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(71) Applicant: **Hitachi Construction Machinery Co., Ltd.**
Bunkyo-ku,
Tokyo 112-8563 (JP)

(72) Inventors:
- **Tanaka, Masamichi**
  Ibaraki 300-0013 (JP)
- **Hasebe, Takanao**
  Ibaraki 300-0013 (JP)
- **Uchikoshi, Hirotaka**
  Ibaraki 300-0013 (JP)
- **Iwase, Kazuhiro**
  Ibaraki 300-0013 (JP)
- **Ono, Hiroyuki**
  Ibaraki 300-0013 (JP)

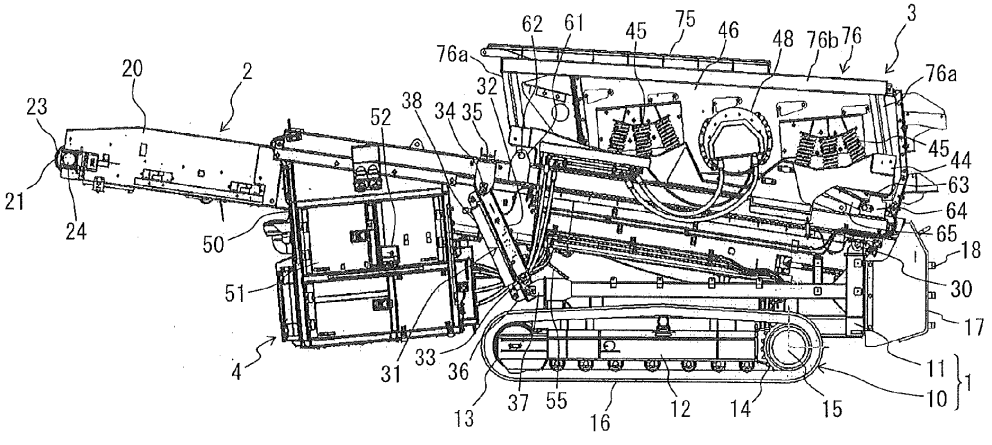
(74) Representative: **Beetz & Partner Patentanwälte**
Steinsdorfstrasse 10
80538 München (DE)

(54) Self-propelled screen

(57) A self-propelled screen for sorting materials according to grain size includes: a truck device (10); a body frame (11) provided substantially above the truck body (10); a discharge conveyor (2) tiltably coupled to the body frame (11); a screening device (3) coupled tiltably relative to a conveyor frame (20) so as to be positioned above the discharge conveyor (2); a screen angle changing cylinder (38) coupled at one end thereof to the body frame (11) and at another end to the conveyor frame (20); and a screening device opening/closing cylinder (65) coupled at one end thereof to a screening device frame (44) and at another end to the conveyor frame (20).

This configuration makes it possible to maintain a constant clearance between the screening device and the conveyor independently of an inclination angle of the screening device, and enables easy access to a bottom deck of the screening device and hence improves maintainability.

Fig. 1



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Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a self-propelled screen for sorting materials according to grain size.

[0002] Vibrating screens are devices that vibrate a screening device, that is, a frame with a screening member mounted therein, and then selectively separate loaded materials into two groups, one smaller than the screening grain size at the screening member side, and the other larger than the screening grain size. In a vibrating screen of this type, for example, if the inclination angle of the screening device to the horizontal increases, the moving rate of the materials on the screening member also increases during screening. This increase correspondingly shortens the dwell time of the materials on the screening member, increasing throughput (screening volume) per unit time. Conversely, decreases in the inclination angle of the screening device give more chances for the materials to collide against the screening member, and correspondingly improve screening accuracy.

[0003] Accordingly, JP,A-307503 introduces a self-propelled screen that includes a screening device tiltably coupled to a frame provided above a truck body and makes adjustable an inclination angle of a vibrating screen according to properties of materials to be screened, screening grain size, and/or other parameters.

SUMMARY OF THE INVENTION

[0004] In the self-propelled screen of JP,A-307503, however, since a conveyor for conveying the materials that have passed through the screening device is fixed with respect to the frame provided above the truck body, changing an inclination angle of the screening device with respect to the frame varies a clearance between the screening device and the conveyor. In addition, if the clearance between the screening device and the conveyor widens, the materials correspondingly become more prone to scatter from the clearance.

[0005] Accordingly, the present applicant already filed Japanese Patent Application No. 2009-044490, a prior application relating to a self-propelled screen that includes, in addition to a conveyor coupled tiltably with respect to a truck body, a screening device installed above the conveyor, thereby to make the conveyor and the screening device integrally tilt with respect to the truck body. In the self-propelled screen of the prior application, tilting the conveyor allows an inclination angle of the screening device to be changed and a clearance between the screening device and the conveyor to be kept constant, independently of the inclination angle of the screening device.

[0006] Vibrating screens, however, are often equipped with a plurality of tiers of screening members, inclusive of the top deck as upper tier that uses a screening element relatively rough in screening grain size, and the bottom deck as lower tier that uses a screening element relatively fine in screening grain size. In such a multi-tier arrangement of screening members, lack of a sufficient operator access space as the clearance between a screening device and a conveyor does not allow an operator to access the bottom deck in order to perform maintenance operations such as cleaning, while the invariant clearance between the screening device and conveyor in that arrangement is maintained. For access, the operator needs to perform very troublesome disassembly tasks such as removing the top deck from the screening device or removing the screening device itself from the conveyor.

[0007] The present invention has been achieved with the above circumstances taken into account. An object of the invention is therefore to provide a self-propelled screen designed so as to make it possible to maintain a constant clearance between a screening device and a conveyor independently of an inclination angle of the screening device, and so as to enable easy access to a bottom deck of the screening device and hence improve maintainability.

[0008] In order to attain the above object, according to a first aspect of the present invention, a self-propelled screen for sorting materials according to grain size includes: a truck device; a body frame provided substantially above the truck device; a conveyor tiltably coupled to the body frame; a screening device coupled tiltably relative to a frame of the conveyor so as to be positioned above the conveyor; a screen angle changing cylinder coupled at one end thereof to the body frame and at another end to the conveyor frame, the cylinder tilting the screening device as well as the conveyor; and a screening device opening/closing cylinder coupled at one end thereof to a screening device frame of the screening device and at another end to the conveyor frame, the cylinder tilting the screening device.

[0009] According to a second aspect of the present invention, a self-propelled screen based on the first aspect of the invention further includes: a support member provided on the screening device frame; and a hopper supported by the support member so as to be positioned above the screening device, the support member serving as a stiffening material for the screening device frame as well as working with the screening device frame to constitute a three-dimensional frame.

[0010] According to a third aspect of the present invention, a self-propelled screen based on the first aspect of the invention further includes a guide member provided on at least one (e.g., the screening device frame) of mutually opposed sections of the screening device frame and the conveyor frame so as to spread towards the other opposed section (e.g., the conveyor frame), the guide member guiding tilt operation of the screening device in a direction of closing with respect to the conveyor frame.

[0011] According to a fourth aspect of the present invention, a self-propelled screen based on the first aspect of the invention further includes: a locking arm provided

pivotably with respect to the screening device frame; a bracket provided on the conveyor frame; and a pin for fixing a distal end of the locking arm to the bracket, the locking arm being constructed so that as the screening device tilts in a direction of opening with respect to the conveyor frame, the arm turns downward under its own weight, and so that upon the screening device reaching a defined angle of opening, a pin hole at the distal end of the arm is positioned at a pin hole of the bracket.

[0012] According to a fifth aspect of the present invention, a self-propelled screen based on the first aspect of the invention further includes: a sensor for detecting whether the screening device frame is in a closed state with respect to the conveyor frame; and a control unit for permitting the truck device and the screening device to operate, only if, on the basis of a detection signal from the sensor, the screening device frame is determined to be in the closed state.

[0013] According to a sixth aspect of the present invention, a self-propelled screen based on the first aspect of the invention is constructed so that the screening device opening/closing cylinder tilts upward or downward a rear side of the screening device to create a space between a proximal end of the conveyor and the screening device, and a step is provided at a rear-end side of the body frame.

[0014] According to a seventh aspect of the present invention, a self-propelled screen based on the first aspect of the invention further includes: a locking arm suspended from a lower section of the screening device frame so as to turnably operate in longitudinal direction of the locking arm; a lock pin provided at a distal end of the locking arm; and a locking block provided on the conveyor frame, the locking block including a securing section to secure the locking pin, wherein, as the screening device opening/closing cylinder is extended and the screening device is tilted upward, the locking arm extends lengthwise under its own weight from a retracted state between the screening device frame and the conveyor frame, next as the screening device opening/closing cylinder is further extended to its defined length, the lock pin provided on the locking arm rides over the securing section of the locking block, and then as the screening device opening/closing cylinder is retracted from the defined length, the lock pin hooks into the securing section, whereby the lock pin is then restrained.

[0015] According to an eighth aspect of the present invention, the locking block in the seventh aspect of the invention has a stopper to limit a lengthwise extending range of the locking arm so as to prevent this arm from turning beyond its vertical position relative to the conveyor frame.

[0016] According to a ninth aspect of the present invention, the lock pin in the seventh aspect of the invention is always supported by the locking block independently of a position or posture of the screening device, and the locking arm in the seventh aspect is always spaced from the conveyor frame supporting the locking block.

[0017] According to a tenth aspect of the present invention, the locking block in the ninth aspect of the invention has an upper face at which is present a guide member that guides the lock pin during the extension and retraction of the locking arm.

[0018] According to an eleventh aspect of the present invention, the lock pin in the seventh aspect of the invention is insertable into and removable from the locking arm, and the locking block in the seventh aspect includes an auxiliary securing section formed so that even if the lock pin is not mounted in the locking arm, the securing section secures the screening device opening/closing cylinder to the distal end of the locking arm when the cylinder is retracted from the defined length.

[0019] According to the present invention, a constant clearance is maintained between a screening device and a conveyor independently of an inclination angle of the screening device, and easy access to a bottom deck of the screening device is achieved, which in turn improves maintainability.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020]

Fig. 1 is a side view illustrating an overall configuration of a self-propelled screen according to a first embodiment of the present invention;

Fig. 2 is a rear view illustrating the overall configuration of the self-propelled screen according to the first embodiment of the present invention;

Fig. 3 is another side view of the self-propelled screen according to the first embodiment of the present invention, the side viewing illustrating the overall configuration of the screen existing in an opening position of a screening device;

Fig. 4 is a side view illustrating the self-propelled screen from which a part of the screen shown in Fig. 3 is removed;

Fig. 5 is a perspective view illustrating a neighboring structure of a screening device opening/closing cylinder as viewed from a rear-left quarter, of the self-propelled screen according to the first embodiment of the present invention;

Fig. 6 is a front view of the screening device as viewed from slightly above in front, of the self-propelled screen according to the first embodiment of the present invention;

Fig. 7 is a front-right side view of a front end and vicinity of the screening device equipped on the self-propelled screen according to the first embodiment of the present invention, the side view illustrating a closed state of a screening device frame relative to a conveyor frame;

Fig. 8 is another front-right side view of a front end and vicinity of the screening device equipped on the self-propelled screen according to the first embodiment of the present invention, the side view illustrat-

ing an open state of the screening device frame relative to the conveyor frame;

Fig. 9 is a side view of a screening device equipped on a self-propelled screen according to a second embodiment of the present invention, the side view illustrating an uptilted state of the screening device;

Fig. 10 is a side view illustrating in enlarged form a neighboring region of the screening device equipped on the self-propelled screen according to the second embodiment of the present invention;

Fig. 11 is a side view illustrating in further enlarged form an essential region of the screening device equipped on the self-propelled screen according to the second embodiment of the present invention;

Fig. 12 is a perspective view illustrating a neighboring structure of a screening device opening/closing cylinder as viewed from a rear-left quarter, of the self-propelled screen according to the second embodiment of the present invention;

Fig. 13 is an explanatory diagram of opening/closing operation of the screening device equipped on the self-propelled screen according to the second embodiment of the present invention, the diagram representing the way in which a lock pin slides along a guide member;

Fig. 14 is another explanatory diagram of the opening/closing operation of the screening device equipped on the self-propelled screen according to the second embodiment of the present invention, the diagram representing the way in which the lock pin abuts a stopper;

Fig. 15 is yet another explanatory diagram of the opening/closing operation of the screening device equipped on the self-propelled screen according to the second embodiment of the present invention, the diagram representing the lock pin secured to a recess of a securing section;

Fig. 16 is a further explanatory diagram of the opening/closing operation of the screening device equipped on the self-propelled screen according to the second embodiment of the present invention, the diagram representing the lock pin released from the recess of the securing section;

Fig. 17 is a further explanatory diagram of the opening/closing operation of the screening device equipped on the self-propelled screen according to the second embodiment of the present invention, the diagram representing a locking arm secured to an auxiliary securing section when the lock pin is not mounted in place; and

Fig. 18 is a conceptual diagram schematically representing another exemplary configuration of the self-propelled screen according to the second embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0021] Hereunder, embodiments of the present invention will be described using the accompanying drawings.

[0022] Fig. 1 is a side view illustrating an overall configuration of a self-propelled screen according to a first embodiment of the present invention, and Fig. 2 is a rear view of the screen as viewed from the right side of Fig. 1. In the following description, the left and right of Fig. 1 is referred to as the front and rear of the self-propelled screen, and the left and right of Fig. 2 as the left and right of the screen.

[0023] Although the present embodiment is described below taking an example of applying the present invention to a screening device of double-floor construction with a top deck and a bottom deck, the invention can also be applied to screening devices of single-floor construction or triple-floor construction or of construction with more floors.

[0024] The self-propelled screen shown in Figs. 1 and 2 includes a truck body 1, a discharge conveyor 2 provided above the truck body 1, a screening device 3 provided above the discharge conveyor 2, and a power pack 4 provided under the discharge conveyor 2.

