

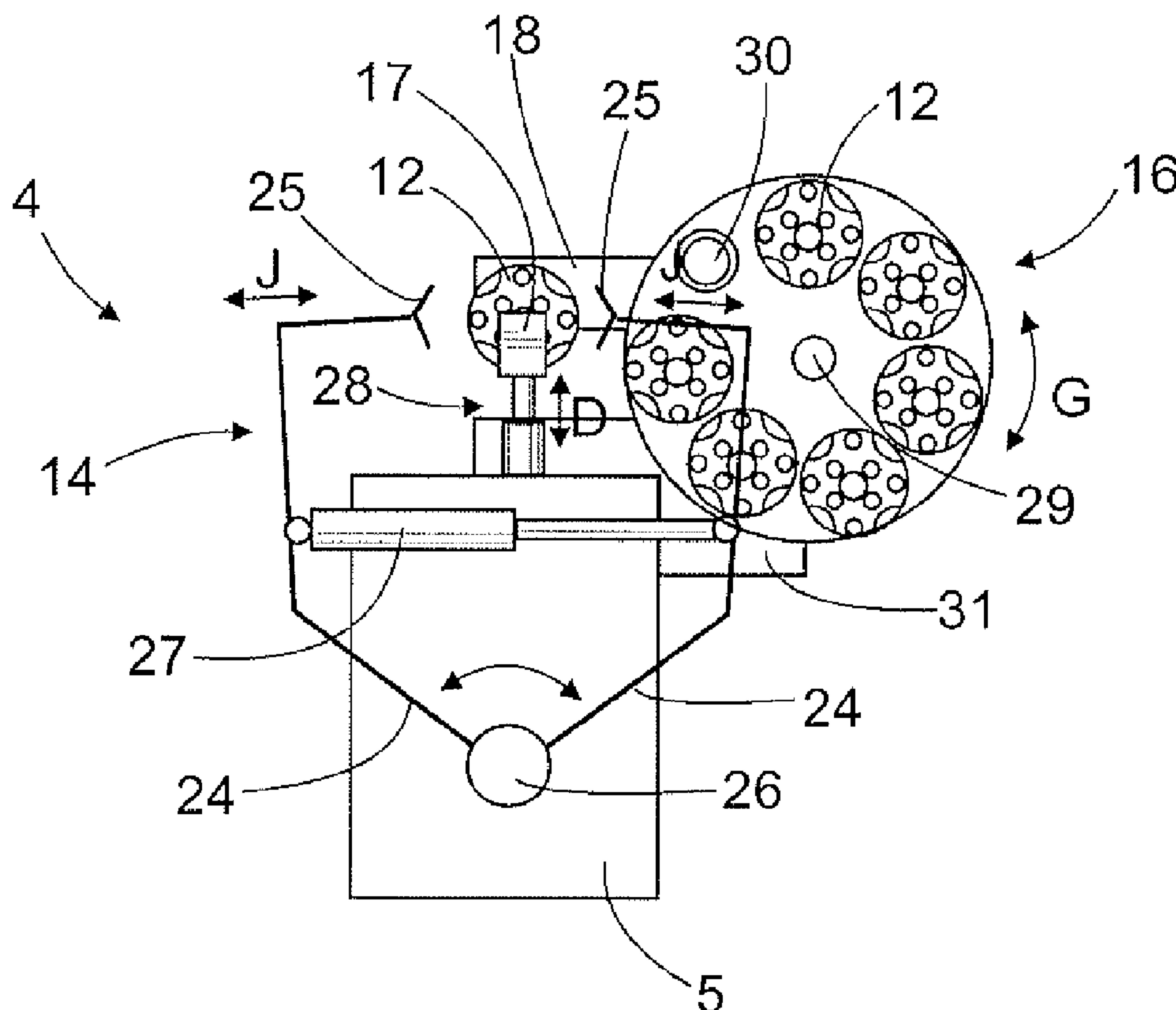


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(72) Inventeur/Inventor:
SILTALA, HANNU, FI
(73) Propriétaire/Owner:
SANDVIK MINING AND CONSTRUCTION OY, FI
(74) Agent: NORTON ROSE FULBRIGHT CANADA
LLP/S.E.N.C.R.L., S.R.L.

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(54) Title: ROCK-DRILLING UNIT, DRILL BIT CHANGER, AND METHOD FOR CHANGING DRILL BIT



(57) Abrégé/Abstract:

The invention relates to a rock-drilling unit, drill bit changer, and method for changing a drill bit. The front part of a feed beam (5) has a retainer (14) and a drill bit changer (15) connected thereto. In changing drill bits (14), a normal retainer fastened to the feed beam is utilised, when the connection between the drill bit and drill rod (11) is opened. The changer also comprises a magazine (16) for storing drill bits and a transfer device (18) for transferring the drill bits between the retainer and magazine.

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(71) Applicant (for all designated States except US): **SANDVIK MINING AND CONSTRUCTION OY** [FI/FI]; Pihlisulunkatu 9, FI-33330 Tampere (FI).

(72) Inventor; and

(75) Inventor/Applicant (for US only): **SILTALA, Hannu** [FI/FI]; Listakatu 9 B 9, FI-33400 Tampere (FI).(74) Agent: **KOLSTER OY AB**; Iso Roobertinkatu 23, P.O.Box 148, FI-00121 Helsinki (FI).

