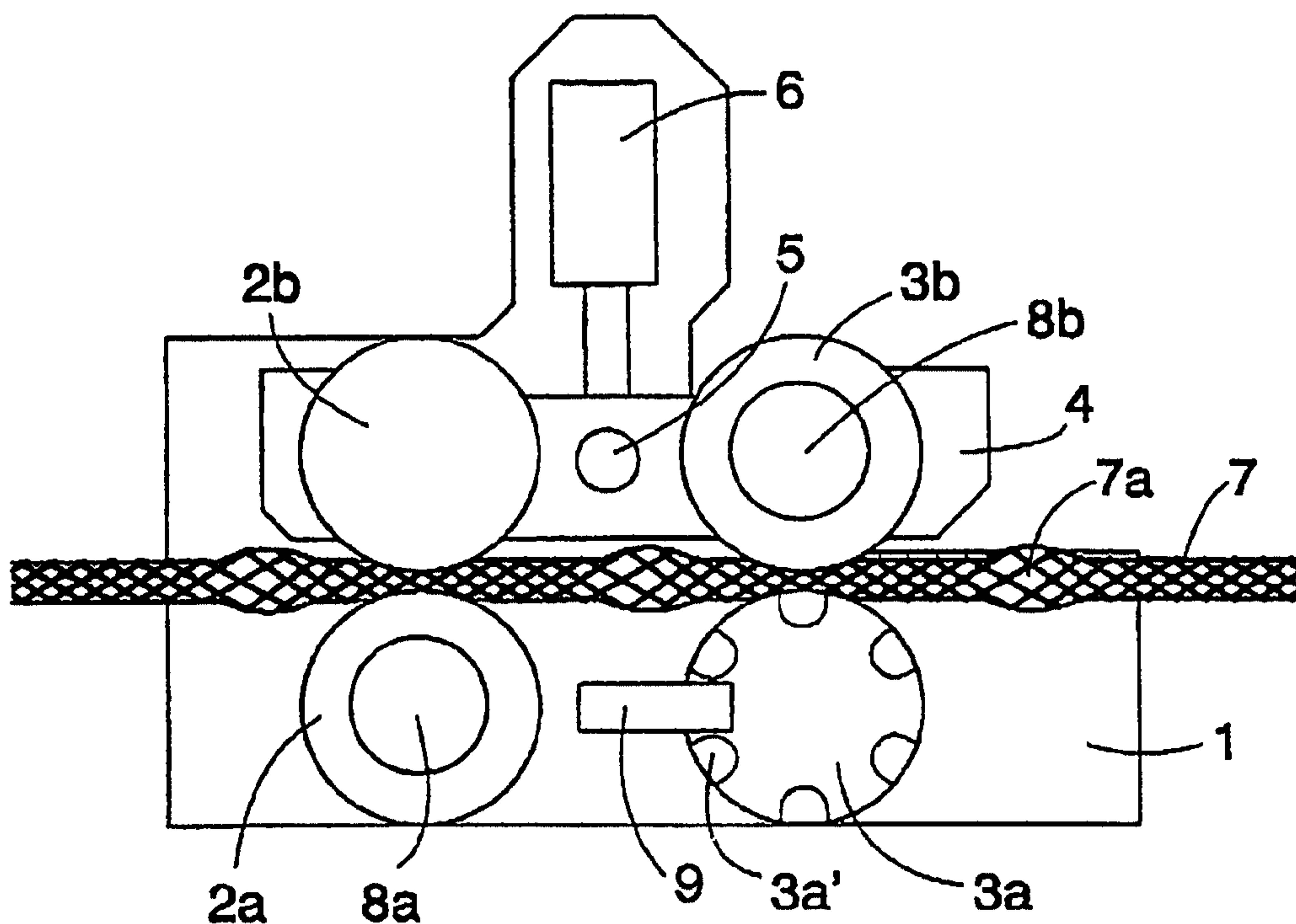




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(54) Titre : DISPOSITIF D'ALIMENTATION D'UN CABLE DANS UN EQUIPEMENT D'ANCRAGE PAR BOULONS
(54) Title: FEEDING DEVICE FOR FEEDING A WIRE IN A ROCK BOLTING EQUIPMENT



(57) Abrégé/Abstract:

