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(54) APPARATUS AND METHOD FOR CLEARING A BOREHOLE OPENING

VORRICHTUNG UND VERFAHREN ZUM REINIGEN EINER BOHRLOCHÖFFNUNG

APPAREIL ET PROCEDE DE DEGAGEMENT D'UNE OUVERTURE DE FORAGE

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Description

TECHNICAL FIELD

[0001] The present disclosure relates to a sweeper assembly arranged at a distal end of a boom of a mining or construction work machine. The sweeper assembly may be used for preparing boreholes for a blasting operation. The present disclosure further relates to a method of using the sweeper assembly for removing blockages from a borehole opening.

BACKGROUND

[0002] Mining operations and construction work commonly utilize drilling and blasting techniques. Usually, a plurality of boreholes need to be drilled into a rock surface. The boreholes extend a proper depth into the rock and are filled with explosive charges when drilling of all the holes is complete.

[0003] In the course of drilling prior to the filling with explosives, drill cuttings need to be removed from the drilled holes with the aid of a flushing medium such as compressed air or liquid. The liquid flush medium such as water may mix with the drill cuttings to form a clay paste. When a number of holes are drilled close together in a downwardly directed manner, the drill cuttings from a hole currently being drilled can block entrance to the already drilled holes nearby. The particularly affected are the lifter holes which are drilled along the floor of a tunnel for lifting the rock to floor level. The lifter holes may become buried and covered up completely by the drill cuttings and/or the clay paste thereof.

[0004] In the state of the art, an operator has to leave the relatively safe control station to manually locate and clean the entrance to every borehole while being exposed to the hazardous mining or construction environment. It is a long laborious process to find the buried borehole openings and subsequently clear them of the drill cuttings and/or the clay paste thereof, which impedes the progress of improving work efficiency and productivity.

[0005] The problem with drill cuttings may be avoided by the method disclosed in WO 2012067579 A1 or US 20020167215 A1. However, the process of installing pipes according to WO 2012067579 A1 or drilling line holes according to US 20020167215 A1 would incur other problems while leaving the problem with drill cuttings unsolved.

[0006] CN210396627U discloses a method of using a brush to remove drill cuttings from a borehole opening during drilling, wherein a rotary actuator is shared by the drill unit and the brush. However, the drill cuttings from a borehole currently being drilled can block entrance to the already drilled boreholes nearby. The method of CN210396627U is not appropriate or efficient for clearing the blocked openings of already drilled boreholes.

[0007] US1612186 discloses a rotatable brush for re-

moval of loose earth resting upon the blade of a boring member or an auger. The rotatable brush is positioned at one side of the blade and fixedly connected to the auger. The rotation of auger causes all portions of the auger blade upon which the loose earth rests to be presented to similarly timed rotative movement of the brush, and results in the removal of the loose earth away from the auger blade and the vicinity of the borehole in the ground. However, the brush is inappropriate for cleaning a lifter hole buried and covered up by tough drill cuttings and/or clay paste thereof.

[0008] There is a high demand for improved apparatus and method for clearing borehole openings which can solve the problem with drill cuttings in a straight-forward and efficient manner.

SUMMARY

[0009] In view of the above, one object of the present disclosure is therefore to reduce manual workload and risks for personnel at the site during operations for clearing a borehole opening of blockages at entrance to the borehole.

[0010] Another object of the disclosure is to increase work efficiency and productivity.

[0011] Yet another object of the disclosure is to provide a novel and advantageous solution for clearing a borehole opening of blockages at entrance to the borehole.

[0012] Yet another object of the disclosure is to provide a robust and reliable solution for clearing a borehole opening of blockages at entrance to the borehole.

[0013] Yet another object of the disclosure is to provide an alternative solution for clearing a borehole opening of blockages at entrance to the borehole.

[0014] Yet another object of the disclosure is to improve mechanization and automation of clearing a borehole opening of blockages at entrance to the borehole.

[0015] The above mentioned objects are achieved according to a first aspect of the disclosure by a boom of a mining or construction work machine as specified in claim 1, which boom comprising a first end connectable to the mining or construction work machine, a distal second end, and at least one sweeper assembly arranged at the distal second end of the boom. The sweeper assembly is configured to clear a borehole opening of blockages at entrance to the borehole. The boom as was described above enables mechanization and automation of the process of clearing a borehole opening of blockages at entrance to the borehole.

