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(54) A spreading device for a road-construction mass substance

(57) The invention relates to a spreading device (10) for a road-construction mass substance, which is intended to be used as an accessory to a work machine (14), and which includes
- a front frame (16) and a rear frame (18) connected to each other arranged to form a feed silo (20) for the road-construction mass to be spread,
- a throat opening (22) between the front frame (16) and the rear frame (18),
- a blade (24) fitted to the said rear frame (18),
- carrier wheels (28) articulated to the front frame (16), and
- a coupling (30) articulated to the rear frame (18),
- operating devices (38, 40) for adjusting the layer thickness of the road-construction mass to be spread.

The blade (24) is fitted to the said rear frame (18) vertically to its end next to the front frame (16), and in connection with the said blade (24) is a fine-adjustment operating device (40) for the fine adjustment of the height of the blade (24) during the spreading of the road-construction mass.

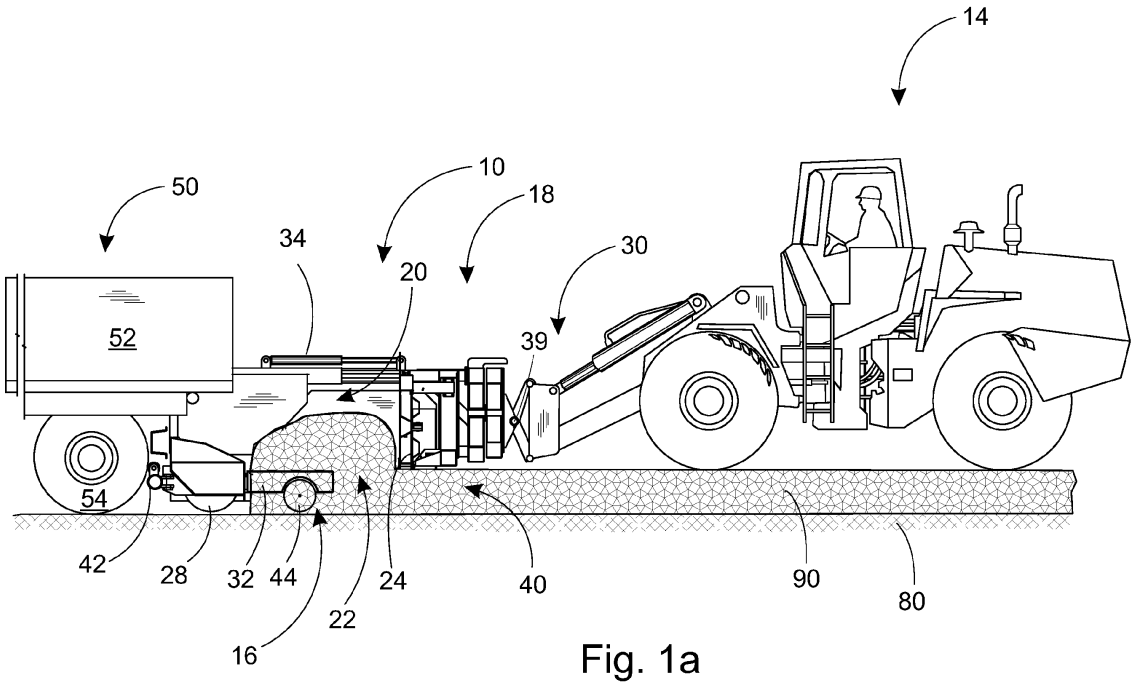

Fig. 1a

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Description

[0001] The present invention relates to a spreading device for a road-construction mass substance, which is intended to be used as an accessory to a work machine, and which includes

- a front frame and a rear frame connected to each other arranged to form a feed silo for the road-construction mass to be spread,
- a throat opening between the front frame and the rear frame,
- a blade fitted to the rear frame,
- carrier wheels articulated to the front frame, and
- a coupling articulated to the rear frame.
- operating devices for adjusting the layer thickness of the road-construction mass being spread.

[0002] In road construction and renovation, an important work stage is the spreading of the load-bearing layer. The load-bearing layer usually consists of a suitable grade of gravel, crushed stone, or other soil. If the spreading of the load-bearing layer is unsuccessful, the road structure will be insufficiently durable, and it will not meet the requirements set for the structure.

[0003] The prior art is represented by the spreader pushed by a work machine, which is attached in place of the bucket of the work machine, and which is disclosed in Finnish patent FI 92944. In this spreader, the layer thickness of the road-construction mass being spread is regulated roughly with the aid of a blade set horizontally. Unevennesses in the base surface mean that the working depth of the blade must be changed actively, in order for the result to be an even surface. However, the horizontally set blade has a large surface area relative to the road-construction mass being spread, making it difficult to adjust the blade sufficiently rapidly according to surface profiles of the base surface while driving, due to the great resistance of the mass layer. The mass layer resists the rapid downwards-directed adjustment movement so powerfully that the vertical cylinders used for the adjustment lift the wheels of the front frame into the air. In other words, a horizontal blade is slow and imprecise in terms of adjustment properties.

[0004] The present invention is intended to create a road-construction mass spreader, with a faster and more precise adjustment than that of devices according to the prior art. The characteristic features of the present invention appear in the accompanying Claim 1.

[0005] This intention can be achieved by fitting the blade of the spreading device vertically to the rear frame, and including a fine-adjustment operating device in connection with the blade, in order to adjust precisely the height of the blade while the road-construction mass is being spread. In this connection, vertically can also mean that the blade is at an angle deviating slightly from the vertical, for example, at a 10-degree slant. The adjustment movement of the blade can then be directly vertical or parallel to the blade. The spreading device according to the invention includes a front frame and a rear frame connected to each other and arranged to form a feed silo for the road-construction mass being spread, a throat opening between the front frame and the rear frame, and a blade fitted to the rear frame. In addition, the spreader includes carrier wheels articulated to the front frame, an attachment counter-piece articulated to the rear frame, and operating devices for regulating the layer thickness of the road-construction mass being spread. The vertical blade together with the fine-adjustment operating device permit the rapid adjustment of the blade height according to the shape of the surface of the road bed being surfaced, because the mass layer being spread only slightly resists the movements of the vertical blade.

[0006] The front frame preferably includes at least one rough-adjustment operating device to adjust the height of the front frame, with the aid of which the rough adjustment of the height of the blade of the spreader is arranged to take place. With the aid of the rough and fine-adjustment operating devices, the height of the spreader blade can be adjusted in two stages, which permits a precise adjustment.

[0007] The spreading device further preferably includes a spreading plough articulated to the front frame inside the throat opening, in order to prevent arching of the mass. The spreading plough can be articulated to be able to move. The spreading plough can include a support wheel to support the spreading plough against the base surface.

[0008] According to one embodiment, between the front frame and the rear frame there is at least one essentially horizontal throat operating device for adjusting the distance between the front frame and the rear frame and thus the throat opening. In addition, the spreading device can include adjustable side plates attached to the sides of the blade in the rear frame, for limiting the lateral spreading of the mass to the selected width. With the aid of the adjustment properties, the spreader is suitable for use with several different road widths and layer thicknesses.

[0009] According to one embodiment, the fine-adjustment operating device is located in the rear frame and arranged to adjust the height and degree of tilt of the blade.