[0025] The truck body 1 includes one pair of left and right truck devices 10, and a body frame 11 provided at an upper section of the truck devices 10. The truck devices 10 include one pair of left and right truck frames 12, driven wheels 13 and driving wheels 14 provided at front and rear positions, respectively, of the truck frames 12, hydraulic traveling motors 15 each with an output shaft coupled to one of the driving wheels 14, and crawlers 16 mounted over the left and right driven wheels 13 and driving wheels 14. The body frame 11, a frame-shaped member three-dimensionally built using a plurality of steel plates extending in vertical, horizontal, and longitudinal directions, is provided above the truck frames 12, and has a front end positioned posterior to a front end of each truck device 10 so that the front end of the body frame 11 stays behind that of the truck device 10. The body frame 11 has a rear end positioned slightly posterior to a rear end of the truck device 10. A guard 17 for preventing materials from interfering with a rear end of the discharge conveyor 2 is provided at the rear of the body frame 11. On a backward oriented face of the guard 17, a plurality of steps 18 are arranged in tiers for an operator to step on for getting on a belt of the discharge conveyor 2.

[0026] The discharge conveyor 2 is designed to carry, of all materials that have been sorted by the screening device 3, only those of a predetermined grain size or less and discharge the carried materials from the front of the machine body. The discharge conveyor 2 is disposed so as to raise its front end obliquely. Fig. 1 shows a transport posture that assumes transport of the machine body by trailer truck or the like, so the discharge conveyor 2 is small in angle of inclination to a ground level. For a

change to a working posture, however, the inclination angle of the discharge conveyor 2 can be increased using a screen angle changing cylinder 38 (to be described later). The angle of inclination can also be adjusted for control of processing efficiency. The discharge conveyor 2 includes a conveyor frame 20, a head pulley 21 pivotably provided at a front end of the conveyor frame 20, a tail pulley (not shown) that is pivotably provided at a rear end of the conveyor frame 20, a conveyor belt 23 mounted over the head pulley 21 and the tail pulley, and a discharge conveyor hydraulic motor 24 coupled to the head pulley 21. The discharge conveyor hydraulic motor 24 drives the head pulley 21, thus driving the conveyor belt 23 to circularly move between the head pulley 21 and the tail pulley.

[0027] The conveyor frame 20 is coupled at its rear end to an upper rear-end portion of the body frame 11 via a pivotal shaft 30 so as to be tiltable towards this upper rear-end portion, and is supported at a longitudinal middle section of the frame 20 via a support member 31 by the body frame 11. The support member 31 includes a tubular casing 32 and a rod 33 inserted into this casing. An upper end of the casing 32 is pivotably coupled to a bracket 35 provided centrally on a longitudinal section of the conveyor frame 20 via a pin 34, and a lower end of the rod 33 is pivotably coupled to a bracket 37 provided on a front section of the body frame 11 via a pin 36. The casing 32 and rod 33 of the support member 31 are coupled to each other by the screen angle changing cylinder 38, and as this screen angle changing cylinder 38 telescopically moves, the rod 33 slides relative to the casing 32. This sliding movement consequently tilts the discharge conveyor 2 using the pivotal shaft 30 as a fulcrum. The casing 32 and the rod 33, both having a plurality of pin holes (not shown) that are lined up in extending and retracting directions of the rod 33, are constructed so that during the above sliding movement, changing an extension rate of the rod 33 and then selectively inserting pins (not shown) into the pin holes allow the support member 31 to be fixed at one of multiple length levels and the screening device 3 to be mechanically fixed at a stepwise adjustable angle position.

[0028] The screening device 3 sorts out the materials loaded, according to grain size. The screening device 3 includes a screening device frame 44 positioned above a rear half of the conveyor frame 20, a frame form of screening device body 46 (vibrating element) supported by the screening device frame 44 via a resilient or elastic member 45 so as to be able to vibrate, a screening member 47 (see Fig. 2) fixed to the inside of the screening device body 46, and an exciter 48 for physically exciting the screening device body 46. The screening device 3 shakes the screening device body 46 and the screening member 47 together by driving the exciter 48 to guide, of all materials loaded for screening, only the materials of a predetermined grain size or less that pass through the screening member 47, to the surface of the discharge conveyor 2. The discharge conveyor 2 discharges the materials of greater grain sizes from the rear of the machine body. Although not shown, the screening device 3 in the present embodiment is of double-floor construction with the screening member 47 disposed on each of two vertical stages. The screening members 47 on the upper and lower stages are hereinafter termed the top deck and the bottom deck, respectively, as appropriate.

[0029] While the present embodiment uses a three-in-one type of coil spring as the resilient or elastic member 45, this member can instead be a rubber spring or any other appropriate resilient or elastic element. The resilient or elastic member 45 is disposed at front and rear positions, each on both left and right sides, in the screening device body 46, and the screening device body 46 is supported in four places in all with respect to the conveyor frame 20. While three resilient or elastic members 45 are arranged in one place, the number of resilient or elastic members 45 per place is not limited to this layout form. The screening member 47 inside the screening device 3 is disposed so that the screening member 47 decreases in height at it goes closer to a rear end of the screening device 3, as with the discharge conveyor 2. Since the screening device 3 is supported by the conveyor frame 20 of the discharge conveyor 2, tilting the discharge conveyor 2, as described above, enables the angle of inclination to be changed according to properties of the materials to be screened, and thus, screening capabilities to be adjusted.

[0030] The power pack 4 contains a motive power supply for the operating units mounted in various places on the machine body, such as an engine, hydraulic pumps, and control valves, and is disposed below the discharge conveyor 2, on a power pack frame 50 suspended from the conveyor frame 20. The power pack frame 50 is suspended from the conveyor frame 20 at a position closer to the front end of the discharge conveyor 2 than the bracket 35 connecting the support member 31, and the power pack 4 is also positioned ahead of the truck body 1. As the discharge conveyor 2 is inclined by retracting the screen angle changing cylinder 38, the power pack 4 moves downward to a space in front of the truck body 1 without overlapping the truck body 1. This makes it possible to lay the discharge conveyor 2 nearly to a horizontal position, and hence to suppress overall machine height to a level within the transport height limits applied to transport on general roads.

[0031] In cases that a margin on the transport height limits exists and there is no need to lower the power pack 4 to the space in front of the truck body 1, the power pack 4 can be installed on or above the body frame 11 or the truck frame 12.

[0032] An operator panel 51 for the operator to specify operation of the discharge conveyor 2, screening device 3, and the like, is provided on a left lateral face of the power pack 4. An operating unit 52 for specifying the above-described telescopic operation of the screen angle changing cylinder 38 is provided adjacently to the operator panel 51. The power pack 4 also has a stepped

section (not shown) that serves as a platform for the operator to stand on for purposes such as operating the operator panel 51 and the operating unit 52.

[0033] A scattering prevention cover 55 for receiving any materials that may scattering and fall from a return surface of the conveyor belt 23 during screening is provided under the discharge conveyor 2. Coverage of the scattering prevention cover 55 ranges at least above the power pack 4, and the cover 55 has its lower end and vicinity bent downward in a backward direction to actively guide received materials to a desired accumulating position (e.g., the ground surface between the left and right truck devices 10).

[0034] In the self-propelled screen of the present embodiment, the screening device 3 is coupled to the conveyor frame 20 in tiltable fashion relative thereto so as to be positioned above the discharge conveyor 2. More specifically, the screening device frame 44 is coupled at its front end to a bracket 61 in a longitudinally central section of the body frame 11 so as to be tiltable relative to the bracket 61 via a pivotal shaft 62. In addition, the screening device frame 44 has a rear section constructed so that a pad 63 at the rear end of the screening device frame 44 is supported by a mounting bracket 64, in a seated condition thereupon, near the rear end of the conveyor frame 20. A posture of the screening device 3 under such a state is hereinafter referred to as the closed posture or position as appropriate. The mounting bracket 64 of the conveyor frame 20 is coupled to the screening device frame 44 by a screening device opening/closing cylinder 65. As the screening device opening/closing cylinder 65 is extended or retracted, the screening device 3 therefore tilts in the supported condition with the pivotal shaft 62 as a fulcrum, this tilting operation spreading or narrowing the clearance between the conveyor frame 20 and the screening device frame 44. A posture of the screening device 3 having its rear half uptilted in the supported condition with the pivotal shaft 62 as the fulcrum, is hereinafter referred to as the open posture or position as appropriate. Fig. 3 illustrates such a state of the self-propelled screen.

[0035] Fig. 4 is a side view of the self-propelled screen from which a part of the screen shown in Fig. 3 is removed, and Fig. 5 is a perspective view of a neighboring structure of the screening device opening/closing cylinder 65 as viewed from a rear-left quarter.

[0036] As shown in Fig. 5, the screening device frame 44 includes a longitudinally extending frame 66 and two covers 67, one internally and one externally to the frame 66, in a lateral direction of the machine body. The screening device frame 44 is therefore constructed to form a longitudinally extending plate-like framework as a whole, and is located to each of the left and right of the screening device 3. Fig. 4 illustrates the self-propelled screen from which the outer cover 67 of the screening device frame 44 is removed.

[0037] The pad 63 is mounted on a rear-end lower surface of the frame 66. More specifically, the pad 63 is provided on both left and right sides of the machine body, with an appropriate number of shims 60 interposed between the pad 63 and the frame 66. This ensures that the pads 63 on the left and right sides become simultaneously seated on related mounting brackets 64, that is, minimizes single-side contact relative to the brackets 64. Briefly, consideration is given so that single-side contact of the pads 43 on the left and right of the machine body can be suppressed by adjusting the shims 60 in thickness and the number of shims 60. The pads 63 each include a downward protruding guide member 59, and when the pad 63 becomes seated on the appropriate mounting bracket 64, the guide member 59 is inserted between two plates constituting the mounting bracket 64. The thus-inserted guide members 59 guide a shift of the screening device 3 to the closed posture, thus restraining a lateral movement of the screening device 3, and ensuring its stable seating position.

[0038] In addition, flared guide members 68 are provided at a lower section of the screening device frame 44 so as to be positioned closer to the front end of the discharge conveyor 2 than the mounting brackets 64, at the rear half side of the screening device 3. The guide members 68 in the present embodiment are partial downward extensions of the inner and outer covers 67, the guide member 68 of the inner cover 67 being inclined downward in an inward direction relative to the machine body, and the guide member 68 of the outer cover 67 being inclined downward in an outward direction relative to the machine body. When the screening device 3 moves downward by tilting in its closing direction relative to the conveyor frame 20, the inner and outer guide members 68 play a role to guide the tilting operation of the screening device 3 so that the conveyor frame 20 is accommodated smoothly between the guide members 68. The guide members 68, although shown by way of example at the screening device frame side in the present embodiment, may be provided at the conveyor frame side or provided on at least one (e.g., the screening device frame 44) of mutually opposed sections of the screening device frame 44 and the conveyor frame 20 so as to spread towards the other opposed section (e.g., the conveyor frame 20).

[0039] As shown in Fig. 4, the screening device opening/closing cylinder 65 has a rod end coupled to the inner and outer covers 67 via a pin 69, and a bottom end coupled to the mounting brackets 64 via a pin 70. A pin 72 at a fulcrum of a locking arm 71 and the pin 69 at the rod side of the screening device opening/closing cylinder 65 would be replaceable by one common pin.

[0040] At the conveyor frame 20 and the screening device frame 44, a locking mechanism for holding the screening device 3 mechanically in its opening position when the screening device opening/closing cylinder 65 is extended to shift the screening device 3 to the open posture is provided on both left and right sides of the machine body. This locking mechanism includes the locking arm 71 provided under the screening device frame 44, and a bracket 73 provided on the conveyor

frame 20.

[0041] The locking arm 71, positioned slightly in front of the pin 69 at the rod side of the screening device opening/closing cylinder 65, is coupled at one end to the screening device frame 44 by the pin 72, and is pivotable with the pin 72 as a fulcrum in a longitudinally extending vertical plane.

[0042] The bracket 73 is provided on the conveyor frame 20 so as to be positioned below the pin 72. The bracket 73 is constructed so that as the screening device 3 tilts in its opening direction relative to the conveyor frame 20 and thus the locking arm 71 turns downward under its own weight, the screening device 3 reaches a defined opening angle, whereby a pin hole at a distal end (other end) of the locking arm 71 is positioned at a pin hole of the bracket 73. When the distal end of the locking arm 71 is positioned at the bracket 73, the distal end of the locking arm 71 is fixed to the pin hole of the bracket 73 by threading a fixing pin 74 into the pin hole of the distal end of the locking arm 71 and the pin hole of the bracket 73. The pin 72 at the fulcrum of the locking arm 71 and the pin 69 at the rod side of the screening device opening/closing cylinder 65 can be replaced by one common pin.

[0043] Fig. 6 is a front view of the screening device as viewed from slightly above in front.

[0044] A hopper 75 for guiding to the top deck of the screening device 3 the materials to be screened is provided at an upper section of the screening device 3. The hopper 75 is a chute-shaped member constructed by laminating a plurality of upward spreading plates, and has plates in three places, namely, a front plate, a left side plate, and a right side plate. The left and right side plates cover a region roughly ranging from the front end of the screening device 3 to a section slightly behind a longitudinally central section of the screening device 3. The hopper 75 is supported on the screening device frame 44 via a support member 76. As shown in Fig. 6, the support member 76 includes vertical frames 76a extending vertically at four corners, horizontal frames 76b arranged longitudinally across the vertical frames 76a, a horizontal frame 76c disposed laterally across two front ones of the vertical frames 76a, and oblique frames 76d arranged obliquely between two forward extending upper ones of the horizontal frames 76b and the front left and right vertical frames 76a. In addition to working with the screening device frame 44 to constitute a truss, the support member 76 serves as a stiffening member for the screening device frame 44. The hopper 75 is installed on the forward extending horizontal frames 76b and above the remaining horizontal frame 76b.

[0045] Figs. 7 and 8 are side views of the screening device front end and vicinity as viewed from the right side of the machine body, Fig. 7 illustrating a closed state of the screening device frame 44 relative to the conveyor frame 20, and Fig. 8 illustrating an open state of the screening device frame 44 relative to the conveyor frame 20.

