

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
22 January 2009 (22.01.2009)

PCT

(10) International Publication Number
WO 2009/010930 A2

(51) International Patent Classification:
E02F 3/407 (2006.01)

(74) Agent: D M KISCH INC; P O Box 781218, 2146 Sandton (ZA).

(21) International Application Number:
PCT/IB2008/052860

(22) International Filing Date: 16 July 2008 (16.07.2008)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
2007/05858 16 July 2007 (16.07.2007) ZA

(71) Applicant (for all designated States except US): VAN REENEN STEEL (PTY) LIMITED [ZA/ZA]; 13 Clarke Street, Alrode, 1449 Alberton (ZA).

(72) Inventor; and

(75) Inventor/Applicant (for US only): HAASBROEK, Albertus Jacobus [ZA/ZA]; 13 Clarke Street, Alrode, 1449 Alberton (ZA).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL,

[Continued on next page]

(54) Title: BUCKET FOR AN EXCAVATION SYSTEM

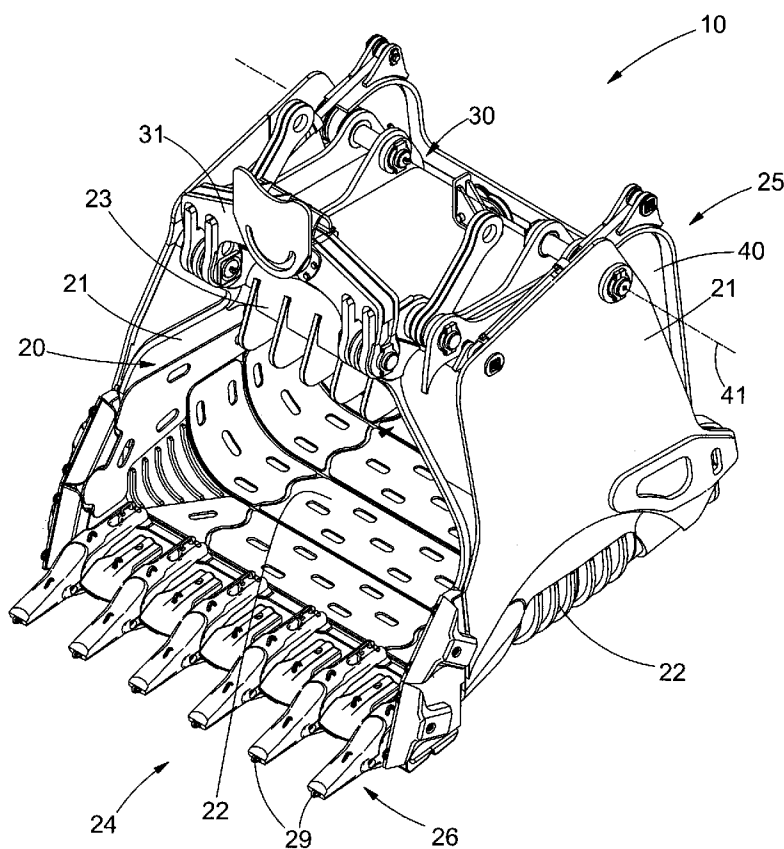


FIGURE 1

(57) Abstract: This invention relates to a bucket for use with a rope shovel excavation system. The bucket includes a hollow body for holding material to be excavated and conveyed. The bucket has a first open end, a second open end, and a displaceable closure provided towards the second open end. The closure is displaceable between a closed position wherein the closure overlies the second open end of the body, and an open position wherein the closure is spaced apart from the second open end of the body so as to enable a load inside the body to be discharged through the second open end of the body. The closure is securable in the closed position by way of at least two locking members located on opposite sides of the closure member, the locking members securing the closure to the body so as to prevent displacement of the closure relative to the body.



NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *without international search report and to be republished upon receipt of that report*

BUCKET FOR AN EXCAVATION SYSTEM

FIELD OF THE INVENTION

This invention relates to a bucket for an excavation system, and more particularly, but not exclusively, to a bucket or dipper for use in a rope shovel excavation system.

BACKGROUND TO THE INVENTION

Many different types of excavation systems are used in mining and civil engineering and constructions applications. One type of excavation system known in industry is a rope shovel excavation system, and more particularly an electrical rope shovel excavator. A rope shovel excavator includes a bucket, also known as a dipper, which is pivotably connected to a boom that extends from a rotating platform. The boom can be rotated through many degrees of freedom so as to allow a digging action to be performed with the bucket.

Once the bucket has been filled, the load contained therein is deposited into a suitable receiving receptacle, such as a haul unit, by tilting the bucket backwards, and opening a rear bucket flap, thus allowing the load to be released through a rear opening of the bucket into the haul unit. The bucket flap is typically opened by releasing a single locking pin, thus resulting in the bucket flap opening under the gravitational force exerted on the flap by the

charge inside the bucket. Once the bucket has been emptied, the bucket is moved to a horizontal position, and the flap automatically moves to a closed position. The locking pin engages the body of the bucket, and the bucket, and hence the rope shovel excavator, is ready for a further operational cycle.

The bucket of a rope shovel excavator must be able to carry a large load, and the design of the bucket must therefore be rugged and robust. A critical component of the bucket is the locking pin, as a considerable force is exerted on the locking pin by the bucket flap (which is in turn exposed to the gravitational force of the load inside the bucket). It will be appreciated that the locking pin can potentially fail in shear, especially after extended use of the bucket.

In use, a rope shovel excavator, and in particular the bucket thereof, is exposed to considerable wear owing to the nature of the digging action performed thereby. It is therefore also of critical importance to endeavor to reduce the frictional wear that the bucket is exposed to, so as to prolong the operational life of the bucket, and to prevent premature failure thereof.

OBJECT OF THE INVENTION

It is accordingly an object of the invention to provide a bucket for an excavation system that will, at least partially, alleviate the above disadvantages. It is also an object of the invention to provide a bucket for an

excavation system that will be a useful alternative to existing buckets known in the art.

SUMMARY OF THE INVENTION

According to a first aspect of the invention there is provided a bucket for use in an excavation system, the bucket including:

- a hollow body for holding excavated material to be conveyed by the bucket, the hollow body having a first open end and a second open end, a base extending longitudinally between the first open end and the second open end and opposed and spaced apart side walls extending upwardly from the base between the first open end and the second open end; and
- a closure member provided towards the second open end, the closure member being displaceable between a closed position wherein the closure member closes the second open end of the body and an open position wherein the closure is spaced apart from the second open end of the body so that the second open end is open to enable excavated material inside the body to be discharged through the second open end of the body,

the closure member being securable in the closed position by way of a locking assembly including at least two locking members located on opposite sides of the closure member, the locking members securing the closure member to the body so as to prevent displacement of the closure member relative to the body.

The locking members may be in the form of locking pins that are movable relative to the closure member between a locked position, wherein the locking pins engage complementary receiving formations provided in the body, and an unlocked position, wherein the locking pins are withdrawn from the receiving formations.

The locking assembly may include a cable of which a first end may be operatively connected to an operating mechanism of the excavation system and of which a second end may be connected to a lever mechanism, which in turn may be connected to the locking pins, the arrangement being such that when a force is exerted on the cable, the lever mechanism pivots about a pivot point to move the locking pins between the locked position and the unlocked position.

The locking pins may be biased in the locked position, so that they automatically move to the locked position when the force exerted on the cable is removed.

The closure member may be in the form of a door that is pivotably connected to the body, the locking pins being substantially parallel to a pivot axis of the door.

The base may be at least partially arcuate when viewed in longitudinal cross-section, in order to reduce contact between an outer surface of the base and

the medium being excavated when the bucket is swiveled during a digging maneuver.

