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Declarations under Rule 4.17:

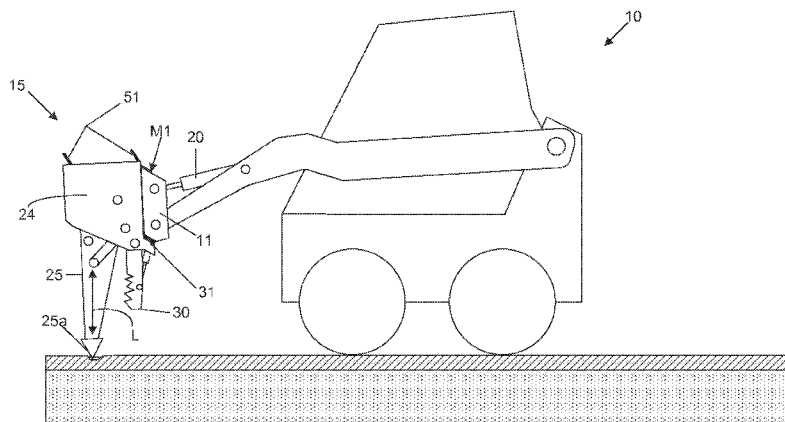
- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))
- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))

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(54) **Title:** PERCUSSION WORK TOOL WITH GRIPPER

FIG. 1



(57) **Abstract:** A percussive work tool for a construction work machine includes a bit, a percussive force generator, at least one actuator, and a gripper. The bit is provided with a longitudinal length. The percussive force generator is adapted to drive the bit in a substantially reciprocating fashion in the direction of the longitudinal length of the bit. The gripper is adjustably oriented relative to the bit via operation of the at least one actuator so that the gripper is adapted to selectively open and close with respect to the bit.

WO 2016/195669 A1

PERCUSSION WORK TOOL WITH GRIPPER

FIELD OF THE INVENTION

The present invention relates to a percussion work tool provided with a gripper.

BACKGROUND OF THE INVENTION

5 Construction work machinery is at times provided with a percussion work tool suitable for fracturing hard structures, objects, and surfaces that may prove too difficult to impact and/or fracture with an excavator bucket, even those that vibrate. By way of example, a percussion work tool in the form of a hydraulic hammer or breaker may impact and/or fracture hardened materials, such as, for example, concrete.

10 While suitable for fracturing a variety of hard structures and materials, percussion work tools have heretofore been incapable of picking up and relocating or removing materials after demolition or fracturing. Typically, even for very small amounts of debris, to remove the impact and/or fractured material, a separate loading work tool, such as a bucket, must be utilized.

15 SUMMARY OF THE INVENTION

According to one embodiment, a percussive work tool for a construction work machine includes a bit, a percussive force generator, at least one actuator, and a gripper. The bit is provided with a longitudinal length. The percussive force generator is adapted to drive the bit in a substantially reciprocating fashion in the direction of the longitudinal length of the bit. The gripper is adjustably oriented relative to the bit via operation of the at least one actuator so that the gripper is adapted to selectively open and close with respect to the bit.

20 According to another embodiment, a method for providing a percussive work tool for a construction work machine includes the steps of providing a bit provided with a longitudinal length, providing a percussive force generator that is adapted to drive the bit in a substantially reciprocating fashion in the direction of the longitudinal length of the bit, providing at least one actuator, and providing a gripper adjustably oriented relative to the bit via operation of the at least one actuator so that the gripper is adapted to selectively open and close with respect to the bit.

30 According to yet another embodiment, a method for operating a percussive work tool that includes a percussive force generator, at least one actuator, a bit provided with a longitudinal length, and a gripper and that is located on a construction work machine provided with at least one actuator includes the steps of using the at least one actuator on the construction work machine to adjustably oriented the percussive work tool relative to the construction work machine, using the percussive force generator to drive the bit in a

substantially reciprocating fashion in the direction of the longitudinal length of the bit, and using the at least one actuator on the percussive work tool to adjustably oriented the gripper relative to the bit so that the gripper selectively opens and closes with respect to the bit.

ASPECTS

5 According to one aspect, a percussive work tool for a construction work machine comprises:

 a bit provided with a longitudinal length;

 a percussive force generator adapted to drive the bit in a substantially reciprocating fashion in the direction of the longitudinal length of the bit;

10 at least one actuator; and

 a gripper adjustably oriented relative to the bit via operation of the at least one actuator so that the gripper is adapted to selectively open and close with respect to the bit.

 Preferably, the percussive force generator is adapted to selectively drive the bit.

15 Preferably, the percussive work tool further comprises a first mounting interface on the percussive work tool that is adapted to selectively cooperate with the construction work machine to provide a first operable configuration and a second mounting interface that is adapted to cooperate with the construction work machine to provide a second operable configuration, wherein the orientation of the bit and the gripper relative to the construction
20 work machine differ when in the first operable configuration compared to the second operable configuration.

 Preferably, the bit includes a blade implement.

 Preferably, the bit includes multiple tips.

25 According to another aspect, a method for providing a percussive work tool for a construction work machine comprises the steps of:

 providing a bit provided with a longitudinal length;

 providing a percussive force generator that is adapted to drive the bit in a substantially reciprocating fashion in the direction of the longitudinal length of the bit;

 providing at least one actuator; and

30 providing a gripper adjustably oriented relative to the bit via operation of the at least one actuator so that the gripper is adapted to selectively open and close with respect to the bit.

 Preferably, the percussive force generator is adapted to selectively drive the bit.

 Preferably, the method further comprises the steps of:

providing a first mounting interface that is adapted to selectively cooperate with the construction work machine to provide a first operable configuration and a second mounting interface that is adapted to cooperate with the construction work machine to provide a second operable configuration, wherein the orientation of the bit and the gripper relative to the construction work machine differ when in the first operable configuration compared to the second operable configuration.

According to yet another aspect, a method for operating a percussive work tool that includes a percussive force generator, at least one actuator, a bit provided with a longitudinal length, and a gripper and that is located on a construction work machine provided with at least one actuator comprises the steps of:

using the at least one actuator on the construction work machine to adjustably oriented the percussive work tool relative to the construction work machine; using the percussive force generator to drive the bit in a substantially reciprocating fashion in the direction of the longitudinal length of the bit; and using the at least one actuator on the percussive work tool to adjustably oriented the gripper relative to the bit so that the gripper selectively opens and closes with respect to the bit.

Preferably, the step of using the percussive force generator to drive the bit in the substantially reciprocating fashion in the direction of the longitudinal length of the bit assists the bit with fracturing or impacting materials.

Preferably, the step of using the using the at least one actuator on the percussive work tool to adjustably oriented the gripper relative to the bit so that the gripper selectively opens and closes with respect to the bit further includes the step of using the gripper and bit to hold and carry material located between the gripper and the bit.

Preferably, the step of using the percussive force generator to drive the bit in the substantially reciprocating fashion in the direction of the longitudinal length of the bit includes the step of selectively driving the bit.

Preferably, the percussive work tool is provide with a first mounting interface adapted to provide a first operable configuration and a second mounting interface adapted to provide a second operable configuration, wherein the orientation of the bit and the gripper relative to the construction work machine differ when in the first operable configuration compared to the second operable configuration.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates a side perspective view of a construction work machine and a percussion work tool, according to one embodiment.

FIG. 2A illustrates a side perspective view of a percussion work tool showing a gripper in an open position, in one embodiment.

5 FIG. 2A illustrates a side perspective view of a percussion work tool showing a gripper in a closed position, in one embodiment.

FIG. 3 illustrates a side perspective view of a construction work machine and a percussion work tool, according to one embodiment.

10 FIG. 4 illustrates a side perspective view of a construction work machine and a percussion work tool, according to one embodiment.

FIG. 5 illustrates a side perspective view of a construction work machine and a percussion work tool, according to one embodiment.