[0046] As shown in Figs. 7 and 8, the present embodiment further includes a sensor 81 that detects whether the screening device frame 44 is in the closed state relative to the conveyor frame 20, that is, whether the screening device 3 is in the closing position. The sensor 81 can be a limit switch, a proximity switch, or any other appropriate detector. A proximity switch is used in the present embodiment.

[0047] The screening device frame 44, in contrast, includes a member 82 to be detected. The member 82 to be detected is mounted on a side face of the screening device frame 44 so as to extend downward. When the screening device frame 44 is in the closed state relative to the conveyor frame 20, the distal end of the screening device frame 44 enters a detection range of the sensor 81, and when the screening device frame 44 is in the open state relative to the conveyor frame 20, the distal end of the screening device frame 44 exits the detection range of the sensor 81.

[0048] A detection signal from the sensor 81 is output to a control unit (not shown), which permits the truck devices 10 and the screening device 3 to operate, only if the control unit determines from the output detection signal of the sensor 81 that the screening device frame 44 is closed relative to the conveyor frame 20. In the present embodiment, when the screening device frame 44 is closed and the member 82 to be detected enters the detection range of the sensor 81, the control unit determines from the output detection signal of the sensor 81 that the screening device frame 44 is closed relative to the conveyor frame 20. The control unit also permits operation of machine elements, inclusive of the truck devices 10, screening device 3, discharge conveyor 2, etc., but except for the cylinders 38 and 65. Conversely, if the screening device frame 44 is open and the sensor detection signal at the member 82 to be detected is off, the control unit determines from this signal state that the screening device frame 44 is open relative to the conveyor frame 20, and then prohibits the operation of the truck devices 10, screening device 3, discharge conveyor 2, etc., but except for the cylinders 38 and 65. In other words, the control unit includes an interlock.

[0049] Although the sensor 81 in the present example is disposed at a section slightly behind the pivotal shaft 62 of the screening device 3, on the right-side face of the conveyor frame 20, the disposition of the sensor 81 is not limited to this position and may be on the left-side face of the conveyor frame 20 or the layout of the sensor 81 and the pivotal shaft 62 may be changed as appropriate. Further alternatively, the sensor 81 would be provided on the screening device frame 44, not on the conveyor frame 20. Moreover, the member 82 to be detected may be omitted if the sensor 81 can be provided at a position that enables direct detection of the screening device frame 44 or the conveyor frame 20. Besides, a possible alternative way to detect whether the screening device frame 44 is in the closed state with respect to the conveyor frame 20 is by, for example, mounting a poten-

tiometer on the pivotal shaft 62 of the screening device 3 and using this potentiometer to detect the inclination angle of the screening device 3 with respect to the discharge conveyor 2.

[0050] Next, operation and operational effectiveness of the self-propelled screen having the above-described configuration are described in that order below.

[0051] For example, when a hydraulic shovel, a recycling machine, a conveyor belt, or the like is used to load materials into the screening device 3, materials smaller than a screening grain size used at the top deck side (upper screening member 47) pass through the top deck and materials larger than the screening grain size move along the surface of the top deck and are discharged from the rear of the machine. In addition, among the materials that have passed through the top deck, only those smaller than a screening grain size used at the bottom deck side (lower screening member 47) pass through the bottom deck and are guided to a conveyance surface of the discharge conveyor 2. Next, these materials are conveyed forward by the conveyor 2 and discharged from the front of the machine. Meanwhile, materials larger than the screening grain size at the bottom deck side move along the surface of the bottom deck and are discharged from the rear of the machine. In this case, although the present embodiment does not use a conveyor to carry the materials discharged from the rear without passing through the screening member 47, the self-propelled screen may have an optional side conveyor to discharge from a side face of the machine body the materials that move along the surface of the top deck and are discharged sideways. Further alternatively, a side conveyor for discharging from a side face of the machine body the materials that move along the surface of the bottom deck and are discharged sideways may be further installed so that the materials divided into three types according to grain size will be discharged in three different directions.

[0052] In the present embodiment, the screening device 3 can be tilted by extending/retracting the screen angle changing cylinder 38 to adjust screening performance of the screening device 3. At this time, since the screening device 3 tilts with the discharge conveyor 2, a positional relationship between the screening device 3 and the discharge conveyor 2 remains undisturbed, regardless of the inclination angle of the screening device 3, so the tilting motion of the screening device 3 basically does not facilitate scattering of any materials passed through the screening member 47.

[0053] In addition, since the screening device 3 can be tilted with respect to the discharge conveyor 2 (only the screening device 3 can be tilted independently of the discharge conveyor 2), an open space can be created between the conveyor frame 20 and the screening device frame 44 by extending the screening device opening/closing cylinder 65. For maintenance, therefore, even in cases such as the screening device 3 becoming clogged at the bottom deck or a need arising for the operator to replace or repair the screening member 47 of the bottom deck, the operator can easily access the bottom deck from the discharge conveyor 2 by leaving the space between the conveyor frame 20 and the screening device frame 44 open, without removing the top deck or removing the screening device 3 from the discharge conveyor 2. In this way, the clearance between the discharge conveyor 2 and the screening device 3 can be kept constant independently of the inclination angle of the screening device 3, and access to the bottom deck of the screening device 3 can be facilitated. Additionally, since the bottom deck is accessible from the discharge conveyor side, this access method, unlike accessing from the top deck side, eliminates any need for the operator to mount a high place on the machine, and makes the operator feel secure in this context.

[0054] Furthermore, in the present embodiment, the screening device opening/closing cylinder 65 moves the rear side of the screening device 3 vertically to create a space between a proximal-end side of the discharge conveyor 2 and the screening device 3, at a rear side of the body frame 11. In addition to this mechanical property, steps 18 are provided on the guard 17, at the rear side of the body frame 11 where the space is created by an uptilt and downslant of the rear side of the screening device 3. If the screening device 3 should ever be constructed so that its front side moves vertically, as the upward inclination angle of the discharge conveyor 2 increases at its front end, the space created by the tilting motion of the screening device 3 would also be higher in position. In the present embodiment, however, since the screening device 3 whose height becomes smaller towards the rear end of the screening device is constructed to move vertically at the rear side, the space between the screening device 3 and the discharge conveyor 2 can be created at a fixed position, which allows a working burden of the operator to be reduced and his/her anxiety about overhead work to be alleviated. The steps 18 provided at appropriate places are useful for access to the space. In addition, since the machine has an overall shape that diminishes machine height towards the rear end of the machine body, the machine rear is lower than sides and the front, the construction of which makes it easier for the operator to mount the machine rear than the sides and the front.

[0055] Furthermore, in the present embodiment, the screening device 3 tilts independently of the discharge conveyor 2 and one of the longitudinal ends of the screening device 3 serves as a fulcrum. Unless sufficient stiffness is given to the screening device 3, uptilting the screening device 3 could distort sections such as the screening device 3 and/or its frame, and should the distortion actually happen, the screening device 3 might not return to its original position, even when later tilted downward.

[0056] In order to allow for these events, the support members 76 for the hopper 75 strengthen the screening device frame 44 to establish a three-dimensional framework (in the present embodiment, truss construction) and

hence to ensure sufficient stiffness of the screening device 3. Additionally, the guide members 68, 59 reliably guide the screening device 3 to its original posture (closing position) when the screening device 3 is tilted in the closing direction. Furthermore, height of the left and right pads 63 which work with the pivotal shaft 62 to support weight of the screening device 3 can be adjusted using the respective shims 60, which in turn allows suppression of an uneven load of the screening device 3 upon the discharge conveyor 2 due to single-side contact of the pads 63 on the left and right sides of the machine body. Furthermore, if deformation due to welding or other fabrication steps should ever be observed in a constituent element of the screening device 3, such as the screening device frame 44 or the supporting members 76, single-side contact might also occur, but even in this case, an uneven load due to the single-side contact at the left and right sides can be suppressed by adjusting pad height with the shims 60.

[0057] Moreover, upon the screening device 3 being shifted to its opening position for maintenance, the locking arm 71 is naturally extended downward by its own weight to match the pin hole of the arm 71 to that of the bracket 73, so that the operator, after shifting the screening device 3 to the opening position, can prevent an unexpected downslant of the screening device 3 just by, on both left and right sides of the machine body, fixing the locking arm 71 to the bracket 73 using the pin 74. The unexpected downslant can therefore be prevented, even if the operator makes a mistake in operating the screening device opening/closing cylinder 65 while accessing the bottom deck.

[0058] Operating the screening device 3 or the truck devices 10 while the screening device 3 is open could induce unwanted events such as the scattering of the materials or damage to the screening device 3 or its peripheral machine components. Occurrence of such trouble, however, can be suppressed in the present embodiment since the screening device 3, the truck devices 10, and the discharge conveyor 2 are constructed so as not to operate, except when the clearance between the screening device frame 44 and the conveyor frame 20 is narrowed by the sensor 81.

[0059] Fig. 9 is a side view of a screening device equipped on a self-propelled screen according to a second embodiment of the present invention, the side view illustrating an open state of the screening device. Fig. 10 is a side view illustrating a closed state of the screening device, Fig. 11 is a side view illustrating in enlarged form an essential region of the present embodiment, and Fig. 12 is a perspective view illustrating a neighboring structure of a screening device opening/closing cylinder 65 as viewed from a rear-left quarter. In Figs. 9 to 12, substantially the same elements as in the first embodiment are assigned the same reference numbers as those used on the drawings, and description of these elements is omitted. Also, covers 67 (to be described later herein) of a screening device frame 44 and body bars 171a of a locking arm 171 on a left side of the machine body are omitted in Fig. 11.

[0060] The self-propelled screen according to the present embodiment differs from that of the first embodiment in terms of configuration of a locking mechanism for holding the screening device 3 mechanically in its opening position.

[0061] The locking mechanism in the present embodiment includes the locking arm 171 provided in the screening device frame 44, and a locking block 173 provided in a conveyor frame 20.

[0062] The locking arm 171 includes one pair of mutually parallel left and right body bars 171a constituting an arm body, a rib 171b coupling the left and right body bars 171a, and grips 171c provided on side faces of each body bar 171a that are opposite to the rib 171b.

[0063] Each of the left and right body bars 171a has a proximal end (upper end) suspended via a pin 172 at a lower section of the screening device frame 44, slightly in front of a pin 69 at a rod side of the screening device opening/closing cylinder 65, and thus the locking arm 171 can be pivoted in a longitudinal direction with the pin 172 as a fulcrum, within a longitudinally extending vertical plane. A pin hole 171d for mounting a lock pin 174 is provided at a distal end of each body bar 171a (for the pin hole 171d, see Fig. 17 to be described later). The lock pin 174 is insertable into and removable from the pin hole 171d, includes a locking element (fixing pin or the like) for fixing the inserted lock pin 174, and a grip 174a that an operator holds by hand when inserting or removing the lock pin 174, and has a cylindrical body. In the present embodiment, when the lock pin 174 is inserted, the lock pin 174 is always supported by any section of the locking block 173. For this reason, the left and right body bars 171a across a securing section 173b (to be described later) of the locking block 173 do not come into contact with the locking block 173, but after the lock pin 174 has been removed, the distal end of the body bar 171a abuts a base 173a (to be described later) of the locking block 173. Accordingly, the distal end (lower end) of the body bar 171a has a semi-circularly chamfered shape to prevent the body bar 171a from scratching the locking block 173 more than necessary, even in the case where the body bar 171a slides against the locking block 173.

[0064] The rib 171b extends from vicinity of the pin 172 supporting the body bar 171a, towards the pin hole 171d. However, the rib 171b has its distal end (the end near the pin hole 171d) is retreated from the distal end of the body bar 171a to the vicinity of the pin 172, to such an extent that even if the body bar 171a slides against the locking block 173 without the lock pin 174 in place, the distal end of the rib 171b will not interfere with the securing section 173b of the locking block 173.

[0065] The grip 171c, a section that the operator holds by hand when manually turning the locking arm 171, is constructed by fastening both ends of a hook-shaped member to a side face of the body bar 171a by means

of welding or the like. In order to render the locking arm 171 turnable with the smallest possible force, the grip 171c is desirably positioned at the longest possible distance from the pin 172 serving as the fulcrum for the locking arm 171. The desirable position here is, for example, near the pin hole 171d in the lock pin 174. In addition, although an example of arranging the grip 171c on both left and right sides of the locking arm 171 is shown in the present embodiment, for example, the grip 171c internal to the machine body, in a lateral direction thereof, that is, located to the right of the left locking arm 171, may be omitted.

[0066] The locking block 173 includes a base 173a fixed to the surface of the conveyor frame 20, the securing section 173b provided on the base 173a, a stopper 173c provided on the base 173a so as to be positioned in front of the securing section 173b, and auxiliary securing sections 173d for securing to the body bar 171a.

[0067] The base 173a is a rectangular plate, which is fixed to the surface of the conveyor frame 20 by means of welding, bolting, or the like so that the front end of the base 173a are positioned below a position slightly posterior to the support pin 172 for the locking arm 171 (i.e., in the present embodiment, near the pin 69 at the rod side of the screening device opening/closing cylinder 65).

[0068] The securing section 173b is a longitudinally extending vertical member of a plate shape, formed integrally with the stopper 173c, and this plate-shaped member has its anterior part serving as the stopper 173c, and has its posterior part serving as the securing section 173b. The securing section 173b has a front face with a semi-circular recess 173ba opened forward when viewed from a side of the machine body, and an upper face with a guide 173bb inclined for height above the conveyor frame 20 to diminish in tapered fashion towards a rear end of the guide. The recess 173ba is a section that receives the lock pin 174 from a forward direction and secures the pin 174, with an inside diameter of the recess 173ba being slightly larger than the body of the lock pin 174. The guide 173bb, a section for sliding and guiding the lock pin 174 during extension and retraction of the locking arm 171, is linearly inclined for height above the conveyor frame 20 to diminish in tapered fashion from above the recess 173ba, towards the rear end of the guide, and thereafter at a rear end of the securing section 173b onward, the guide 173bb is substantially parallel to the conveyor frame 20. When the screening device 3 is in its closed posture, the locking arm 171 assumes a posture in which its angle of inclination to the conveyor frame 20 is minimized (a posture of the locking arm 171 retracted at this time between the screening device frame 44 and the conveyor frame 20 will be referred to as the retracted posture as appropriate). The rear end of the guide 173bb, however, extends at the rear of the machine to such an extent that the locking arm 171, even while in the retracted posture, can accept the lock pin 174.