[0016] The sweeper assembly as was described above comprises at least one rotary actuator and/or at least one linear actuator. The at least one rotary actuator is used to transform energy to mechanical rotation of the sweeper assembly. The at least one linear actuator is used to move the sweeper assembly in a straight line.

[0017] The sweeper assembly as was described above further comprises at least one brush configured to rotate about an axis A. The rotating brush has the

advantage of producing a continuous cleaning of a large area thereby increasing work efficiency and productivity.

[0018] The brush as was described above may comprise a rotatable shaft or drum. The rotary actuator as was described above controls mechanical rotation of the at least one brush via the shaft or drum.

[0019] The brush as was described above may further comprises a plurality of single- and/or multi-strand steel wire packs. The steel wire packs are wear-resistant such that the sweeper assembly can perform in an aggressive manner.

[0020] The sweeper assembly as was described above may comprises at least one scraping tool. The scraping tool has the advantage of providing a more focused cleaning which is particularly efficient for removing tough clay paste of drill cuttings from a borehole opening.

[0021] The sweeper assembly with at least one scraping tool may comprise at least one hydraulic cylinder configured to control operation of the at least one scraping tool. The hydraulic cylinder inherently produces linear motion of the at least one scraping tool. The above mentioned objects are also achieved according to a second aspect of the disclosure by a rig as specified in claim 9, said rig comprising at least one boom as was described above. The rig has all the advantages that have been described above in conjunction with the boom and the sweeper assembly.

[0022] The above mentioned objects are also achieved according to a third aspect of the disclosure by a method of clearing a borehole opening of blockages at entrance to the borehole as specified in claim 10, which method comprising the steps of positioning the sweeper assembly as was described at entrance to the borehole; and controlling operation of the at least one brush and/or the at least one scraping tool of the sweeper assembly as was described above to remove blockages from the borehole opening. The method has all the advantages that have been described above in conjunction with the boom and the sweeper assembly.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] With reference to the appended drawings, below follows a more detailed description of embodiments of the disclosure cited as examples.

[0024] In the drawings:

Figure 1 is a schematic representation of a mining or construction work machine;

Figure 2 depicts a sweeper assembly with a brush in a perspective view;

Figure 3 is a schematic representation of a brush with a rotatable drum;

Figure 4 is a schematic representation of a sweeper assembly with a scraping tool.

Figure 5 is a schematic representation of a sweeper assembly with a telescopically extendable connect-

ing means.

DETAILED DESCRIPTION

[0025] The present disclosure aims to reduce or even eliminate exposure of personnel to the hazardous work environment during operations for clearing a borehole opening of blockages at entrance to the borehole. The present disclosure further aims to reduce manual workload and increase work efficiency or productivity. The present disclosure improves mechanization and automation of the operations for clearing a borehole opening of blockages at entrance to the borehole by providing a novel, robust and reliable solution which is advantageous over the state of the art.

[0026] According to a first aspect of the disclosure, there is provided a boom 4 of a mining or construction work machine 1, which boom 4 comprising a first end 4a connectable to the mining or construction work machine 1, a distal second end 4b, and a sweeper assembly 6 arranged at the distal second end 4b of the boom 4. The sweeper assembly 6 is configured to clear a borehole opening of blockages at entrance to the borehole. The boom 4 comprising the sweeper assembly 6 enables mechanization and automation of the process of clearing a borehole opening of blockages at entrance to the borehole. Furthermore, the sweeper assembly 6 is easy to operate.

[0027] The mining or construction work machine 1 may be a charging rig for loading boreholes with explosive charges. The charging rig 1 may comprise a mounting device 3 attached to the distal second end 4b of the at least one boom 4 (Fig. 1), which mounting device 3 comprises a beam 5, wherein the sweeper assembly 6 is arranged on the beam 5 (Fig. 2). Other devices or tools, e.g. a loading assembly as was described in our patent application SE 2030174-3, a hose for flushing medium, an explosive delivery hose, a hose handling unit, etc. may also be arranged on the same beam 5 of the charging rig 1 as the sweeper assembly 6.

[0028] The sweeper assembly 6 may comprise at least one rotary actuator and/or at least one linear actuator.

