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APPARATUS FOR FEEDING TUBE ELEMENTS, ROCK DRILLING RIG AND METHOD OF SUPPORTING DRILL HOLE OPENINGS

- (57)

An apparatus for feeding a tube element inside a drill hole, a rock drilling rig, and a method of supporting mouth openings of drill holes. The apparatus (8) comprises a feed actuator (22) and an elongated guide tube (25) provided with an inner space (26) through which the feed actuator is configured to feed the tube elements (14).

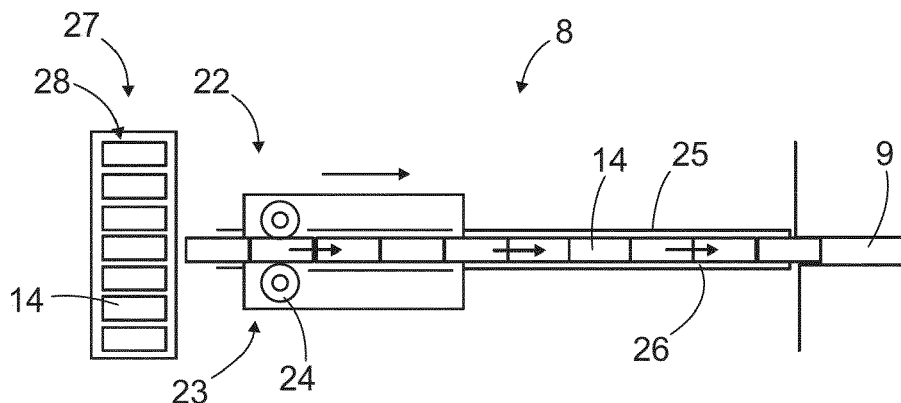


FIG. 3

Description

Background of the invention

[0001] The invention relates to an apparatus intended for feeding tube elements inside drill holes. Purpose of the fed tube elements is to provide support for drill hole openings against collapsing and for preventing drilling cuttings entering the previously drilled holes.

[0002] The invention further relates to a rock drilling rig and method.

[0003] The field of the invention is defined more specifically in the preambles of the independent claims.

[0004] In mines, construction sites and at other work areas different type of rock drilling rigs are used for drilling drill holes to rock surfaces. The rock drilling rigs are provided with one or more booms and rock drilling units are arranged at distal ends of the booms for drilling the drill holes. Typically the drilled holes are charged by inserting explosive material inside them after all drill holes of a round have been drilled. However, during the drilling drilling cuttings are formed and the drilling cuttings may block openings of the already drilled holes or may otherwise hamper feeding of charges. Typically, tube-like elements are mounted manually inside drill hole mouths for protecting the drill holes. There are also some mechanized structures developed for feed the tube elements. However, the present solutions for feeding the tube elements have shown to include some drawbacks.

Brief description of the invention

[0005] An object of the invention is to provide a novel and improved apparatus and method for inserting protective tube elements inside drill hole openings. A further object is to provide a novel and improved rock drilling rig implementing the mentioned apparatus and method.

[0006] The apparatus according to the invention is characterized by the characterizing features of a first independent apparatus claim.

[0007] The rock drilling rig according to the invention is characterized by the characterizing features of a second independent apparatus claim.

[0008] The method according to the invention is characterized by the characterizing features and steps of an independent method claim.

[0009] An idea of the disclosed solution is that an apparatus for feeding tube elements partly inside drill holes is introduced, as well as a rock drilling rig provided with the disclosed feed means.

[0010] The apparatus comprises a feed actuator for feeding tube elements inside drill holes. The apparatus further comprises at least one elongated guide tube provided with an inner space through which the feed actuator is configured to feed the tubular object. In other words, the tube elements are fed inside the protective guide tube to the drill hole.

[0011] An advantage of the disclosed solution is that

the guide tube ensures proper feeding of the tube elements in harsh conditions. The guide tube can be implemented in connection with several different tube elements, and it is a relatively simple, durable, and inexpensive way to increase productivity and reliability of the tube feeding process.

[0012] Further, the feeding of the tube element may be executed immediately after the drilling phase of the drill hole whereby the drill hole opening is being protected all the time.

[0013] According to an embodiment, the guide tube is a flexible structure. An advantage of the flexible structure is that the guide tube can bend and adjust when a drilling unit and its devices are moved to different positions.