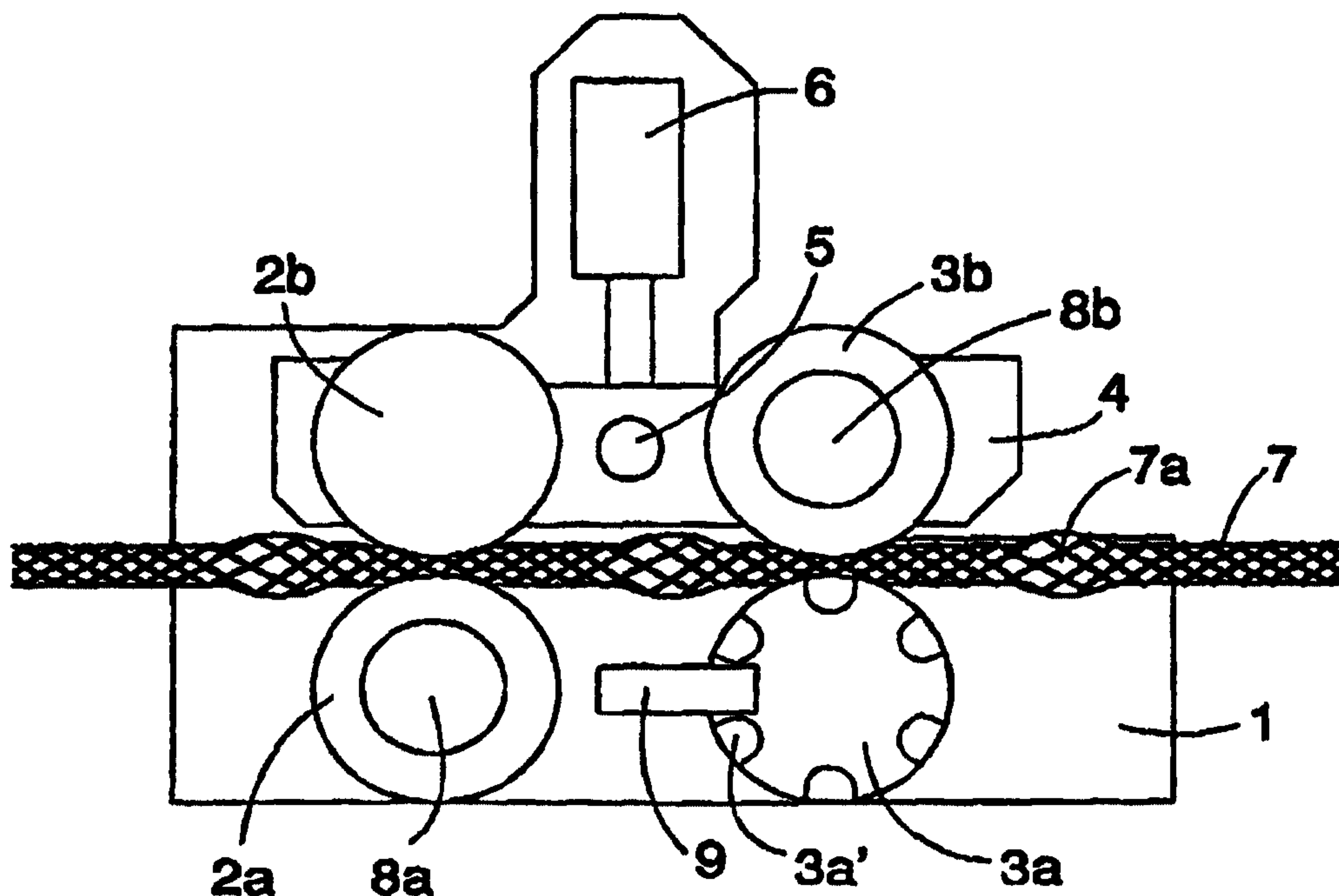
The feeding device comprises two pairs of feed wheels (2a, 2b; 3a, 3b) between which the wire (7) is made to pass. One feed wheel (2b, 3b) of each pair is connected to a separate bogie frame (4) that is pressed towards the other feed wheels (2a, 3a) with a loading means (6) that is most preferably a pressure medium cylinder connected directly to the bogie frame (4).

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(21) International Application Number: PCT/FI98/00338 (22) International Filing Date: 16 April 1998 (16.04.98) (30) Priority Data: 971681 18 April 1997 (18.04.97) FI (71) Applicant (for all designated States except US): TAMROCK OY [FI/FI]; Kelloportinkatu 1 B, FIN-33100 Tampere (FI). (72) Inventors; and (75) Inventors/Applicants (for US only): TIENARI, Ossi [FI/FI]; Kilvakkalantie 12, FIN-39530 Kilvakkala (FI). LAUNIEMI, Markku [FI/CA]; 1265 Ontario Street #PH 3, Burlington, Ontario L7S 1X8 (CA). PELTONEN, Vesa [FI/FI]; Paavalinkuja 3 B 10, FIN-33300 Tampere (FI). (74) Agent: KOLSTER OY AB; Iso Roobertinkatu 23, P.O. Box 148, FIN-00121 Helsinki (FI).		(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, GM, GW, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG). Published With international search report. With amended claims.

(54) Title: FEEDING DEVICE FOR FEEDING A WIRE IN A ROCK BOLTING EQUIPMENT



(57) Abstract

The feeding device comprises two pairs of feed wheels (2a, 2b; 3a, 3b) between which the wire (7) is made to pass. One feed wheel (2b, 3b) of each pair is connected to a separate bogie frame (4) that is pressed towards the other feed wheels (2a, 3a) with a loading means (6) that is most preferably a pressure medium cylinder connected directly to the bogie frame (4).