[0029] The at least one rotary actuator is used to transform energy to mechanical rotation of the sweeper assembly 6. The at least one rotary actuator may be hydraulically, pneumatically or electrically powered.

[0030] The at least one linear actuator is used to move the sweeper assembly 6 in a straight line. The at least one linear actuator may be hydraulically, pneumatically or electrically powered. The at least one linear actuator may be a hydraulic or pneumatic cylinder that inherently produces linear motion.

[0031] The sweeper assembly 6 may further comprise at least one brush 7 configured to rotate about an axis A (Figs. 2 and 3). The rotating brush 7 has the advantage of producing a continuous cleaning of a large area thereby increasing work efficiency and productivity.

[0032] The sweeper assembly 6 may further comprise

a connection means 20, which connection means 20 connects the brush 7 to the distal second end 4b of the boom 4. The connection means 20 may comprise an extendable first part with at least two telescopic sections 51, 52 (Fig. 5), wherein the first part is connectable to the distal second end 4b of the boom 4; and a second part connectable to the brush 7. A mining or construction work machine 1 may typically comprise a mounting device 3 attached to the distal second end 4b of the at least one boom 4 (Fig. 1), which mounting device 3 comprises a beam 5, wherein the connection means 20 of the sweeper assembly 6 connects the brush 7 to the beam 5 at the distal second end 4b of the boom 4 (Fig. 2).

[0033] The connection means 20 comprising an extendable first part with at least two telescopic sections 51, 52 provides the advantage of space-saving storage of the brush 7 when the sweeper assembly 6 is not in use and the advantage of flexibility in getting access to the area to be swept. Operation of the extendable first part of the connection means 20 may be controlled by a linear actuator.

[0034] The brush 7 as illustrated in Fig. 2 may comprise a rotatable shaft. The rotary actuator as was described above controls mechanical rotation of the at least one brush 7 via the shaft.

[0035] The brush 7 as illustrated in Fig. 2 may comprise a single-piece mounting flange 21, wherein a plurality of single- and/or multi-strand wire packs 8 are mechanically affixed to the single-piece mounting flange 21. Preferably, the wire packs 8 are made of wear-resistant material such as steel wires, which enables more aggressive performance of the sweeper assembly 6.

[0036] The brush 7 as illustrated in Fig. 3 may comprise a rotatable drum 9 (Fig. 3a). Fig. 3b is a cross-sectional view of the brush 7 with a rotatable drum 9. A cutting plane 30 indicated in Fig. 3a defines the cross-section shown in Fig. 3b. The rotary actuator as was described above controls mechanical rotation of the at least one brush 7 via the drum 9.

[0037] The brush 7 as illustrated in Fig. 3 may comprise a plurality of single- and/or multi-strand wire packs 8 mechanically affixed to the drum 9. Preferably, the wire packs 8 are made of wear-resistant material such as stainless steel, which enables aggressive performance of the sweeper assembly 6.

[0038] The sweeper assembly 6 may comprise at least one scraping tool 10. The scraping tool 10 has the advantage of providing a more focused cleaning which is particularly efficient for removing tough clay paste of drill cuttings from a borehole opening.

[0039] The sweeper assembly 6 may comprise at least one hydraulic cylinder 11 configured to control operation of the at least one scraping tool 10. The hydraulic cylinder 11 inherently produces linear motion of the at least one scraping tool 10.

[0040] The sweeper assembly 6 may comprise a connection means 20, which connection means 20 comprising a shank 40 connected to the at least one scraping tool

10, a pivot member 42 connecting the shank 40 to the distal second end 4b of the boom 4, and a feeding device 41 arranged at the distal second end 4b of the boom 4, wherein the feeding device 41 is connected to the shank 40. The pivot member 42 enables rotary motion of the shank 40 around the pivot member 42 (Fig. 4).

[0041] Typically, a mining or construction work machine 1 comprises a mounting device 3 attached to the distal second end 4b of the at least one boom 4 (Fig. 1). The mounting device 3 comprises a beam 5, wherein the shank 40 is connected to the beam 5 via the pivot member 42 at the distal second end 4b of the boom 4, and wherein the feeding device 41 is attached to the beam 5 at the distal second end 4b of the boom 4 (Fig. 4). The feeding device 41 is configured to move along the longitudinal axis of the beam 5. Preferably, the feeding device 41 comprises an even number of rollers, which has the advantage of ensuring stable movement of the feeding device 41.