[0010] According to one embodiment, the spreading device includes a buffer beam articulated in its centre in front of the front frame, in order to permit driving into a curve.

[0011] According to one embodiment, the spreading device is arranged to be pushed by a work machine. In that way, the heavy work machine will not disturb the soft road bed before the road-construction mass has been spread.

[0012] The operating devices are preferably arranged to perform the rough adjustment of the road-construction mass being spread with the aid of the rough-adjustment device, by adjusting the height of the front frame, and the

fine adjustment with the aid of the fine-adjustment device, by adjusting the height of the blade while driving, according to the base surface. The fine adjustment can be 10 - 30 %, preferably 15 - 25 % of the total adjustment margin. The total adjustment margin can be 30 - 65 cm, preferably 45 - 55 cm. In that case, the fine adjustment can be preferably 10 cm and the rough adjustment 40 cm.

[0013] According to one embodiment, a slot in the front frame for the towing hitch of a truck will permit a truck to be backed against the spreading device.

[0014] According to one embodiment, the coupling includes a pivot, to permit a difference of angle between the spreader and the work machine.

[0015] By means of the spreading device according to the invention, in which the thickness of the road-construction mass layer being spread can be adjusted by a rough adjustment and a fine adjustment, faster adjustment properties than those of devices according to the prior art can be achieved, thanks to which the stepless height adjustment of the blade can be used to implement the desired surface shape, irrespective of unevennesses in the base surface, so that the spread mass layer can be made flat and even. In other words, the use of the spreading device according to the invention avoids an undulating shape in the finished spread surface, which is very usual when using spreading devices according to the prior art. The two-stage height adjustment of the road-construction mass being spread permits the adjustment of several different variables, such as the size of the throat opening, the width of the surface being spread, and the height of the front frame, without the quality of the work suffering. With the aid of the good adjustment properties, it is also sought to achieve materials savings by means of better control of the mass layer being spread.

[0016] The structure of the spreading device according to the invention is also relatively light, so that the work machine used can be considerably lighter than the work machines that must be used when using spreading devices according to the prior art.

[0017] In the following, the invention is described in greater detail with reference to the accompanying drawings showing some embodiments of the invention, in which

Figure 1a	shows a side view of the spreading device according to the invention at the rear of a truck, when the height of the mass layer being spread is at a maximum,
Figure 1b	shows a side view of the spreading device according to the invention at the rear of a truck, when the height of the mass layer being spread is at a minimum,
Figure 1c	shows a side view of the spreading device according to the invention at the rear of a truck, when the blade adjustment is in the maximum position,
Figure 2	shows an axonometric view of the spreading device according to the invention seen from in front and from above,
Figure 3	shows a top view of the spreading device according to the invention,
Figure 4	shows an axonometric view of the spreading device according to the invention seen from the rear and from above,
Figure 5a	shows an axonometric view of the front and rear frames of the spreading device according to the invention,
Figure 5b	shows a side view of the front and rear frames of the spreading device according to the invention,
Figure 5c	shows a top view of the front and rear frames of the spreading device according to the invention,
Figure 6	shows an axonometric view of the spreading plough of the spreading device according to the invention,
Figures 7a - 7b	show axonometric front and rear views of the side walls of the spreading device according to the invention, and
Figure 8	shows an axonometric view of the blade of the spreading device according to the invention.

[0018] Figures 1a - 8 show one embodiment of the spreading device according to the invention. Figure 1a shows a side view of the spreading device 10 at the rear of a truck 50, when the height of the mass layer being spread is at a maximum. In Figure 1b, the height of the mass layer being spread is at a minimum, and in Figure 1c the blade adjustment is shown in the maximum position. The spreading device includes a front frame 16 and a rear frame 18, which, when connected to each other, form a feed silo 20 for the road-construction mass to be spread. Hereinafter, the road-construction mass will be referred to as the mass. An open opening, i.e. a throat opening 22, through which the mass flows out from the feed silo onto the base surface 80, remains between the front frame 16 and the rear frame. The mass flowing from the feed silo 20 is levelled with the aid of a blade 24 attached to the rear frame 18. The blade 24 is fitted vertically to the rear frame 18. Carrier wheels 28, on which the front frame 16 travels along the base surface 80, are articulated under the front frame 16. In this connection, the term base surface 80 is used to refer to the surface of the ground, on top of which the mass layer 90 is spread. The spreading device 10 is attached to the work machine 14 with the aid of a coupling 30 articulated to the rear frame 18 of the spreading device 10. The coupling 30 is preferably compatible with couplings according to the standard for work machines.

[0019] When using the spreading device 10, the spreading device 10 is first attached to the work machine 14, such as a front loader, in place of its bucket. Using the work machine 14, the spreading device 10 is pushed into contact with the rear wheel 54 of the truck 50 transporting the mass. Both the truck 50 and the work machine 14 with the spreading device 10 start moving and the platform 52 of the truck 50 is tilted, when the mass falls into the feed silo 20 of the spreading device 10. The mass flows from the feed silo 20 through the throat opening 22 to form a mass layer 90 on top of the base surface 80, which the blade 24 attached to the rear frame 18 scrapes to the selected thickness. The work machine 14 travels on top of the spread mass layer 90.

[0020] According to Figure 1a, the spreading device can include a buffer beam 42, which is articulated in the centre in front of the front frame 16, so that it permits driving into a curve. Figure 1a also shows the coupling 30, which is articulated to the rear frame 18 with the aid of a pivot 39. When raising the guides between the front frame 16 and the rear frame 18 with the aid of the rough adjustment, the rear frame 18 also rises. The rear frame is then temporarily articulated relative to the work machine at the pivot 39. The pivot 39 should be durable, as a great strain is placed upon during the spreading work. In the spreading work, the thickness adjustments of the mass layer being spread are preferably made only with the aid of the operating devices of the spreading machine 10. The front frame always travels on the base surface and the rear frame in the same position with the work machine on the spread surface.

[0021] Figure 2 shows an axonometric view of the spreading device. The spreading device 10 preferably includes a spreading plough 32 articulated inside the throat opening 22 in the lower part of the feed silo 20 of the front frame 16, in order to prevent arching of the mass. The task of the spreading plough 32 articulated to the front frame 16 by means of a pivot shaft 43 (Figure 6) is also to assist the mass to travel to the side from the centre of the throat opening 22, without causing resistance to the movement of the mass. The spreading plough 32 can be articulated to be able to move. The spreading plough 32 can include a carrier wheel 44 to support the spreading plough against the base surface 80. The spreading plough 32 travels along the base surface 80 carried by the carrier wheel 44. The carrier wheel 44 can be seen more clearly in Figure 4. When the carrier wheel 44 encounters various unevennesses in the base surface 80, the spreading plough 32 rises and falls in accordance with the unevennesses. This causes a pumping action in the spreading plough 32, which prevents the mass from becoming packed, i.e. arching in the feed silo 20.

[0022] The shaping of the feed silo 20, and the spreading plough 32 seek to reduce the separating of the crushed stone, which can occur in the spreading device 10. Separation will result in the rougher material trying to roll over the surface and collect and form a barrier to the throat opening. Separation is also detrimental to the quality of the work.