Feeding device for feeding a wire in a rock bolting equipment

5 The invention relates to a feeding device for feeding a wire in a rock bolting equipment, the feeding device comprising at least one pair of feed wheels between which the wire is arranged to pass during its feeding, and a feed motor for rotating the feed wheels during the feeding of the wire.

10 During rock bolting, longer holes require the use of wire bolting wherein a wire provided on a reel is pushed into a drilled hole and soldered thereto. The most common manner is to push the wire into the hole manually and to thereafter supply a soldering material to the hole.
15 This technique is rather unreliable, laborious and dangerous. Wire bolting devices are further known for example from US Patent 4,728,219. In these devices, the soldering material is first fed into the hole, whereafter the wire is pushed mechanically into the soldering
20 material.

Finnish Published Specification 831,481 discloses a feeding device where the feeding takes place by means of three feed wheels such that they are positioned
25 triangularly with respect to each other and a bolt is fed from between them. In this arrangement, the bolt is bent by feeding two of the feed wheels towards the third feed wheel that is situated in the middle thereof on the other side of the wire, so that the bolt bends. During normal feeding, the wheels are in a fixed position with respect
30 to each other.

Such mechanical feeding can be implemented in a rather simple manner when the wire thickness is constant at all times. On the other hand, with a so-called bulb-anchor wire such a device cannot be used. A bulb-anchor
35 wire comprises at regular intervals points where the wire

strands have been spread into a sparse section that is thicker than the rest of the wire, so that the soldering material can penetrate between the wire strands and it locks the wire in place effectively. Sections that have
5 been widened with a conventional mechanical feeding device would be compressed and would not therefore be useful.

The purpose of the present invention is to provide a feeding device that can also be used to feed this kind of bulb-anchor wires such that they
10 substantially maintain their shape. The device according to the invention is characterized in that at least one of the feed wheels of the pair of feed wheels is mounted movably with respect to the body of the device in the transverse direction of the wire, and that a loading means
15 is connected to act on the feed wheel, which presses the wire placed between the pair of feed wheels with the desired force by the action of the loading means while the wheel may move transversely to the wire to be fed according to the wire thickness.

20 The basic idea of the invention is that one feed wheel or, if desired, both feed wheels of a pair of feed wheels are connected to a loading means that keeps the pressure between the feed wheels substantially constant. Therefore, the feed wheels press the wire situated between
25 them with a suitable predetermined force that does not damage the wire while the wheels may move further apart from each other as the wire thickness changes, but the loading still remains substantially unchanged. The basic idea of a preferred embodiment of the invention is that it
30 comprises two pairs of feed wheels, and the wire passes between each pair of wheels during the feeding. Another essential feature of the invention is that the feed wheels of the wheel pair situated on the other side of the wire are mounted on a bogie assembly that may turn around the
35 mounting shaft between the wheels such that when the

expanded section reaches the pair of wheels, the wheels may move further away from each other. Yet another basic idea is that the bogie assembly is connected from its central shaft to the loading means that is operated by a pressure medium and that contains a pressure that keeps the feed force acting against the wire substantially constant and allows the bogie assembly to move away from the wire when the expanded section passes between the feed wheels and, correspondingly, to return so that the feed force remains substantially constant. According to another preferred embodiment of the invention, each pair of feed wheels comprises one drive wheel and one freely rotating wheel, in which case both pairs of wheels feed the wire in a substantially similar manner. According to yet another preferred embodiment, one of the freely rotating wheels is a measuring wheel the rotation of which produces a measurement signal that is proportional to the feed length of the wire, so that the exact wire feed length can be measured in a simple and easy manner.

It is an aspect of the present invention to provide a feeding device for feeding a wire in a rock bolting equipment, the feeding device comprising at least one pair of feed wheels between which the wire is arranged to pass during its feeding, loading means for pressing said pair of feed wheels towards each other, and a feed motor for rotating the feed wheels during the feeding of the wire, characterized in that at least one of the feed wheels of the pair of feed wheels is movably mounted with respect to a body of the device in a transverse direction of the wire, and that said loading means is connected to act on the at least one movably mounted feed wheel with a

3a

desired force so that the at least one movably mounted wheel is moved transversely to the wire to be fed according to the wire thickness.

The invention will be described in greater
5 detail in the accompanying drawings, in which