[0042] The sweeper assembly 6 as illustrated in Fig. 4 may further comprise a first hydraulic cylinder 11 configured to control operation of the scraping tool 10, a second hydraulic cylinder 11 configured to control operation of the shank 40, and a third hydraulic cylinder 11 configured to control operation of the feeding device 41.

[0043] The sweeper assembly 6 as was described above provides the advantage of space-saving storage of the scraping tool 10 when the sweeper assembly 6 is not in use and the advantage of flexibility in get access to the area to be cleaned.

[0044] According to a second aspect of the disclosure, there is provided a rig 1 comprising at least one boom 4 as was described above. The rig 1 may be a complex equipment intended for earth surface use or underground use. The rig 1 may be a mining or construction work machine adapted for various mining operations or construction work. The rig 1 may be a drilling rig adapted for drilling blasting holes, injection holes, holes for rock bolt reinforcement, etc.. The rig 1 may be a charging rig for loading boreholes with explosive charges.

[0045] Fig. 1 shows schematically a mining or construction work machine 1 comprising a carrier 2, at least one boom 4 and a mounting device 3 attached to the distal second end 4b of the at least one boom 4. Typically, the mounting device 3 comprises a beam 5 on which the sweeper assembly 6 may be arranged (Figs. 2 and 4). Other devices or tools, e.g. a drilling machine, a loading assembly as was described in our patent application SE 2030174-3, a hose for flushing medium, an explosive delivery hose, a hose handling unit, etc. may also be arranged on the same beam 5 as the sweeper assembly 6. An enlarged view of the beam 5 with the sweeper assembly 6 is provided in Figs. 2 and 4. The rig 1 has all the advantages that have been described above in conjunction with the boom 4 and the sweeper assembly 6.

[0046] According to a third aspect of the disclosure, there is provided a method of clearing a borehole opening

of blockages at entrance to the borehole, which method comprising the steps of positioning the sweeper assembly 6 as was described above at entrance to the borehole; and controlling operation of the at least one brush 7 and/or the at least one scraping tool 10 of the sweeper assembly 6 to remove blockages from the borehole opening. Optionally, the method further comprises a step of rinsing the swept borehole opening with water, which removes any residual debris from the entrance to the borehole. The method has all the advantages that have been described above in conjunction with the boom 4 and the sweeper assembly 6.

[0047] The method as was described above for clearing a borehole opening of blockages at entrance to the borehole is a straightforward method which may be at least partially automatized.

[0048] Although the invention has been described in terms of example embodiments as set forth above, it should be understood that the examples are given solely for the purpose of illustration and are not to be construed as limitations of the claims, as many variations thereof are possible without departing from the scope of the invention. Each feature disclosed or illustrated in the present disclosure may be incorporated in the claims, whether alone or in any appropriate combination with any other feature disclosed or illustrated herein. The scope of protection is therefore provided by the appended claims.

Claims

1. A boom (4) of a mining or construction work machine (1), which boom (4) comprising
 - a first end (4a) connectable to the mining or construction work machine (1),
 - a distal second end (4b), and
 - at least one sweeper assembly (6) arranged at the distal second end (4b) of the boom (4), wherein the sweeper assembly (6) is configured to clear a borehole opening of blockages at the entrance to the borehole, and wherein the sweeper assembly (6) comprises at least one linear actuator configured to move the sweeper assembly (6) in a straight line.
2. The boom (4) according to claim 1, wherein the sweeper assembly (6) further comprises at least one rotary actuator.
3. The boom (4) according to claim 1 or 2, wherein the sweeper assembly (6) further comprises at least one brush (7) configured to rotate about an axis A.
4. The boom (4) according to claim 3, wherein the brush (7) comprises a rotatable shaft.
5. The boom (4) according to claim 3, wherein the brush

(7) comprises a rotatable drum (9).

6. The boom (4) according to any one of the claims 3 to 5, wherein the brush (7) further comprises a plurality of single- and/or multi-strand steel wire packs (8).
7. The boom (4) according to claim 1 or 2, wherein the sweeper assembly (6) comprises at least one scraping tool (10).
8. The boom (4) according to claim 7, wherein the sweeper assembly (6) comprises at least one hydraulic cylinder (11) configured to control operation of the at least one scraping tool (10).
9. A rig (1) comprising at least one boom (4) according to any one of the previous claims.
10. A method of clearing a borehole opening of blockages at the entrance to the borehole, which method comprising the steps of

positioning the sweeper assembly (6) according to any one of the claims 1 to 8 at entrance to the borehole; and
controlling operation of the sweeper assembly (6) to remove blockages from the borehole opening.