A rear section of the base may be at least partially rounded.

A bottom edge of the first open end may be operatively lower than a bottom edge of the second open end due to the rounded configuration of the rear section of the base.

The bottom edge of the first open end may also be operatively lower than a bottom edge of the closure due to the rounded configuration of the base.

The side walls of the hollow body of the bucket may be at least partially tapered.

More particularly, the body of the bucket may be shaped at least partially trapezoidal when viewed in cross-section.

According to a second aspect of the invention there is provided an excavation system including a bucket according to the first aspect of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described further by way of a non-limiting example with reference to the accompanying drawings wherein:

- Figure 1 is a perspective view from above of a bucket for an excavation system, according to a preferred embodiment of the invention;
- Figure 2 is a side view of the bucket of Figure 1;
- Figure 3 is a perspective view of a closure member for use with the bucket of Figure 1; and
- Figure 4 is a front view of a locking pin assembly located in the closure member of Figure 3.

DESCRIPTION OF A PREFERRED EMBODIMENT OF THE INVENTION

Referring to the drawings, in which like numerals indicate like features, a bucket for use in an excavation system, and more particularly in an electrical rope shovel system, is generally indicated by reference numeral 10. In the trade, the bucket 10 is also referred to as a dipper.

The bucket 10 includes a hollow body 20 in the form of a shell for holding excavated material to be conveyed. The body 20 of the bucket 10 comprises two opposing side walls 21, a base 22 and a top wall 23. Both of the side walls 21, the base 22 and the top wall 23 are continuous so as to form a substantially cylindrical hollow shell having a first open end 24 and a second open end 25, with the base 22 extending longitudinally between the first open end 24 and the second open end 25. A bottom edge of the first open end 24 is provided with engaging members 26, which includes a plurality of teeth 29 that, in use, engage the medium to be excavated. The second open end 25 is

selectively covered by a closure member 40, as is described in more detail herein below.

A top section 30 of the bucket 10 includes a plurality of connecting formations that are connectable to driving and controlling mechanisms of the excavation system, and are used to manipulate the bucket 10. For the purposes of this invention, the exact details and configuration of the top section 30, the driving and controlling mechanisms and excavation system are not imperative. However, it is important to note that a bail 31 of the bucket 10 is of a relatively small size, in comparison with prior art, due to the particular configuration of the body 20. More particularly, the side walls 21 of the body 20 are at least partially tapered relative to one another when viewed in cross-section, thus rendering the cross-section profile of the body 20 to be substantially trapezoidal. This arrangement ensures that the dead space inside the body 20, when filled with excavated material, is minimized, and the tapered side walls 21 also result in the top section 30, and thus the bail 31, to be of smaller span and thus size. This results in a substantial weight saving of the bucket 10 as a whole.

As can be best seen in Figure 2, it is an important aspect of this invention that the base 22 of the hollow body 20 is not entirely linear. More particular, the base 22 is somewhat curved, especially towards a rear section thereof proximate to the second open end 25. The broken line indicated by arrow A indicates a standard linear profile, from which the deviation of the curved bottom wall is apparent.

In use, the bucket 10 is swivelled so as to perform a digging action when a medium is excavated. The engaging members 26 and in particular the teeth 29 engage the medium to be excavated, but preferably the contact between the base 22 and the medium excavated should be minimized so as to reduce wear of the hollow body 20. In accordance with the invention this is achieved by providing a curved or rounded base 22 as opposed to linear bottom walls (line "A") typically found in the prior art. This curvature has the effect that contact between the base 22 and the medium to be excavated is reduced. In particular contact between a lower section 43 of the closure member 40 and the medium to be excavated is considerably reduced.