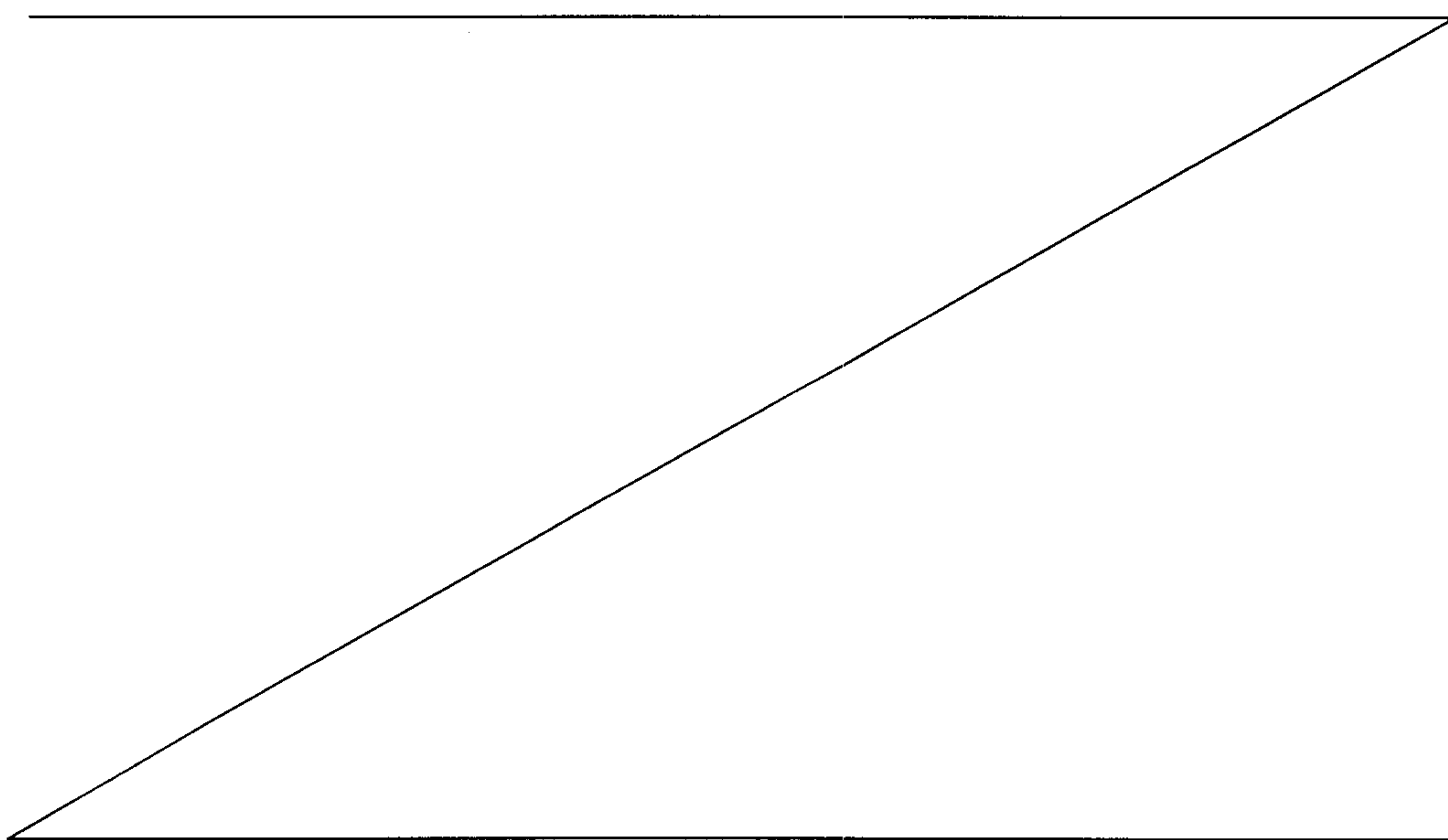
Figure 1 is a schematic side view of a device according to the invention,

Figure 2 shows schematically a simplified hydraulic diagram of a device according to the invention,
10 and

Figure 3 is a schematic side view of another embodiment of a device according to the invention.

Figure 1 shows schematically a wire feeding device according to the invention. The device comprises a
15 body 1. It also comprises two pairs of feed wheels the first of which consists of feed wheels 2a and 2b and the second of which consists of feed wheels 3a and 3b. One wheel of each pair of feed wheels, in this case wheels 2a and 3a, is mounted on the body 1 rotatably but otherwise

20



immovably with respect to it. Further, the other feed wheel of each pair of feed wheels, i.e. wheels 2b and 3b, is mounted on a separate bogie assembly comprising a bogie frame 4. The feed wheels 2b and 3b are connected to the bogie frame 4 rotatably but otherwise immovably with respect to it. The bogie frame 4 is in turn connected movably with respect to the body 1 so that it can move substantially perpendicularly to the axes of the feed wheels towards or away from the feed wheels 2a and 3a connected to the body. For this purpose, the bogie frame 4 is attached from the middle of the feed wheels 2b and 3b mounted thereon to a loading means 6, which in this case is a pressure medium cylinder connected to the body 1, such that the frame can turn around the shaft 5. The bogie frame 4 is attached to the piston rod of the pressure medium cylinder such that the frame can turn with respect to the rod around the shaft 5 that is parallel to the axes of the feed wheels. For the purpose of feeding, a wire 7 is arranged to pass between the pairs of feed wheels, i.e. feed wheels 2a and 2b, and 3a and 3b, respectively, so that it is pressed between them. The pressure medium in the pressure medium cylinder acting as the loading means 6 is provided with such a pressure that the feed wheels 2a and 2b, and 3a and 3b, respectively, are pressed together with a force that makes the wire 7 move ahead in the desired manner also when it is pushed into a hole filled with soldering material.