[0014] According to an embodiment, the guide tube is formed of flexible hose. Then material of the guide tube is resilient material, such as rubber or polymer based material.

[0015] According to an embodiment, the guide tube is made of rigid material and comprises structural elements allowing bending of the guide tube. The structural elements allowing the bending may be hinges, joints or corresponding elements.

[0016] According to an embodiment, the feed actuator is configured to push several successive tube elements simultaneously inside the guide tube, whereby each tube element is configured to transmit the feed movement to following next tube element inside the guide tube. In other words, the tube elements can be pushed from a rear end part and when each tube element inside the guide tube move towards a front end part of the guide tube, then a front most tube element protrudes out of the guide tube to the drill hole. Thus, it can be considered that the several tube elements inside the guide tube serve as individual feed transmission elements. In the disclosed solution the individual tube elements are in a way loaded inside the guide tube at the rear end and then dosed one by one out of the opposite front end of the guide tube.

[0017] According to an embodiment, the feed actuator is a roll feeder comprising at least two rotatable feed rolls. In other words, the feed actuator is configured to feed the tube elements by means two, three, or even more rotating rolls, which are arranged in contact with the tube elements to be fed.

[0018] According to an alternative embodiment, the feed actuator comprises a linear actuator, such as a pressure medium operated cylinder or an electrical linear motor.

[0019] According to an embodiment, the apparatus comprises a magazine provided with several storage places for receiving the tube elements, and the magazine is located at a rear end portion of the guide tube. In other words, the apparatus can take the tube elements from the magazine and feed them by means of the feed apparatus through the guide tube towards a front end of the guide tube and inside the drill hole.

[0020] According to an embodiment, the magazine is a rotatable magazine wherein the several can be indexed

to a feed position one by one. The feed position may be in line with the rear end of the guide tube.

[0021] According to an embodiment, the magazine is a linearly indexable magazine wherein the several storage places can be indexed to a feed position one by one.

[0022] According to an embodiment, the apparatus comprises a cutting device which is configured to cut the tube elements with desired length from a longer tube element blank.

[0023] According to an embodiment, the apparatus comprises a separation device for detaching the tube elements one by one from a longer tube element blank comprising several successive tube element.

[0024] According to an embodiment, the apparatus comprises an indexing device for moving a front end portion of the guide tube transverse direction.

[0025] According to an embodiment, the apparatus is without any indexing device whereby the front end of the guide tube is indexed to a drill hole opening by means of feed beam movements. The feed beam may be rotated so that the drilling tool is move away from the drill hole opening and simultaneously the front end of the guide tube is brought in line with the drilled hole.

[0026] According to an embodiment, the disclosed solution relates also to a rock drilling rig comprising: a movable carrier; at least one drilling boom; a drilling unit at a distal end part of the drilling boom, wherein the drilling unit comprises a feed beam and a rock drilling machine supported movably on the feed beam; and an apparatus for feeding a tubular element inside a drill hole. Further, the mentioned tubular elements are individual pieces which are configured to be fed to the drill hole through a guide tube under control of a feed actuator of the apparatus. The apparatus is according to the features and embodiment disclosed in this document and is configured to insert the tube elements to only cover mouth portions of the drill holes.

[0027] According to an embodiment, the apparatus is mounted in connection with the drilling unit.

[0028] According to an embodiment, the feed actuator is located on the carrier and the guide tube extends from the carrier to a front part of the drilling unit.

[0029] According to an embodiment, the disclosed solution relates also to a method of supporting mouth openings of drill holes. The method comprises inserting a tube element partly inside the drill hole and extending a front end of the tube element only a limited distance from a mouth of the drill hole and feeding the tube element through a guide tube to the drill hole.

[0030] The above disclosed embodiments may be combined in order to form suitable solutions having those of the above features that are needed.

Brief description of the figures

[0031] Some embodiments are described in more detail in the accompanying drawings, in which

Figure 1 is a schematic side view of a rock drilling rig, Figures 2a - 2c are schematic views showing three successive phases relating to the present solution, and wherein the phases are drilling, tube element feeding and charging of blast material,

Figures 3 - 5 are schematic side views of apparatuses for feeding the tube elements,

Figure 6 is a schematic side view showing an apparatus wherein a magazine is mounted on a carrier of a rock drilling rig, and

Figure 7 is a schematic side top showing an apparatus mounted in connection with a rock drilling unit.