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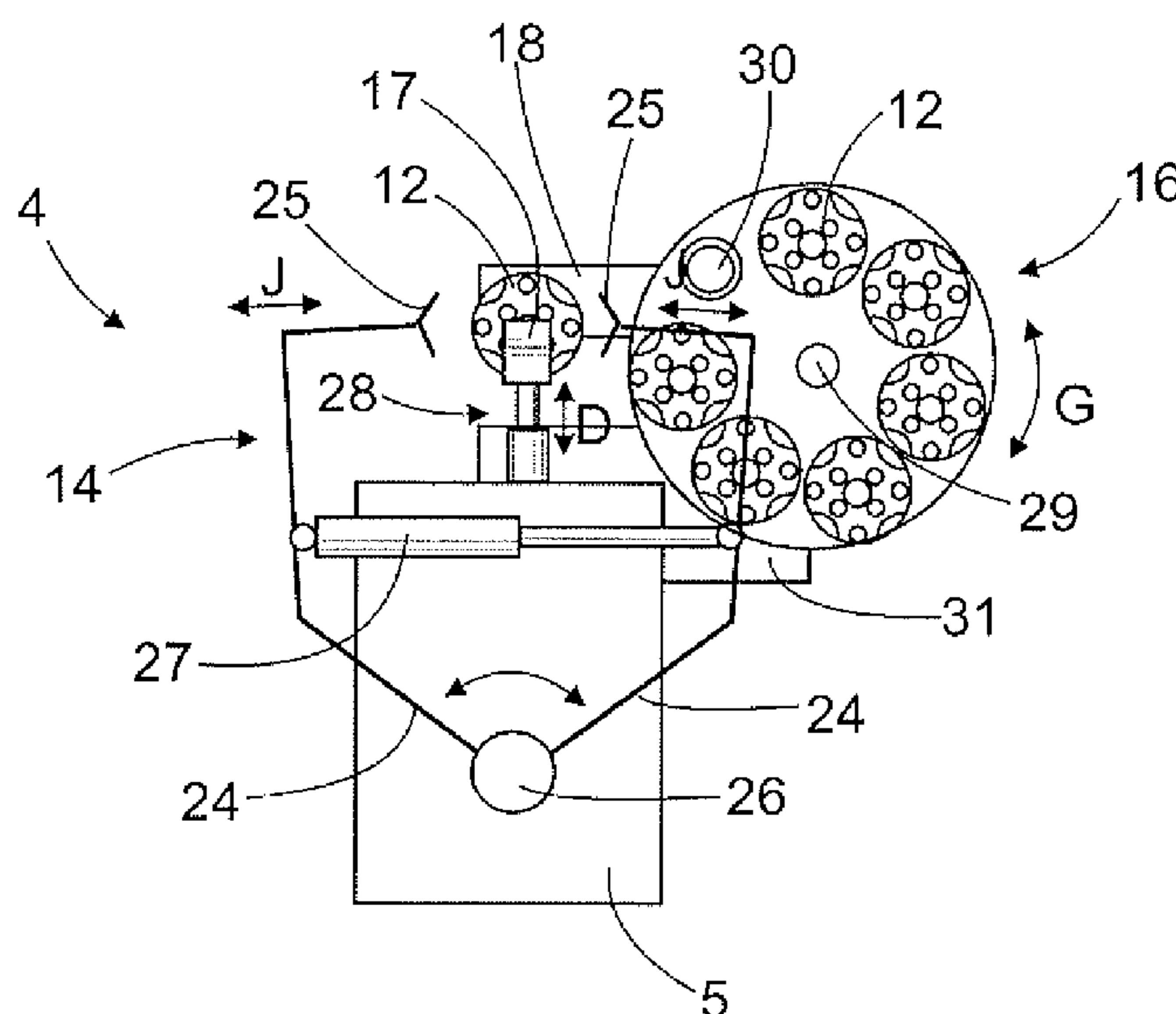


FIG. 3

(57) Abstract: The invention relates to a rock-drilling unit, drill bit changer, and method for changing a drill bit. The front part of a feed beam (5) has a retainer (14) and a drill bit changer (15) connected thereto. In changing drill bits (14), a normal retainer fastened to the feed beam is utilised, when the connection between the drill bit and drill rod (11) is opened. The changer also comprises a magazine (16) for storing drill bits and a transfer device (18) for transferring the drill bits between the retainer and magazine.

Rock-drilling unit, drill bit changer, and method for changing drill bit

Background of the invention

[0001] The invention relates to a drill bit changer, by means of which a drill bit of a tool connected to a rock-drilling machine may be changed. The drill bit changer comprises a magazine into which the drill bits to be changed are stored. The changer further comprises a transfer device, by means of which the drill bit may be transferred from the magazine to the drilling centre and back.

[0002] Further the invention relates to a rock-drilling unit equipped with such a drill bit changer and to a method for changing the drill bit.

[0003] The subject matters of the invention are described in more detail in the preambles of the independent claims of the application.

[0004] In rock drilling, a rock drilling machine is used with a tool connected thereto which can be rotated around its longitudinal axis and through which impact pulses may be delivered to the rock being drilled so that the rock will break and a drill bore will be formed. The tool may comprise one or more drill rods and a replaceable drill bit connected to its outermost end. Typically, the leading end of the drill bit is equipped with several bit buttons that penetrate the rock being drilled. The drill bit experiences wear and is occasionally also damaged, because very high loads are directed to it during drilling. Thus, it is necessary to change the drill bit at times so as to ensure the quality and efficiency of drilling. Changing drill bits manually by the operator is difficult and slow, and what is worse, also dangerous. Thus, drill bit changers have been developed so as to mechanize the changing of the drill bits. However, the present solutions have not fully satisfied the requirements of users.

[0005] US publication 4 065 845 discloses a drill bit changer in which the drill bits are stored in spaces in a magazine, which sets restrictions on the shape and dimensioning of the drill bits. In addition, the changer is equipped with its own retainer having a hydraulic cylinder that presses the drill bit against the magazine. This causes extra loads to the magazine.

Brief description of the invention

[0006] It is an object of the present invention to obtain a novel and improved rock-drilling unit and a drill bit changer. Another object is to provide a novel and improved method for changing drill bits.

[0007] The rock-drilling unit of the invention is characterised in that the drill bit changer is arranged to a retainer fastened to a feed beam and that the drill bit is arranged to be brought to be retained by the retainer when the connection threads of the drill bit are turned open and closed.

[0008] The changer of the invention is characterised in that the drill bit changer is arranged to a normal retainer fastened to a feed beam.

[0009] The method of the invention is characterised by using for retaining the drill bit the retainer fastened to the feed beam, the retainer having a fixed position in the longitudinal direction of the feed beam, and using for handling the drill bits the drill bit changer that is arranged to the retainer and comprises said magazine and transfer device.

[0010] The idea of the invention is that the drill bit changer is not equipped with its own retainer, but the changer is arranged to the basic retainer of the rock-drilling unit, whereby the drill bits are retained by a normal retainer. The basic retainer is fastened to the feed beam and its position is fixed in the longitudinal direction of the feed beam.

[0011] The invention provides the advantage that the drill bit changer need not be equipped with its own separate retainer, but a normal retainer may be utilized in the invention. The structure of the changer is then simpler and it may be mounted on feed beams equipped with different retainers, even to feed beams equipped with already existing basic retainers. In addition, no loads are caused by the operation of the retainer to the magazine, whereby the magazine may be relatively light in structure.

[0012] The idea of an embodiment is that the relative positions of the retainer and magazine in the longitudinal direction of the feed beam is constant during the operation of the rock-drilling unit. Further, the transfer device is arranged to transfer drill bits in the transverse direction of the feed beam between the magazine and drilling centre. An advantage of this embodiment is that the movements of the changer may be simple. In addition, when the transfer movement of the changer is in the transverse direction of the feed beam, the changer may also be used when the leading end of the feed beam is against a rock or close to some other obstacle in front of the feed beam.

[0013] The idea of an embodiment is that the drill bit to be changed is always set in a predefined axial position in the drilling centre before the drill bit is gripped with the retainer. This way, it is possible to select the point where the drill bit is gripped.

[0014] The idea of an embodiment is that the jaws of the retainer grip the outer surface of the frame part of the drill bit to be changed at a distance from the working portion in the front part of the drill bit. This way, it is possible to ensure that the retainer does not damage the critical tip part of the drill bit in any situation. In addition, gripping the frame part ensures that the drill bit is straight between the jaws, whereby the connection of the drill rod and drill bit may take place without difficulty.