When a so-called bulb-anchor wire shown in Figure 1 is used, the forward movement of the wire makes the expanded wire sections 7a push the feed wheels belonging to the same pair of wheels away from each other. In such a situation, a feed wheel, such as feed wheel 3a, that is mounted on the bogie frame 4 may move away from the other feed wheel 3a so that the expanded section is not damaged but a sufficient feed force is maintained due to the

active pressure medium. Since the other pair of feed wheels is not normally forced to change its distance at the same time, the bogie frame 4 naturally turns around its shaft 5. When the expanded section 7a has passed the pair of feed wheels, the feed wheel 3b moves back towards the other feed wheel 3a along the surface of the wire 7 by the action of the pressure of the pressure medium, and a corresponding movement also occurs with the feed wheels 2a and 2b when the expanded section 7a reaches them.

In order to provide a feed force, the pairs of feed wheels are provided with feed motors such that one of the wheels in each pair is equipped with a motor and the other wheel rotates freely. In the embodiment shown in the figure, the feed motors 8a and 8b are placed such that the feed motor 8a rotates the feed wheel 2a and the feed motor 8b rotates the feed wheel 3b. The feed wheel 2b rotates freely with respect to the bogie frame 4 and, correspondingly, the feed wheel 3a rotates freely with respect to the body 1. The feed wheel 3a is preferably formed into a measuring wheel that provides signals to a sensor 9 when it rotates, so that the feed length of the wire 7 can be measured accurately and the feeding of the wire into the hole can therefore be monitored easily.

The feed wheel 3a is provided through machining with recesses 3a' at regular intervals around it. The body 1 is correspondingly provided with a sensor 9, which produces an electric pulse whenever a recess reaches it. The sensor 9 is preferably an inductive sensor which also operates reliably under difficult circumstances. Some other kind of sensor arrangement known per se can naturally also be used to measure the rotation of the measuring wheel 3a and thus to measure the feed length of the wire.

Figure 2 shows schematically the hydraulic coupling of the feeding device of Figure 1 as regards the

operation of the device. When a wire is fed, a pressure fluid is supplied to the loading means 6 along a duct 10a, so that the piston 6a of the hydraulic cylinder acting as the loading means comes out and pushes the bogie frame 4 shown in Figure 1 and the feed wheels 2b and 3b that are connected to the frame and that are shown above in Figure 1 towards the feed wheels 2a and 3a mounted on the body 1 and shown below in the figure. The pressure in the duct 10a is adjusted such that the pressure acting on the wire between the feed wheels is suitable and it does not compress the expanded sections of the wire when for example bulb-anchor wires are used. In order to keep the loading substantially constant, the duct 10a is connected to a pressure accumulator 11 having a pressure of 50 bar, for example. When the piston 6a moves as the expanded wire sections pass between the feed wheels, the pressure fluid flows from the duct 10a to the pressure accumulator 11 and back, so that the pressure remains substantially unchanged. The pressure medium is discharged along the duct 10a when the piston 6a is moved forward and it is also possible to feed the pressure medium along this duct when the piston 6a is to be moved to its rearmost position when a new wire is placed between the feed wheels, for example, or for some other reason. Figure 2 further shows the feed motors 8a and 8b that are connected hydraulically in parallel such that a pressure fluid is fed simultaneously into each motor along a duct 12a and the pressure fluid that has flown through the motors is discharged along a duct 12b. The pressure fluid that arrives along the duct 12a ends in a control circuit 13 where it is distributed to pass along different ducts 14a and 14b to feed motors 8a and 8b, respectively. In order that both motors would rotate at the same speed, the control circuit 13 comprises pressure-controlled throttles 15a and 15b that are guided by the pressure of the

pressure fluid passing to the other motor. In this manner, the control circuit 13 distributes the flow of the pressure fluid in exactly equal amounts to each motor so that their speeds of rotation are also the same. As a result, both pairs of feed wheels constantly pull the wire at the same speed and no skidding or idle rotation occurs.

Figure 3 is a schematic side view of another embodiment of a device according to the invention. The device shown in the figure corresponds otherwise to the one shown in Figure 1 and like reference numerals refer to corresponding parts. The difference is that instead of a bogie assembly, each upper feed wheel 2b and 3b is provided with a separate loading means 6' and 6'', respectively. In this embodiment, the feed wheels 2b and 3b are placed movably in a manner known per se, such as by means of a slide structure, so that they can move with respect to the body 1 either towards their pair of drive wheels 2a and 3a, respectively, or away from them. The loading means 6' and 6'' of each upper drive wheel 2b and 3b are for example hydraulic cylinders connected to the pressure accumulator as shown in Figure 2, or pneumatic cylinders that are provided beforehand with a sufficient pressure. Air or gas contained in the pneumatic cylinder allows the drive wheels 2b and 3b to move back and forth depending on the wire thickness without a need for additional pressure fluid ducts or other extra components.