[0032] For the sake of clarity, the figures show some embodiments of the disclosed solution in a simplified manner. In the figures, like reference numerals identify like elements.

Detailed description of some embodiments

[0033] Figure 1 shows a rock drilling rig 1. The rock drilling rig 1 comprises a movable carrier 2 and at least one boom 3 connected to the carrier 2. At a distal end portion of the boom 3 is a drilling unit 4. The drilling unit 4 may comprise a feed beam 5 and a rock drilling machine 6 supported on it. The rock drilling machine 6 may comprise a rotating unit for rotating a tool 7. The rock drilling machine 6 may be of top hammer type machine and may comprise an impact device for generating impact pulses for a drill bit of the tool. The rock drilling unit 4 may further comprise an apparatus 8 for feeding tube elements to drill holes being drilled. The apparatus 8 may be capable of handling, supporting, storing, feeding and detaching material and objects relating to the tube inserts. These issues have been discussed already above and will be shortly discussed in connection with more detailed Figures below.

[0034] Let it be further mentioned that operation of the rock drilling rig 1 and the related devices and apparatuses may be controlled under control of a control unit CU or in assistance with it.

[0035] Figure 2a discloses that at first a drill hole 9 is drilled 10 to a rock surface 11. During drilling rock material is removed and drilling cuttings 12 are flushed out of the drill hole 9. Drilling direction is indicated by a reference A and reverse direction as B.

[0036] Figure 2b discloses tube insertion 13 in which a tube element 14 with relatively short length is inserted partly inside the drilled hole 9. Then the tube element 14 covers a mouth portion or opening 15 of the drill hole 9. The rest of the drill hole 9 is without any tube elements. As can be seen, the tube element 14 prevents the drilling cuttings 12 entering into the drill hole opening 15. Furthermore, the tube element 14 may provide the drill hole opening 15 with support against collapse in case the rock material is loose or weak 16 at the mouth portion of the drill hole 9. Part of the tube element 14 may remain outside the drill hole 9 and only part of it is inserted inside

the drill hole 9.

[0037] Figure 2c discloses a charging phase 18 wherein explosive material or charges 19 are inserted to a bottom part of the drill hole 9 through a central opening 20 of the tube element 14. A wiring 21 for blasting the charge 19 may be arranged via the opening 20.

[0038] Figure 3 discloses an apparatus 8 for feeding tube elements 14 inside a drill hole 9 by means of a feed actuator 22. The feed actuator 22 may be a roll feeder 23 comprising at least two rotatable feed rolls 24. The apparatus 8 further comprises at least one elongated guide tube 25 provided with an inner space 26 through which the feed actuator 22 is configured to feed the tube elements 14 towards the drill hole 9. As can be noted, the feed actuator 22 pushes several successive tube elements 14 simultaneously inside the guide tube 25 so that each tube element 14 transmits the feed movement to the following next tube element 14 inside the guide tube 25.

[0039] The apparatus 8 also comprises a magazine 27 provided with several storage places 28 for receiving the tube elements 14. The magazine 27 is located at a rear end portion of the guide tube 25. The magazine 27 may be of revolving type, or alternatively, it may be indexed by means of linear movements relative to the feed actuator 22 and a feed line. The guide tube 25 may be either a rigid structure or a flexible structure.

[0040] Figure 4 discloses an apparatus 8 comprising a reel 29 for storing and handling a flexible tube element blank 30. There is a cutting device 31 for cutting the tube elements 14 with desired length from the longer tube element blank 30. The cut tube elements 14 are fed by means of a feed actuator 22 to a guide tube 25 and towards to an opening of a drill hole 9. Thus, in this solution the magazine 27 disclosed in the previous Figure 3 is substituted by the reel 29 and the cutting device 31. In the disclosed solution the tube elements 14 are at first cut into individual pieces from the tube element blank and are thereafter fed through the guide tube 25 to their intended mounting position at the opening of the drill hole 9.

[0041] Figure 5 discloses a solution wherein the apparatus 8 comprises a separation device 32 for detaching tube elements 14 one by one from a longer tube element blank 33 comprising several successive tube elements 14.