[0023] According to Figure 3, the front frame 16 is connected to the rear frame 18 with the aid of guides 29. According to one embodiment, at least one horizontally placed throat operating device 34 is inserted between the front frame 16 and the rear frame 18, in order to adjust the throat opening 22 by moving the front frame 16 horizontally relative to the rear frame 18. There is preferably one throat operating device at each side of the spreading device. The throat operating device 34 is attached at one end to the guide 29 attached to the rear frame 18 and at the other end to the front frame 16. The guides 29 can be seen more clearly in Figure 4. There are also corresponding guides between the beam 33 belonging to the rear frame 18 and the part 31 of the front frame 16, permitting the rear frame 18 to be raised with the aid of the rough-adjustment operating device 38. With the aid of the throat operating device, the distance between the front frame 16 and the rear frame 18 and also the capacity of the feed silo can be adjusted. The horizontal adjustment margin can be a total of about 50 cm.

[0024] When spreading the mass over the maximum working width of the spreading device, the amount of mass being fed should be larger, in order to achieve the desired layer thickness. With wider and thicker mass layers, the distance between the front frame and the rear frame can be kept greater, so that the mass will become thicker and it will be more sufficient for the sides of the spreading device. In spreading devices of the prior art, there has been the problem that, at maximum width, insufficient mass is obtained, so that the layer thickness remains thinner. This problem is reduced, or even eliminated by the possibility of adjusting the throat opening to be smaller or larger.

[0025] Figure 4 also shows the adjustable side plates 36 belonging to the spreading device, attached to the rear frame 18 at the sides of the blade 24 for limiting the lateral spreading of the mass to the selected width. The side plates 36 are attached to extension plates 41, which can act at the same time as extensions of the blade 24, according to Figure 2. With the aid of the side plates 36, the working width of the spreading device 10 can be adjusted to as much as 2 m. The adjustment of the side plates 36 takes place with the aid of a widening operating device 47 (Figure 3). The side plates 36 include skirt plates 37, which run on the base surface 80 and keep the edge of the mass under control. The adjustable side plates are also useful in transportation, when lifting the spreading device, and when starting moving. The side plates 36 are preferably about 100 cm wider than the front and rear frames when spreading the mass, but in the transport position are closed in the rear frame 18, when the extension plates 41 (Figure 2) of the side plates 36 are folded behind the blade 24.

[0026] The front frame 16 of the spreading device preferably includes at least one rough-adjustment operating device 38, for adjusting the height of the front frame 16, according to Figure 4. The thickness of the mass layer

90 spread by the spreading device 10 is regulated by adjusting the height of the blade 24, preferably in two parts. Rough adjustment is performed by adjusting the height of the front frame 16 with the aid of the rough-adjustment operating device 38, when the rear frame 18 connected to the front frame 16 will rise by the same amount. When adjusting using the rough-adjustment operating device 38, the front frame 16, the carrier wheel 28, and the spreading plough 32 with its carrier wheel 44 form the front part, in relation to which the other parts of the spreading device, including the rear frame 18 move upwards. According to Figures 1a - 1c, the carrier wheels 28 and the carrier wheel 44 of the spreading plough 32 travel on the base surface 80.

[0027] For its part, the fine adjustment of the blade 24 is performed with the aid of the rear frame 18 and the blade 24, which can be adjusted using the fine-adjustment operating device 40 located in the rear frame 18. The blade 24 can be adjusted by 10 cm with the aid of the fine adjustment, and the height of the rear frame by 40 cm with the aid of the rough adjustment of the front frame. The total adjustment margin then becomes 50 cm. Figure 1c shows precisely the situation, in which the rear frame 18 is at its maximum height and the blade 24 is adjusted downwards to the maximum extent. Using the spreading device according to this embodiment, the thickness of the mass layer can be at a minimum 1 cm and at a maximum 40 cm. In practice, 50 cm is the limit of the layer thickness, which can, within approved limits, be spread at one time in connection with normal road building. Greater layer thicknesses, and through them also greater adjustment margins, can be possible in some embodiments of the spreading device, intended for special operations. In other words, the minimum and maximum values can vary according to different embodiments of the spreading device. By means of the fine-adjustment operating device 40, the height and tilt of the blade 24 can be adjusted. The blade 24, attached to the end wall 21, moves vertically in slots 23, according to Figure 3. The fine-adjustment operating device can include, for example, two hydraulic cylinders. The tilt of the blade can be adjusted by about 5°. The extensive adjustment margin permits comprehensive working properties for the spreading device, making it suitable for use in many different work situations.

[0028] The rough and fine adjustments form a combination of the adjustment of the height of the blade of the spreading device, which permits the precise and rapid stepless adjustment of the height of the blade continuously during mass spreading according to the shapes of the base surface, so that the end result is an even surface. The rough adjustment can be used to set the desired thickness of the mass layer being spread and the fine adjustment can be used while driving to ensure that the final surface will be even, despite unevennesses in the base surface. A simultaneous use of the rough adjustment and fine adjustment of the front frame can also be used while driving to adjust the layer thickness, particularly in the case of large changes. The rough adjustment can be used within some specific tolerance, for example, a tolerance of 5 cm. The fine adjustment is 10 - 30 %, preferably 15 - 25 % of the total adjustment margin. The total adjustment margin is 30 - 65 cm, preferably 45 - 55 cm. The control of the rough adjustment and fine adjustment is combined in such a way that the frame of the spreading device will remain nearly straight in all circumstances. The term operating device intended for adjusting height refers, in this connection, to the fine-adjustment operating device 40 and the rough-adjustment operating device 38.

[0029] Figures 5a - 5c show the front frame 16 and the rear frame 18 attached to each other. In the front frame 16, there is a groove 46 in the centre, which permits a truck to be backed against the spreading device, without the truck's towing hitch coming in contact with the front frame 16 of the spreading device (Figure 3). The dimensions of the spreading device can vary according to where it is used. The width of the front and rear frame of one embodiment is 3,2 m, the height about 1,2 m, the overall length of the spreading device with the throat opening in the minimum position 3,7 m, and the length of the throat opening at its minimum about 0,95 m.

[0030] Figure 6 shows the spreading plough 32 of the spreading device. The spreading plough 32 can have a triangular shape, so that it will spread the mass effectively. There is a hole 35 in the spreading plough for a carrier wheel, into which the carrier wheel is partly sunk, so that it will be better protected from the mass being spread flowing in from the sides. The spreading plough 32 is articulated to the front frame with the aid of a pivot shaft 43.

[0031] Figure 8 shows the blade 24 in greater detail. In the blade 24, there can be a blade strip 27, which can be changed when it wears. The blade strip 27 can be part of the blade 24. The thickness of the blade can be about 1 - 3 cm and it forms a wall delimiting the rear frame of the feed silo. The blade 24 is installed in a vertical attitude, so that the surface area of the blade 24 against the mass, when lowered, is considerably smaller than that of the blade of the prior art installed in a horizontal attitude. Thus, the resistance resisting the adjustment of the blade 24 is also considerably smaller, so that the height adjustment of the blade can be performed quickly and precisely. The blade 24 is attached to the rear frame 18 with the aid of the fine-adjustment operating device and the fine-adjustment operating device is, in turn, attached to the frame beams of the rear frame, which can be seen in Figures 1 - 3.