It will be appreciated that, due to the geometry of the bucket 10, contact between the medium to be excavated and the base 22 would have been excessive during the swivelling digging action if the base 22 was of linear configuration (line "A"). As mentioned above, it is of particular importance that a lower section 43 of the closure member 40 is at a substantially higher elevation than the engaging members 26 of the hollow body 20, and contact between the medium to be excavated and the lower section 43 of the closure member 40 is also minimized by utilizing this particular configuration.

In use, the bucket 10 is swivelled about a swivelling axis in order for the bucket to perform a digging or excavating action, with the closure member 40 in a closed position, as shown in Figures 1 and 2. In the closed position, the closure member 40 overlies the second open end 25 so as to form a

substantially closed receptacle suitable for receiving and conveying material to be excavated.

Once a digging or shovelling sequence has been completed, the bucket 10 is orientated so that the first open end 24 is upwardly directed, the closure member 40 thus effectively defining a bottom wall in this configuration. The bucket 10 can now be displaced to a location where the load inside the bucket 10 is to be discharged. Once the discharge location has been reached, the closure member 40 is displaced to an open position, to open the second open end and to discharge the load through the second open end 25.

The closure member 40 is pivotally connected to the hollow body 20, and can pivot about a pivot axis 41. The closure member 40 is configured to be opened and closed under the force of gravity, the direction of which can be altered by changing the orientation of the bucket 10 through suitable manoeuvres of the operating mechanism of the excavation system. The closure member 40 is retained in a closed position by way of a locking pin assembly 44, which is designed to withstand the full force exerted on the closure member 40 by the load inside the bucket 10 when the bucket 10 is in a discharge orientation.

Referring particularly to Figure 3, the closure member 40 comprises a planar door being pivotable about the pivot axis 41. The door includes two opposite side zones 42 and a bottom zone 43.

Referring particularly to Figure 4, the locking pin assembly 44 includes two locking pins 44.5 that are sideways displaceable relative to the closure member 40. The locking pins 44.5 are displaceable between a locking position, wherein the locking pins 44.5 extend from the closure member 40 so as to engage complementary receiving formations in the body 20 of the bucket 10, and an unlocked position wherein the locking pins 44.5 are retracted inside the closure member 40 so as to disengage the receiving formation in the body 20. Of particular importance is the fact that the locking pin assembly 44 includes two locking pins 44.5. One locking pin 44.5 is provided on each side zone 42 of the closure member 40. In this way the total load exerted on the locking pin assembly 44 is shared between the two locking pins 44.5, thus reducing the risk of failure and improving the mechanical integrity of the system.

The locking pins 44.5 are actuated by manipulating a cable 44.1 that is operatively connected to the excavation system. The cable 44.1 engages a lever mechanism 44.2 which can rotate about a pivot point 44.3. When the lever 44.2 is rotated the locking pins 44.5 are moved to the retracted or closed position by way of two actuating members 44.4. The locking pins 44.5 are biased towards the locked position and will move back to the locked position when the force exerted on the cable 44.1 is removed.

It is foreseen that the locking pin assembly 44 including two locking pins 44.5 constitutes a substantial advance over the prior art, as the integrity of the locking mechanism is substantially improved. The locking pins 44.5 are a

crucial component of the bucket 10 of the rope shovel excavator, as these pins 44.5 allow the closure 40 to act as a bottom wall when conveying the material excavated, whilst still allowing the closure 40 to act as a discharge flap when the locking pin assembly 44 is unlocked.

It will be appreciated that variations in detail are possible with a bucket for an excavation system according to the invention without departing from the scope of the appended claims.