[0015] The idea of an embodiment is that the rock-drilling unit comprises at least one mechanical stopping member, against which the drill bit is arranged to be pushed before it is gripped with the jaws of the retainer. The stopping member may reside in front of the jaws of the retainer at a predefined axial distance from the jaws.

[0016] The idea of an embodiment is that the stopping member is a slide piece. The stopping member is arranged to be moved in the transverse direction of the drilling centre by means of at least one actuator. An advantage of the slide is that its axial-direction dimension may be very small. In addition, the slide can be rigidly supported.

[0017] The idea of an embodiment is that a connecting hole in the drill bit is acted on during transfers and storage. The appearance and outer dimensions of the drill bit do not then affect the handling device.

[0018] The idea of an embodiment is that a separate drill bit holder is arranged inside each drill bit during transfers and storage. The drill bit holder is a kind of independent transfer and storage adapter that is easily changed. Further, the drill bit holder may be adjustable for drill bits of different dimensions.

[0019] The idea of an embodiment is that the drill bit holder comprises an arm and, on the portion of its first end, a gripping part, to which a gripping member in the transfer device may be connected and from which the drill bit holder may be easily detachably fastened to the magazine.

[0020] The idea of an embodiment is that the drill bit holder has at least two support pieces that are arranged to support themselves against connection threads of the drill bit. The distance between the support pieces is adjustable in accordance with the dimensions of each handled drill bit.

[0021] The idea of an embodiment is that at least two different drill bits that differ in outer dimensions or shape from each other are stored and

handled with the drill bit changer simultaneously. Widely different drill bits, even for special drilling situations, may then be stored inside the magazine.

[0022] The idea of an embodiment is that the transfer device is arranged to transfer drill bits by using linear movement only.

[0023] The idea of an embodiment is that the transfer device comprises at least one first transfer device for transferring a drill bit crosswise from the magazine to the drilling centre and back. The transfer device comprises at least one second transfer device for transferring a drill bit in the axial direction of the drilling centre. The magazine and retainer may then reside in different locations as seen axially.

[0024] The idea of an embodiment is that the magazine is arranged in the same axial location as the retainer, whereby the drill bit being changed is arranged to be transferred from the magazine to the retainer by using only one transverse linear movement of the transfer device. The drill bit then settles in the required position in the retainer jaws and need not be positioned with a drilling centre-direction movement against the stopping member. Instead, the drill bit to be detached from the drill rod is positioned by means of a feeding device against the stopping member before it is gripped with the jaws so that the drill bit is positioned in the correct axial position for transfer. It is easy to arrange a precise and simple linear transfer movement between the magazine and retainer. The transfer device may comprise first and second transfer devices. The first transfer device is for the transverse transfer movement and the second transfer device may be arranged to move the pin-like drill bit holder in and out of the drill bit.

[0025] The idea of an embodiment is that the magazine is a disc-like structure that is turnable relative to the turning axle. The magazine may have several fastening holes for drill bit holders. The magazine further has one changing station, to which each fastening hole may be turned.

[0026] The idea of an embodiment is that the retainer comprises at least two jaws that are arranged to press the outer surface of the drill bit from opposite sides.

Brief description of the figures

[0027] Some embodiments of the invention will be described in more detail in the attached drawings, in which

Figure 1 is a schematic side view of a rock-drilling rig having a drilling unit equipped with a retainer and drill bit changer connected thereto,

Figures 2a to 2c are schematic perspective views of drill bits, and Figure 2b also illustrates gripping the hole inside the drill bit,

Figure 3 is a schematic view from the leading end of the feed beam of a retainer and a magazine connected thereto,

Figure 4 is a schematic view from the leading end of the feed beam of the structure of a drill bit changer and stopping device, and

Figure 5 is a schematic top view of the structure and operation of a drill bit changer together with a retainer.

[0028] In the figures, some embodiments of the invention are shown simplified for the sake of clarity. Similar parts are marked with the same reference numbers in the figures.

Detailed description of the invention

[0029] The rock drilling rig 1 shown in Figure 1 comprises a movable carrier 2 on which one or more drilling booms 3 are arranged having a drilling unit 4 at their outermost ends. The drilling unit 4 comprises a feed beam 5 supporting a rock drilling machine 6 that may be moved by means of a feed device 7 in the drilling direction A and reverse direction B. In the figure, a dotted line marks a drilling line, that is, drilling centre C. The rock drilling machine 6 may comprise an impact device 8 for providing impact pulses on a tool 9 connected to the rock drilling machine 6. Further, the rock drilling machine 6 may comprise a rotating device 10 for turning the tool 9 about its longitudinal axis. During drilling, the tool 9 is in the drilling centre C and may comprise a drill rod 11 that has at its outermost end a replaceable drill bit 12. Further, in what is known as extension rod drilling, several drill rods 11 are connected consecutively to drill long bores 13. When drilling rock, the bit buttons of the drill bit 12 or corresponding parts cutting the rock wear and may also be damaged, which is why drill bits 12 are changed during drilling. Further, different special bits for various drilling situations and rock conditions may be used to improve rock drilling and drilling quality. The drill bit 12 is typically connected to the drill rod 11 with a threaded connection.

[0030] At the leading end of the feed beam 5, that is, in the outermost part of the feed beam 5 as seen in the drilling direction A, there is a retainer 14 that comprises jaws or corresponding holding members, with which a replaceable drill bit 12 may be fastened stationary at least for as long as the threaded connection between the drill rod 11 and drill bit 12 is opened or closed by rotating the drill rod by means of the rotating device 10 of the rock

drilling machine 6. The retainer 14 is positioned in such a manner that the held tool 9 is in the drilling centre C. The retainer 14 is typically utilised in holding drill rods 11 when the drill rods are changed or they are connected consecutively into an extended rod assembly. In this invention, the retainer 14 is also utilised in changing the drill bits 12. The basic retainer 14 is fastened to the feed beam 5, and is part of the feed beam 5. The position of the retainer 14 on the feed beam 5 thus remains unchanged during the operation of the drilling unit. The structure of such a retainer 14 may be robust and the movements required by its operation may be simple. The structure of the retainer 14 may be constructed in different ways.

[0031] On the leading edge portion of the feed beam 5, in connection with the retainer 14, a drill bit changer 15 is also arranged, and it comprises a magazine 16 in which a required number of drill bits, typically 5 to 10, may be stored. The magazine 16 may be a rotating disc, in which spaces are formed for the drill bits 12 to be stored. Alternatively, the magazine 16 may be a chain magazine or any other suitable construction. The drill bit changer 15 may further comprise one or more stopping members 17 with which the drill bit 12 may be mechanically stopped at a predefined axial position in the drilling centre C. The stopping member 17 may be a slide, for instance, which may be pushed from the front side of the retainer 14 into the drilling centre C and against whose surface on the rock drilling machine 6 side the leading end of the drill bit 12 is pushed before the drill bit 12 is fastened stationary with the retainer 14 for the purpose of change. Yet further, the drill bit changer 15 comprises one or more transfer devices 18 with which the drill bits 12 may be transferred from the magazine 16 to the retainer 14 and vice versa. However, the changer 15 does not have its own retainer, because the idea is to utilise the basic retainer 14 already on the feed beam 5.