[0032] The adjustment operations of the spreading device are controlled using generally known technologies, for example, GPS, lasers, or tacheometry, so that the adjustment of the blade height takes place automatically according to the planned shapes. The adjustments can also be performed manually. The operating devices are preferably hydraulic cylinders, but they can also be other operating devices suitable for the purpose. For adjusting

the layer thickness, it is also possible to install, for example, a rod potentiometer, or ultrasound or laser devices, or some similar device, in which case the height adjustment of the layer thickness or surface will take place automatically using the work machine's own hydraulics.

[0033] Because the spreading device is attached in front of the work machine and is preferably pushed, the work machine can be any work machine with a hoist suitable for the purpose. Pushing the device also has the advantage that the truck need not drive on top of the mass layer being spread. With the aid of alterations, the spreading device can also be manufactured to be pulled.

[0034] A compacting roller wheel, which will pre-compact the spread mass, can also be installed in the spreading device after the rear frame.

[0035] Side scoops, which are used to connect the spreading device to the truck driving in front of it, can also be used in the spreading device.

[0036] The spreading device can be used primarily for the spreading of a road-construction mass, such as gravel or crushed stone, but it can also be used in other corresponding applications.

Claims

1. Spreading device (10) for a road-construction mass substance, which is intended to be used as an accessory to a work machine (14), and which includes

- a front frame (16) and a rear frame (18) connected to each other arranged to form a feed silo (20) for the road-construction mass to be spread,
- a throat opening (22) between the front frame (16) and the rear frame (18),
- a blade (24) fitted to the said rear frame (18),
- carrier wheels (28) articulated to the front frame (16),

and

- a coupling (30) articulated to the rear frame (18),
- operating devices (38, 40) for adjusting the layer

thickness of the road-construction mass to be spread,

characterized in that the said blade (24) is fitted to the said rear frame (18) vertically to its end next to the front frame (16), and in connection with the said blade (24) is a fine-adjustment operating device (40) for the fine adjustment of the height of the blade (24) during the spreading of the road-construction mass.

2. Spreading device according to Claim 1, **characterized in that** the said front frame (16) includes at least one rough-adjustment operating device (38) for adjusting the height of the front frame (16), with the aid of which the rough adjustment of the height of the blade (24) of the spreading device (10) is arranged to be performed.

3. Spreading device according to Claim 1 or 2, **characterized in that** the said spreading device (10) further includes a spreading plough (32) articulated inside the said throat opening (22) of the front frame (16), in order to prevent arching of the road-construction mass.

4. Spreading device according to Claim 3, **characterized in that** the said spreading plough (32) is articulated to be able to move.

5. Spreading device according to Claim 3 or 4, **characterized in that** the said spreading plough (32) includes a carrier wheel (44) for supporting the spreading plough (32) against the base surface (80).

6. Spreading device according to any of Claims 1 - 5, **characterized in that** there is at least one essentially horizontal throat operating device (34) between the said front frame (16) and rear frame (18) for adjusting the distance between the said front frame (16) and rear frame (18) and through that the said throat opening (22).

7. Spreading device according to any of Claims 1 - 6, **characterized in that** it includes adjustable side plates (36) attached to the said rear frame (18) at the sides of the said blade (24), for limiting the lateral spread of the road-construction mass to the selected width.

8. Spreading device according to any of Claims 1 - 7, **characterized in that** the said fine-adjustment operating device (40) is located in the rear frame (18) and is arranged to adjust the height and the tilt of the blade (24).

9. Spreading device according to any of Claims 1 - 8, **characterized in that** it includes a buffer beam (42) articulated to the front side of the front frame (16), in order to permit driving into a curve.

10. Spreading device according to any of Claims 1 - 9, **characterized in that** it is arranged to be pushed by the said work machine (14).

11. Spreading device according to any of Claims 2 - 10, **characterized in that** the said operating devices (38, 40) are arranged to perform the rough adjustment of the layer thickness of the road-construction mass being spread with the aid of the rough-adjustment operating device (38), by adjusting the height of the front frame (16) and the fine adjustment with the aid of the fine-adjustment device (40), by adjust-

ing the height of the blade (24) while driving, according to the base surface (80).

12. Spreading device according to any of Claims 1 - 11, **characterized in that** the said fine adjustment is 5 - 30 %, preferably 10 - 15 % of the total adjustment margin.

13. Spreading device according to Claim 12, **characterized in that** the said total adjustment margin is 30 - 120 cm, preferably 60 - 80 cm.

14. Spreading device according to any of Claims 1 - 13, **characterized in that** there is a groove (46) in the front frame (16) for the towing hitch of a truck, thus permitting a truck to back against the spreading device (10).

15. Spreading device according to any of Claims 1 - 14, **characterized in that** the said coupling (30) includes a pivot (39), in order to permit a difference of angle between the spreading device (10) and the work machine (14).