CLAIMS

1. A bucket for use in an excavation system, the bucket including a hollow body for holding excavated material to be conveyed by the bucket, the hollow body having a first open end and a second open end, a base extending longitudinally between the first open end and the second open end and opposed and spaced apart side walls extending upwardly from the base between the first open end and the second open end; and a closure member provided towards the second open end, the closure member being displaceable between a closed position wherein the closure member closes the second open end of the body and an open position wherein the closure is spaced apart from the second open end of the body so that the second open end is open to enable excavated material inside the body to be discharged through the second open end of the body, the closure member being securable in the closed position by way of a locking assembly including at least two locking members located on opposite sides of the closure member, the locking members securing the closure member to the body so as to prevent displacement of the closure member relative to the body.
2. A bucket according to claim 1 wherein the locking members are in the form of locking pins that are movable relative to the closure member between a locked position, wherein the locking pins engage complementary receiving formations provided in the body, and an

unlocked position, wherein the locking pins are withdrawn from the receiving formations.

3. A bucket according to claim 2 wherein the locking assembly includes a cable of which a first end is operatively connected to an operating mechanism of the excavation system and of which a second end is connected to a lever mechanism, which in turn is connected to the locking pins, the arrangement being such that when a force is exerted on the cable, the lever mechanism pivots about a pivot point to move the locking pins between the locked position and the unlocked position.
4. A bucket according to claim 3 wherein the locking pins are biased in the locked position, so that they automatically move to the locked position when the force exerted on the cable is removed.
5. A bucket according to claim 2 wherein the closure member is in the form of a door that is pivotably connected to the body, the locking pins being substantially parallel to a pivot axis of the door.
6. A bucket according to any one of the preceding claims wherein the rear section of the base is at least partially rounded.
7. A bucket according to claim 6 wherein the bottom edge of the first open end is operatively lower than a bottom edge of the second open end due to the rounded configuration of the base.

8. A bucket according to claim 7 wherein the bottom edge of the first open end is also operatively lower than a bottom edge of the closure due to the rounded configuration of the base.
9. A bucket according to any one of the preceding claims wherein the side walls of the hollow body of the bucket are at least partially tapered.
10. A bucket according to claim 9 wherein the body of the bucket is shaped at least partially trapezoidal when viewed in cross-section.
11. An excavation system including a bucket according to the first aspect of the invention.
12. A bucket substantially as herein described and with reference to the accompanying drawings.
13. An excavation system substantially as herein described and with reference to the accompanying drawings.