The invention is described above in the specification and in the drawings by way of example only, and it is not restricted thereto in any way. The feed motors can be placed in different ways and they can be connected hydraulically in different manners for example in series so that the same pressure fluid flows through each motor. The measurement of the wire feeding can also be implemented with different measuring devices known per se, and a separate feed motor can also be used in each

feed wheel, if desired. The loading means 6 may be a pressure medium cylinder connected directly to the bogie frame as shown in the figure, or it may be attached thereto indirectly by means of different mechanical transmission means. Further, even though the figure shows a preferred structure of the invention where two of the feed wheels are fixedly mounted on the body 1 and the other two wheels 2b and 3b are attached movably and rotatably to the bogie frame, it is also possible to connect the fixedly placed feed wheels 2a and 3a to a bogie frame of their own. In practice, this arrangement is not usually necessary, but the embodiment shown in Figure 1 is very advantageous in use. It is also possible to attach the feed motors for example to three feed wheels or to all of the wheels. When only one pair of feed wheels is used, the loading means can be connected to act on one of the wheels, and correspondingly when two pairs of feed wheels are used, one or both wheels of each pair of feed wheels can be provided with separate loading means that keep the compression force substantially constant on a predetermined level and that allow the feed wheels to move towards and away from each other as the wire thickness changes without a substantial change in the compression force.

Claims

1. A feeding device for feeding a wire in a rock bolting equipment, the feeding device comprising at least one pair of feed wheels between which the wire is arranged to pass during its feeding, loading means for pressing said pair of feed wheels towards each other, and a feed motor for rotating the feed wheels during the feeding of the wire, characterized in that at least one of the feed wheels of the pair of feed wheels is movably mounted with respect to a body of the device in a transverse direction of the wire, and that said loading means is connected to act on the at least one movably mounted feed wheel with a desired force so that the at least one movably mounted wheel is moved transversely to the wire to be fed according to the wire thickness.

2. The feeding device according to claim 1, characterized in that it comprises two pairs of feed wheels, the loading means being configured and disposed to act on at least one of the feed wheels of each pair of feed wheels.

3. The feeding device according to claim 2, characterized in that one of the feed wheels of each pair of feed wheels is mounted on a bogie frame that is movable with respect to the body of the device, and that the bogie frame is pivotally connected to the loading means between the feed wheels mounted on the bogie frame.

4. The feeding device according to any one of claims 1 to 3, characterized in that it comprises two feed motors, the feed motors being arranged to rotate one

feed wheel of the pair of feed wheels.

5. The feeding device according to claim 4, characterized in that the feed motors are arranged in the pairs of feed wheels to rotate the feed wheels provided on opposite sides of the wire with respect to each other.

6. The feeding device according to any one of claims 1 to 5, characterized in that the loading means is a pressure medium cylinder.

7. The feeding device according to claim 1 or 2, characterized in that the loading means is a pressure medium cylinder, each movably mounted feed wheels being connected to a bogie frame that is pivotally connected to a piston rod of the pressure medium cylinder.

8. The feeding device according to any one of claims 1 to 7, characterized in that at least one of the feed wheels is a measuring wheel, and that the feeding device comprises a sensor that detects a rotation of the measuring wheel and therefore a feed length of the wire.