[0042] In Figures 3 - 5 there are shown different types of devices 27, 29, 31, 32 arranged to provide the apparatus 8 with the tube elements 14 for feeding them the drill holes 9.

[0043] Figure 6 discloses that an apparatus 8 wherein a rotatable magazine 27 and a feed actuator 22 are both mounted on a carrier 2 of a rock drilling rig 1. In this solution tube elements 14 are fed through a flexible guide tube 25 to a drill hole. The flexible guide tube 25 is supported to a drilling boom 3 and to a rock drilling unit 4. The apparatus 8 may comprise an indexing device 34 for moving a front end portion of the guide tube 25 in

transverse direction. When drilling of the drill hole is completed a drilling machine 6 can be reversed so that the front end portion of the guide tube 25 can be moved to an opening of the drill hole for executing insertion of the tube element 14.

[0044] The apparatus 8 disclosed in Figure 6 may alternatively be provided with the tube element blank 30, 33 handling devices disclosed in Figures 4 and 5.

[0045] Figure 7 discloses that an apparatus 8 for feeding the tube elements may be mounted in connection with a rock drilling unit 4. Then a magazine 27 and a feed actuator 22 may be mounted to a feed beam 5 or they may mounted to a separate support system parallel with the feed beam 5. Then there may needed indexing or turning mechanism for positioning the apparatus 8 in line with the drilled hole 9.

[0046] One more alternative is to mount the apparatus 8' to a drilling boom 3, as it is illustrated in Figure 6.

[0047] The drawings and the related description are only intended to illustrate the idea of the invention. In its details, the invention may vary within the scope of the claims.

Claims

1. An apparatus (8) for feeding a tube element (14) inside a drill hole (9) by means of at least one feed actuator (22);
characterized in that
the apparatus (8) further comprises at least one elongated guide tube (25) provided with an inner space (26) through which the feed actuator (22) is configured to feed the tube elements (14).
2. The apparatus as claimed in claim 1, **characterized in that**
the guide tube (25) is a flexible structure.
3. The apparatus as claimed in claim 1 or 2, **characterized in that**
the feed actuator (22) is configured to push several successive tube elements (14) simultaneously inside the guide tube (25), whereby each tube element (14) is configured to transmit the feed movement to the following next tube element (14) inside the guide tube (25).
4. The apparatus as claimed in any one of the preceding claims 1 - 3, **characterized in that**
the feed actuator (22) is roll feeder (23) comprising at least two rotatable feed rolls (24).
5. The apparatus as claimed in any one of the preceding claims 1 - 4, **characterized in that**
the apparatus (8) comprises a magazine (27) provided with several storage places (28) for receiving the tube elements (14), and the magazine (27) is

located at a rear end portion of the guide tube (25).

6. The apparatus as claimed in any one of the preceding claims 1 - 5, **characterized in that**
the apparatus (8) comprises a cutting device (31) which is configured to cut the tube elements (14) with desired length from a longer tube element blank (30). 5
7. The apparatus as claimed in any one of the preceding claims 1 - 5, **characterized in that**
the apparatus (8) comprises a separation device (32) for detaching the tube elements (14) one by one from a longer tube element blank (33) comprising several successive tube elements (14). 10
15
8. The apparatus as claimed in any one of the preceding claims 1 - 7, **characterized in that**
the apparatus (8) comprises an indexing device (34) for moving a front end portion of the guide tube (25) in transverse direction. 20
9. A rock drilling rig (1) comprising:
 a movable carrier (2);
 at least one drilling boom (3); 25
 a drilling unit (4) at a distal end part of the drilling boom (3), wherein the drilling unit (4) comprises a feed beam (5) and a rock drilling machine (6) supported movably on the feed beam (5); and
 an apparatus (8) for feeding tube elements (14) inside drill holes (9); 30
characterized in that
 the mentioned tube elements (14) are individual pieces which are configured to be fed to the drill holes (9) through a guide tube (25) under control of a feed actuator (22) of the apparatus (8); 35
 and the apparatus (8) is according to the previous claims 1 - 8 and is configured to insert the tube elements (14) to only cover mouth portions of the drill holes (9). 40
10. The rock drilling rig as claimed in claim 9, **characterized in that**
the apparatus (8) is mounted in connection with the drilling unit (4). 45
11. The rock drilling rig as claimed in claim 10, **characterized in that**
the feed actuator (22) is located on the carrier (2) and the guide tube (25) extends from the carrier (2) to a front part of the drilling unit (4). 50
12. A method of supporting mouth openings of drill holes (9), wherein the method comprises: 55
 inserting a tube element (14) partly inside the drill hole (9) and extending a front end of the tube element (14) only a limited distance from a