FIG. 6 illustrates a side perspective view of a construction work machine and a percussion work tool, according to one embodiment.

15 FIG. 7 illustrates a side perspective view of a construction work machine and a percussion work tool, according to one embodiment.

FIG. 8 illustrates a side perspective view of a construction work machine and a percussion work tool, according to one embodiment.

20 FIG. 9 illustrates a side perspective view of a construction work machine and a percussion work tool, according to one embodiment.

FIG. 10 illustrates a side perspective view of a construction work machine and a percussion work tool, according to one embodiment.

FIG. 11 illustrates a bit for a percussion work tool according to one embodiment.

FIG. 12 illustrates a bit for a percussion work tool according to one embodiment.

25 DETAILED DESCRIPTION OF THE INVENTION

FIGS. 1-10 depict a construction work machine 10 provided with a percussion work tool 15 according to one embodiment of the present invention. By way of example and not limitation, the construction work machine 10 may be a skid steer loader, as shown; however, in alternative embodiments, a variety of construction work machines may be provided with the percussion work tool 15, including, but not limited to, excavators or a loaders, for example.

Those of ordinary skill in the art will appreciate that the percussion work tool 15 is operated by the construction work machine and is preferably adjustably oriented relative to the construction work machine 10 via at least one actuator on the construction work machine

10, an example of which is illustrated at 20. Those of ordinary skill in the art will also appreciate that the at least one actuators are typically hydraulic actuators typically controlled by an operator of the construction work machine 10 in order to lift, lower, and rotate the percussion work tool 15 relative to the construction work machine 10.

5 According to one aspect of the present embodiment, the percussion work tool 15 is configured to impact and/or fracture a variety of materials, such as, for example, and not limitation, stone, concrete, and building materials. While especially suited for hardened materials, the percussion work tool may also impact and/or fracture relatively softer materials, such as earth, asphalt, gravel, or aggregate. In the present embodiment percussion
10 work tool 15 is commonly referred to as a hydraulic breaker, hammer, or hoe ram.

 As shown, the percussion work tool 15 is provided with a percussive force generator 24 and a bit 25 provided with a longitudinal length L and a tip 25a. According to another aspect of the present embodiment, the percussive force generator 24 is adapted to drive the bit 25 in a substantially reciprocating fashion in the direction of the longitudinal length L of the
15 bit 25 in order to assist the bit 25 and tip 25a with fracturing materials D. Those of ordinary skill in the art will appreciate that the percussive force generator 24 may be any mechanism capable of driving the bit 25 in a substantially reciprocating fashion in the direction of the longitudinal length L of the bit 25, including, but not limited to hydraulic or pneumatic ram or vibration generator.

20 According to another aspect of the present embodiment, the percussion work tool 15 is configured to pick up and relocate materials, including, but not limited to impact and/or fractured materials D. As shown, the percussion work tool 15 of the present embodiment is further provided with a gripper 30. As shown in FIGS. 2A-2B, the gripper 30 is adjustably oriented relative to the bit 25 via operation of at least one actuators, an example of which is
25 illustrated at 31, whereby the gripper 30 is adapted to selectively open and close with respect to the bit 25 so that the gripper 30 and bit 25 may cooperate to hold and carry material D located between the gripper 30 and the bit 25. Advantageously, the percussive force generator 24 may selectively drive the bit 25, such as, for example, via actuation of a switch (not shown), when the gripper 30 and bit 25 cooperate to hold and carry material D.

30 According to one aspect of the present embodiment, the percussion work tool 15 may be provided a plurality of operable configurations, such as, for example, M1 and M2, shown in FIGS. 1 and 7. According to still yet a further aspect of the present embodiment, as shown in FIGS. 1 and 7, the percussion work tool 15 may be provided with a first mounting interface 50 that is adapted to cooperate with the construction work machine 10 to provide

the first operable configuration M1 and a second mounting interface 51 that is adapted to cooperate with the construction work machine 10 to provide the second operable configuration M2. As shown the first and second mounting interfaces 50, 51 may selectively couple to a mounting interface 11 on the construction work machine 10. As shown in FIGS. 4-7, the construction work machine 10 may transition from the first operable configuration M1 to the second operable configuration M2 by rotating the percussion work tool 15 so that the tip 25a extends towards the construction work machine 10, disconnecting the first mounting interface 50 from the mounting interface 11 on the construction work machine 10, and connecting the second mounting interface 51 to the mounting interface 11 on the construction work machine 10.

The coupling between the mounting interface 11 and mounting interface 50 or, alternatively, mounting interface 11 and mounting interface 51, if desired may be a quick connection, such as, for example, and not limitation ISO 24410 SSL. As shown by a comparison of FIGS. 1 and 7, advantageously, the first and second mounting interfaces 50, 51 may be adapted so that the orientation of the bit 25 and the gripper 30 relative to the construction work machine 10 differ when in the first operable configuration M1 compared to the second operable configuration M2.

As shown in FIGS. 1, 3-10, the bit 25 may take the form of a shaft, however, within the scope of the present embodiment, as shown in FIGS. 2A, 2B, 11, and 12, the bit 25 may be provided with a variety of shapes, within the scope of the present embodiment, and may, for example, and not limitation, include a blade implement 25c, for root cutting, for example, as shown in FIGS. 2A, 2B, 11, and 12, may include multiple tips 25a, 25b, as shown in FIG 12, or may include a replaceable tooth at the tip, similar to those mounted on buckets.

Persons skilled in the art will recognize that certain elements of the above-described embodiments and examples may variously be combined or eliminated to create further embodiments, and such further embodiments fall within the scope and teachings of the invention. It will also be apparent to those of ordinary skill in the art that the above-described embodiments may be combined in whole or in part to create additional embodiments within the scope and teachings of the invention. Thus, although specific embodiments of, and examples for, the invention are described herein for illustrative purposes, various equivalent modifications are possible within the scope of the invention, as those skilled in the relevant art will recognize. Accordingly, the scope of the invention is determined from the appended claims and equivalents thereof.

The present description depicts specific examples to teach those skilled in the art how to make and use the best mode of the invention. The detailed descriptions of the above embodiments are not exhaustive descriptions of all embodiments contemplated by the inventors to be within the scope of the invention. Persons skilled in the art will recognize that

5 certain elements of the above-described embodiments may variously be combined or eliminated to create further embodiments, and such further embodiments fall within the scope and teachings of the invention. Thus, although specific embodiments of, and examples for, the invention are described herein for illustrative purposes, various equivalent modifications are possible within the scope of the invention, as those skilled in the relevant art will

10 recognize. Accordingly, the scope of the invention is determined from the appended claims and equivalents thereof.

I CLAIM:

1. A percussive work tool for a construction work machine, comprising:
 - a bit provided with a longitudinal length;
 - a percussive force generator adapted to drive the bit in a substantially reciprocating fashion in the direction of the longitudinal length of the bit;
 - at least one actuator; and
 - a gripper adjustably oriented relative to the bit via operation of the at least one actuator so that the gripper is adapted to selectively open and close with respect to the bit.
2. The percussive work tool for a construction work machine according to claim 1, wherein the percussive force generator is adapted to selectively drive the bit.
3. The percussive work tool for a construction work machine according to claim 1, further comprising:
 - the construction work machine; and
 - a first mounting interface on the percussive work tool that is adapted to selectively cooperate with the construction work machine to provide a first operable configuration and a second mounting interface that is adapted to cooperate with the construction work machine to provide a second operable configuration,, wherein the orientation of the bit and the gripper relative to the construction work machine differ when in the first operable configuration compared to the second operable configuration.
4. The percussive work tool for a construction work machine according to claim 1, wherein the bit includes a blade implement.
5. The percussive work tool for a construction work machine according to claim 1, wherein the bit includes multiple tips.
6. A method for providing a percussive work tool for a construction work machine, comprising the steps of:
 - providing a bit provided with a longitudinal length;

providing a percussive force generator that is adapted to drive the bit in a substantially reciprocating fashion in the direction of the longitudinal length of the bit;
providing at least one actuator; and
providing a gripper adjustably oriented relative to the bit via operation of the at least one actuator so that the gripper is adapted to selectively open and close with respect to the bit.