[0032] Figures 2a to 2c show different drill bits 12. As seen from the figures, the drill bits 12 are externally quite different. The drill bit 12 of Figure 2a has a spiral groove 19 on the outer circumference of the frame part 12a, whereas in the drill bit 12 of Figure 2b, the frame part 12a is a smooth cylinder. Further, in Figure 2c, the frame part 12a is equipped with a grooved shoulder 20. Because the external appearances of different drill bits 12 may differ quite a lot from each other, it is difficult to handle the drill bits 12 at their frame parts 2a. It is demanding to create a universal gripper or the like. On the other hand, gripping the tip or working part 12b at the leading end of the drill bit 12 should

be avoided, because it is the most critical part of the drill bit and equipped with hard, but fragile drill buttons 21. However, the drill bits 12 may be handled by means of a suitable pin-like drill bit holder 22 that may be pushed into a hole 23 in the frame part 12a of the drill bit arranged to normally receive the connecting part of the drill rod 11. Owing to such a separate drill bit holder 22, the drill bits 12 may be handled in the magazine 16 and during transfers without the risk of damaging the working part 12b. It should be noted that the positioning of the drill bit 12 against the stopping member 17 in front of the retainer 14 is controlled and takes place at a sufficiently low rate of travel. In addition, the load acting on the drill bit 12 is in the drilling direction A, that is, is in the same direction as during normal drilling. The drill bit 12 and steel buttons 21 will thus not be damaged, even though the positioning takes place against a physical obstacle.

[0033] Figure 3 shows in a very simplified manner the structure and operation of the retainer 14 and drill bit changer 15 located at the leading edge of the feed beam 5. The retainer 14 may comprise arms 24 that are equipped with retaining jaws 25 or the like. The arms 24 may be turned relative to the turning axle 26 with an actuator 27 that may be a pressure medium cylinder, for instance. In the situation of Figure 3, the jaws 25 are open and the drill bit 12 being changed has been brought with the transfer device 18 from the magazine 16 to the drilling centre and arranged against the mechanical stopping member 17 of the stopping device 28. The stopping device 28 may comprise a pressure medium cylinder or some other suitable actuator with which the stopping member 17 may be transferred in the transverse direction D to the drilling centre and away from it. When the drill bit 12 being changed is in the drilling centre at a predefined axial position, the jaws 25 may be closed. Then, the transfer device 18 may be transferred away from the drilling centre and the drill rod connected to the retained drill bit.

[0034] Figure 3 also shows that the magazine 16 may be a disc or revolver that may be turned relative to the rotation axis 29 to select the required drill bit 12. The magazine 16 may also have fastening points 30, such as holes or the like, to which the drill bit holder 22 shown in Figures 2b and 5 may be arranged. Figure 3 further shows that the changer 15 may have its own frame 31 to which the magazine 16, stopping device 28, and transfer device 18 may be supported. The changer 15 may then be fastened robustly to the feed beam 5 by means of a rigid fastening.

[0035] Figure 4 shows an alternative solution, in which the stopping member 17 is a slide, and the stopping device 28 comprises a frame 32 with control surfaces 33 for controlling the movement of the slide in the transverse direction D to the drilling centre. Further, the actuator 34 of the stopping device 28 may be a motor that is arranged to move the slide by means of a gear transmission, for instance. An advantage of a slide-type stopping device is that it only takes a little space in the axial direction, whereby it is easy to locate to the front side of the retainer 14.

[0036] Figure 5 shows an alternative drill bit changer 15 that is arranged to the retainer 14. The changer 15 may comprise a transfer device 18 that is a kind of manipulator. The transfer device 18 may comprise a first transfer device 18a and a second transfer device 18b that are connected to each other by means of a fastening piece 35. The first transfer device 18a is arranged to move the second transfer device 18b and a gripping member 36 connected thereto linearly in the transverse direction E so that the drill bit 12 may be transferred between the magazine 16 and the jaws 25 of the retainer 14. The second transfer device 18b is arranged to move the drill bit holder 22 in and out of the drill bit hole 23. The drill bit holder 22 is an elongated piece whose first end may comprise a gripping part 38 to which the gripping member 36 of the transfer device 18 may attach and by means of which the drill bit holder 22 is fastened to the magazine 16. Further, the drill bit holder 22 may comprise an arm 39 with two or more support pieces 40a and 40b arranged thereto and dimensioned to support themselves against connection threads 41 when inside the hole 23 of the drill bit 12. Further, the rearmost first support piece 40a may comprise a shoulder 46, flange or the like that may support itself against the rear surface of the drill bit 12 and support the drill bit 12 in the axial direction. When the drill bit holder 22 is pushed by means of the second transfer device 18b into the hole 23, the first support piece 40a settles against the rear part of the drill bit 12, whereas the second support piece 40b that is rigidly connected to the arm 39 may push even further toward the leading end of the drill bit 12. The support pieces 40a and 40b then settle at a distance from each other, whereby the drill bit 12 is firmly supported by the surfaces of the hole 23. The spaced apart support pieces 40a, 40b ensure that the drill bit 12 remains straight. The bit holder 22 may have adjusting members 45, such as adjusting screws, with which the maximum distance between the support pieces 40a, 40b in the direction H may be adjusted. At the same time, the ad-

justing member 45 affects the distance between the gripping part 38 and the first support piece 40a in the direction H. Because the drill bit 12 is supported at its rear by means of a shoulder 46, the adjustment of the drill bit holder 22 permits the setting of the leading ends of drill bits 12 of different lengths at the same point in the magazine 16. When the magazine is positioned at the retainer 14 in the axial direction and when the leading ends of the drill bits 12 are set level in the magazine 16, transfers between the magazine 16 and retainer 14 may be done using a simple crosswise linear movement E of the first transfer device 18a.

[0037] When the drill bit 12 is pressed between the jaws 25, the second transfer device 18b is used to pull the drill bit holder 22 backward, that is, in the reverse direction B, whereby the support pieces 40a, 40b settle against each other and emerge from the hole 23. Next, the drill bit holder 22 is transferred by means of the first transfer device 18a away from the drilling centre C, and the drill rod 11 is connected to the drill bit 12, after which the stopping member 17 and jaws 25 are opened. Normal drilling may then begin. The drill bit holder 22 is detached from the drill bit 12 before it is connected to the drill rod 11, whereby the drill bit holder 22 does not participate in the actual fastening of the drill bit 12 but serves as an aid during transfers and storage. Thus, the drill bit holder is not connected to the tool during drilling.

[0038] Figure 5 shows that the jaws 25 of the retainer 14 may be arranged to the piston rods 42 of the pressure medium cylinders acting as the actuators 34, whereby the structure of the retainer 14 may be very simple. The jaws 25 may be moved in the transverse direction J. The jaws 25 press the frame part 12a of the drill bit at opposite sides. The working part 12b of the drill bit is free of forces caused by the retainer. When the drill bit 12 is gripped with the jaws 25 at the frame part 12a, the drill bit 12 also remains better parallel to the drilling centre C, which facilitates connection operations.