[0069] The stopper 173c limits an extending range (in the present embodiment, a forward turning range) of the locking arm 171. Upon the screening device opening/closing cylinder 65 being extended to a defined stroke (in the present embodiment, full stroke), the lock pin 174 rides over the securing section 173b and moves away therefrom to temporarily free the distal end of the locking arm 171, but the locking arm 171, after leaving the securing section 173b, turns forward under its own weight and the forward turning range is limited at where the lock pin 174 touches the stopper 173c. The locking arm 171 is for supporting the open screening device 3 with respect to the conveyor frame 20. In principle, therefore, the stopper 173c needs only to limit the extending range of the locking arm 171 at least so as not to allow the locking arm to turn in excess of its vertical posture relative to the conveyor frame 20.

However, in order that the lock pin 174 abuts the stopper 173c during the extension of the locking arm 171 under its own weight, the present embodiment includes the stopper 173c at a position posterior to the pin 172 serving as the fulcrum for the locking arm 171. A rear wall of the stopper 173c (i.e., a wall facing the securing section 173b), as with the guide 173bb, is linearly inclined for height above the conveyor frame 20 to diminish in tapered fashion towards the rear end of the stopper, and thereafter connects gently to a lower wall of the recess 173ba in the securing section 173b, in substantially parallel to the conveyor frame 20.

[0070] The auxiliary securing sections 173d are plate-shaped members provided on both left and right sides of the securing section 173b so as to be positioned slightly posterior to the recess 173ba, these members being strongly or securely fixed to the securing section 173b and the base 173a by means of welding or the like. The auxiliary securing sections 173d each includes a front wall at where either a slight clearance from the distal end of the locking arm 171 or a clearance required only for the distal end of the locking arm 171 to come into contact with the front wall is created with the lock pin 174 secured to the recess 173ba. Height of each auxiliary securing section 173d above the base 173a is desirably greater than a radius of the curved distal end of the locking arm's body bar 171a.

[0071] In the present embodiment, the locking arm 171 is supported on an upper face of the locking block 173 via the lock pin 174 and does not come into direct contact with the locking block 173 while the lock pin 174 remains mounted. Instead, the lock pin 174 comes into contact only with the upper face of the locking block 173. The extension and retraction of the locking arm 171 are thus guided. In addition, since, as described above, the guide 173bb of the locking block 173 extends at a rear position convenient for accepting the lock pin 174 of the retracted locking arm 171, the lock pin 174, while it remains mounted in the locking arm 171, is constantly supported by the locking block 173 irrespective of the posture of the screening device 3. Even the lowest portions of the guide 173bb and stopper 173c above the conveyor frame 20 or the base 173a have a height greater than a distance

from an outside-diametral portion of the distal end of the locking arm 171 to the pin hole 171d. Under the mounted state of the lock pin 174, therefore, the locking arm 171 is always spaced from the base 173a of the locking block 173 as well as from the conveyor frame 20 serving to support the locking block 173, and thus does not come into contact with these sections.

[0072] Other constituent elements of the self-propelled screen, and basic operation associated with materials screening by the screening device 3 are substantially the same as in the first embodiment. Next, the open/close operation of the screening device 3 in the present embodiment is described below using Figs. 13 to 17, along with the drawings heretofore described and shown. The covers 67 of the screening device frame 44 and the body bar 171a of the locking arm 171 (i.e., the body bar 171a on the left side of the machine body) are omitted in Figs. 13 to 17.

[0073] For maintenance of a bottom deck, for example, first the screening device opening/closing cylinder 65 is extended to uptilt the screening device 3 for a shift from the closed posture (see Figs. 10, 11, etc.) to the open posture (see Fig. 12). During this sequence, as the screening device opening/closing cylinder 65 is extended from the closed posture of the screening device 3, the screening device 3 rises and the lock pin 174 slides upward along the guide 173bb of the locking block 173. At the same time, the locking arm 171 extends forward from the retracted posture under its own weight (see Fig. 13), and upon the screening device opening/closing cylinder 65 extending to defined length (in the present embodiment, full stroke), the lock pin 174 climbs up the guide 173bb, rides over the securing section 173b of the locking block 173, and abuts the stopper 173c of the locking block 173 (see Fig. 14).

[0074] After this, slightly retracting the screening device opening/closing cylinder 65 from the defined length makes the lock pin 174 slide downward along a slope of the stopper 173c and fit into the recess 173ba of the securing section 173b (see Fig. 15). The amount of screening device opening/closing cylinder 65 retracted at this time can be adjusted to a preset value or to a level at which the lock pin 174 comes into contact with an inner wall of the recess 173ba. In this way, the lock pin 174, while becoming involved with the securing section 173b, restrains the locking arm 171, thus causing the conveyor frame 20 to mechanically support a load of the screening device 3 via the locking arm 171 and the locking block 173. At this time, since the conveyor frame 20 is in a backward downwardly-tilted condition, gravity acts to press the lock pin 174 against the wall of the recess 173ba, and in addition, a portion constituting an upper part (ceiling) of the recess 173ba covers the lock pin 174, so the locking arm 171 is stably secured to the recess 173ba. This prevents the screening device 3 from unexpectedly tilting downward, for example even in the case of hydraulic oil leakage from the screening device opening/closing cylinder 65 with the screening device 3 in the open posture.

[0075] Conversely for a return of the screening device 3 from the open posture (see Fig. 15) to the closed posture, first the screening device opening/closing cylinder 65 is extended to the defined length (or vicinity thereof). This makes the lock pin 174 exit the recess 173ba of the locking block 173 and climb up to a midway position on the slope of the stopper 173c (see Fig. 16). After temporarily removing this lock pin 174 from the locking arm 171, the operator holds the grip(s) 171c and lifts up the locking arm 171 to the upper end of the securing section 171b. Reinserting the lock pin 174 into the lifted locking arm 171 and then moving this locking arm downward rests the lock pin 174 on the guide 173bb of the securing section 173b. After this, merely retracting the screening device opening/closing cylinder 65 causes the machine to operate conversely to the operation shown in Fig. 13. That is, the screening device 3 tilts downward and along with this operation, the lock pin 174 slides along the guide 173bb of the locking block 173, thus shifting the locking arm 171 to the retracted posture, and hence shifting the screening device 3 to the closed posture (see Figs. 10, 11, etc.).

[0076] In addition, for the shift of the screening device 3 to the open posture, even if the lock pin 174 is not mounted or the operator is unaware of the lock pin 174 not being mounted, the auxiliary securing section 173d in the present embodiment functions to restrain the locking arm 171. More specifically, extending the screening device opening/closing cylinder 65 from the open posture (see Figs. 10, 11, etc.) uptilts the screening device 3, makes the distal end of the body bar 171a slide along the base 173a of the locking block 173 during the uptilt, extends the locking arm 171 forward from its retracted posture under its own weight during that sliding movement, and causes the locking arm 171 to ride over the auxiliary securing section 173d before the screening device opening/closing cylinder 65 is extended to the defined length. Retracting the screening device opening/closing cylinder 65 after that will cause the distal end of the locking arm 171 to slide along the base 173a of the locking block 173 and abut the auxiliary securing section 173d (see Fig. 17). The locking arm 171 is thus restrained by the auxiliary securing section 173d, whereby the load of the screening device 3 is mechanically supported via the locking arm 171 and the locking block 173 by the conveyor frame 20.

[0077] Operational advantageous effects of the present embodiment are described in order below.

[0078] In the present embodiment, telescopically moving the screen angle changing cylinder 38 tilts the screening device 3, thus enabling the screening device 3 to be adjusted in screening performance. At this time, since the screening device 3 tilts together with the discharge conveyor 2, a positional relationship between the screening device 3 and the discharge conveyor 2 remains undisturbed, regardless of the inclination angle of the screening device 3, so the tilting motion of the screening

device 3 basically does not facilitate scattering of any materials passed through the screening member 47.

[0079] In addition, since the screening device 3 can be tilted with respect to the discharge conveyor 2 (only the screening device 3 can be tilted independently of the discharge conveyor 2), an open space can be created between the conveyor frame 20 and the screening device frame 44 by extending the screening device opening/closing cylinder 65. For maintenance, therefore, even in cases such as the screening device 3 becoming clogged at the bottom deck or a need arising for the operator to replace or repair the screening member 47 of the bottom deck, the operator can easily access the bottom deck from the discharge conveyor 2 by leaving the space between the conveyor frame 20 and the screening device frame 44 open, without removing a top deck or removing the screening device 3 from the discharge conveyor 2. In this way, the clearance between the discharge conveyor 2 and the screening device 3 can be kept constant independently of the inclination angle of the screening device 3, and access to the bottom deck of the screening device 3 can be facilitated. Additionally, since the bottom deck is accessible from the discharge conveyor side, not the top deck side, this access method eliminates any need for the operator to mount a high place on the machine, and makes the operator feel secure in this context.

[0080] Furthermore, upon the screening device 3 being shifted to its opening position for maintenance, the locking arm 171 mechanically supports the screening device 3. This prevents an unexpected downslant of the screening device 3, even if the operator makes a mistake in operating the screening device opening/closing cylinder 65 while accessing the bottom deck.

[0081] At this time, in the present embodiment, slightly retracting the screening device opening/closing cylinder 65 after extending it to the defined length, automatically activates the lock pin 174 to secure the locking arm 171 to the locking block 173, and makes the locking arm 171 easily support the screening device 3 mechanically in its opening position upon its shift to the opening position. Therefore, the present machine construction, compared with construction in which a bracket with a pin hole is provided on a conveyor frame 20 so that a locking arm 171 is restrained by matching the pin hole of the bracket and a pin hole of a locking arm 171 and then inserting a pin into the pin holes, improves working efficiency since the former construction requires no troublesome operations such as delicate pin-hole matching between the locking arm 171 and the bracket or the insertion of the pin.

[0082] Furthermore, the locking block 173 has a stopper 173c, which limits the extending range of the locking arm 171 to prevent the locking arm 171 from turning in excess of the vertical posture relative to the conveyor frame 20 after the lock pin 174 has left the securing section 173b. Thus, when the screening device opening/closing cylinder 65 is retracted to secure the lock pin 174 to the recess 173ba of the securing section 173b, the locking arm 171 can be reliably turned towards the securing section 173b at rear. That is, if the stopper 173c should ever be absent, for example, while the self-propelled screen is in a front tilting posture on an slope, the locking arm 171 might turn forward in excess of the vertical posture relative to the conveyor frame 20. If this is the case, retracting the screening device opening/closing cylinder 65 from that state would cause the conveyor frame 20 to urge the distal end of the locking arm 171 forward and could thus tilt downward the screening device 3 unexpectedly without the locking arm 171 being secured to the locking block 173. In the present embodiment, the stopper 173c prevents such potential trouble from occurring.

[0083] Furthermore, should the screening device 3 be shifted to the open posture without the lock pin 174 mounted in the locking arm 171 and without the auxiliary securing section 173d, when the screening device opening/closing cylinder 65 is retracted to fit the lock pin 174 into the recess 173ba, the screening device 3 might be unexpectedly tilted downward because of no element for restraining the locking arm 171. In another situation, if the operator mistakenly thinks that the lock pin 174 not actually fit in the recess 173ba is properly rested therein, this is likely to cause an unexpected downslant of the screening device 3 due to hydraulic oil leakage from the screening device opening/closing cylinder 65. In the present embodiment, however, since the auxiliary securing section 173d is provided, even if the lock pin 174 is not mounted in the locking arm 171, the locking arm 171 is restrained by the auxiliary securing section 173d when the screening device opening/closing cylinder 65 is retracted from the defined length. The unexpected downslant of the screening device 3 is therefore suppressed, which further improves safety.

[0084] As described above, while the lock pin 174 is mounted in the locking arm 171, this arm does not come into direct contact with the locking block 173. Instead, the lock pin 174 itself comes into contact with the upper face only of the locking block 173, so that the extension and retraction of the locking arm 171 are guided. Sections that suffer friction during the extension and retraction of the locking arm 171 are minimized in surface area to suppress frictional resistance, which in turn leads to smoother operation and longer cycles of part replacement.

[0085] Additionally, as described above, while in the properly mounted state in the locking arm 171, the lock pin 174 is always supported by the locking block 173 independently of the posture of the screening device 3, and under the mounted state of the lock pin 174, the locking arm 171 is always spaced from the base 173a of the locking block 173 as well as from the conveyor frame 20 serving to support the locking block 173. This also contributes to suppressing frictional resistance, achieving smoother operation, and prolonging the replacement cycles of parts.

[0086] Furthermore, in the present embodiment, the screening device opening/closing cylinder 65 moves the

rear side of the screening device 3 vertically to create a space between a proximal-end side of the discharge conveyor 2 and the screening device 3, at a rear side of a body frame 11. In addition to this mechanical property, steps 18 are provided on a guard 17, at the rear side of the body frame 11 where the space is created by an uptilt and downslant of the rear side of the screening device 3. If the screening device 3 should ever be constructed so that its front side moves vertically, as the upward inclination angle of the discharge conveyor 2 increases at its front end, the space created by the tilting motion of the screening device 3 would also be higher in position. In the present embodiment, however, since the screening device 3 whose height becomes smaller towards the rear end of the screening device is constructed to move vertically at the rear side, the space between the screening device 3 and the discharge conveyor 2 can be created at a fixed position, which allows a working burden of the operator to be reduced and his/her anxiety about overhead work to be alleviated. The steps 18 provided at appropriate places are useful for access to the space. In addition, since the machine has an overall shape that diminishes machine height towards the rear end of the machine body, the machine rear is lower than sides and the front, the construction of which makes it easier for the operator to mount the machine rear than the sides and the front.

