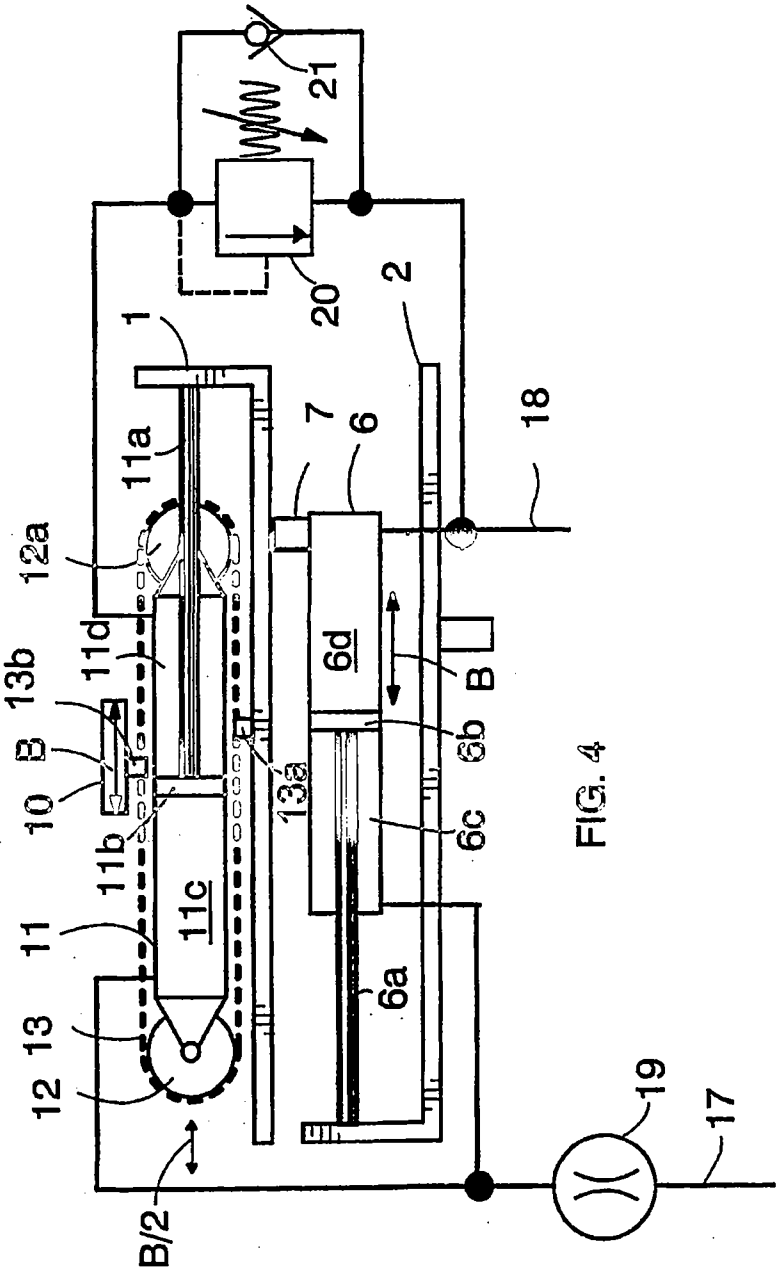

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FIG. 4