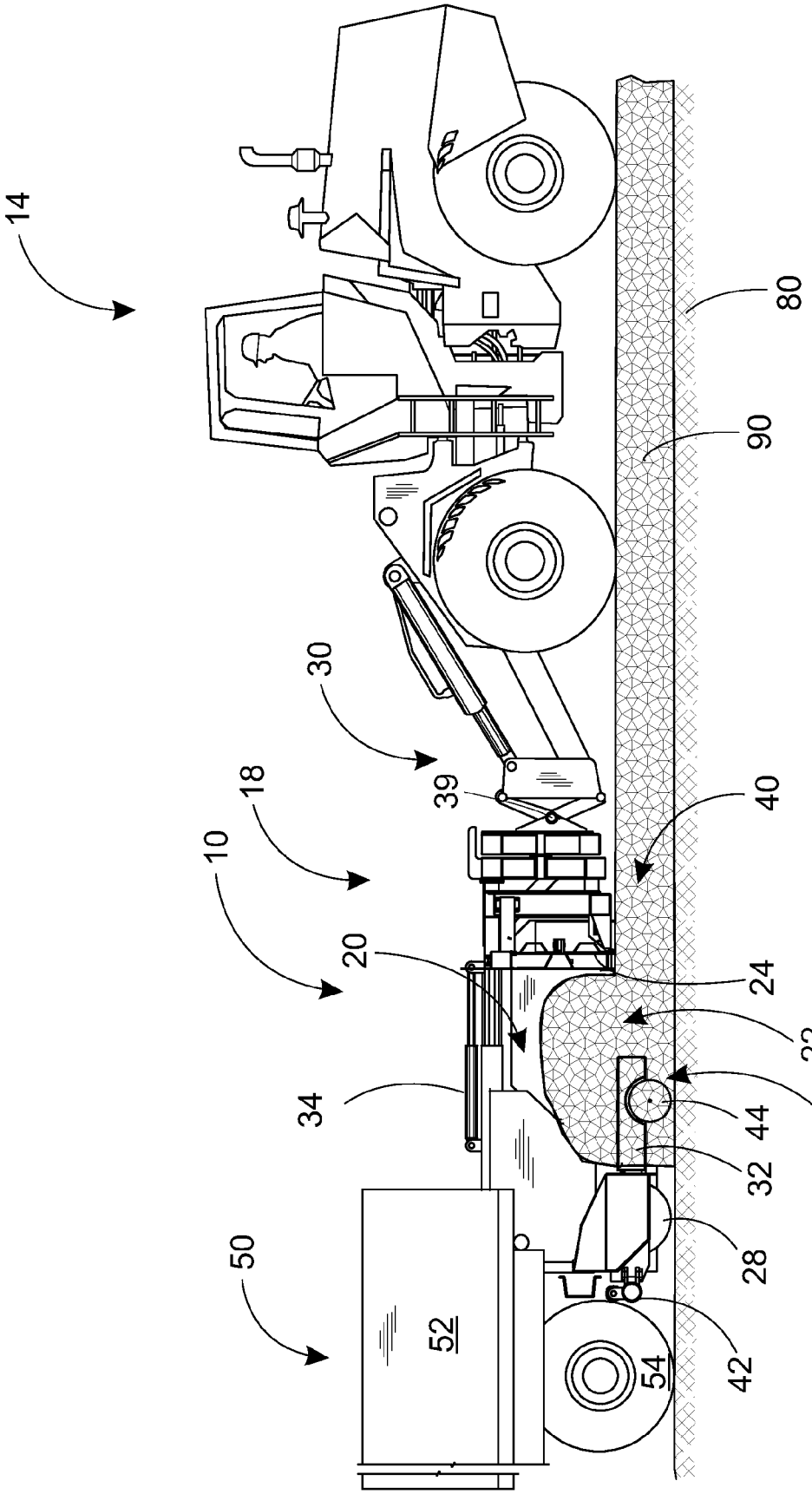

Fig. 1a

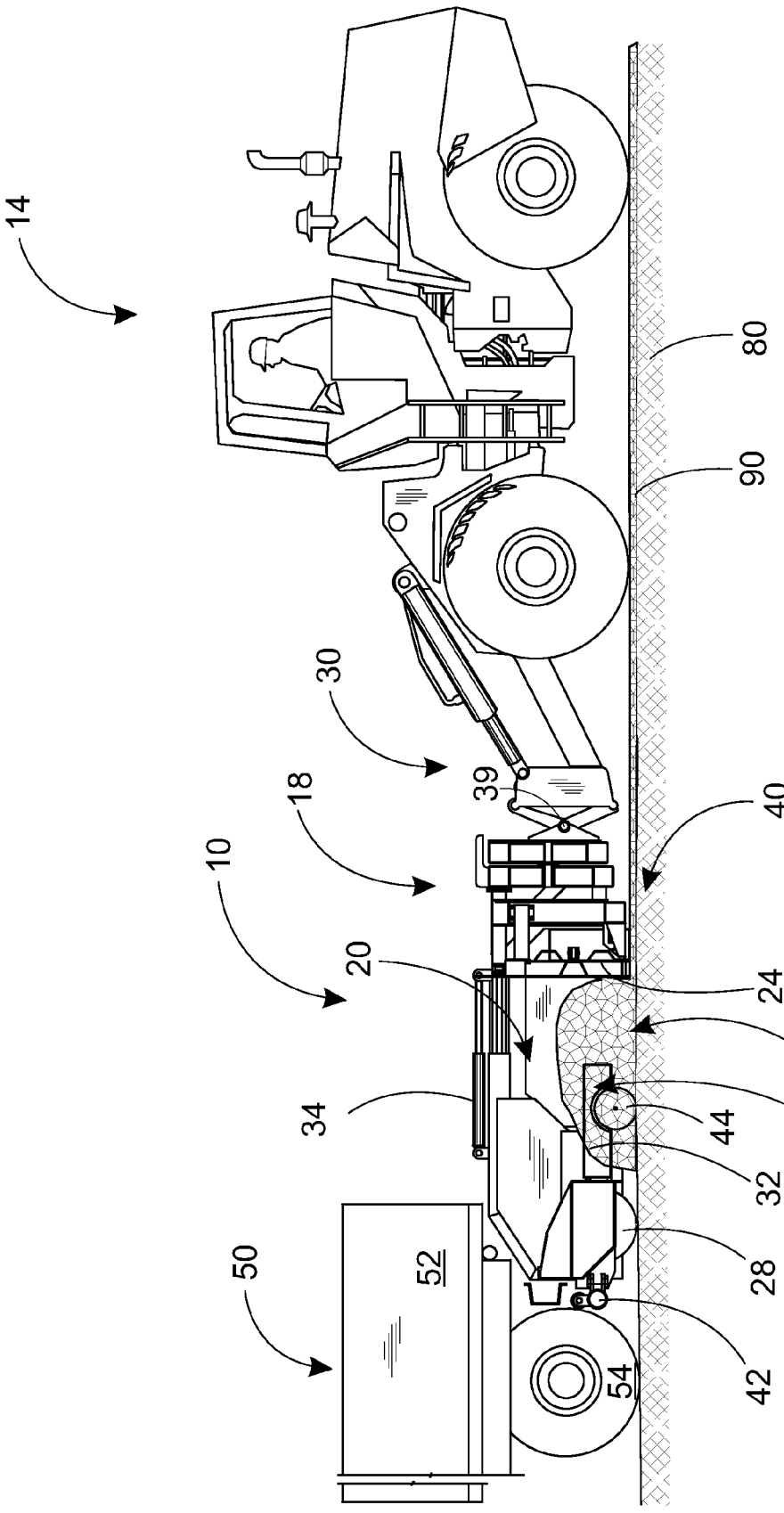

Fig. 1b

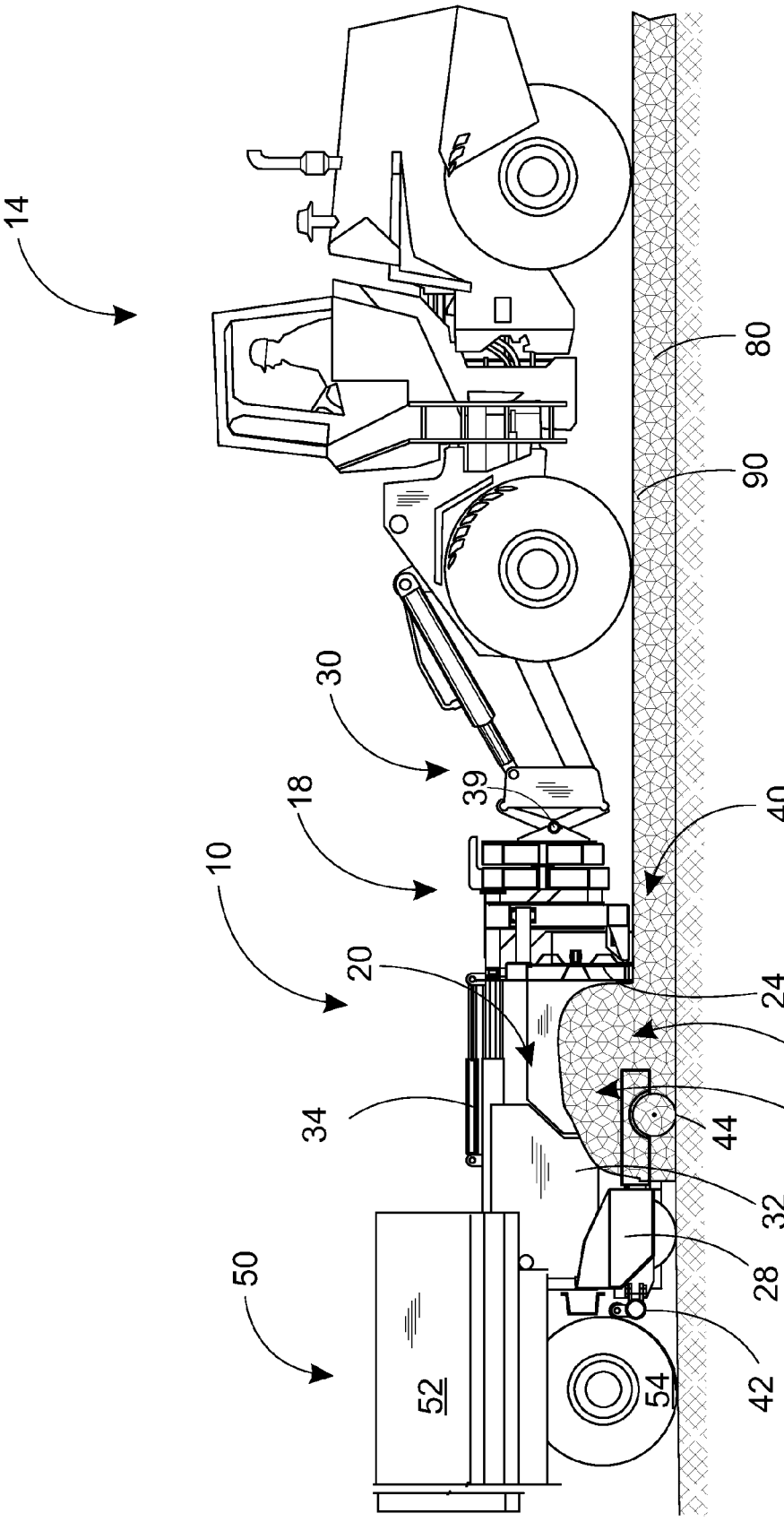

Fig. 1c

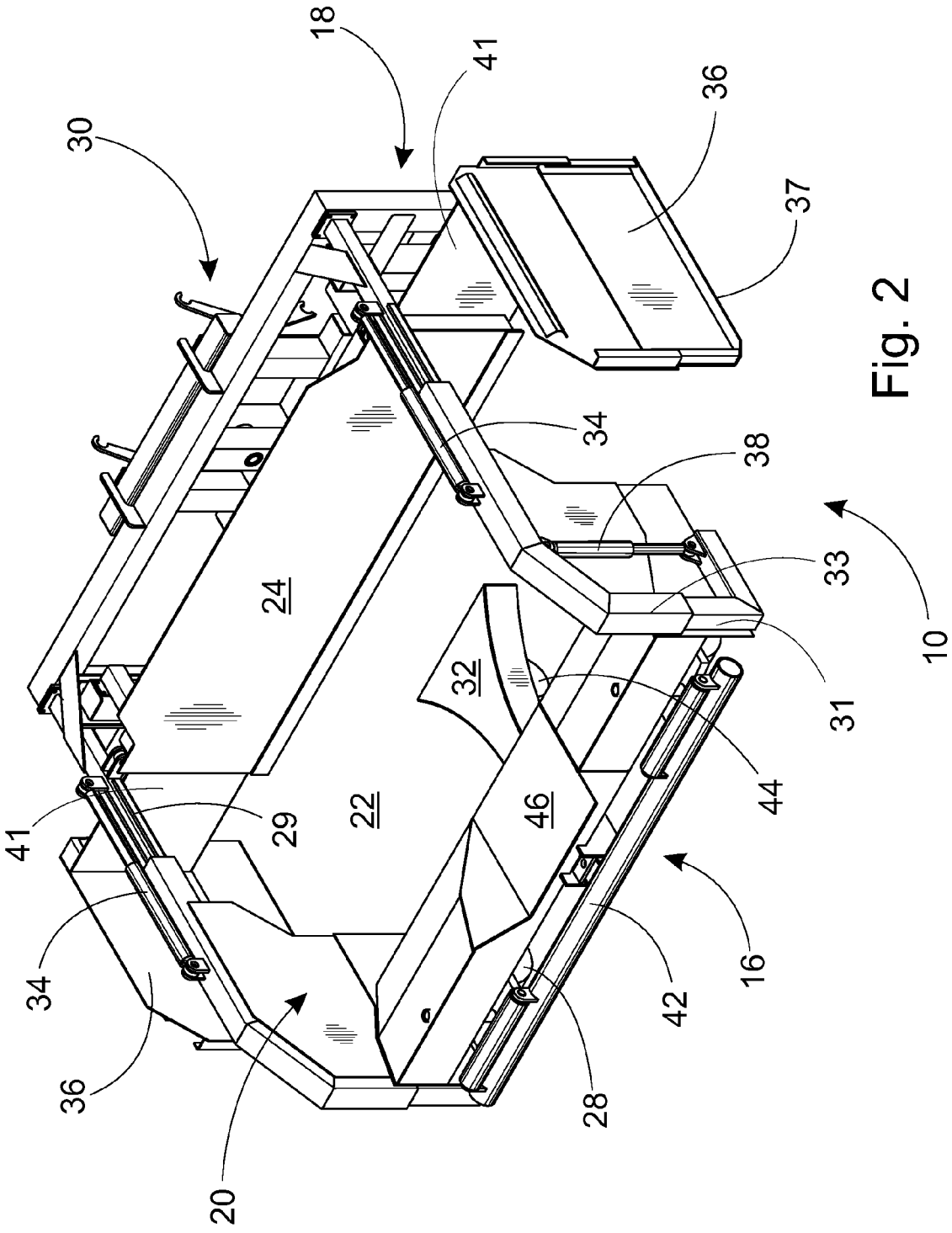