[0087] Furthermore, in the present embodiment, the screening device 3 tilts independently of the discharge conveyor 2 and one of longitudinal ends of the screening device 3 serves as a fulcrum. Unless sufficient stiffness is given to the screening device 3, uptilting the screening device 3 could distort sections such as the screening device 3 and/or its frame, and should the distortion actually happen, the screening device 3 might not return to its original position, even when later tilted downward.

[0088] In order to allow for these events, support members 76 for a hopper 75 strengthen the screening device frame 44 to establish a three-dimensional framework (in the present embodiment, truss construction) and hence to ensure sufficient stiffness of the screening device 3. Additionally, guide members 68, 59 reliably guide the screening device 3 to its original posture (closing position) when the screening device 3 is tilted in the closing direction. Furthermore, left and right pads 63 that work with the pivotal shaft 62 to support weight of the screening device 3 can be adjusted in height using respective shims 60, which in turn allows suppression of an uneven load of the screening device 3 upon the discharge conveyor 2 due to single-side contact of the pads 63 on the left and right sides of the machine body. Furthermore, if deformation due to welding or other fabrication steps should ever be observed in a constituent element of the screening device 3, such as the screening device frame 44 or the supporting members 76, single-side contact might also occur, but even in this case, an uneven load due to the single-side contact at the left and right sides can be suppressed by adjusting pad height with the shims 60.

[0089] Moreover, operating the screening device 3 or truck devices 10 while the screening device 3 is open could induce unwanted events such as the scattering of the materials or damage to the screening device 3 or its peripheral machine components. Occurrence of such trouble, however, is suppressed in the present embodiment since the screening device 3, the truck devices 10, and the discharge conveyor 2 are constructed so as not to operate, except when the clearance between the screening device frame 44 and the conveyor frame 20 is narrowed by a sensor 81.

[0090] While the construction that extends the locking arm 171 by turning it forward from its retracted posture has been described and shown by way of example in the above embodiment, the locking arm 171 can also be constructed so as to turn backward from the retracted posture and extend the arm. In this case, as in another example of construction that is schematically shown in the conceptual diagram of Fig. 18, positional and directional association between the support pin 172 for the locking arm 171 and the locking block 173 needs to be substantially the same as in the examples of construction that are described in other figures. More specifically, the extending range of the locking arm 171 needs to be limited using the stopper 173c to prevent the locking arm 171 from turning backward in excess of the vertical posture relative to the conveyor frame 20, that is, to prevent one end of the locking arm from moving past the pin 172 and going backward beyond a perpendicular line L orthogonal to the conveyor frame 20. Obviously in that case, the recess 173ba of the securing section 173b is opened backward, the stopper 173c is positioned posteriorly to the securing section 173b, and the guide 173bb is forward downwardly-tilted.

[0091] In addition, in the above embodiment, when the locking arm 171 is made to move beyond the securing section 173b, the screening device opening/closing cylinder 65 is extended to its full stroke as the defined length. However, if for whatever reason a stroke shorter than the full stroke of the screening device opening/closing cylinder 65 is to be set as the defined length, a program that automatically stops the extension of the screening device opening/closing cylinder 65 at the defined length is preferably prestored within a control unit (not shown) so that during the succession of machine actions occurring in connection with the locking mechanism when the screening device 3 is shifted to the open posture, the extending length of the screening device opening/closing cylinder 65 is within the defined length and the lock pin 174 stays on the stopper 173c. The successive open/close actions of the screening device 3 can also be achieved by the operator's manual operations, or these actions are likely to be executed by the program automatically.

Claims

1. A self-propelled screen for sorting materials accord-

ing to grain size, the screen comprising:

a truck device (10);
a body frame (11) provided substantially above the truck device (10);
a conveyor (2) tiltably coupled to the body frame (10);
a screening device (3) coupled tiltably relative to a frame of the conveyor (2) so as to be positioned above the conveyor (2);
a screen angle changing cylinder (38) coupled at one end thereof to the body frame (11) and at another end to the conveyor frame (20), the cylinder (38) tilting the screening device (3) as well as the conveyor (2); and
a screening device opening/closing cylinder (65) coupled at one end thereof to a screening device frame (44) of the screening device (3) and at another end to the conveyor frame (20), the cylinder tilting the screening device (3).

2. The self-propelled screen according to claim 1, further comprising:

a support member (31) provided on the screening device frame (44); and
a hopper (75) supported by the support member (76) so as to be positioned above the screening device (3),
wherein the support member (31) serves as a stiffening material for the screening device frame (44) as well as working with the screening device frame (44) to constitute a three-dimensional framework.

3. The self-propelled screen according to claim 1, further comprising:

a guide member (59, 68) provided on at least one of mutually opposed sections of the screening device frame (44) and the conveyor frame (20) so as to spread towards the other opposed section, the guide member guiding tilt operation of the screening device (3) in a direction of closing with respect to the conveyor frame (20).

4. The self-propelled screen according to claim 1, further comprising:

a locking arm (71) provided pivotably with respect to the screening device frame (44);
a bracket (73) provided on the conveyor frame (20); and
a pin (72) for fixing a distal end of the locking arm (71) to the bracket (73),
wherein the locking arm is constructed so that as the screening device (3) tilts in a direction of opening with respect to the conveyor frame (20), the arm (71) turns downward under its own weight, and so that upon the screening device (3) reaching a specified angle of opening, a pin hole at the distal end of the locking arm (71) is positioned at a pin hole of the bracket (73).

5. The self-propelled screen according to claim 1, further comprising:

a sensor (81) for detecting whether the screening device frame (44) is in a closed state with respect to the conveyor frame (20); and
a control unit for permitting the truck device and the screening device (3) to operate only if, on the basis of a detection signal from the sensor (81), the screening device frame (44) is determined to be in the closed state.

6. The self-propelled screen according to claim 1,
wherein: the screening device opening/closing cylinder (65) tilts upward or downward a rear side of the screening device (3) to create a space between a proximal end of the conveyor (2) and the screening device (3); and
a step is provided at a rear-end side of the body frame.

7. The self-propelled screen according to claim 1, further comprising:

a locking arm (171) suspended from a lower section of the screening device frame (44) so as to pivotably operate in longitudinal direction of the locking arm (171);
a lock pin (174) provided at a distal end of the locking arm (171); and
a locking block (173) provided on the conveyor frame (20), the locking block including a securing section to secure the locking pin (174),
wherein: as the screening device opening/closing cylinder (65) is extended and the screening device (3) is tilted upward, the locking arm (171) extends lengthwise under its own weight from a retracted state between the screening device frame (44) and the conveyor frame (20);
next as the screening device opening/closing cylinder (65) is further extended to its defined length, the lock pin (174) provided on the locking arm (171) rides over the securing section of the locking block; and then
as the screening device opening/closing cylinder (65) is retracted from the defined length, the lock pin (174) hooks into the securing section, whereby the lock pin (174) is then restrained.

8. The self-propelled screen according to claim 7, wherein the locking block (173) includes a stopper to limit a lengthwise extending range of the locking

arm (171) so as to prevent the locking arm from turning beyond its vertical position relative to the conveyor frame.

9. The self-propelled screen according to claim 7, wherein: the lock pin (174) is always supported by the locking block (173) independently of a position or posture of the screening device (3); and
the locking arm (171) is always spaced from the conveyor frame (20) supporting the locking block (173).

10. The self-propelled screen according to claim 9, wherein the locking block (173) includes an upper face at which is present a guide member that guides the lock pin (174) during the extension and retraction of the locking arm (171).

11. The self-propelled screen according to claim 7, wherein: the lock pin (174) is provided insertably, as well as removably, with respect to the locking arm; and
the locking block includes an auxiliary securing section formed so that even before the lock pin is mounted in the locking arm (171), the securing section secures the screening device opening/closing cylinder (65) to the distal end of the locking arm (171) when the cylinder is retracted from the defined length.

Fig. 1

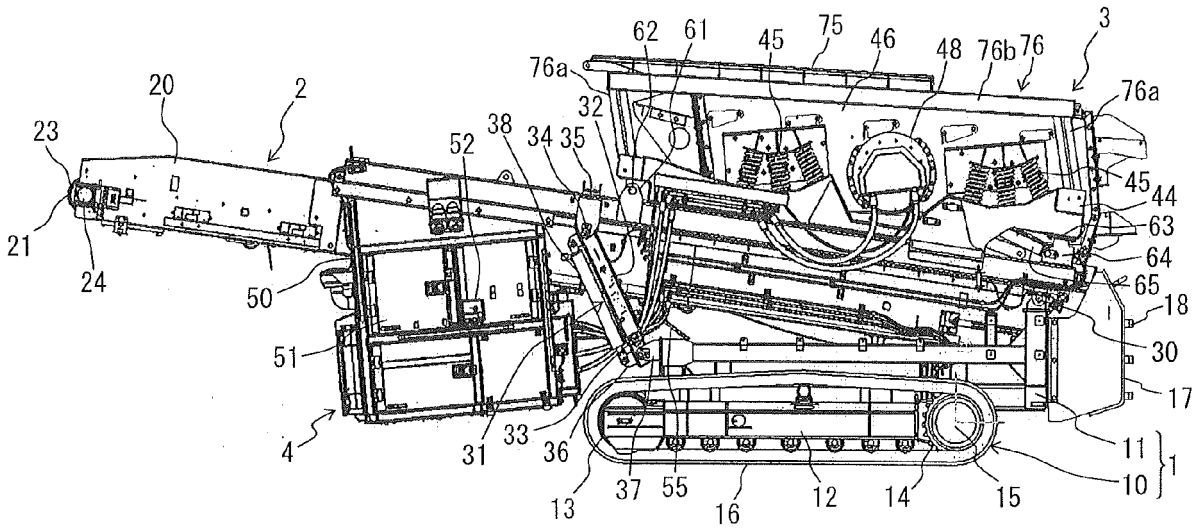
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Fig. 2

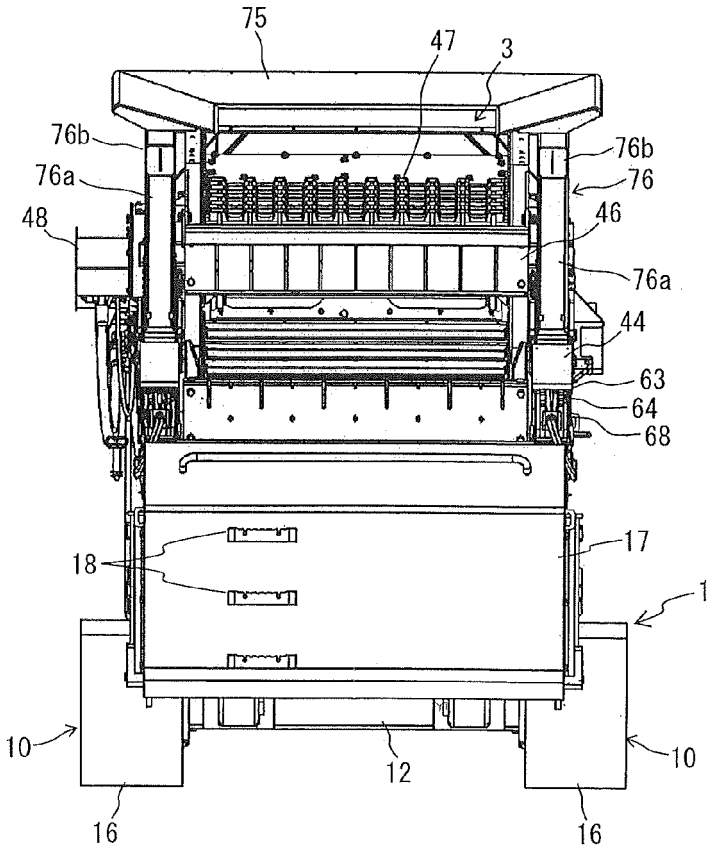
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Fig. 3

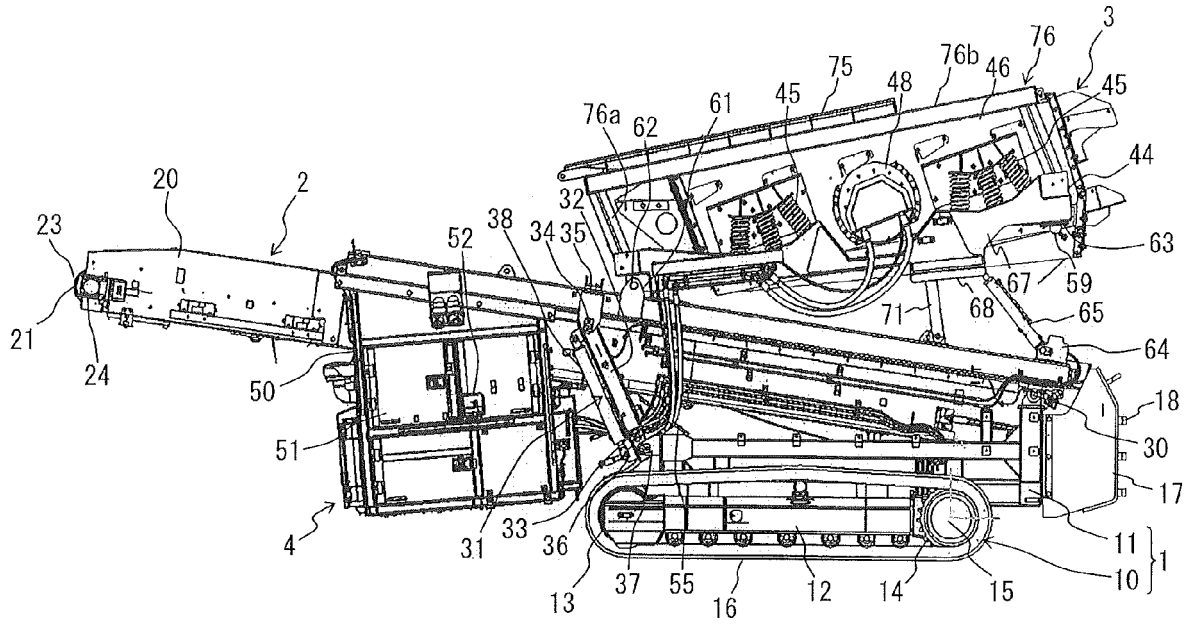
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Fig. 4