1/3

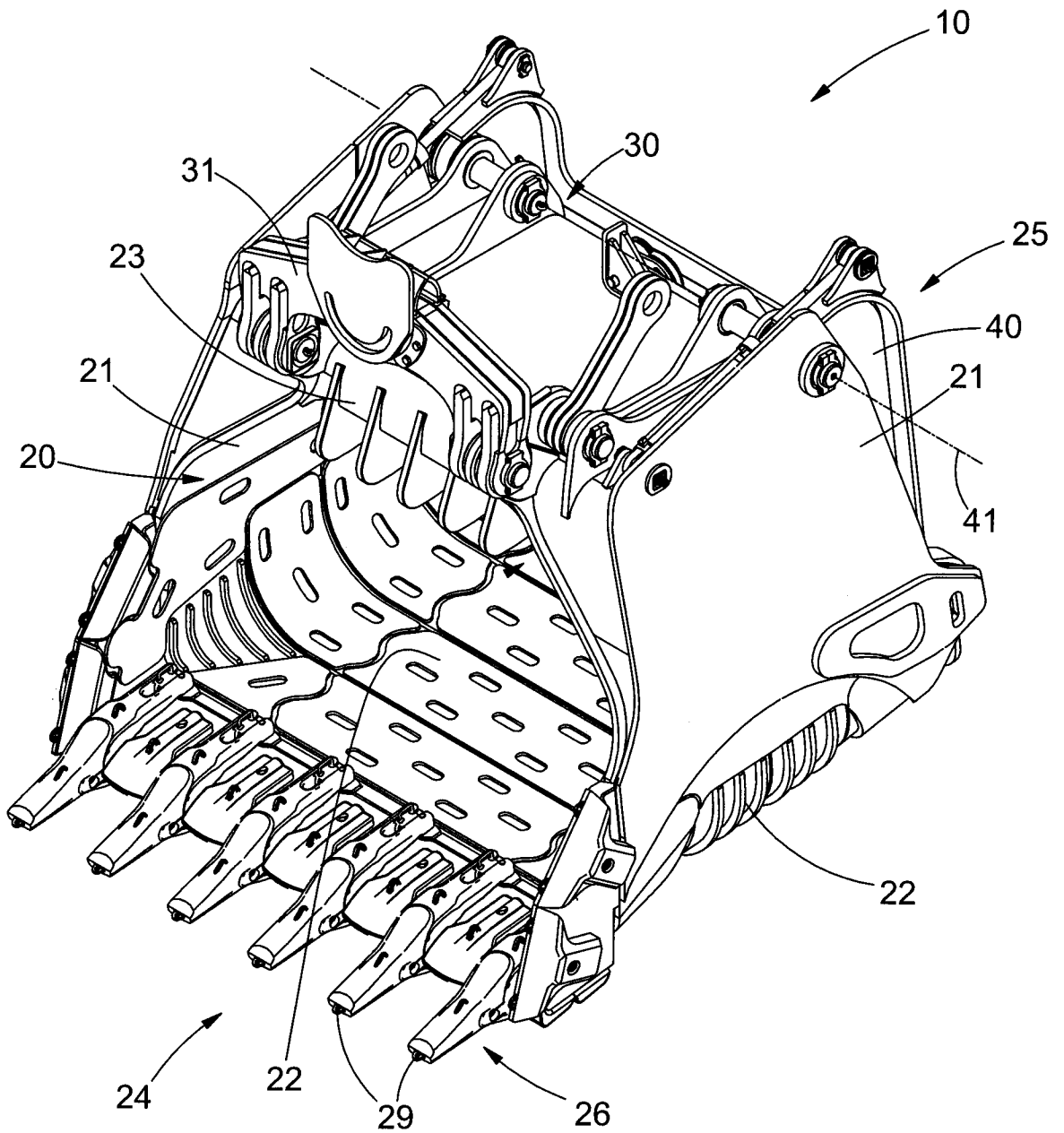


FIGURE 1

2/3