7. The method for providing a percussive work tool for a construction work machine according to claim 6, wherein the percussive force generator is adapted to selectively drive the bit.
8. The method for providing a percussive work tool for a construction work machine according to claim 6, further comprising the steps of:
 - providing a first mounting interface that is adapted to selectively cooperate with the construction work machine to provide a first operable configuration and a second mounting interface that is adapted to cooperate with the construction work machine to provide a second operable configuration, wherein the orientation of the bit and the gripper relative to the construction work machine differ when in the first operable configuration compared to the second operable configuration.
9. A method for operating a percussive work tool that includes a percussive force generator, at least one actuator, a bit provided with a longitudinal length, and a gripper and that is located on a construction work machine provided with at least one actuator, comprising the steps of:
 - using the at least one actuator on the construction work machine to adjustably oriented the percussive work tool relative to the construction work machine;
 - using the percussive force generator to drive the bit in a substantially reciprocating fashion in the direction of the longitudinal length of the bit; and
 - using the at least one actuator on the percussive work tool to adjustably oriented the gripper relative to the bit so that the gripper selectively opens and closes with respect to the bit.
10. The method for operating the percussive work tool according to claim 9, wherein the step of using the percussive force generator to drive the bit in the substantially reciprocating

fashion in the direction of the longitudinal length of the bit assists the bit with fracturing or impacting materials.

11. The method for operating the percussive work tool according to claim 9, wherein the step of using the using the at least one actuator on the percussive work tool to adjustably oriented the gripper relative to the bit so that the gripper selectively opens and closes with respect to the bit further includes the step of using the gripper and bit to hold and carry material located between the gripper and the bit.

12. The method for operating the percussive work tool according to claim 9, wherein the step of using the percussive force generator to drive the bit in the substantially reciprocating fashion in the direction of the longitudinal length of the bit includes the step of selectively driving the bit.

13. The method for operating the percussive work tool according to claim 9, wherein the percussive work tool is provide with a first mounting interface adapted to provide a first operable configuration and a second mounting interface adapted to provide a second operable configuration, wherein the orientation of the bit and the gripper relative to the construction work machine differ when in the first operable configuration compared to the second operable configuration.