[0039] Figure 5 further shows that the drill rod 11 is transferred in the drilling centre C in the reverse direction B for the time of the drill bit 12 replacement. The leading end of the drill rod 11 is equipped with a connection part 43 with a connection thread 44 that may be connected to an inside connection thread 41 of the drill bit 12 in the retainer 14 by feeding the drill rod 11 in the drilling direction A and at the same time turning the drill rod 11 about its longitudinal axis by means of the rotating device 10 of the rock drilling machine 6. When the drill bit 12 connected to the drill rod 11 is detached, the stopping

member 17 is closed and the drill bit 12 is pushed against the stopping member 17. This way, the drill bit 12 is always positioned correctly for the transfer device 18 and retainer 14.

[0040] It should be noted that the support pieces 40a, 40b of the drill bit holder 22 may comprise means for gripping the drill bit hole 23 so that the drill bit 12 will not detach from the holder 22 even though the feed beam 5 was directed downward. The support pieces 40a, 40b may comprise friction pieces, such as retaining rings made of rubber or a corresponding elastic material. Further, the drill bit holder 22 may have an expanding section that may expand under the effect of a pressure medium or mechanical movement and press against the inner surfaces of the hole 23 of the drill bit 14.

[0041] It is also possible to arrange the positioning of the drill bit 12 in the retainer 14 in some other manner than with the stopping devices 28 shown in Figures 3 to 5. It is, for example, possible to arrange a sensor to monitor the axial position of the drill bit 12 in the drilling centre C, whereby the drill bit 12 may be moved to the correct position on the basis of data received from the sensor. The stopping of the drill bit against a mechanical obstacle as described in Figures 3 to 5 is, however, simple in structure and reliable and does not need precise controlling of the feeding device 7.

[0042] In some cases, the features described in this application may be used as such, regardless of other features. On the other hand, the features described in this application may also be combined to provide various combinations as necessary.

[0043] The drawings and the related description are only intended to illustrate the idea of the invention. The invention may vary in detail within the scope of the claims.

Claims

1. A rock-drilling unit that comprises:
 - a feed beam (5),
 - a rock-drilling machine (6),
 - a feeding device (7) for moving the rock-drilling machine (6) on a feed beam (5) in the drilling direction (A) and reverse direction (B),
 - a retainer (14) which is fastened to the feed beam (5) and whose position on the portion of the leading end of the feed beam (5) is fixed at least as seen in the longitudinal direction of the feed beam, and
 - a drill bit changer (15) that comprises a magazine (16) for storing drill bits (12) and a transfer device (18) for transferring the drill bits (12) between the magazine (16) and drilling centre (C),
 - and wherein the drill bit changer (15) is arranged to the retainer (14) fastened to the feed beam (5),
 - and wherein the drill bit (12) is arranged to be brought to be retained by the retainer (14) when the connection threads (41, 44) between the drill bit (12) and drill rod (12) are turned open and closed,
 - wherein
 - the relative position of the retainer (14) and magazine (16) in the longitudinal direction of the feed beam (5) is unchanged during the operation of the rock-drilling unit, and
 - the transfer device (18) is arranged to transfer the drill bits (12) in the transverse direction of the feed beam (5).
2. The rock-drilling unit as claimed in claim 1, wherein
 - the retainer (14) comprises at least two jaws (25) that are arranged to press the outer surface of the drill bit (12).
3. The rock-drilling unit as claimed in any one of claims 1 to 2, wherein
 - the rock-drilling unit (4) comprises at least one openable and closable stopping member (17) against which the drill bit (12) is arranged to be pushed before it is gripped with the jaws (25) of the retainer (14), and
 - the stopping member (17) is located in front of the jaws (25) of the retainer (14) at a predefined axial distance (L) from the jaws (25).

4. The rock-drilling unit as claimed in claim 3, wherein
the stopping member (17) is a slide piece that is arranged to be moved in the transverse direction (D) of the drilling centre (C) by means of at least one actuator (34).

5. The rock-drilling unit as claimed in any one claims 1 to 4, wherein
the drill bit changer (15) comprises several separate drill bit holders (22) that are supportable to the inside surfaces of the drill bits (12) being handled, and

each drill bit (12) is connected to a drill bit holder (22) during storage and transfers.

6. The rock-drilling unit as claimed in claim 5, wherein
the drill bit holder (22) comprises an arm (39) and, on the portion of its first end, a gripping part (38), to which a gripping member (36) in the transfer device (18) is connectable and from which the drill bit holder (22) is easily detachably fastenable to the magazine (16), and

said arm (39) has at least two support pieces (40a, 40b) that are arranged to support themselves against the inside connection threads (41) of the drill bit (12).

7. The rock-drilling unit as claimed in any one claims 1 to 6, wherein
the transfer device (18) comprises at least one first transfer device (18a) for transferring the drill bit (12) with a transverse (E) linear movement from the magazine (16) to the drilling centre (C) and back.

8. A drill bit changer that is arrangeable on a feed beam of a rock-drilling unit and comprises:

a magazine (16) for storing several drill bits (12), and

a transfer device (18) for transferring drill bits (12) between the magazine (16) and drilling centre (C),

and wherein the drill bit changer (15) is arranged to a normal retainer (14) fastened to a feed beam (5),

wherein

the relative position of the retainer (14) and magazine (16) in the longitudinal direction of the feed beam (5) is unchanged, and

the transfer device (18) is arranged to transfer the drill bits (12) in the transverse direction of the feed beam (5).

9. A method for changing a drill bit in a rock drilling unit, the rock-drilling unit (4) comprising: a feed beam (5), a rock-drilling machine moved by means of a feeding device (7) on the feed beam (5), a rotating device (8) belonging to the rock-drilling machine (6), and a tool (9) that comprises at least one drill rod (11) and a drill bit (12) connected thereto,

the method comprising:

storing several replaceable drill bits (12) into a magazine (16),

detaching a threaded connection between the drill rod (11) and drill bit (12) by rotating the drill rod with the rotating device (8) about its longitudinal axis in the drilling centre (C),

bringing the detached drill bit (12) from the drilling centre (C) into the magazine (16) by means of a transfer device (18),

taking with the transfer device (18) from the magazine a new drill bit (12) and transferring it to the drilling centre (C),

connecting a connection thread (44) of the drill rod (11) to a connection thread (41) of the new drill bit (12) by rotating the drill rod (11) with the rotating device (8) about its longitudinal axis in the drilling centre (C),

keeping the drill bit (12) stationary in the drilling centre (C), when a drill rod (11) is connected to or disconnected from it,

using for retaining the drill bit (12) a retainer (14) fastened to the feed beam (5), the retainer having a fixed position in the longitudinal direction of the feed beam (5), and

using for handling the drill bits (12) a drill bit changer (15) that is arranged to the retainer (14) and comprises said magazine (16) and transfer device (18),

keeping the relative position of the retainer (14) and magazine (16) in the longitudinal direction of the feed beam (5) unchanged, and

transferring drill bits (12) between the magazine (16) and drilling centre (C) by using a transverse movement of the transfer device (18) in the transverse direction of the feed beam (5).