9. The feeding device according to claim 8, characterized in that the measuring wheel is a freely rotating feed wheel.

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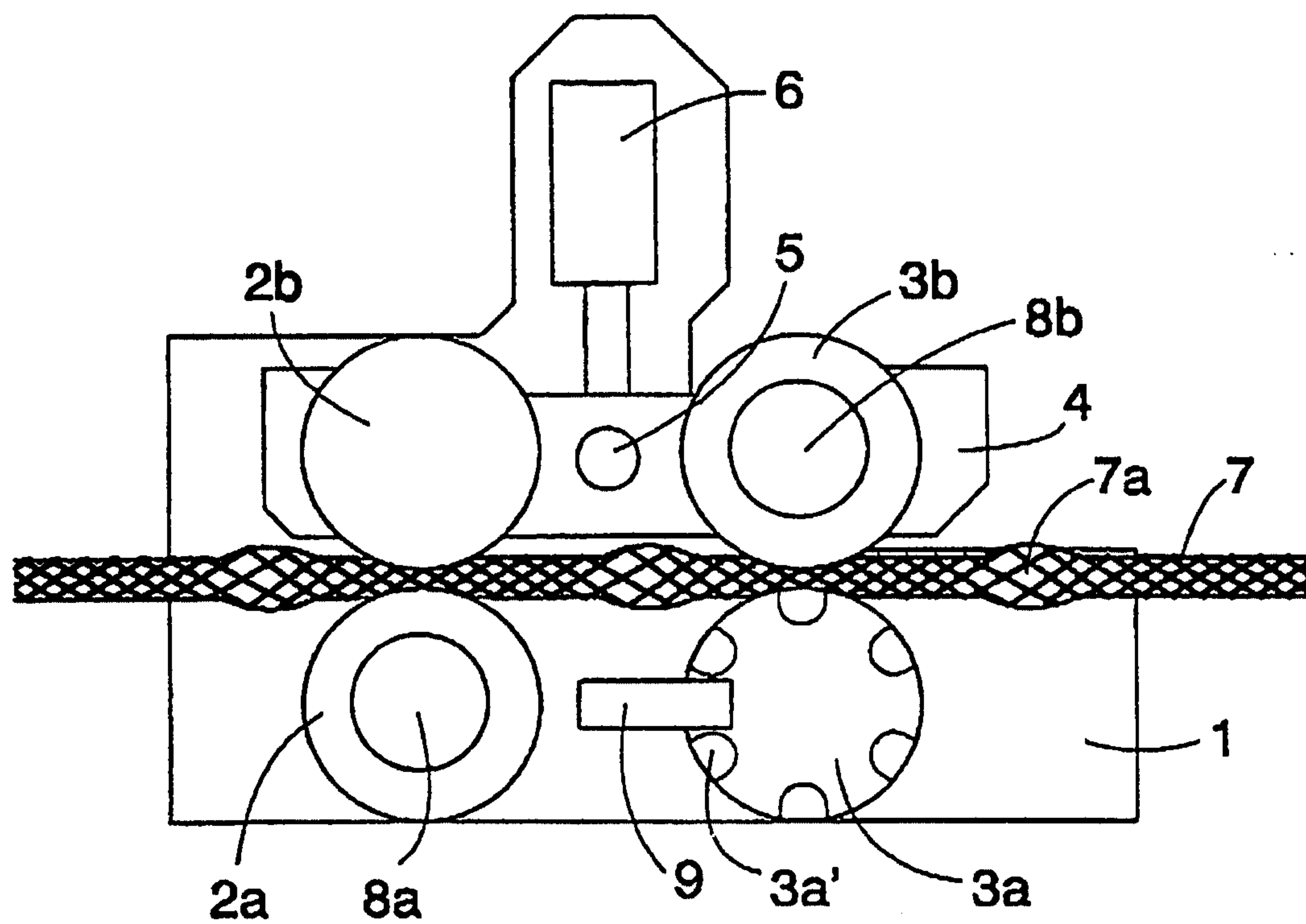