FIG. 1

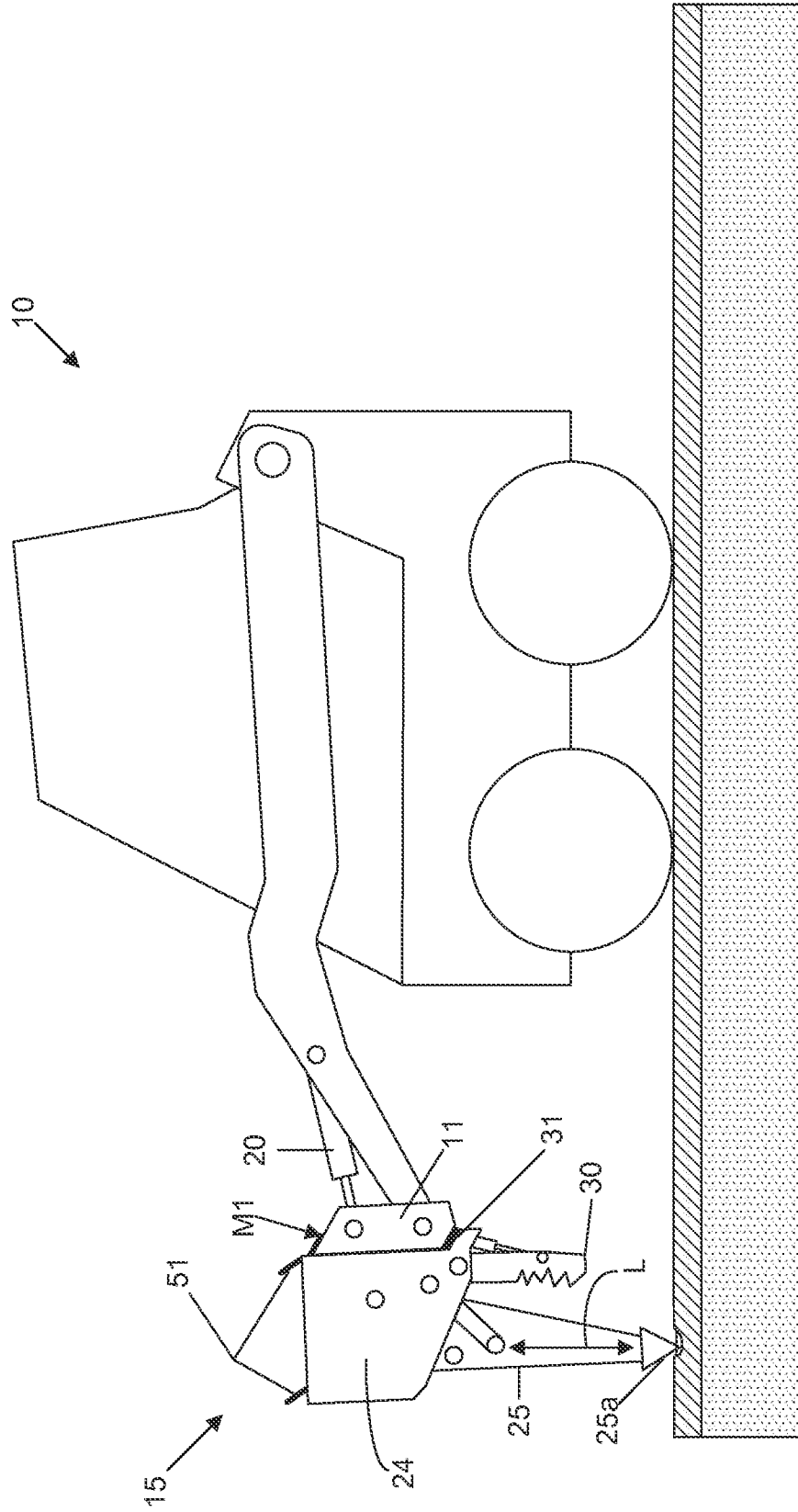


FIG. 2A

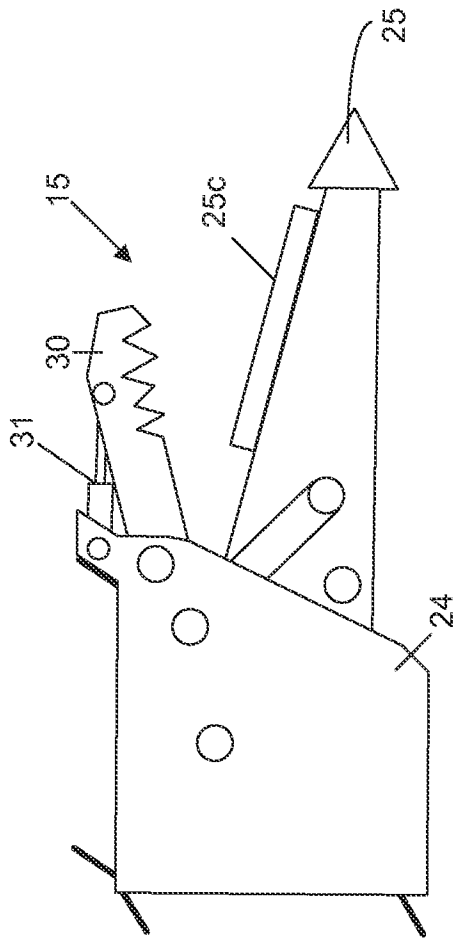


FIG. 2B

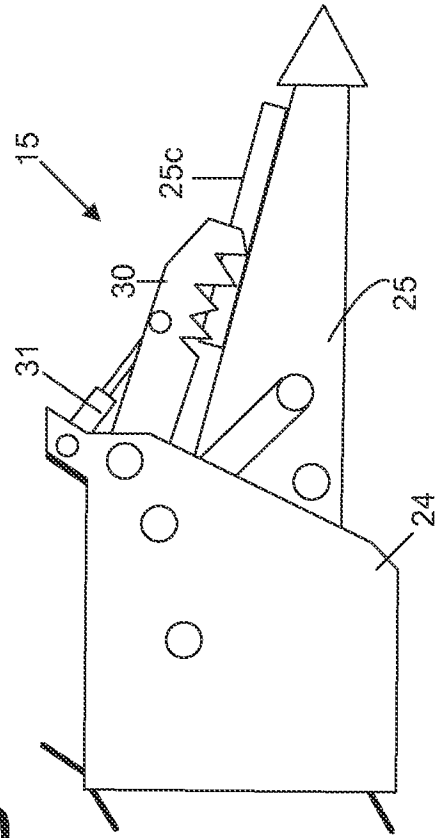