10. The method as claimed in claim 9, comprising

setting the drill bit (12) being changed always in a predefined axial position in the drilling centre (C) before the drill bit (12) is gripped with the retainer (14).

11. The method as claimed in claim 10, comprising pushing the drill bit (12) to be detached from the drill rod (11) in the drilling centre (C) in the drilling direction (A) against a mechanical stopping member (17) whose location defines the relative position of the retainer (14) and drill bit (12).

12. The method as claimed in any one claims 9 to 11, comprising gripping with the jaws (25) of the retainer (14) the outer surface of the frame part (12a) of the drill bit (12) to be changed at a distance (L) from the working portion (12b) in the front part of the drill bit (12).

13. The method as claimed in any one of claims 9 to 12, comprising arranging inside each drill bit (12) a separate drill bit holder (22) during transfers and storage.

14. The method as claimed in claim 13, comprising supporting the pin-like drill bit holder (22) to the inside connection threads (41) of the hole (23) in the drill bit.

15. The method as claimed in any one of claims 9 to 14, comprising storing and handling with the drill bit changer (15) at least two different drill bits (12) that differ from each other in outer dimensions or shapes.

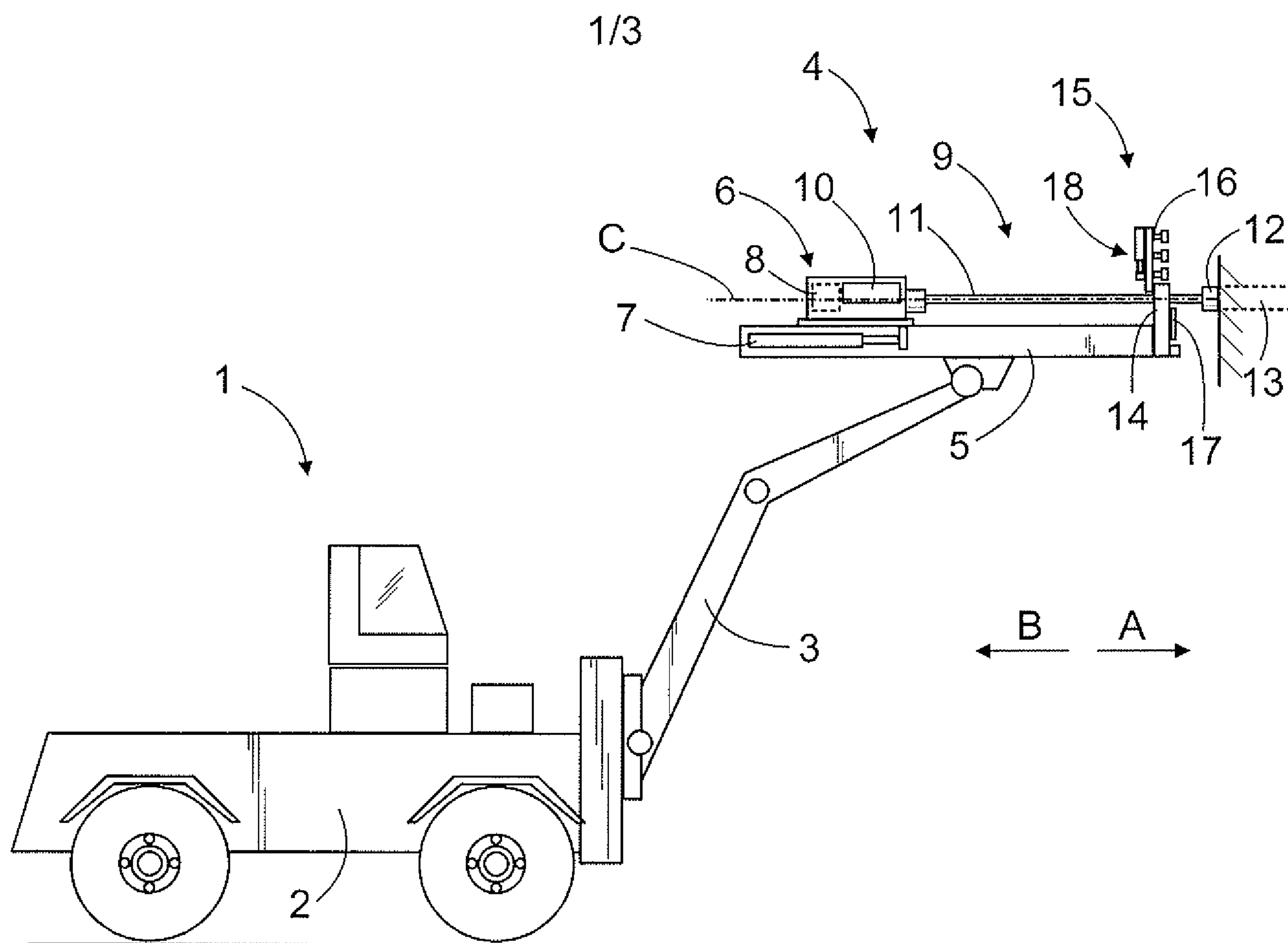


FIG. 1

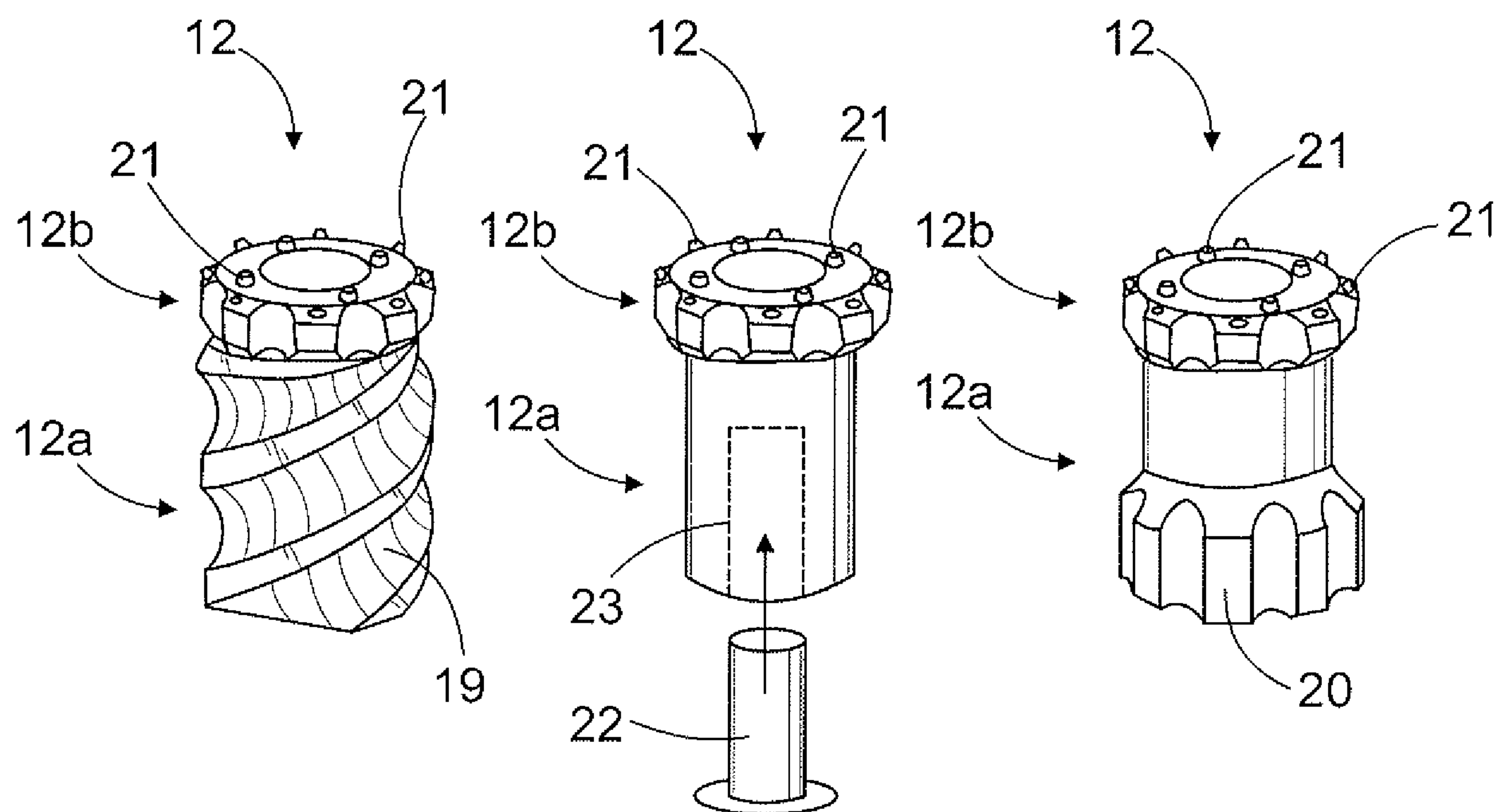


FIG. 2a

FIG. 2b

FIG. 2c

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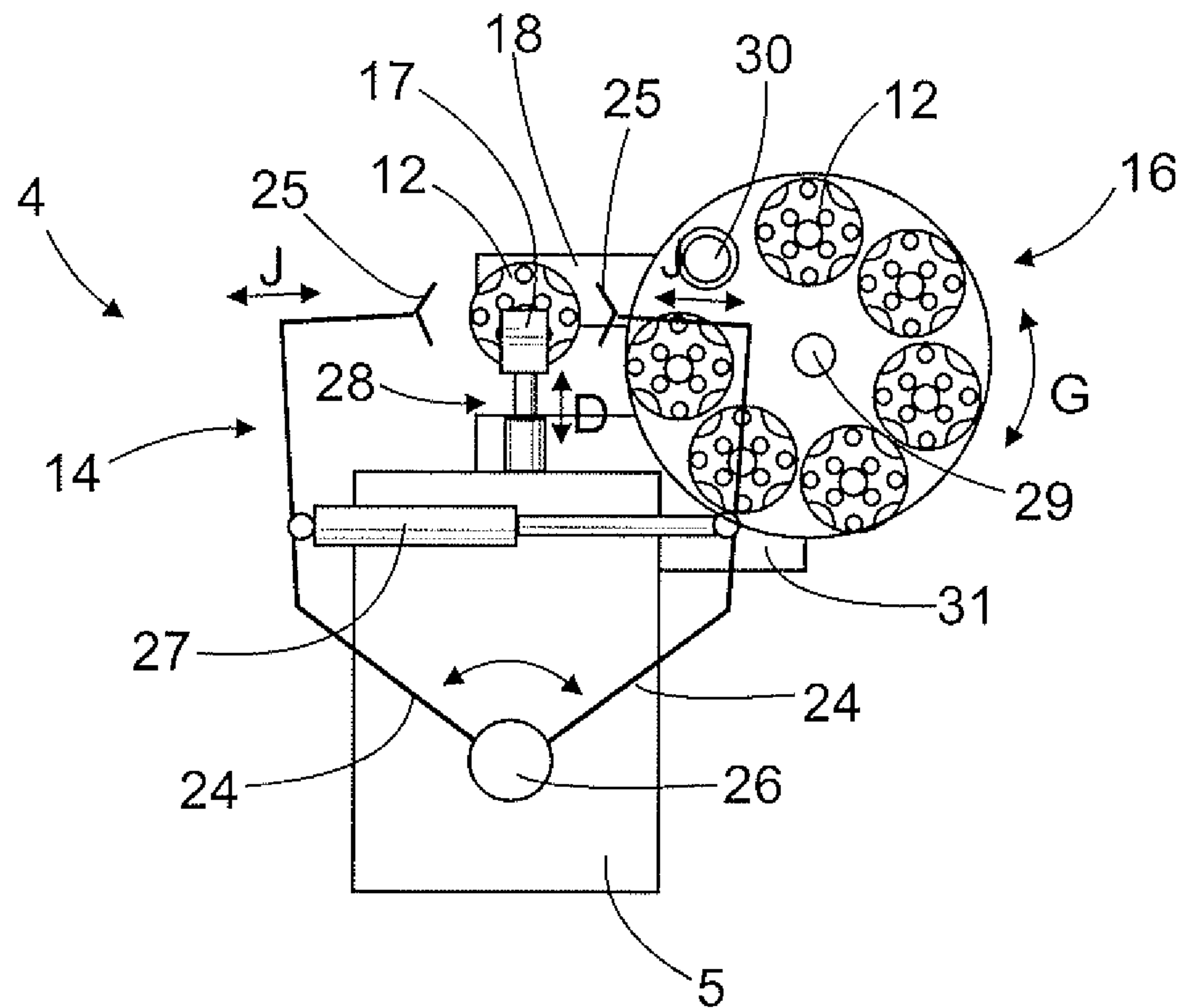