FIG. 1

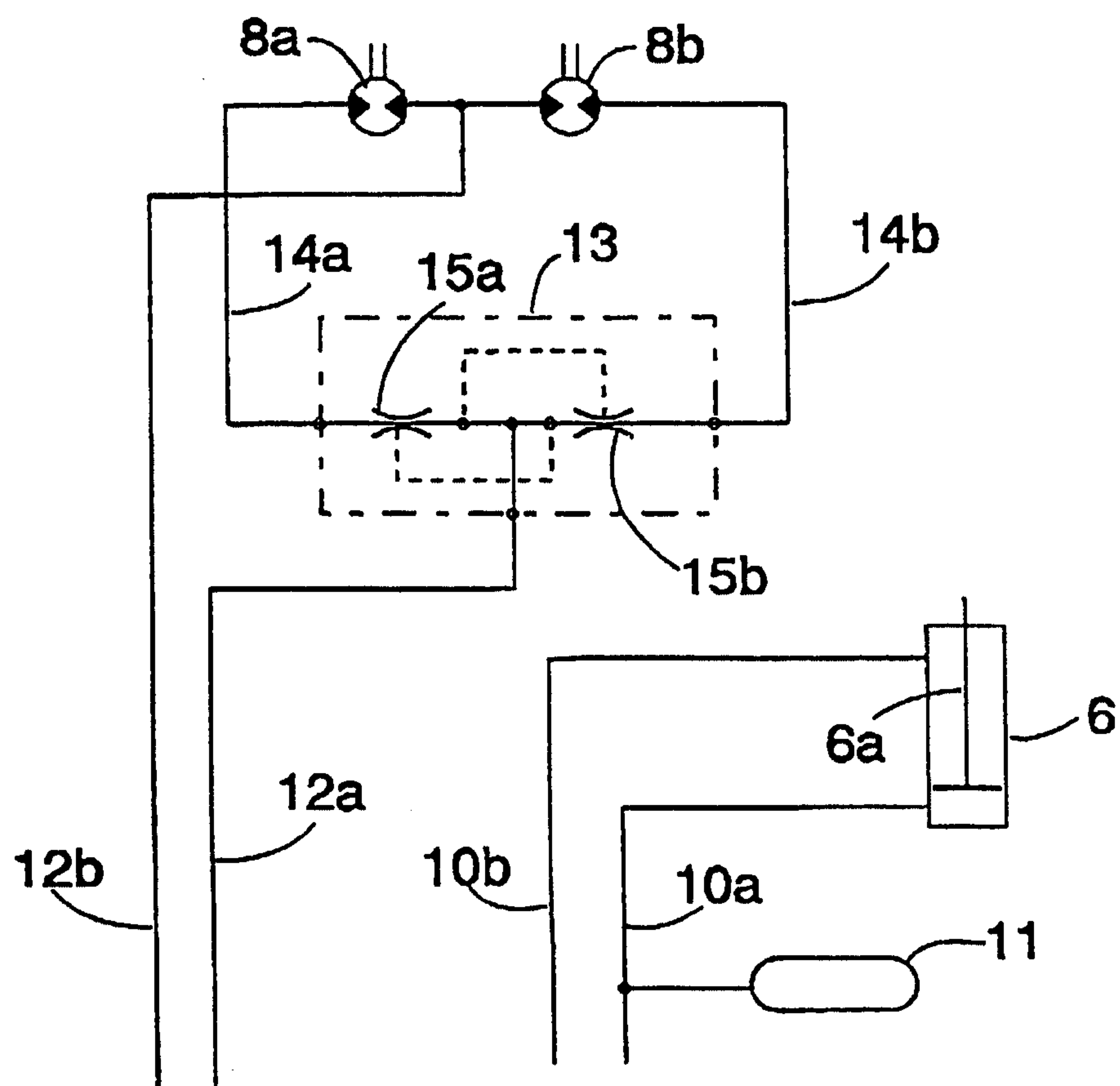


FIG. 2

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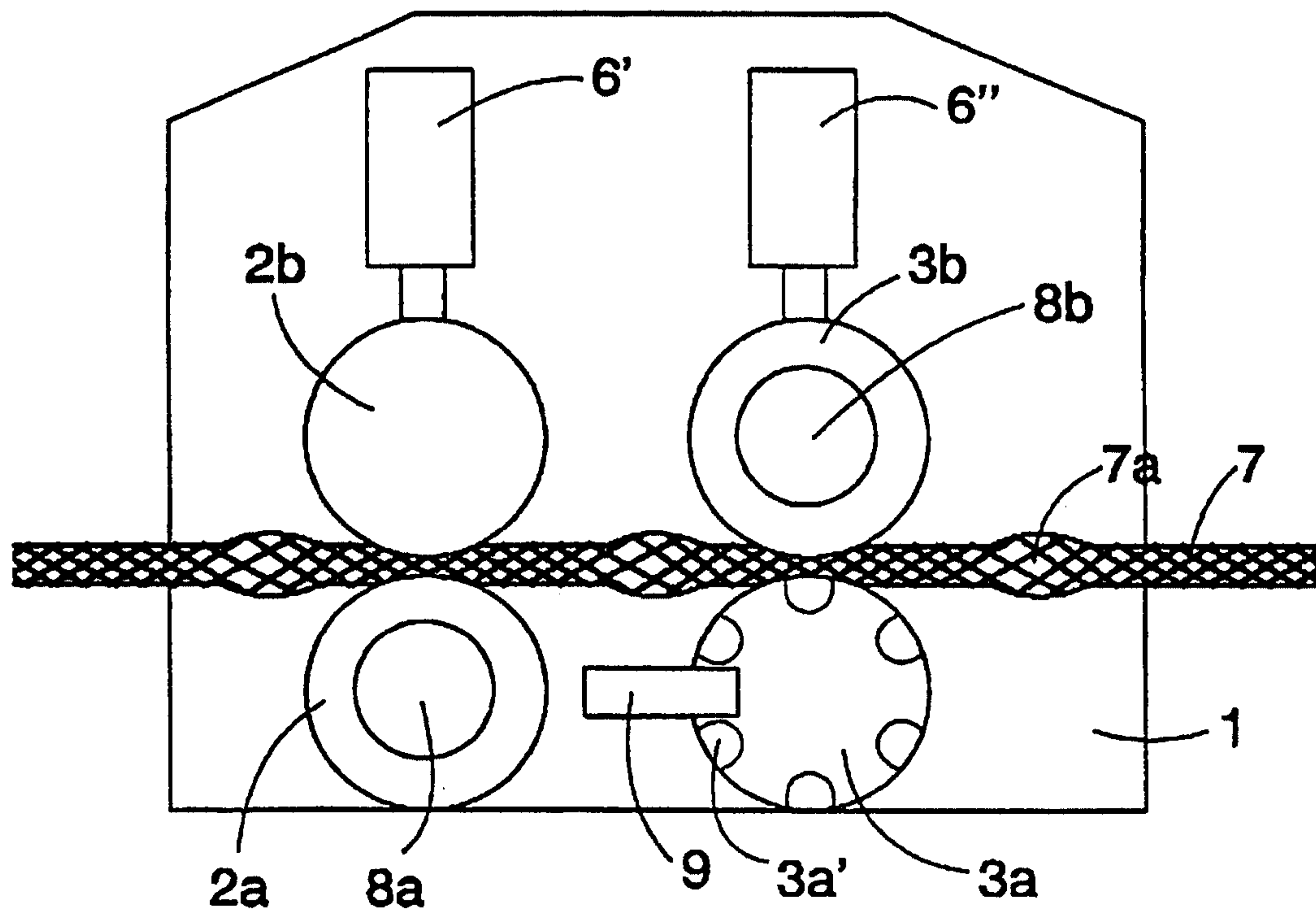


FIG. 3