Fig. 2

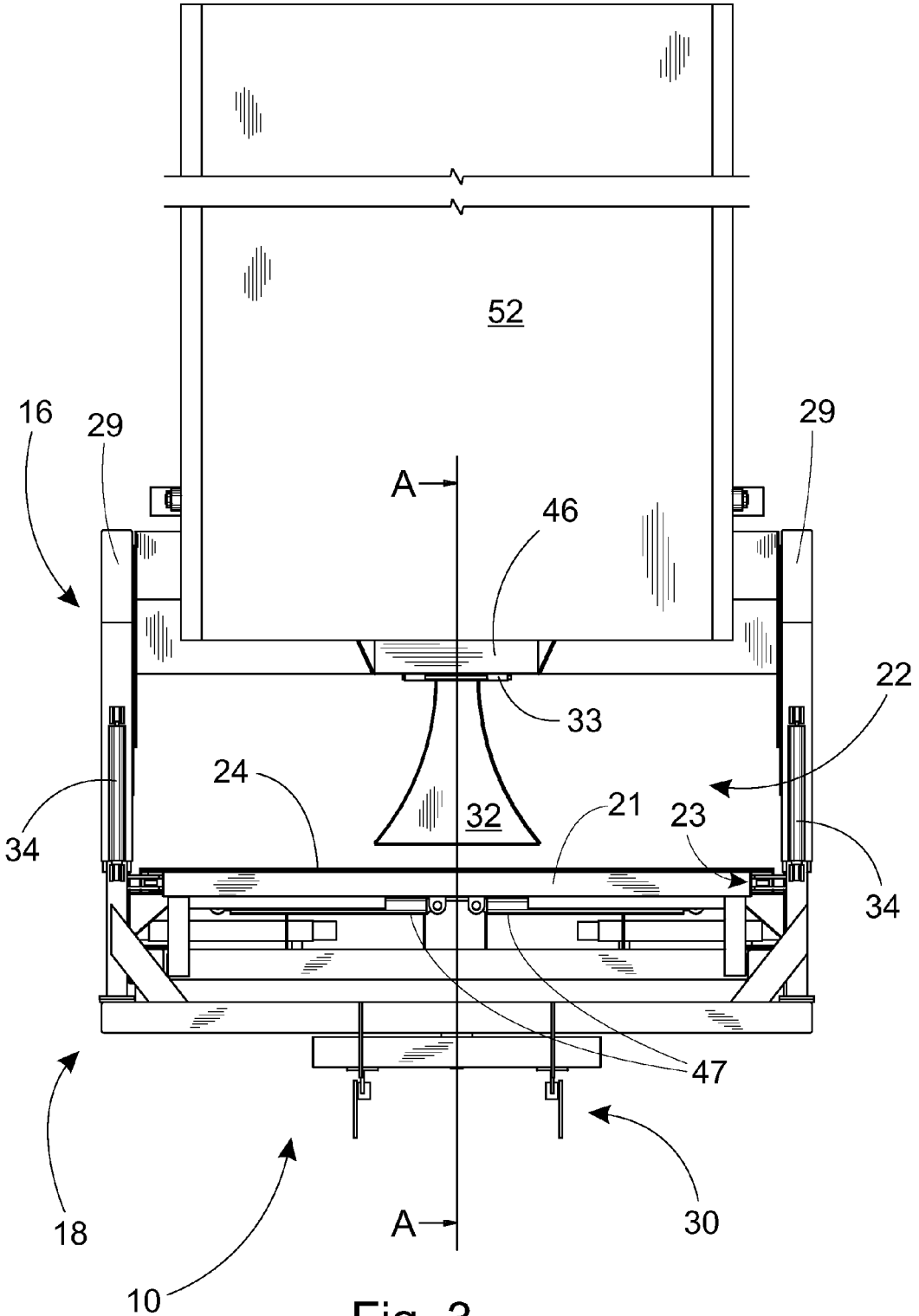

Fig. 3

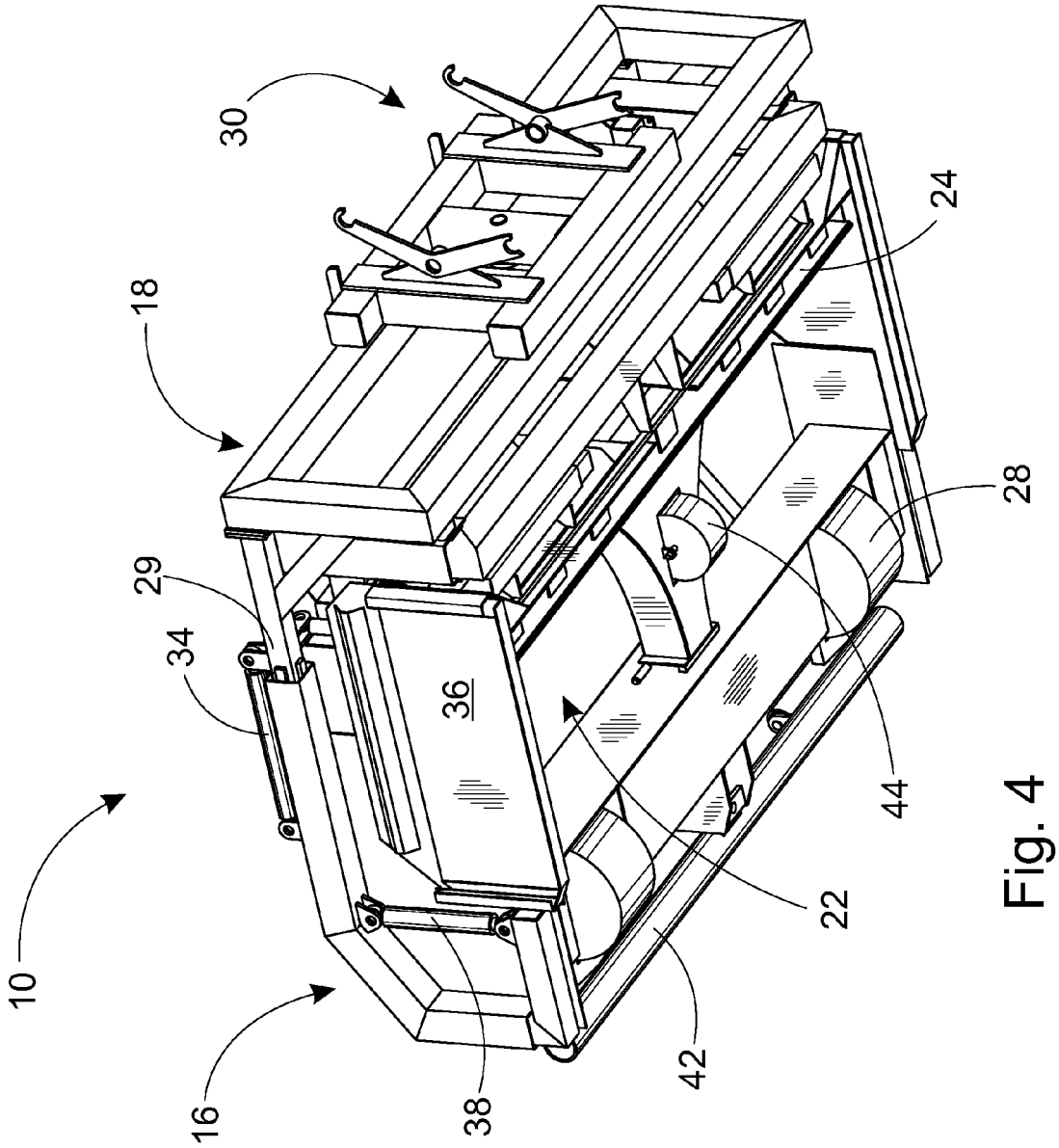

Fig. 4

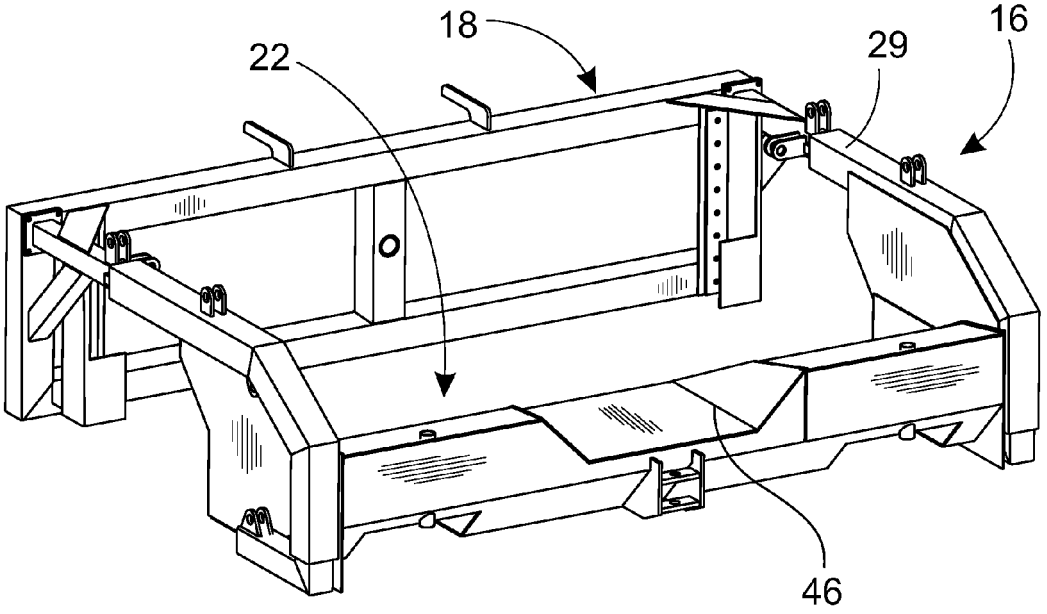

Fig. 5a

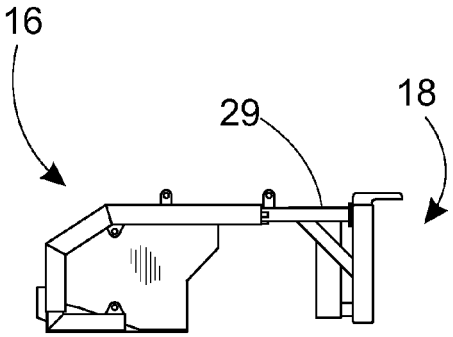