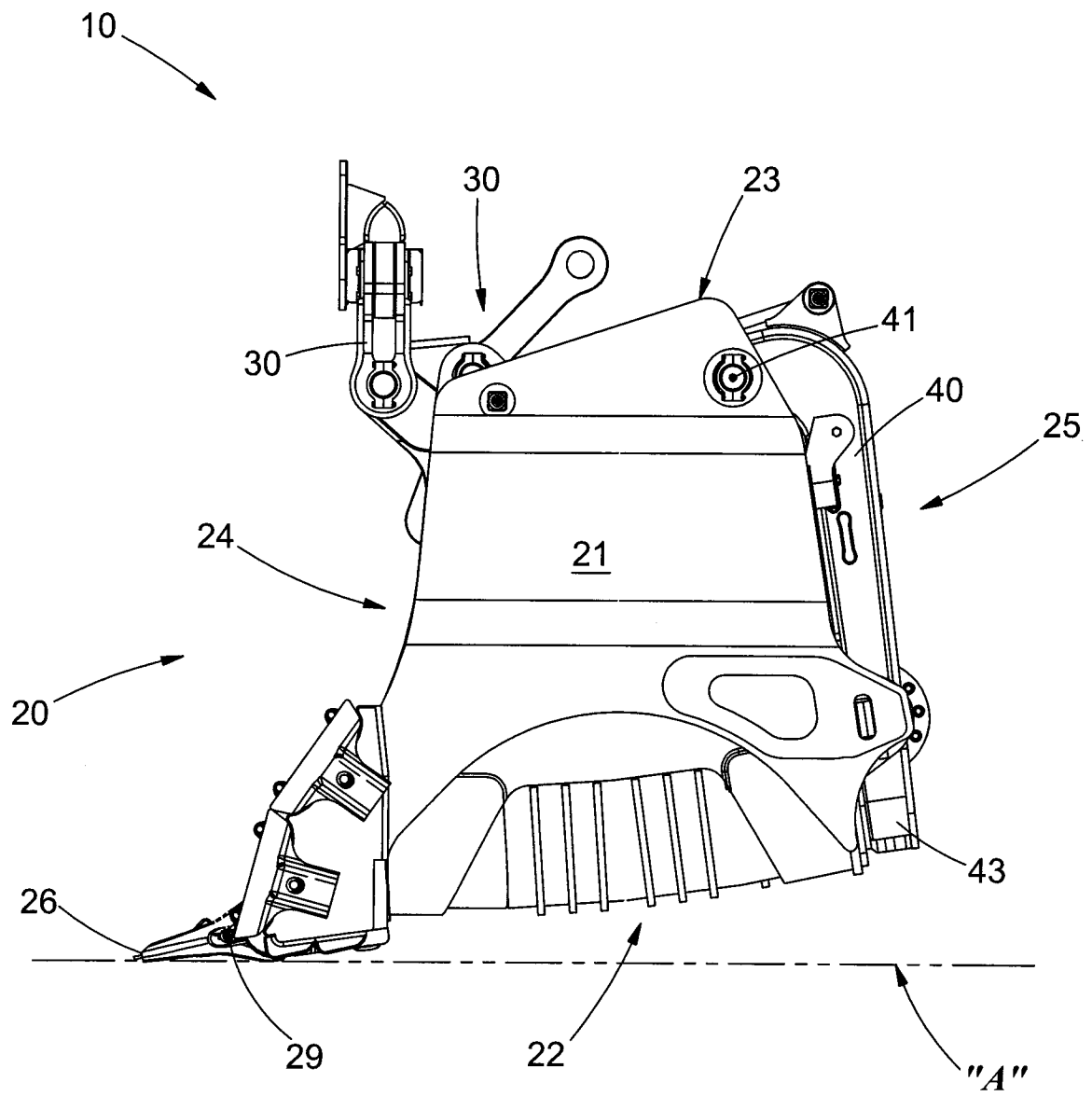


FIGURE 2

3/3

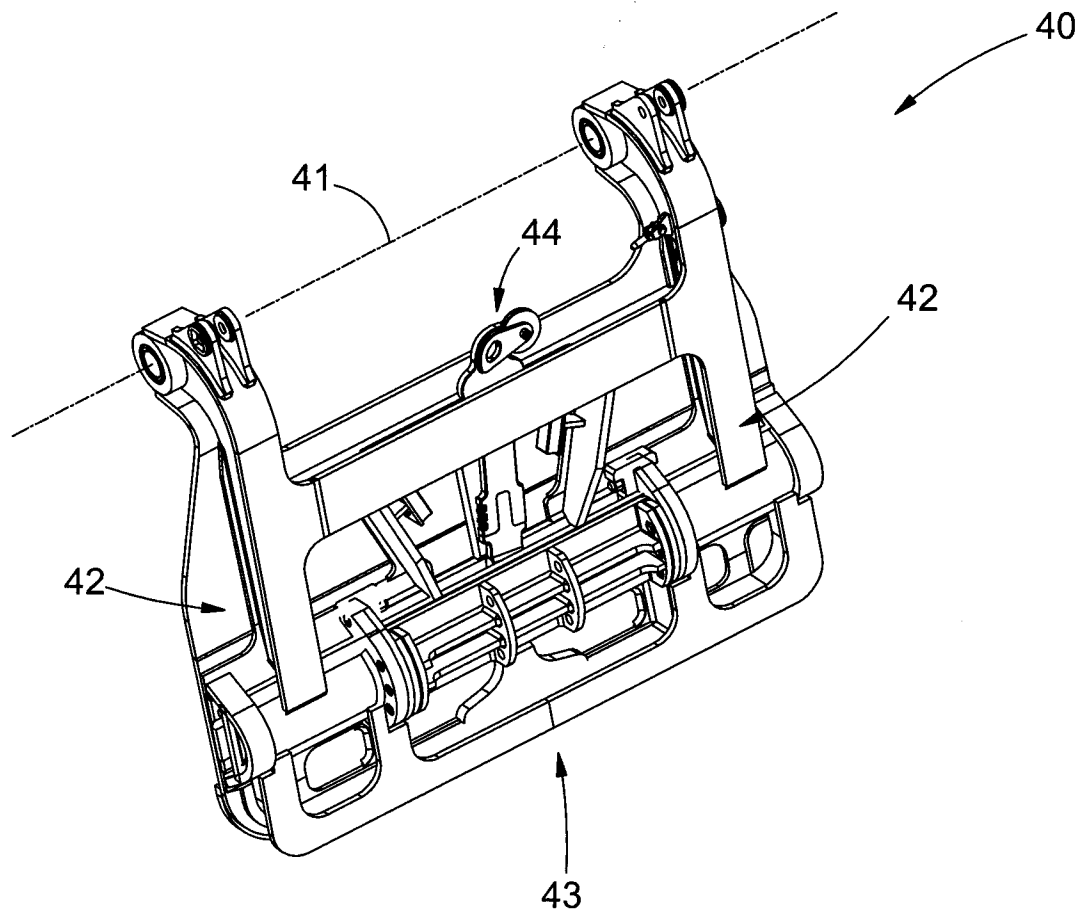