Patentansprüche

1. Ausleger (4) einer Bergbau- oder Bauarbeitsmaschine (1), wobei der Ausleger (4) Folgendes umfasst:
 - ein erstes Ende (4a), das mit der Bergbau- oder Bauarbeitsmaschine (1) verbindbar ist,
 - ein distales zweites Ende (4b), und
 - mindestens eine Kehranordnung (6), die an dem distalen zweiten Ende (4b) des Auslegers (4) angeordnet ist, wobei die Kehranordnung (6) dazu ausgebildet ist, Verstopfungen an einer Bohrlochöffnung am Eingang des Bohrlochs zu beseitigen, und wobei die Kehranordnung (6) mindestens ein lineares Stellglied umfasst, das dazu ausgebildet ist, die Kehranordnung (6) in einer geraden Linie zu bewegen.
2. Ausleger (4) nach Anspruch 1, wobei die Kehranordnung (6) weiter mindestens ein drehendes Stellglied umfasst.
3. Ausleger (4) nach Anspruch 1 oder 2, wobei die Kehranordnung (6) weiter mindestens eine Bürste (7) umfasst, die dazu ausgebildet ist, sich um eine Achse A zu drehen.
4. Ausleger (4) nach Anspruch 3, wobei die Bürste (7)

eine drehbare Welle umfasst.

5. Ausleger (4) nach Anspruch 3, wobei die Bürste (7) eine drehbare Trommel (9) umfasst.
6. Ausleger (4) nach einem der Ansprüche 3 bis 5, wobei die Bürste (7) weiter eine Vielzahl von einfach und/oder mehrfach verseilten Stahldrahtpaketen (8) umfasst.
7. Ausleger (4) nach Anspruch 1 oder 2, wobei die Kehrordnung (6) mindestens ein Schabwerkzeug (10) umfasst.
8. Ausleger (4) nach Anspruch 7, wobei die Kehrordnung (6) mindestens einen Hydraulikzylinder (11) umfasst, der dazu ausgebildet ist, den Betrieb des mindestens einen Schabwerkzeugs (10) zu steuern.
9. Bohranlage (1), die mindestens einen Ausleger (4) nach einem der vorstehenden Ansprüche umfasst.
10. Verfahren zum Beseitigen von Verstopfungen von einer Bohrlochöffnung am Eingang des Bohrlochs, wobei das Verfahren die Schritte umfasst zum *Positionieren* der Kehrordnung (6) nach einem der Ansprüche 1 bis 8 am Eingang des Bohrlochs; und *Steuern* des Betriebs der Kehrordnung (6), um Verstopfungen von der Bohrlochöffnung zu entfernen.

Revendications

1. Flèche (4) d'une machine (1) d'exploitation minière ou de construction, laquelle flèche (4) comprenant
 une première extrémité (4a) pouvant être reliée à la machine (1) d'exploitation minière ou de construction,
 une seconde extrémité distale (4b), et
 au moins un ensemble de balayage (6) agencé au niveau de la seconde extrémité distale (4b) de la flèche (4), dans laquelle l'ensemble de balayage (6) est configuré pour débayer une ouverture de puits de forage d'obstructions au niveau de l'entrée du puits de forage, et dans laquelle l'ensemble de balayage (6) comprend au moins un actionneur linéaire configuré pour déplacer l'ensemble de balayage (6) en ligne droite.
2. Flèche (4) selon la revendication 1, dans laquelle l'ensemble de balayage (6) comprend en outre au moins un actionneur rotatif.
3. Flèche (4) selon la revendication 1 ou 2, dans laquelle l'ensemble de balayage (6) comprend en

outre au moins une brosse (7) configurée pour tourner autour d'un axe A.