FIG. 3

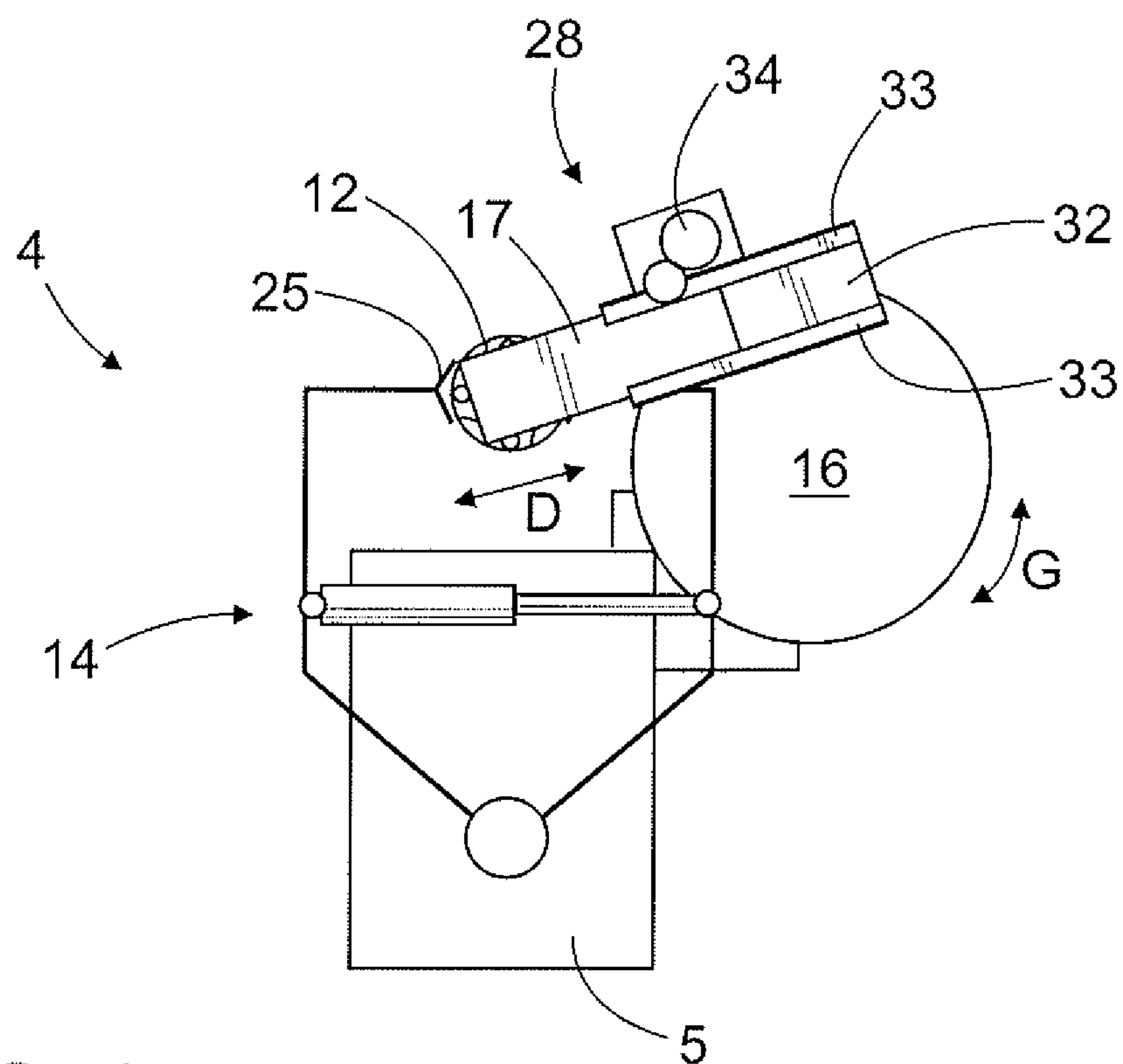


FIG. 4

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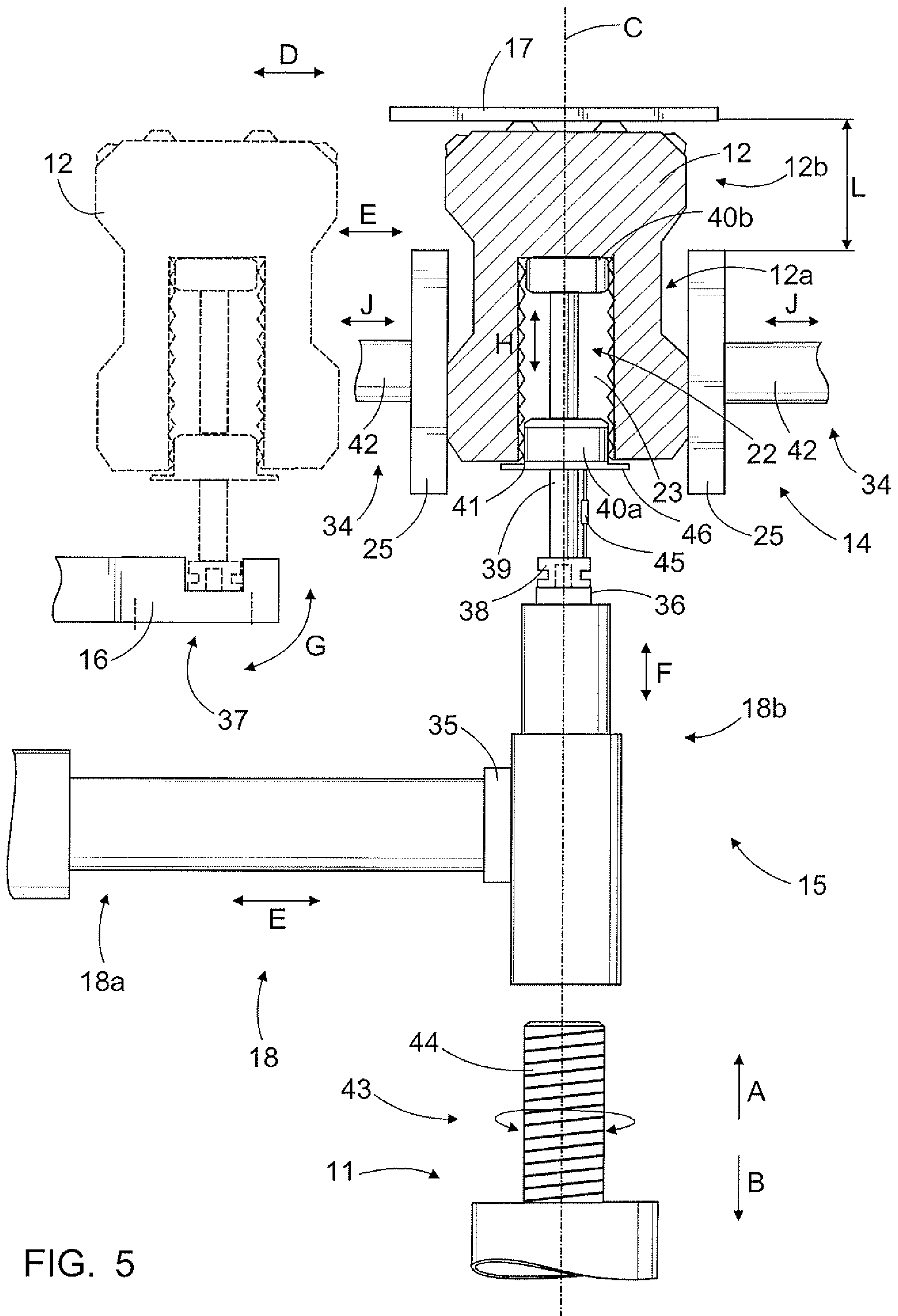


FIG. 5

