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(54) **MATERIAL HANDLING MACHINE**

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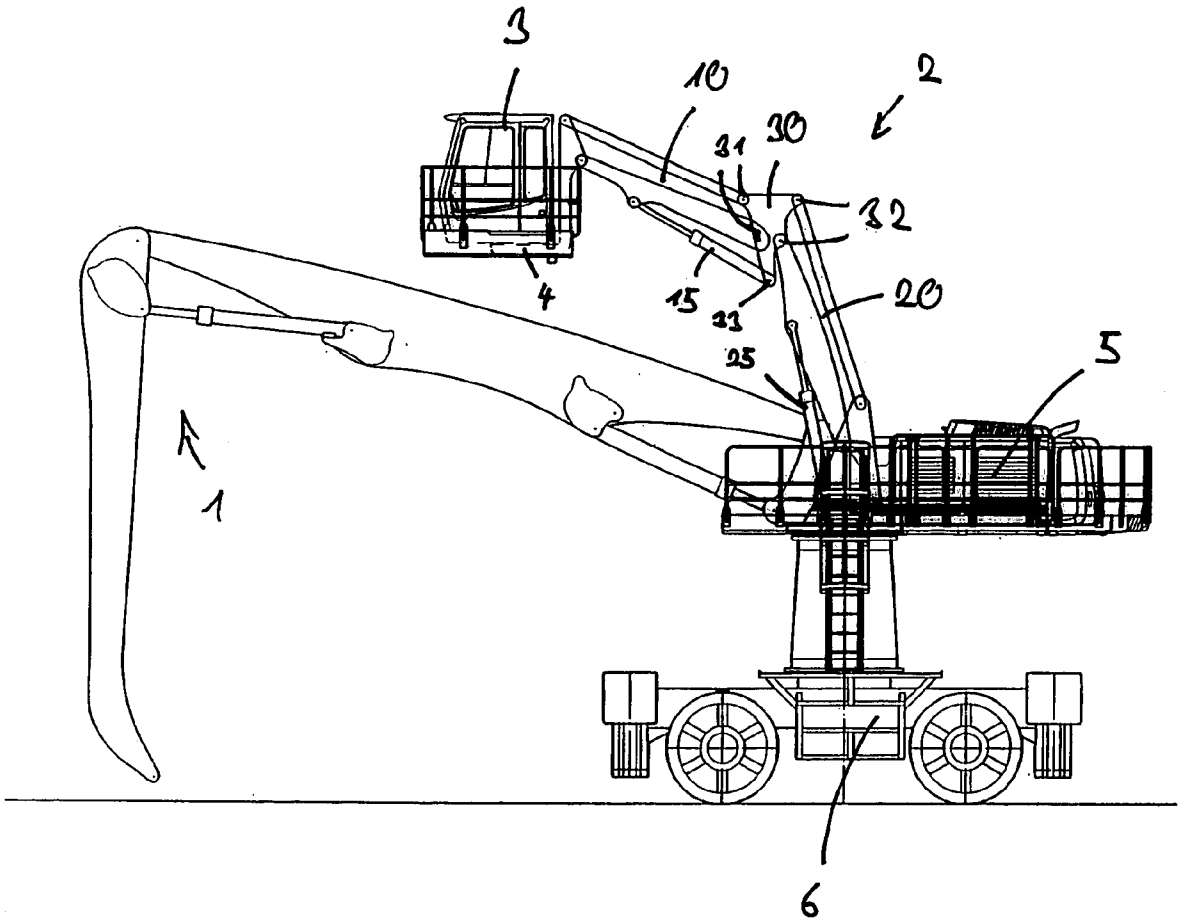
(57) **ABSTRACT**

The present invention relates to a material handling machine with a material handling boom and a cabin boom, wherein the cabin boom comprises first and second arms, which are pivotally connected with each other via a connecting element, and a first actuator for moving the first arm. In accordance with the invention, the actuator is pivotally mounted on the connecting element via a pivot point, which is disposed below the pivot point(s) of the first arm.