Fig. 5b

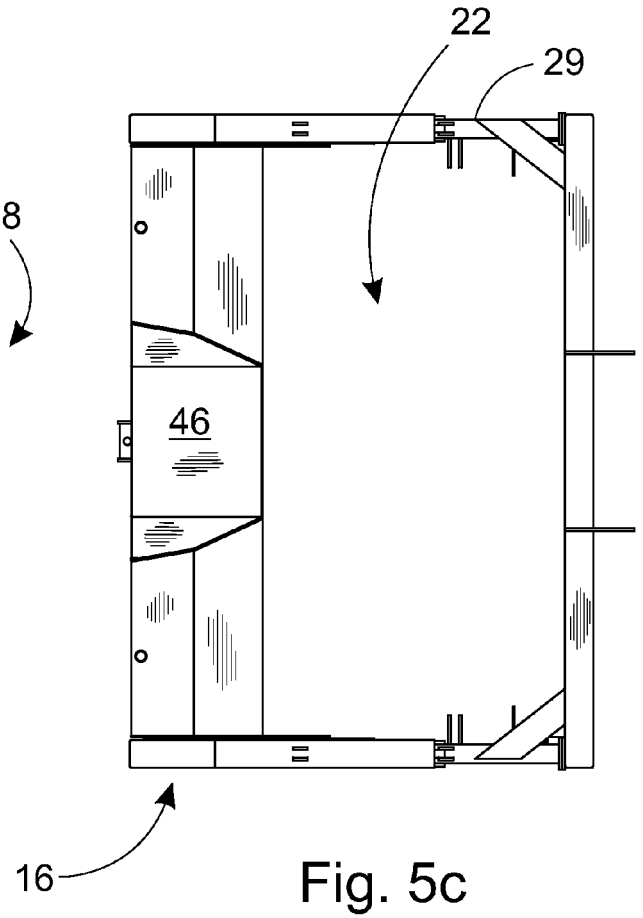

Fig. 5c

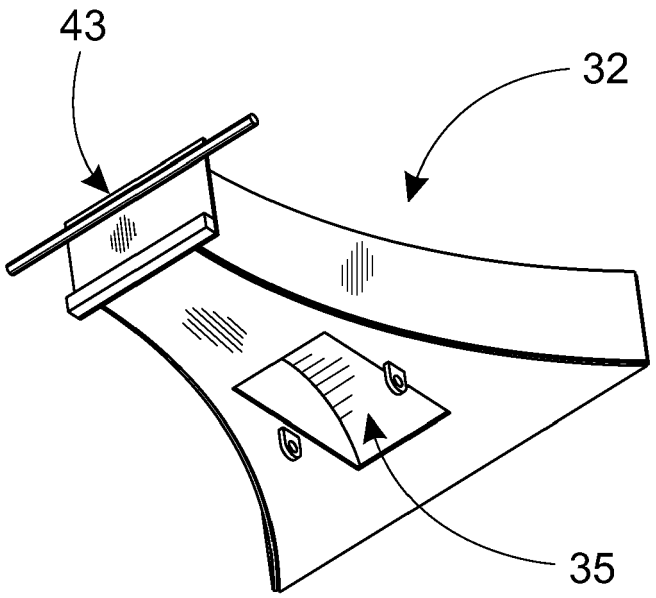

Fig. 6a

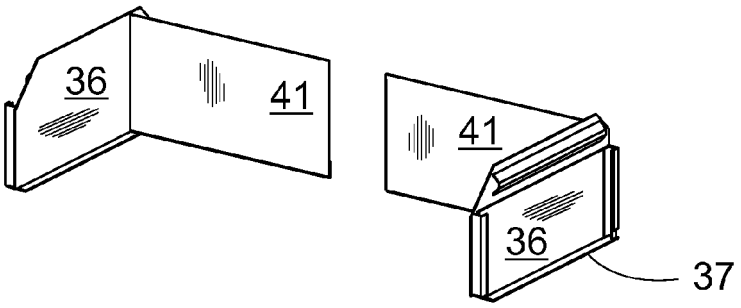

Fig. 7a