4. Flèche (4) selon la revendication 3, dans laquelle la brosse (7) comprend un arbre rotatif.
5. Flèche (4) selon la revendication 3, dans laquelle la brosse (7) comprend un tambour rotatif (9).
6. Flèche (4) selon l'une quelconque des revendications 3 à 5, dans laquelle la brosse (7) comprend en outre une pluralité de paquets (8) de fils d'acier à simple et/ou plusieurs brins.
7. Flèche (4) selon la revendication 1 ou 2, dans laquelle l'ensemble de balayage (6) comprend au moins un outil de raclage (10).
8. Flèche (4) selon la revendication 7, dans laquelle l'ensemble de balayage (6) comprend au moins un vérin hydraulique (11) configuré pour commander le fonctionnement de l'au moins un outil de raclage (10).
9. Appareil de forage (1) comprenant au moins une flèche (4) selon l'une quelconque des revendications précédentes.
10. Procédé de déblayage d'une ouverture de puits de forage d'obstructions au niveau de l'entrée du puits de forage, lequel procédé comprenant les étapes de *positionnement* de l'ensemble de balayage (6) selon l'une quelconque des revendications 1 à 8 au niveau de l'entrée du puits de forage ; et *commande* du fonctionnement de l'ensemble de balayage (6) pour retirer des obstructions de l'ouverture de puits de forage.