mouth of the drill hole (9) ;

characterized by

feeding the tube element (14) through a guide tube (25) to the drill hole (9).

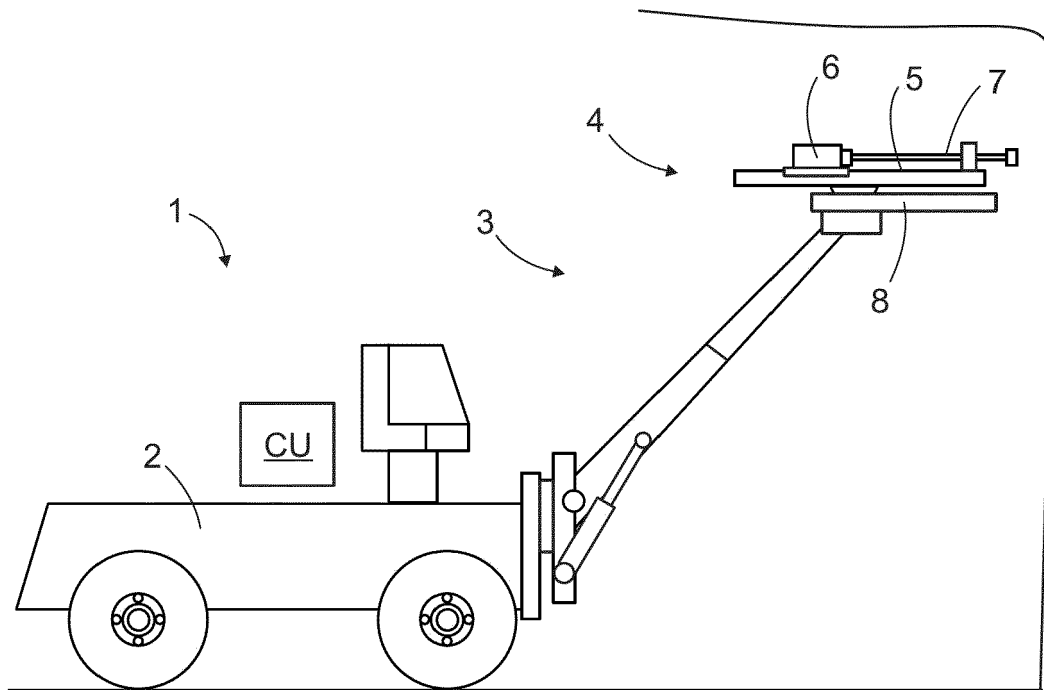


FIG. 1

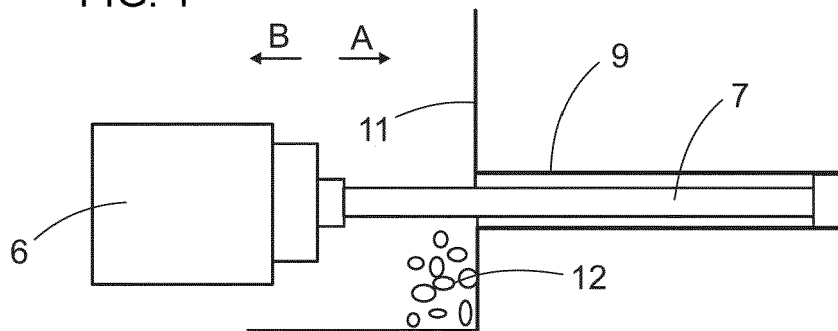


FIG. 2a

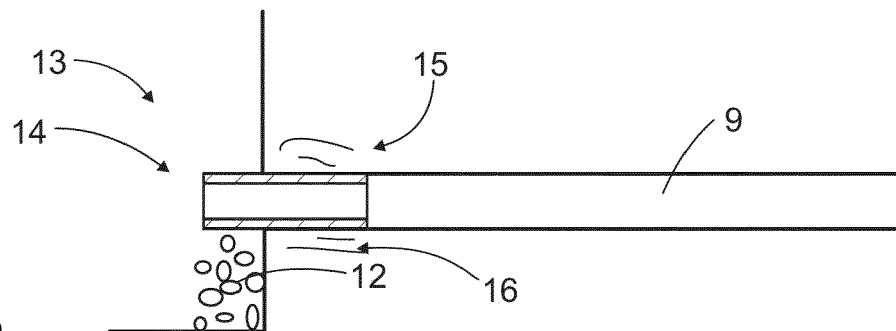


FIG. 2b

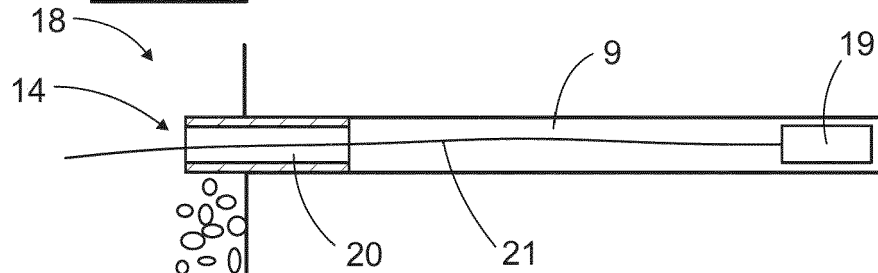


FIG. 2c