FIG. 3

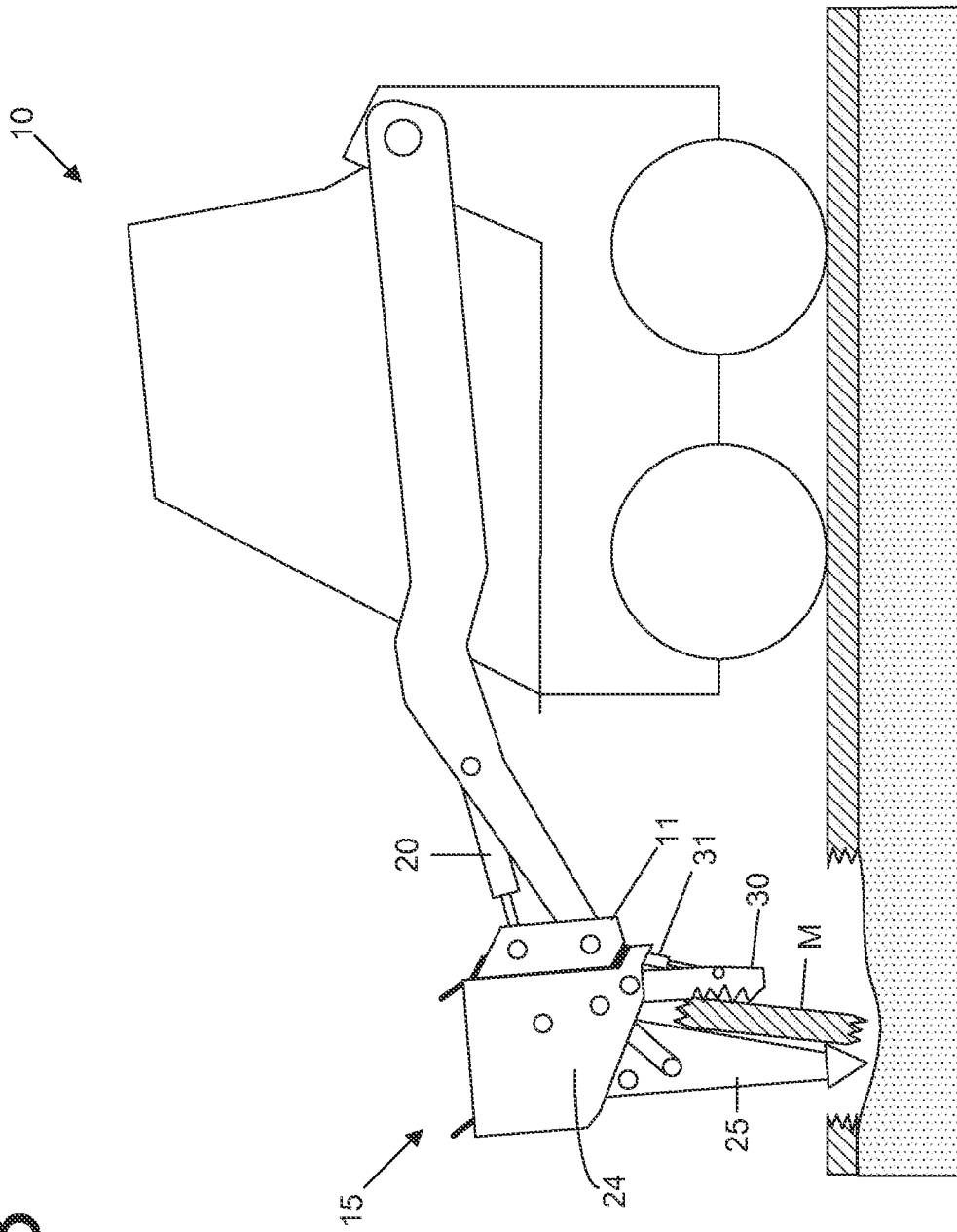


FIG. 4

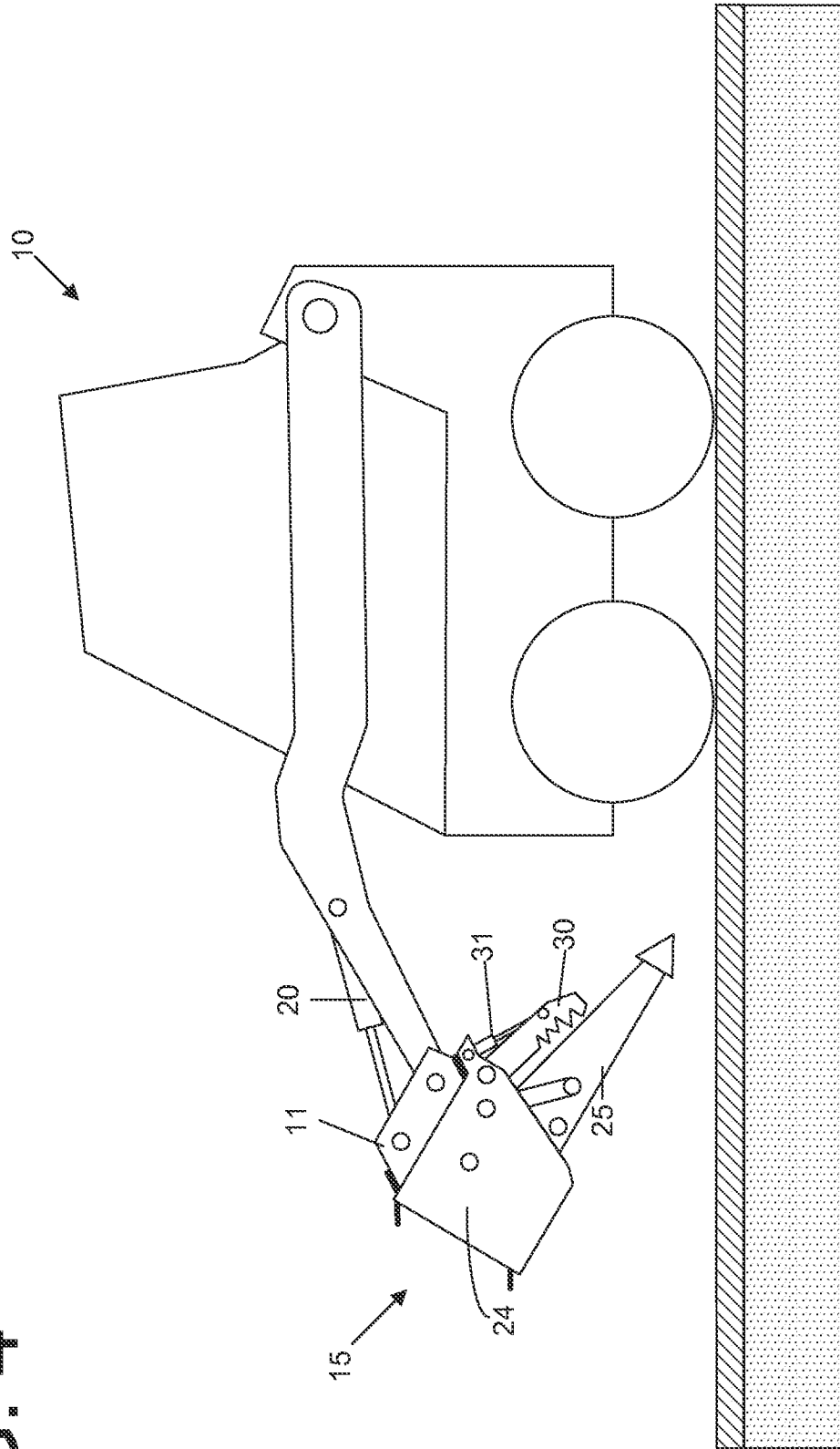


FIG. 5