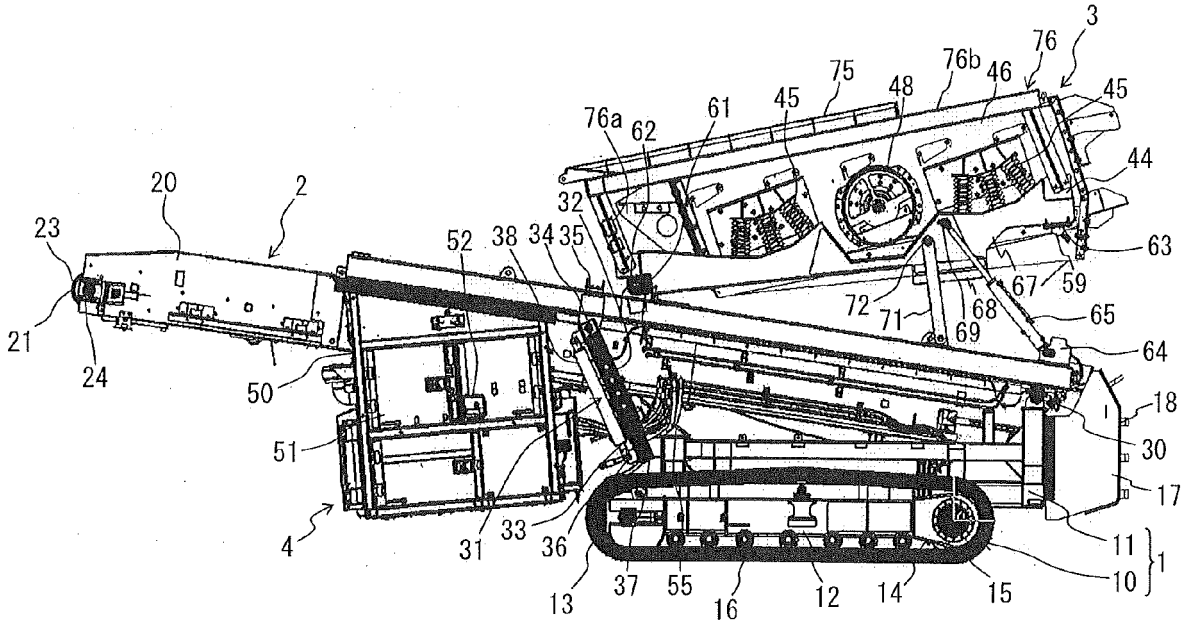
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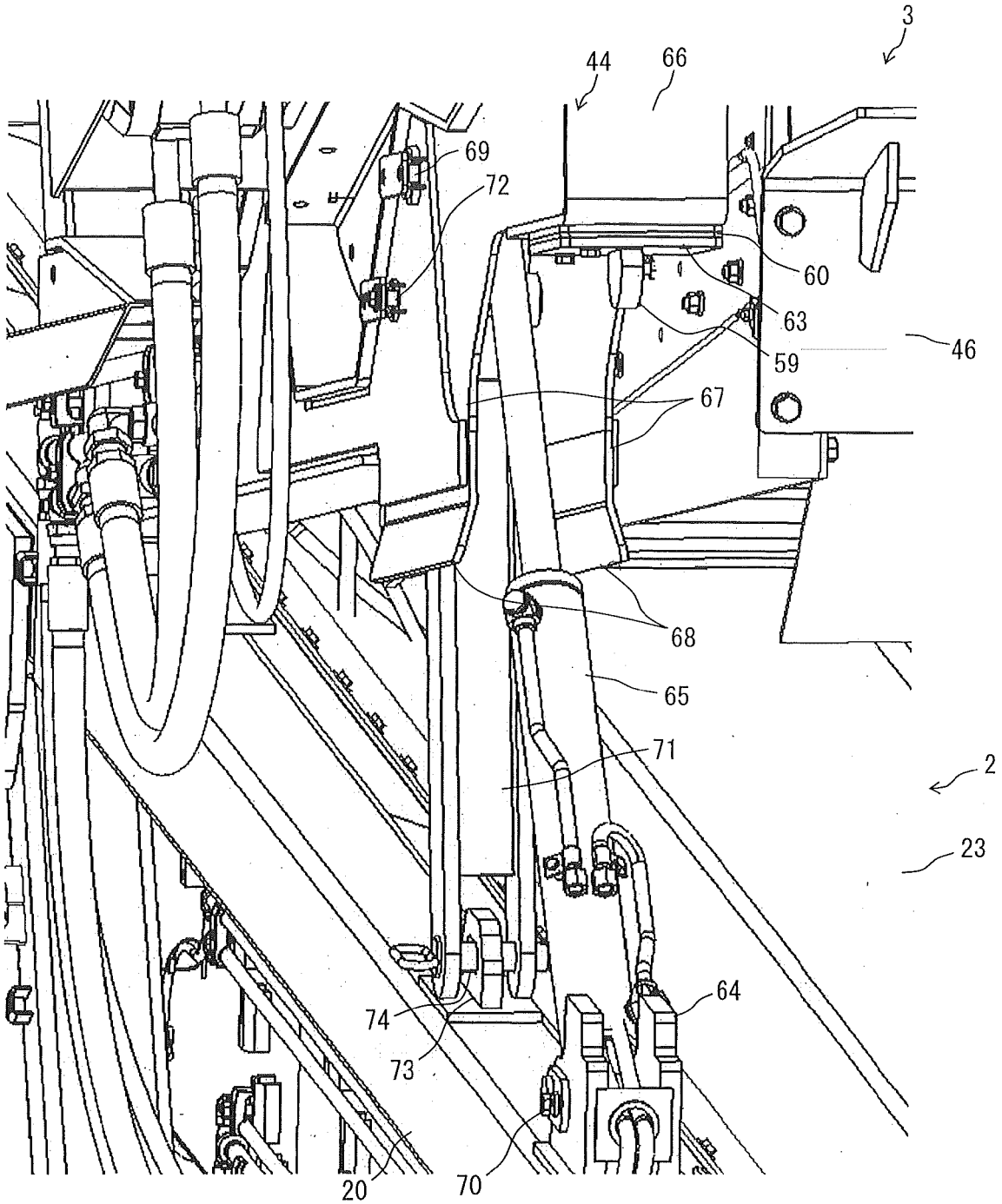
Fig. 5



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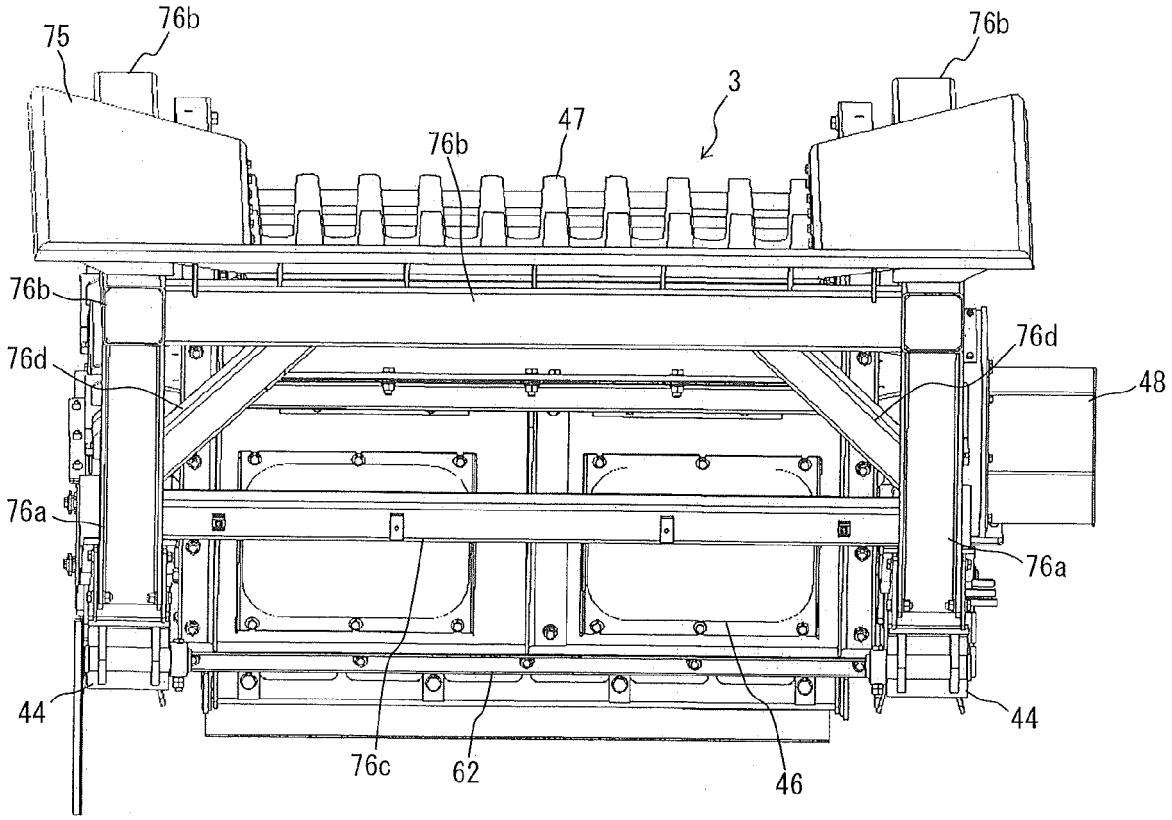

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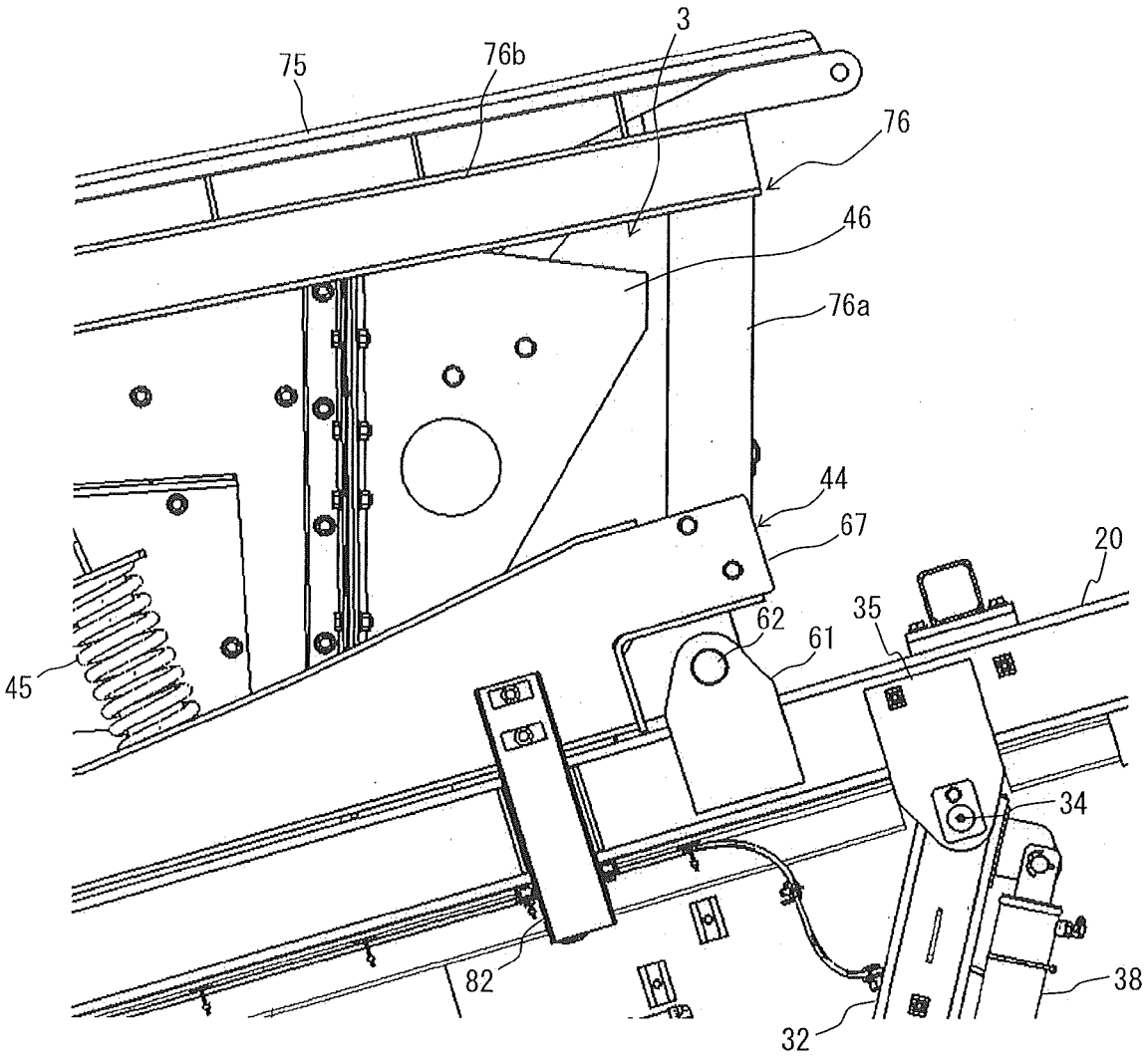