FIGURE 3

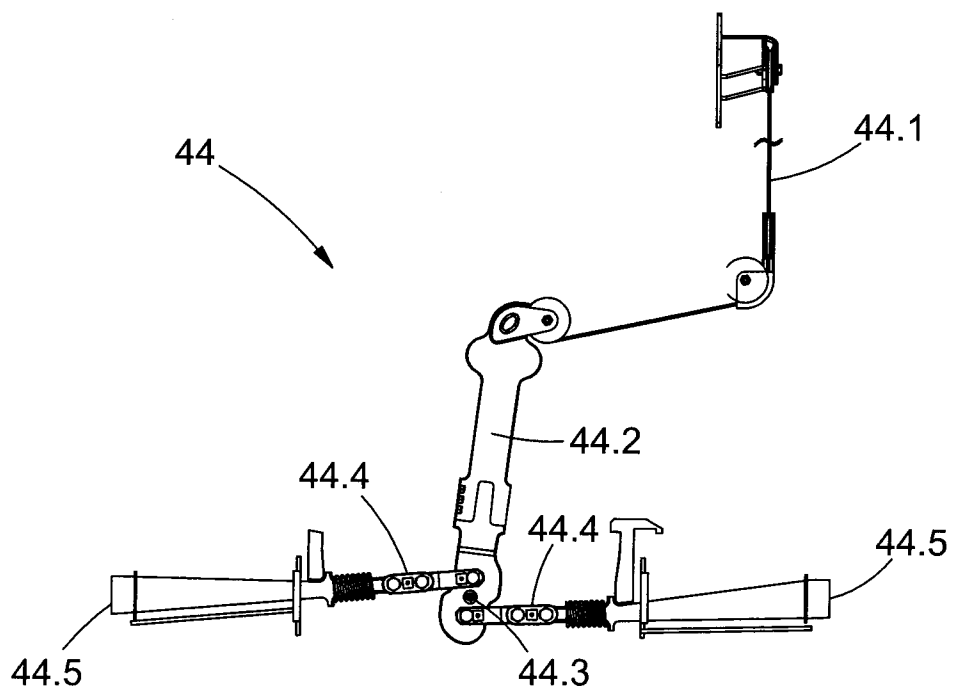


FIGURE 4