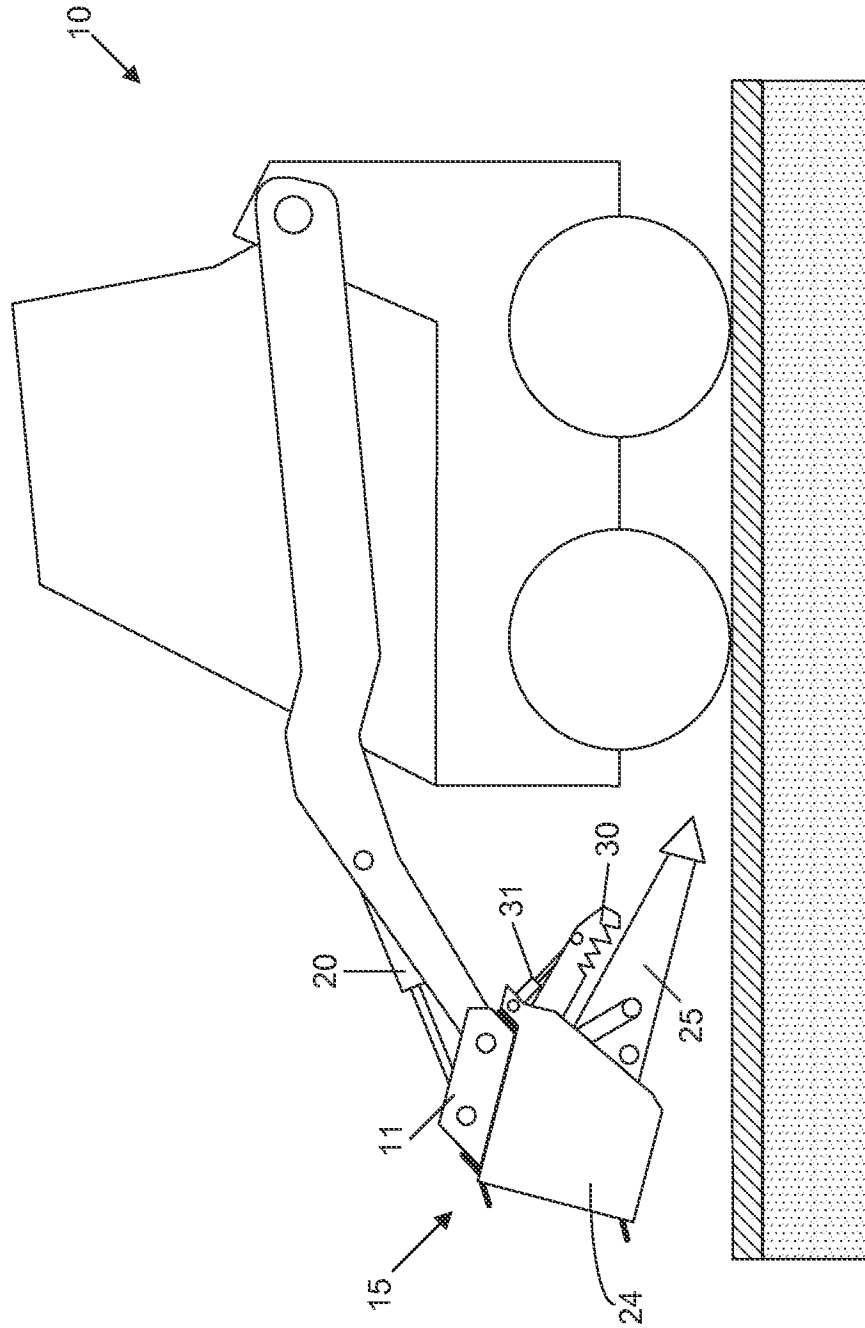


FIG. 6

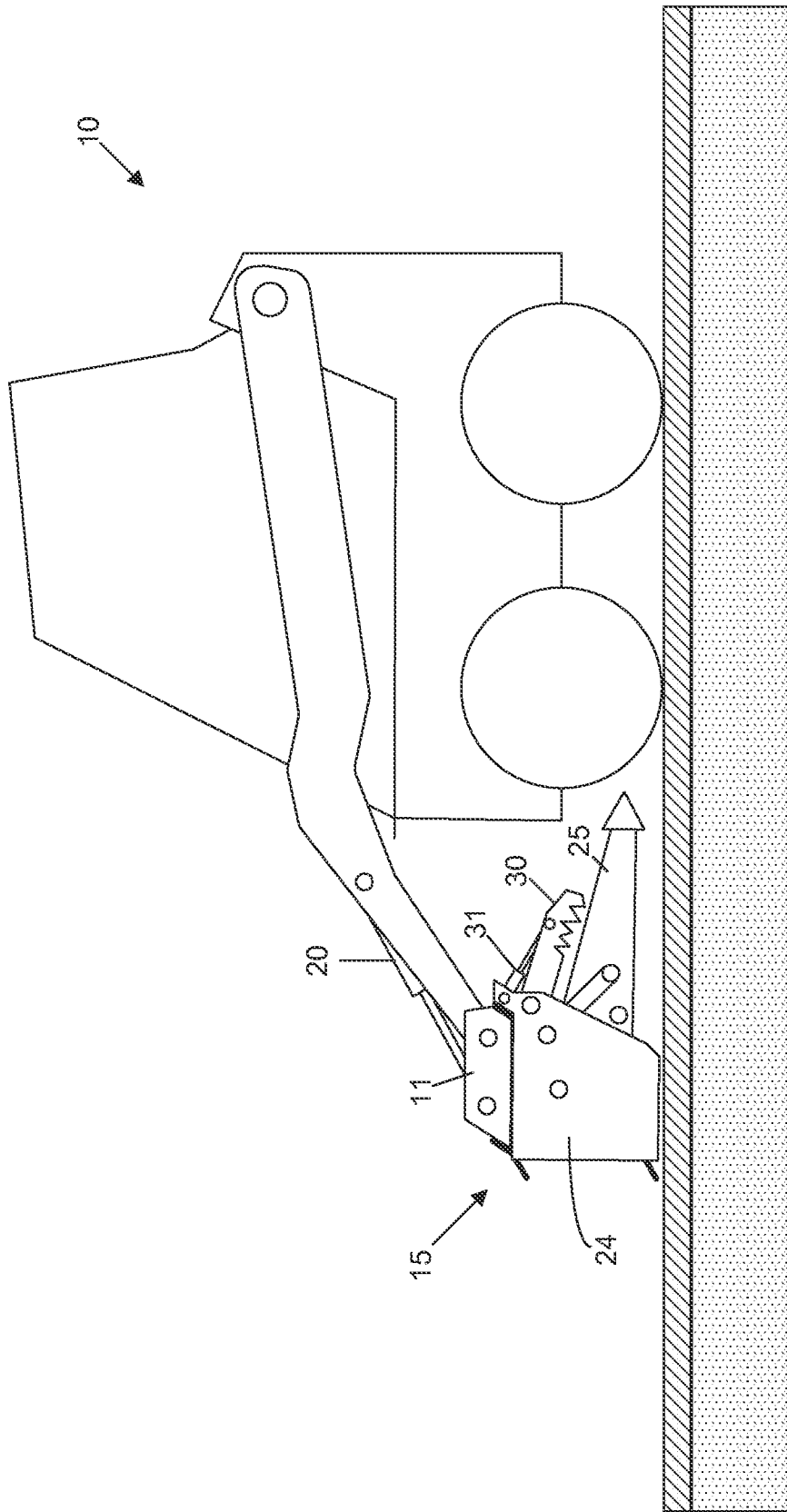


FIG. 7

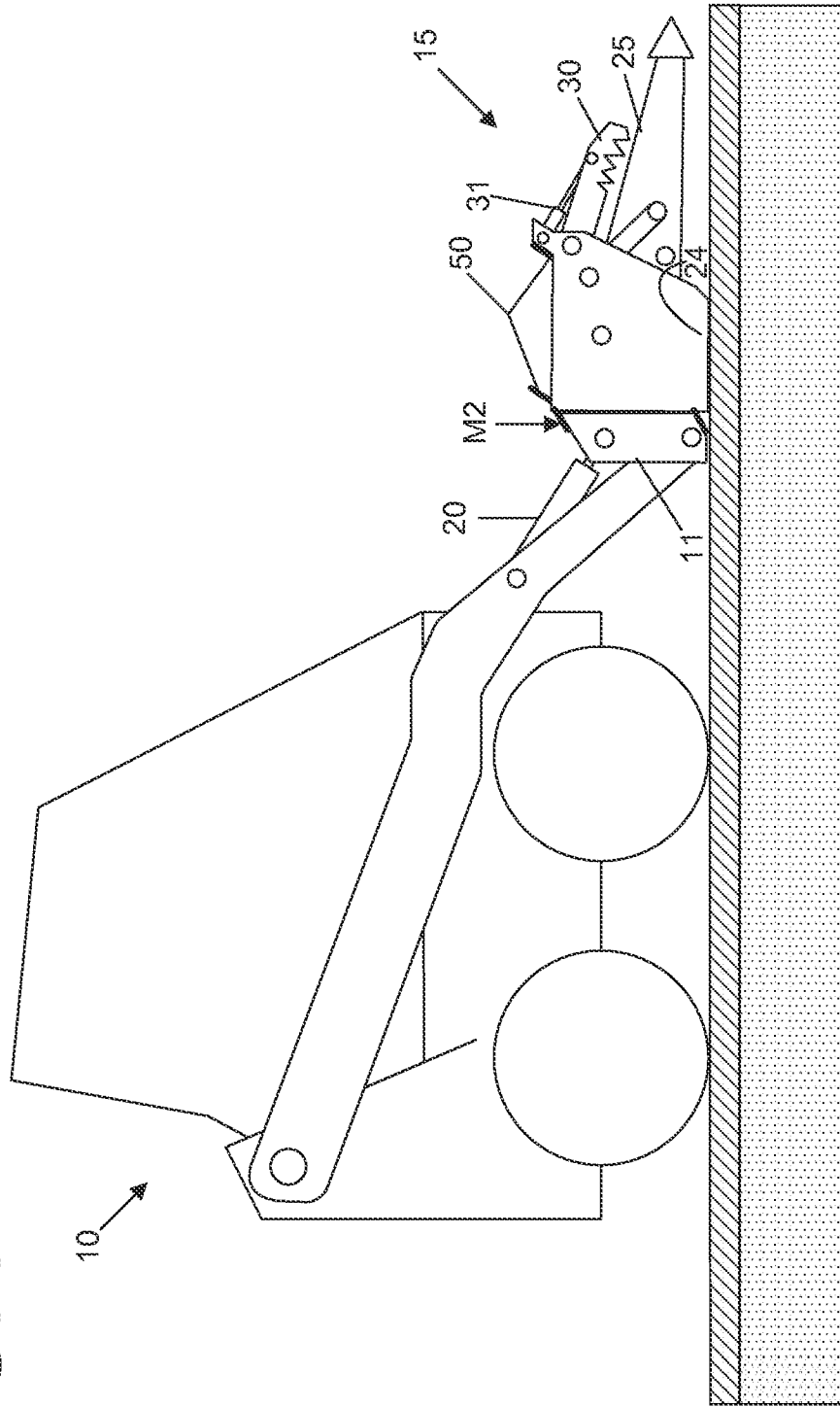


FIG. 8