Fig. 8

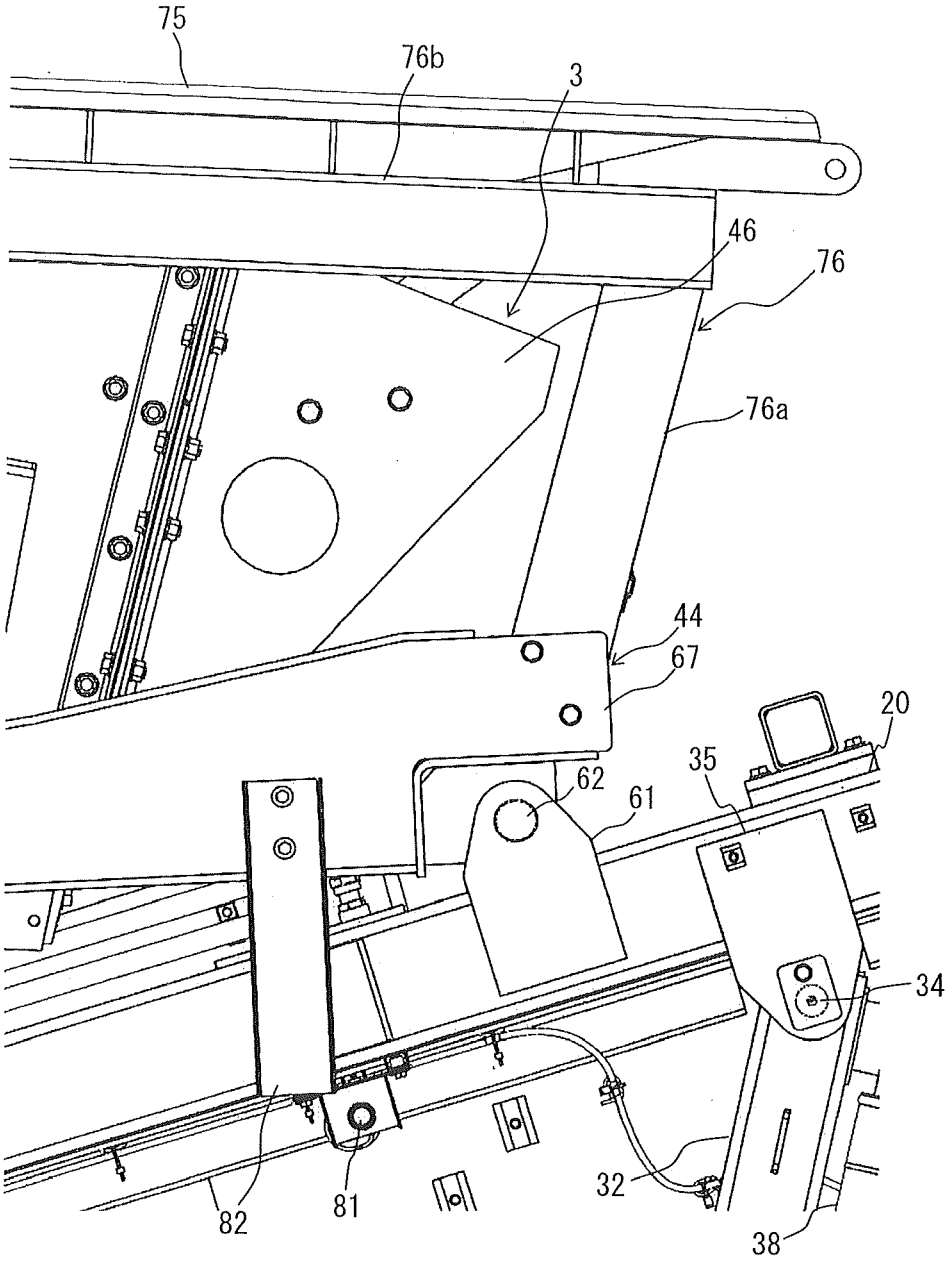

Fig. 9

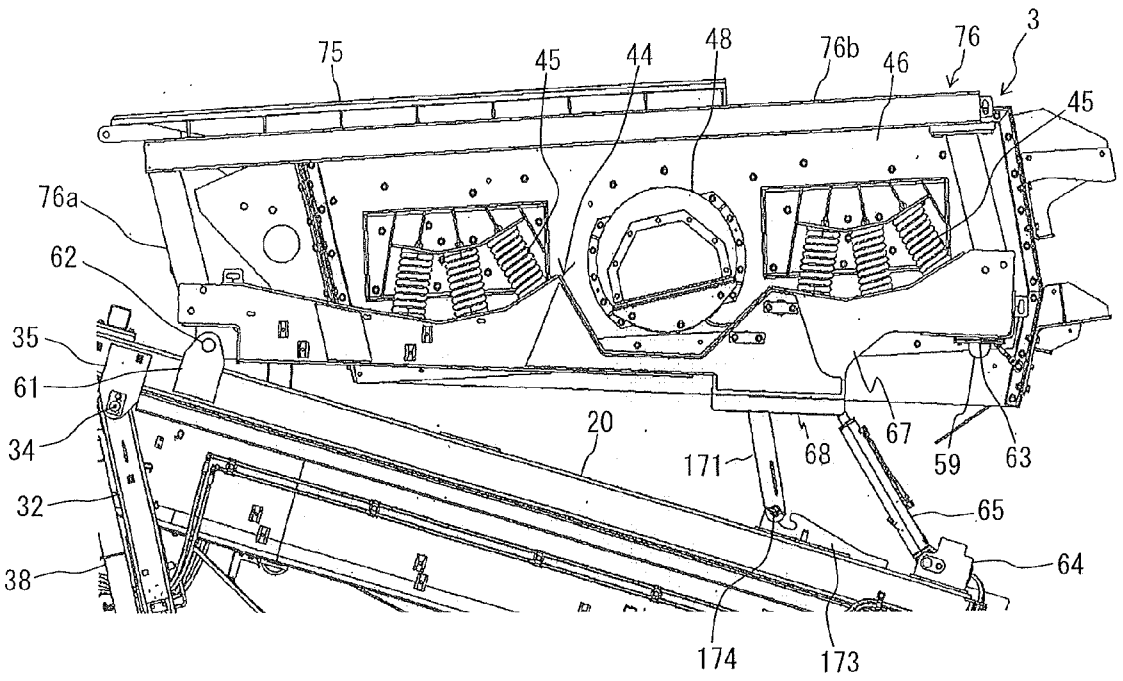
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Fig. 10

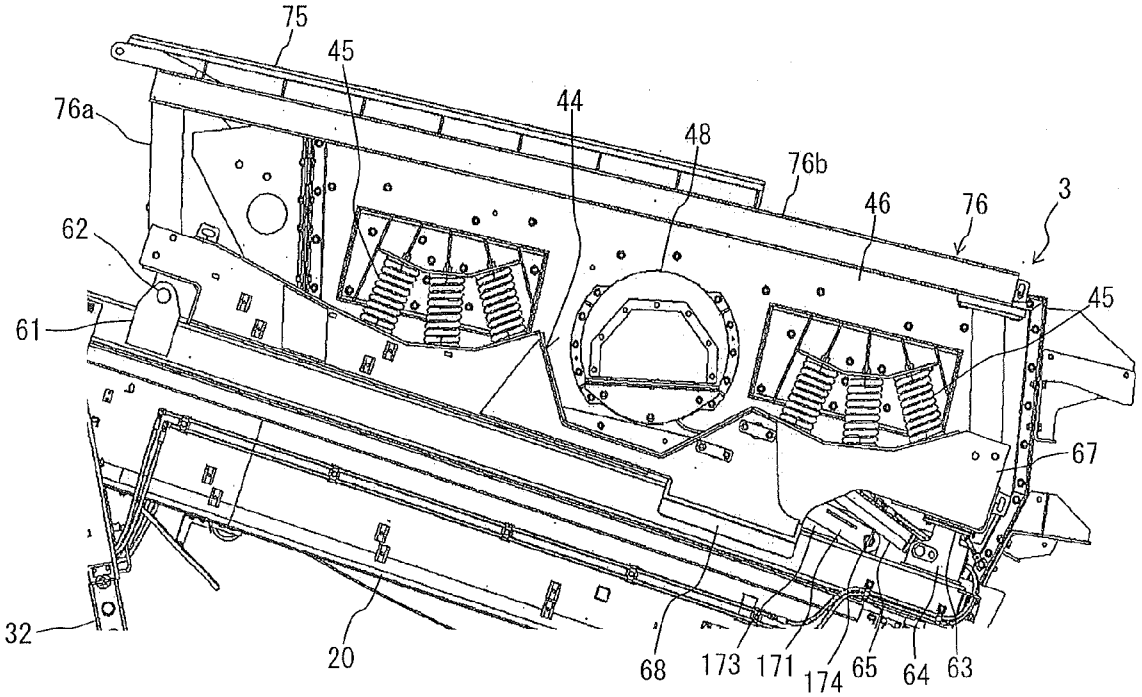
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Fig. 11

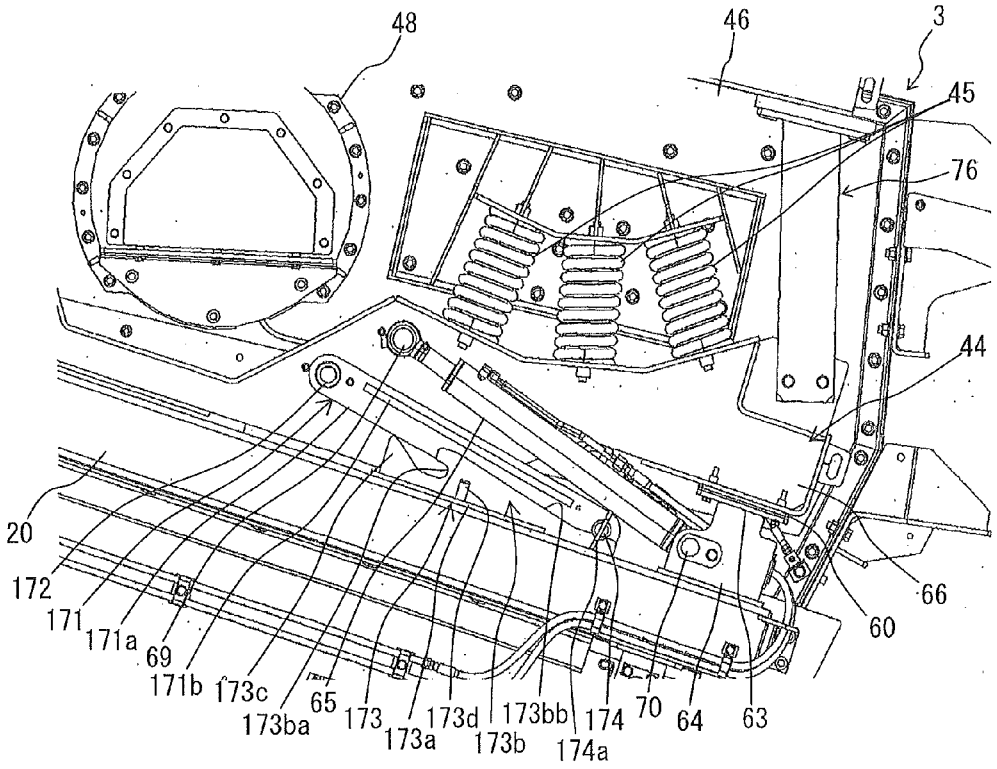
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Fig. 12

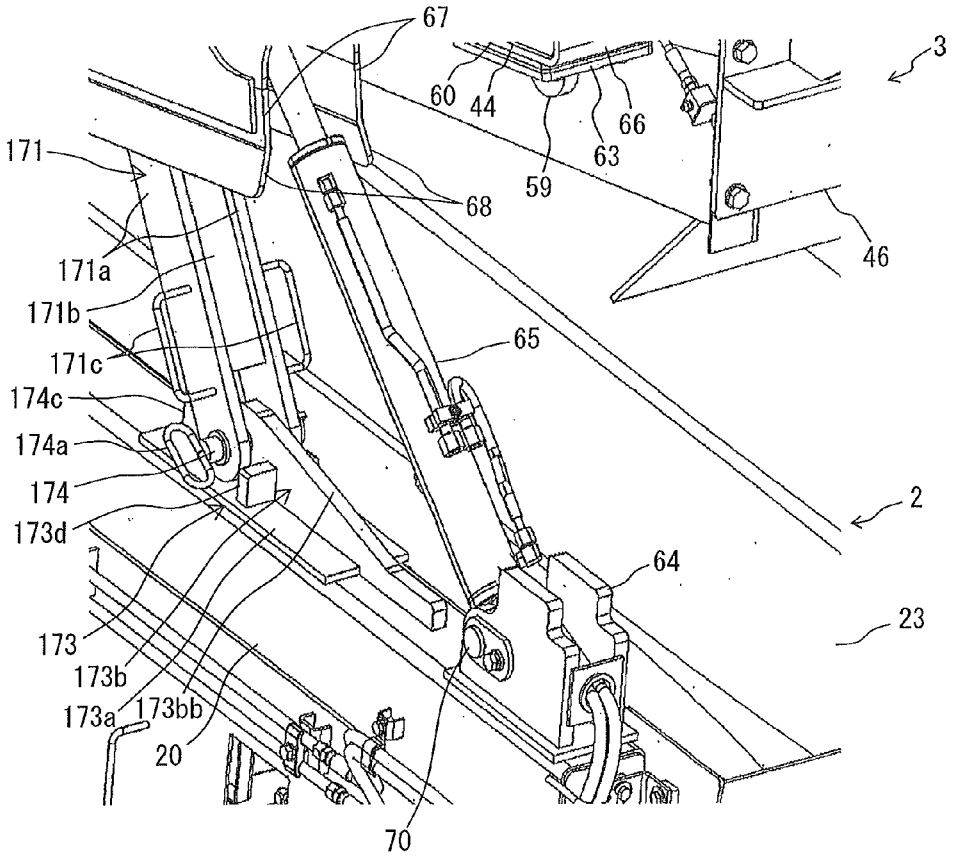
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Fig. 13