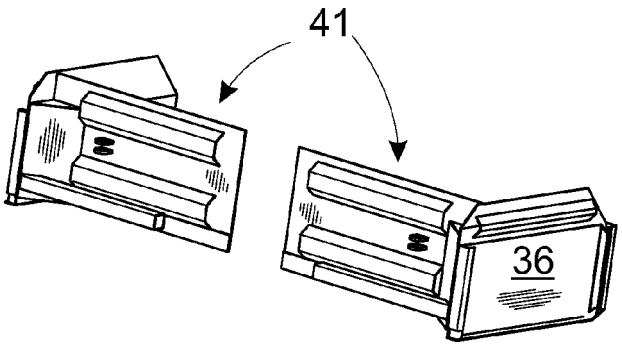

Fig. 7b

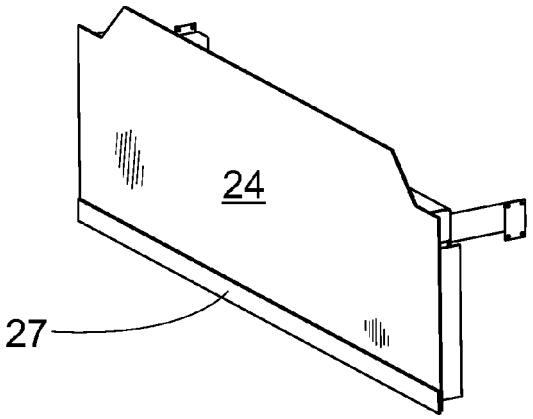

Fig. 8

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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