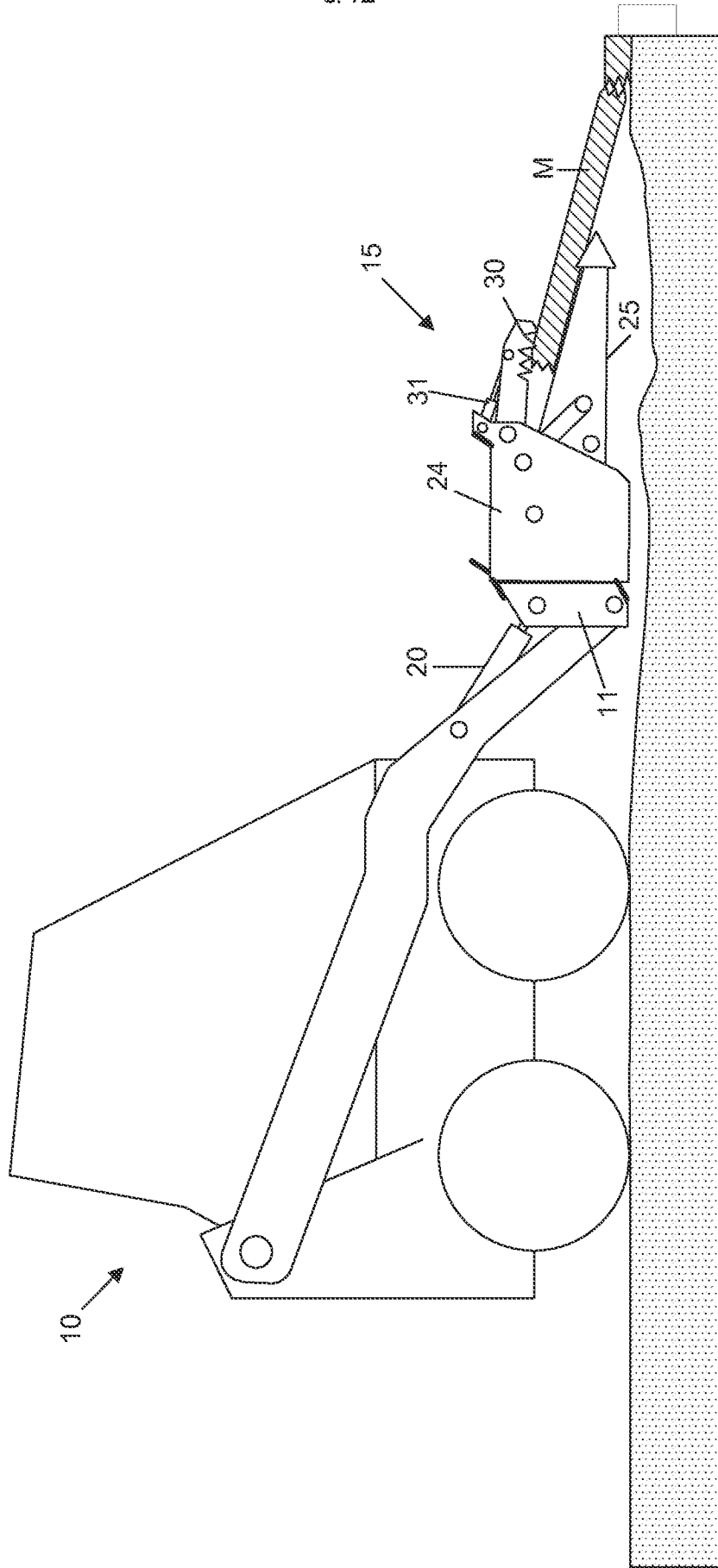


FIG. 9

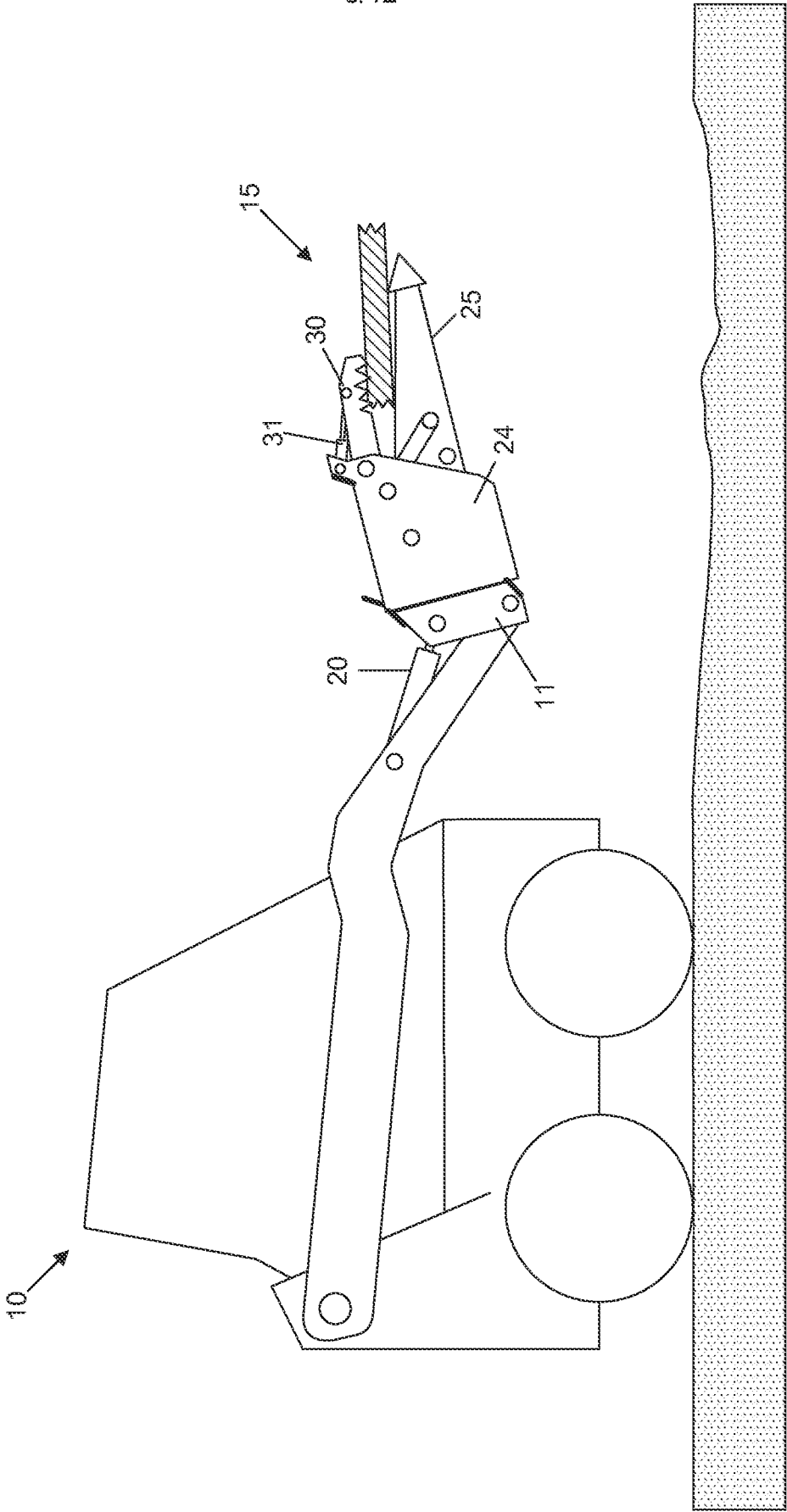
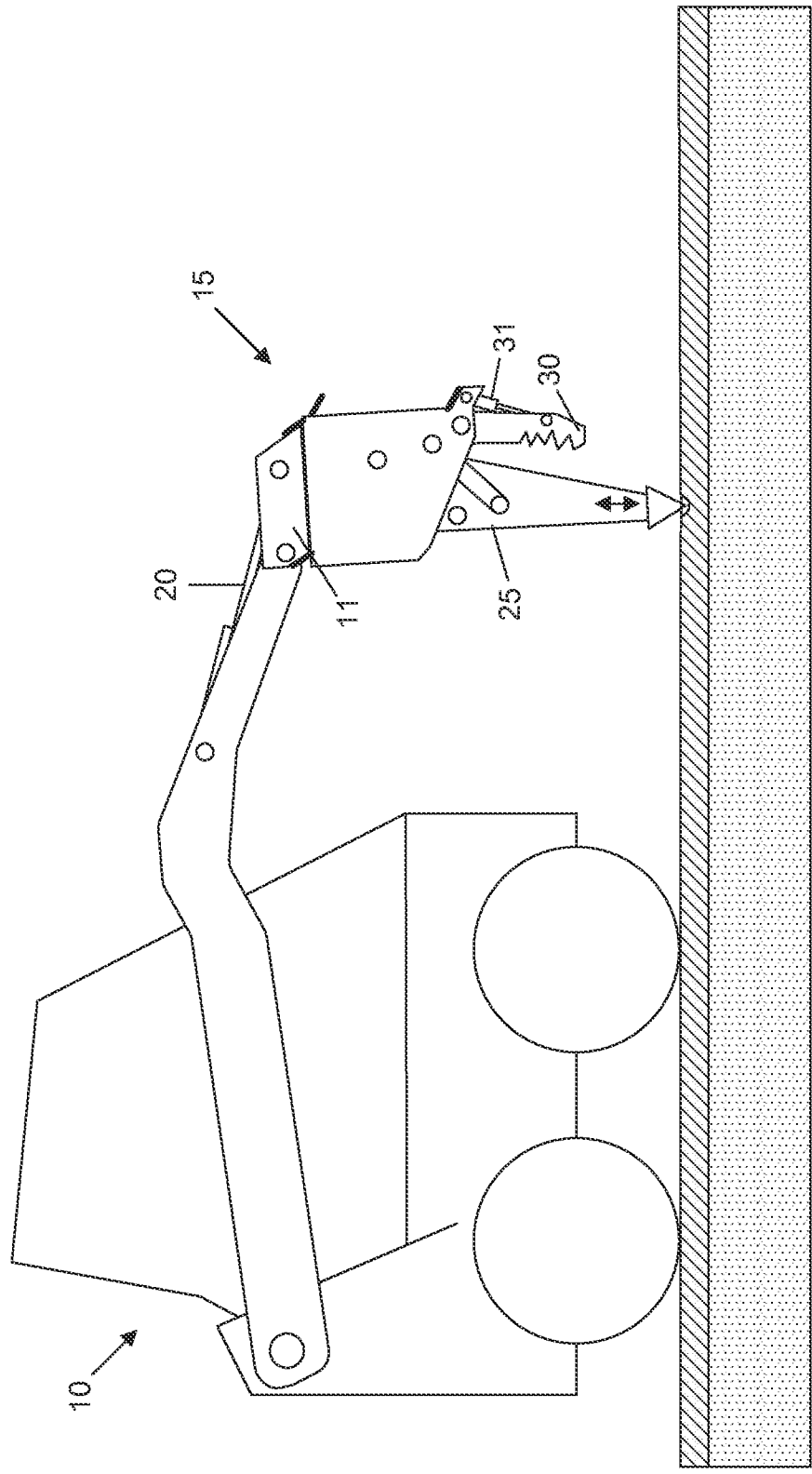