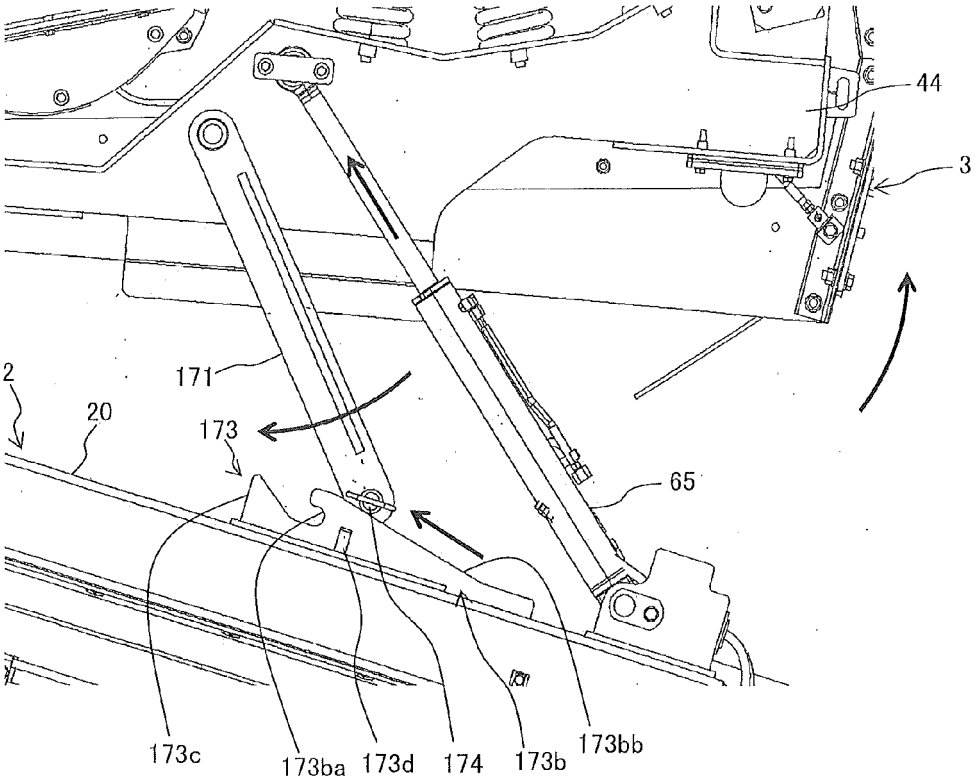
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Fig. 14

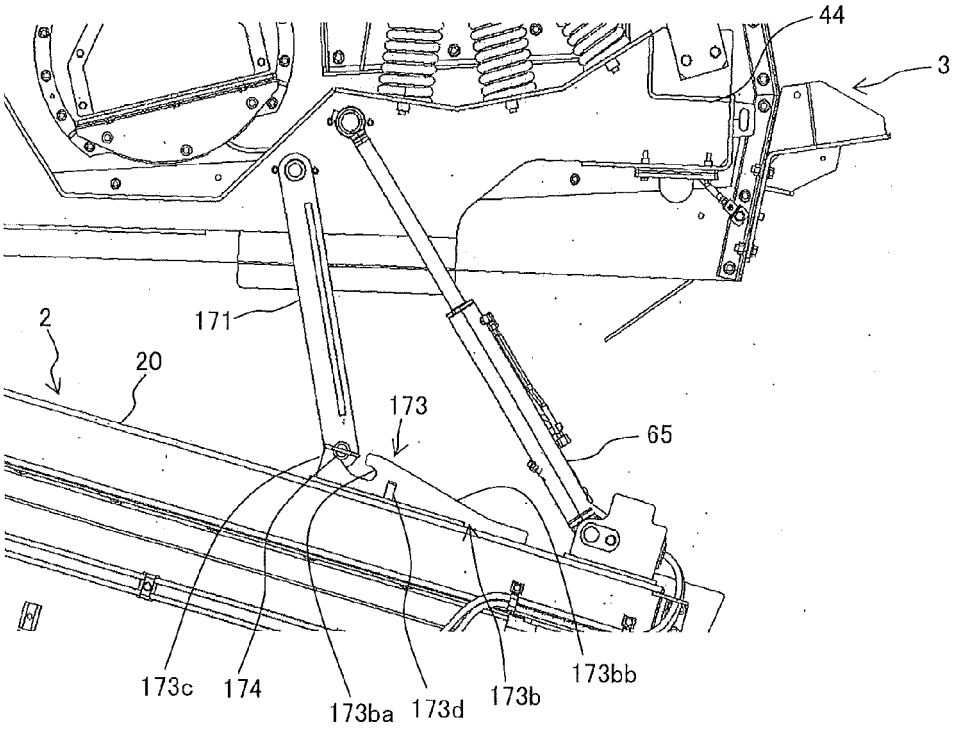
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Fig. 15

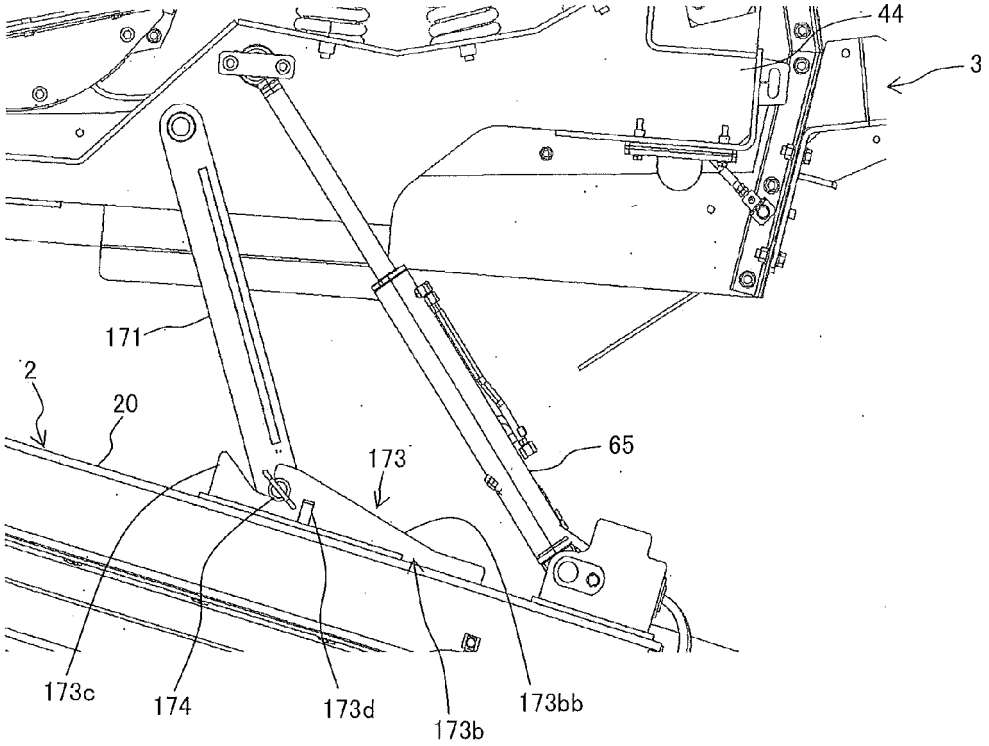
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Fig. 16

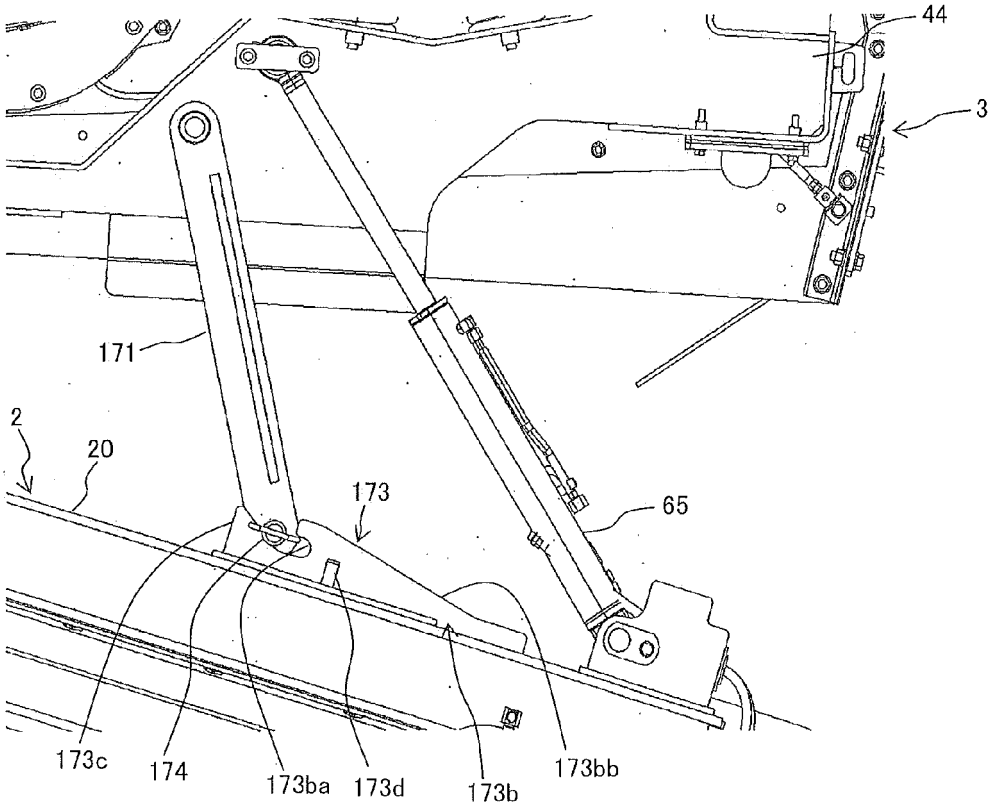
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Fig. 17

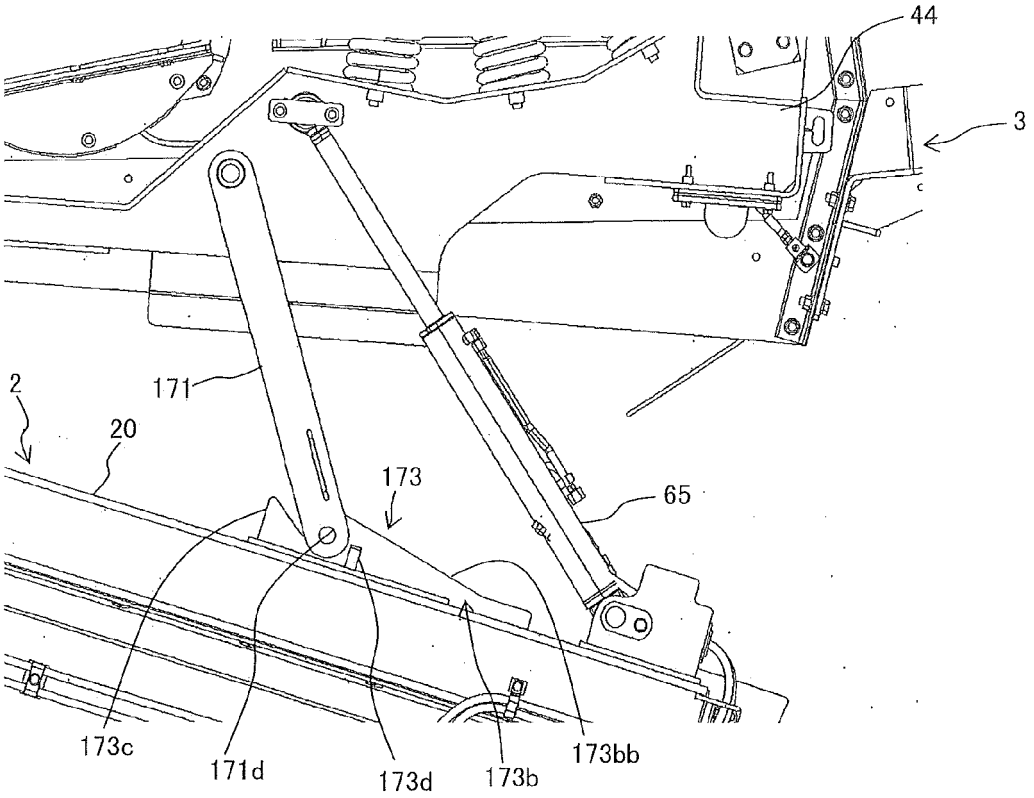
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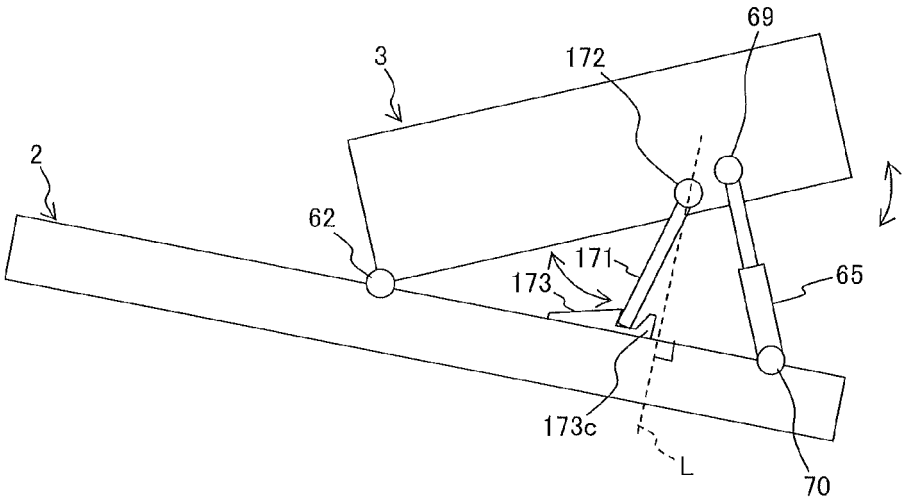
Fig. 18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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 307503 A **[0003] [0004]**
- JP 2009044490 A **[0005]**