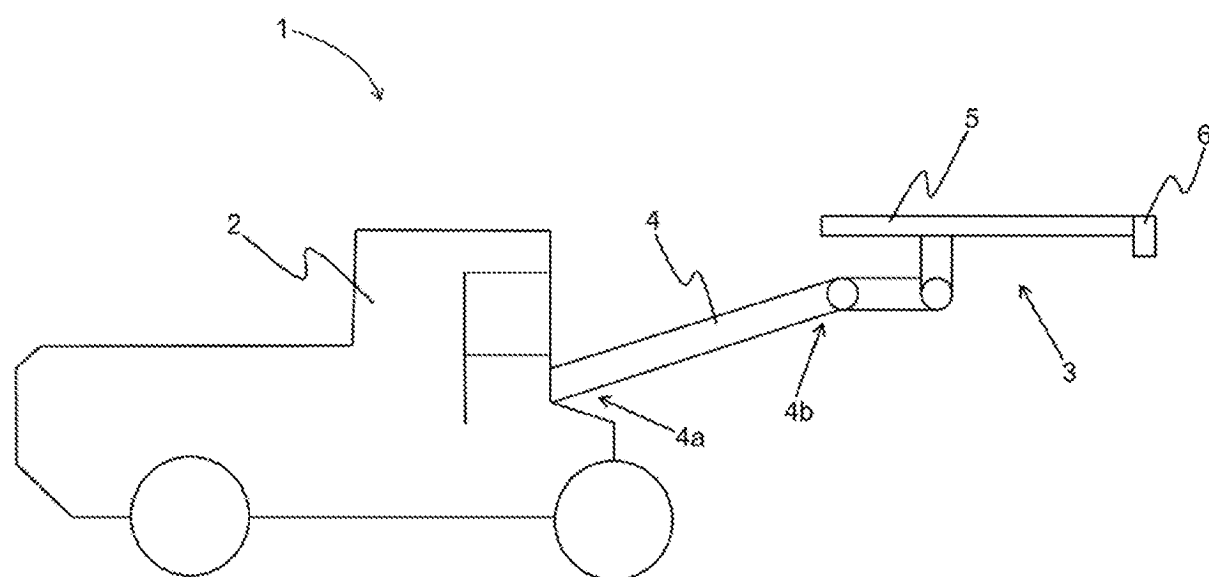


Fig. 1

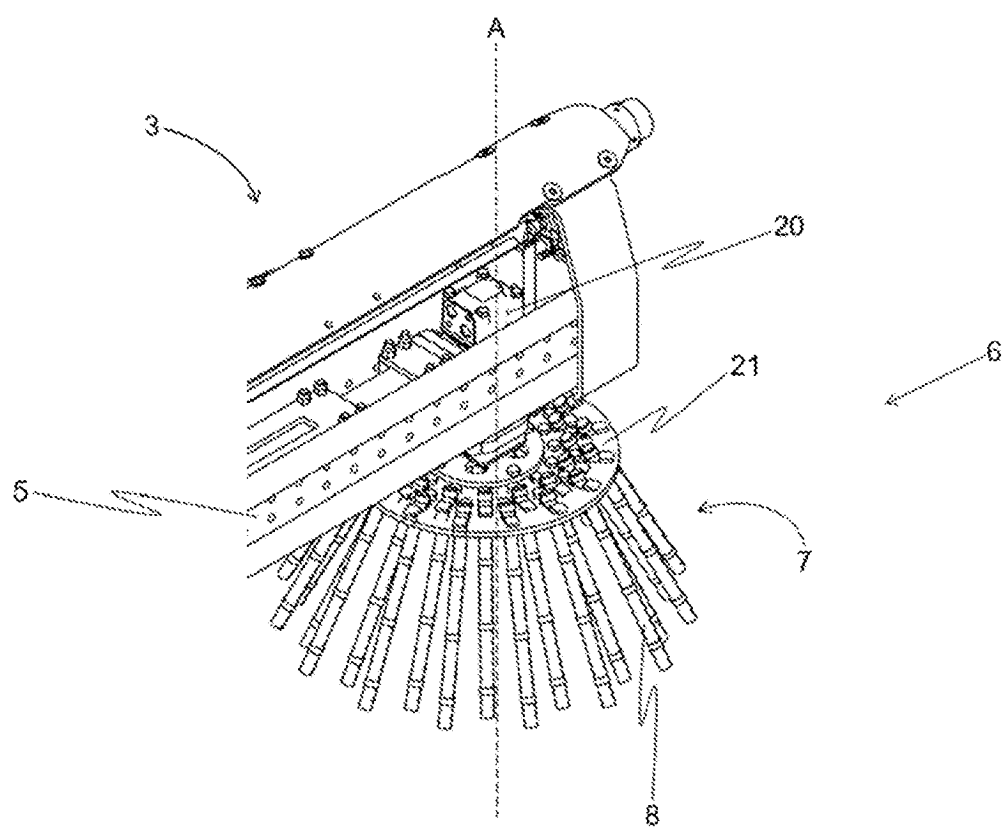


Fig. 2

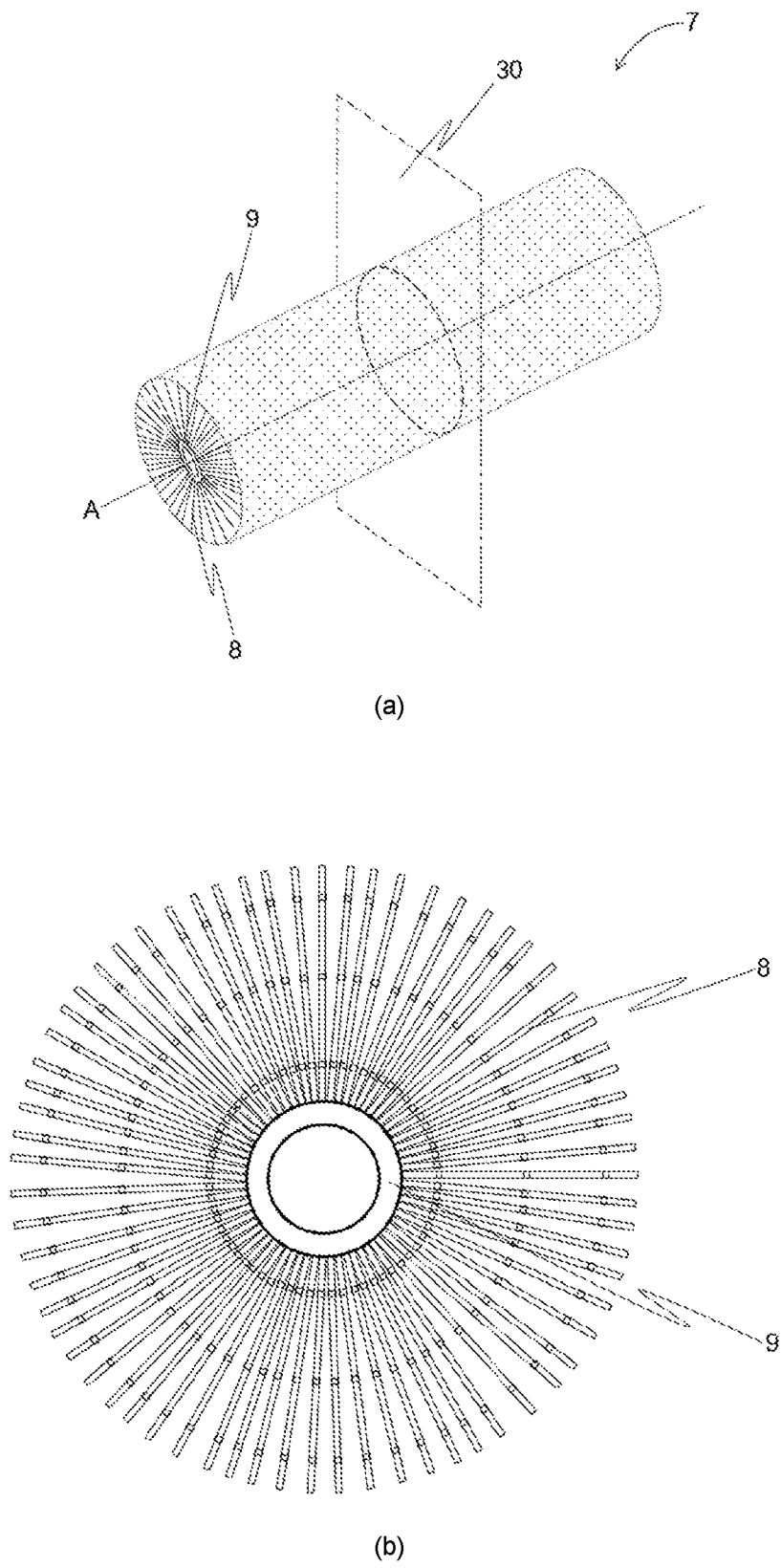


Fig. 3