FIG. 10



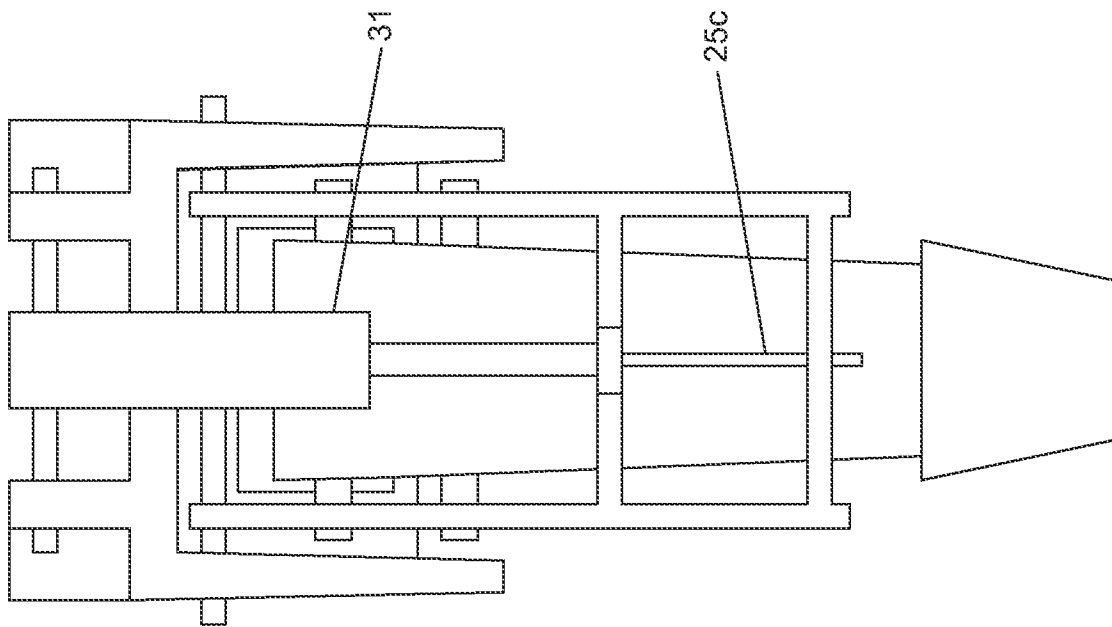
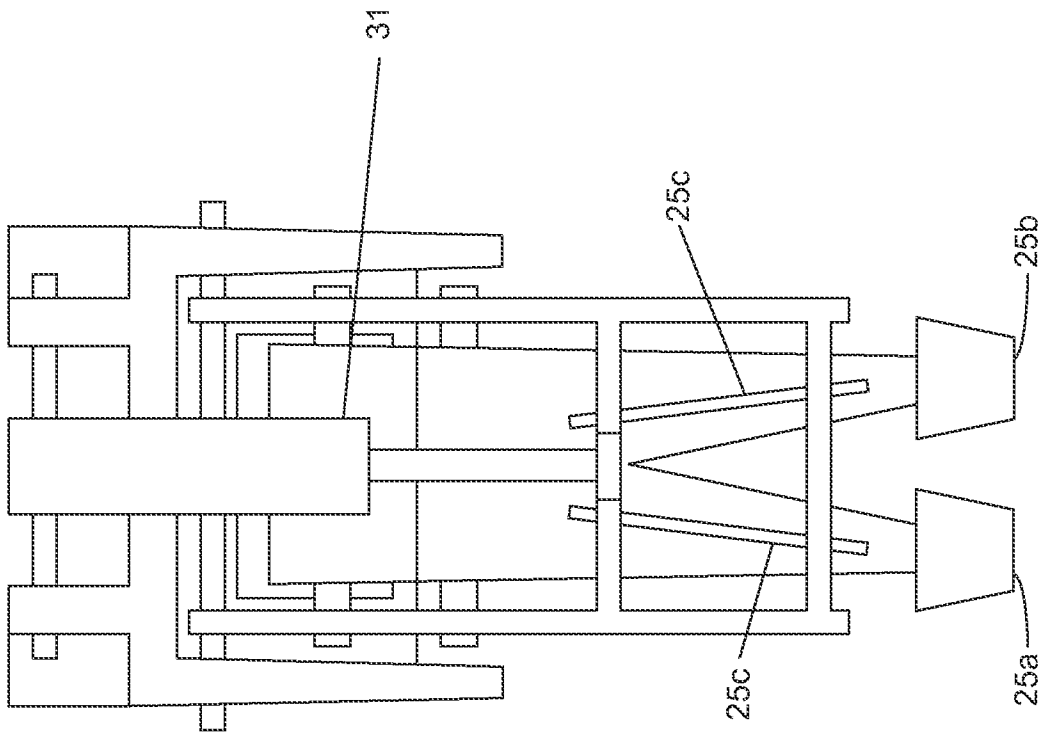


FIG. 11

FIG. 12



INTERNATIONAL SEARCH REPORT

International application No.

PCT/US15/33882

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - E02F 3/00, 3/96; E02F 9/00 (2015.01)

CPC - E02F 3/96, 3/964, 3/965

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC(8) Classification(s): E02F 3/00, 3/96; E02F 9/00 (2015.01)

CPC Classification(s): E02F 3/96, 3/963, 3/964, 3/965, 3/966

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

PatSeer (US, EP, WO, JP, DE, GB, CN, FR, KR, ES, AU, IN, CA, INPADOC Data); excavator, backhoe, break, crush, drill, hammer, bit, tool, heavy machinery, reciprocate, oscillate, blade, cut, multi tip, grip, clamp, jaw, bucket, adjust, depth, height, mount, bayonet

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 7,117,618 B2 (UNDERWOOD L.A.) October 10, 2006; figures 4-7, 19-20; column 7, lines 10-25, column 8, lines 55-65	1-2, 6-7, 11-12, 14 --- 4-5
X	RECS Bayonet Breaker Construction Equipment [online]. February 19, 2014; [retrieved on 2015-18-08]. Retrieved from the Internet: <URL: http://www.constructionequipment.com/recs-bayonet-breaker >	1, 3, 6, 8, 11, 13, 15
Y	US 6,764,139 B1 (WORTMAN R. F.) July 20, 2004; figures 3a, 3b; column 7, lines 50-60	4
Y	US 8,028,774 B2 (HALL D. R. et al.) October 4, 2011; figure 24; column 11, lines 10-35	5
A	US 6,058,632 A (HAWKINS P. A. T.) May 9, 2000; entire document	1-8, 11-15
A	US 5,689,905 A (IBUSUKI Y.) November 25, 1997; entire document	1-8, 11-15
A	US 4,719,975 A (LABOUNTY K. R.) January 19, 1988; entire document	1-8, 11-15
A	US 4,070,772 A (MOTOMURA M. et al.) January 31, 1978; entire document	1-8, 11-15
A	US 2,517,980 A (CORNETT W. V.) August 8, 1950; entire document	1-8, 11-15

Further documents are listed in the continuation of Box C.

See patent family annex.

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"P" document published prior to the international filing date but later than the priority date claimed

Date of the actual completion of the international search

18 August 2015 (18.08.2015)

Date of mailing of the international search report

14 SEP 2015

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