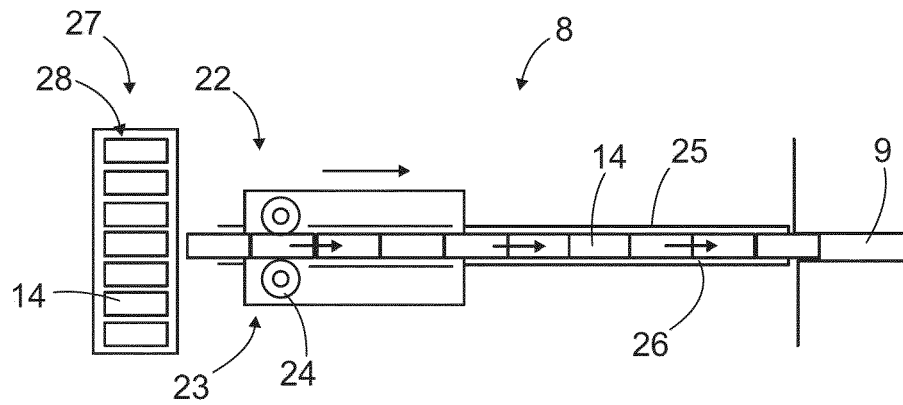


FIG. 3

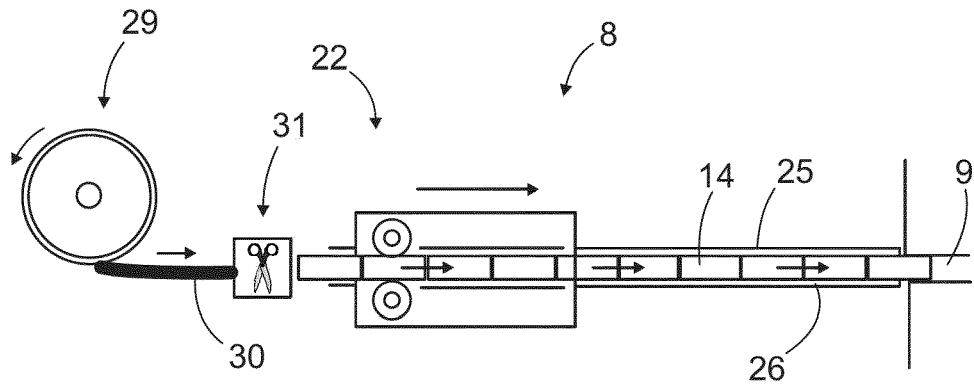


FIG. 4

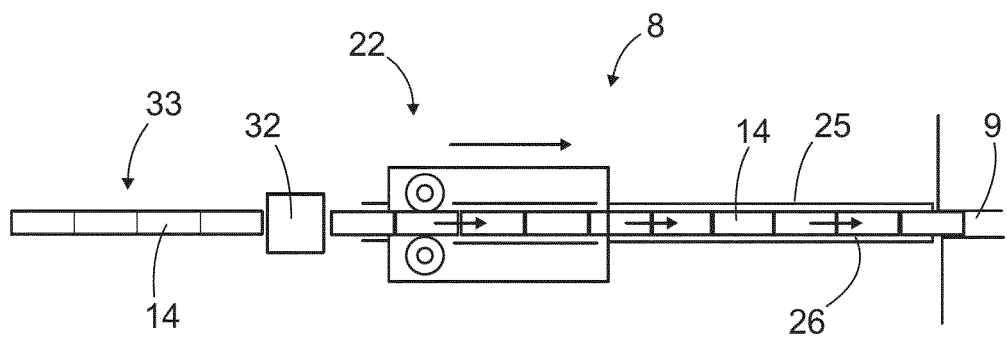


FIG. 5

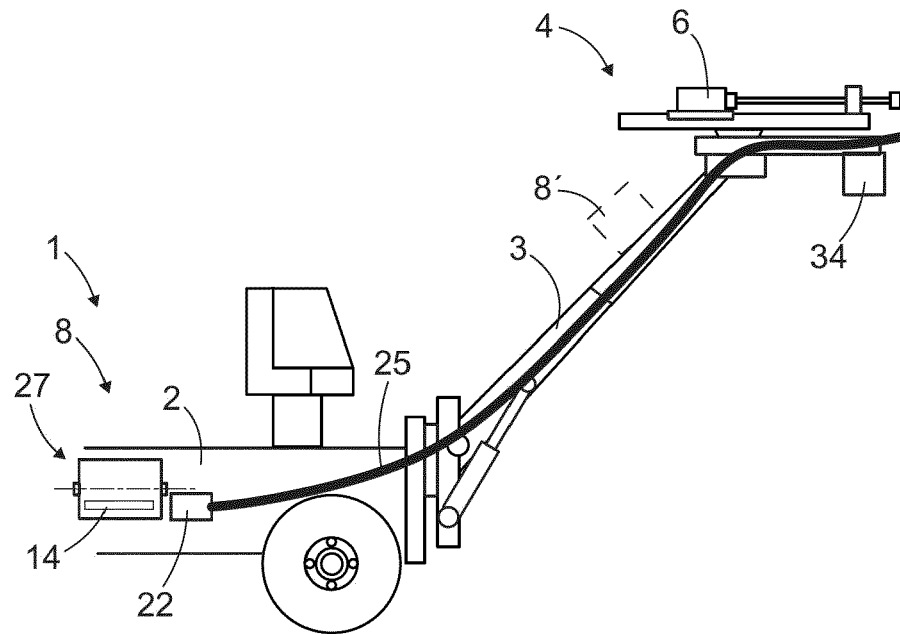


FIG. 6

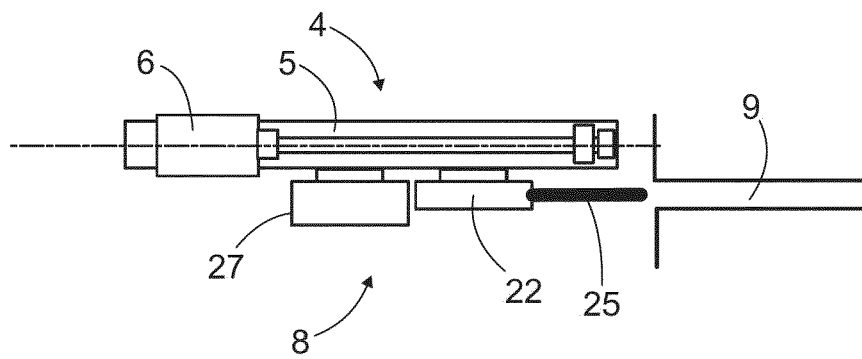


FIG. 7



EUROPEAN SEARCH REPORT

Application Number

EP 23 17 6716

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The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
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Place of search	Date of completion of the search	Examiner
Munich	16 October 2023	Georgescu, Mihnea
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

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