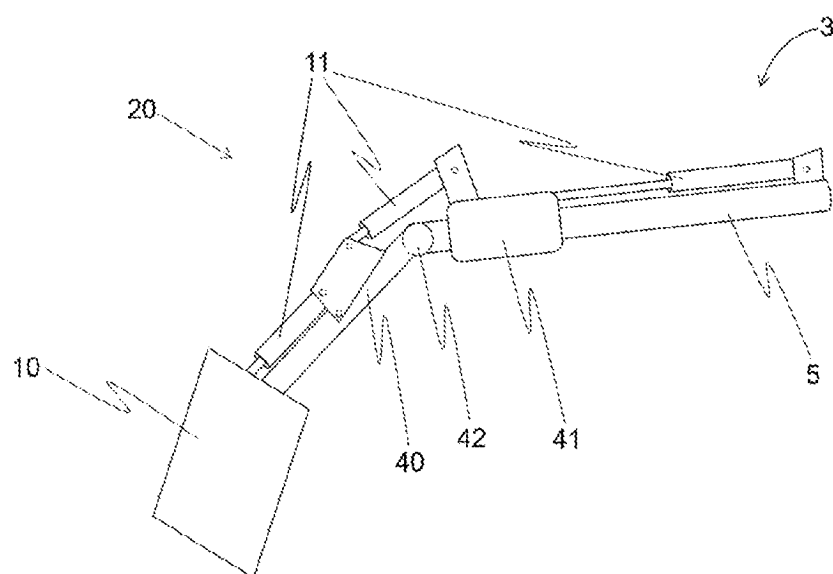


Fig. 4

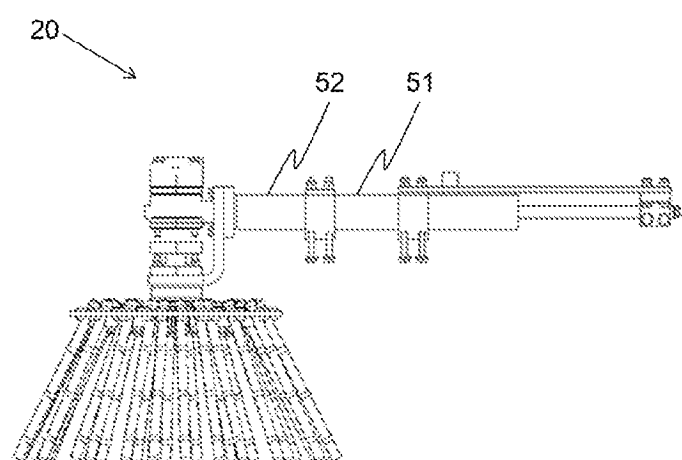


Fig. 5

REFERENCES CITED IN THE DESCRIPTION

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