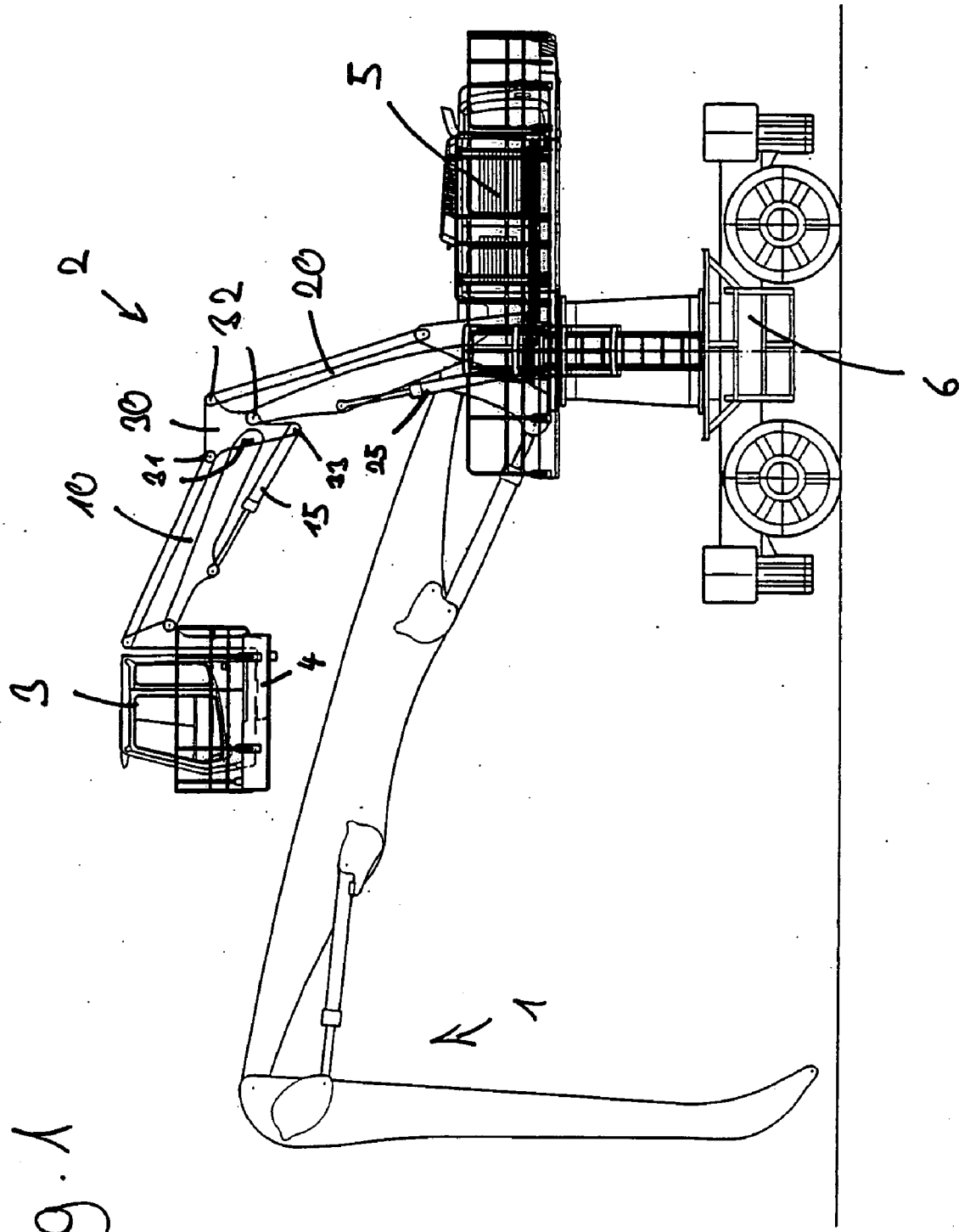


Fig. 1

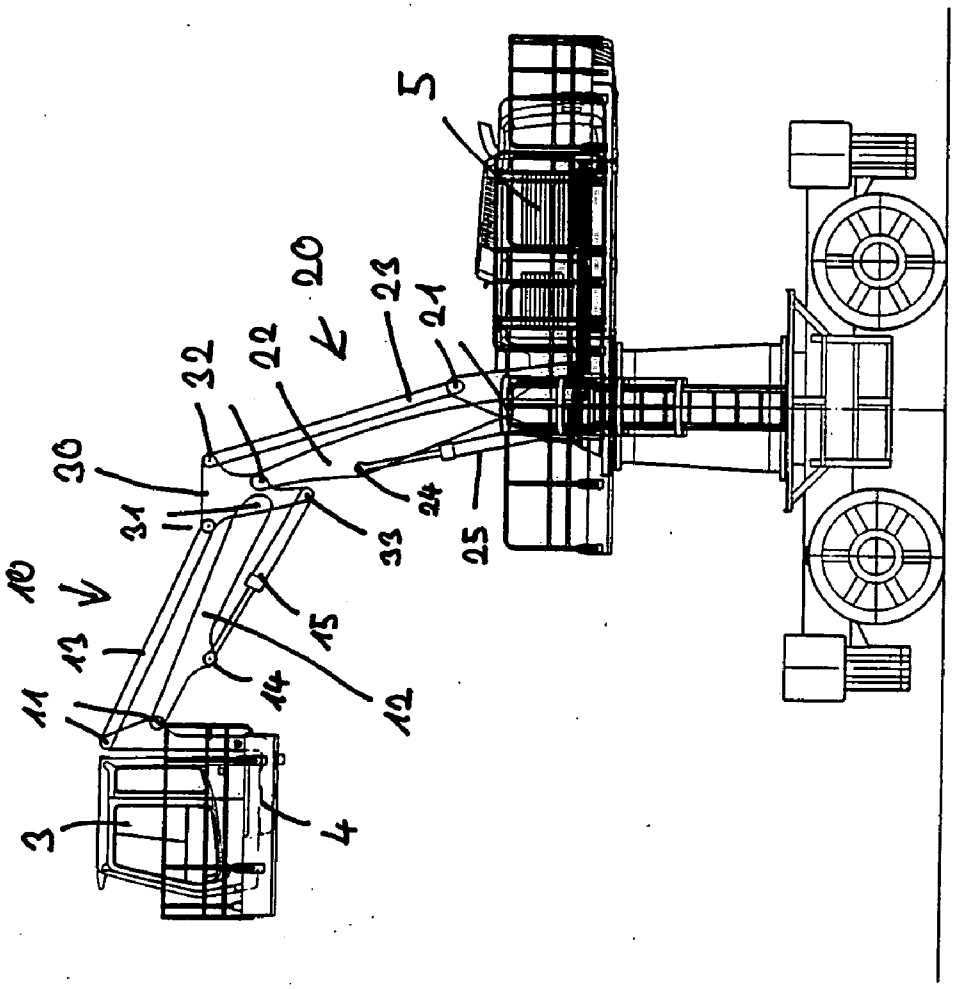


Fig. 2

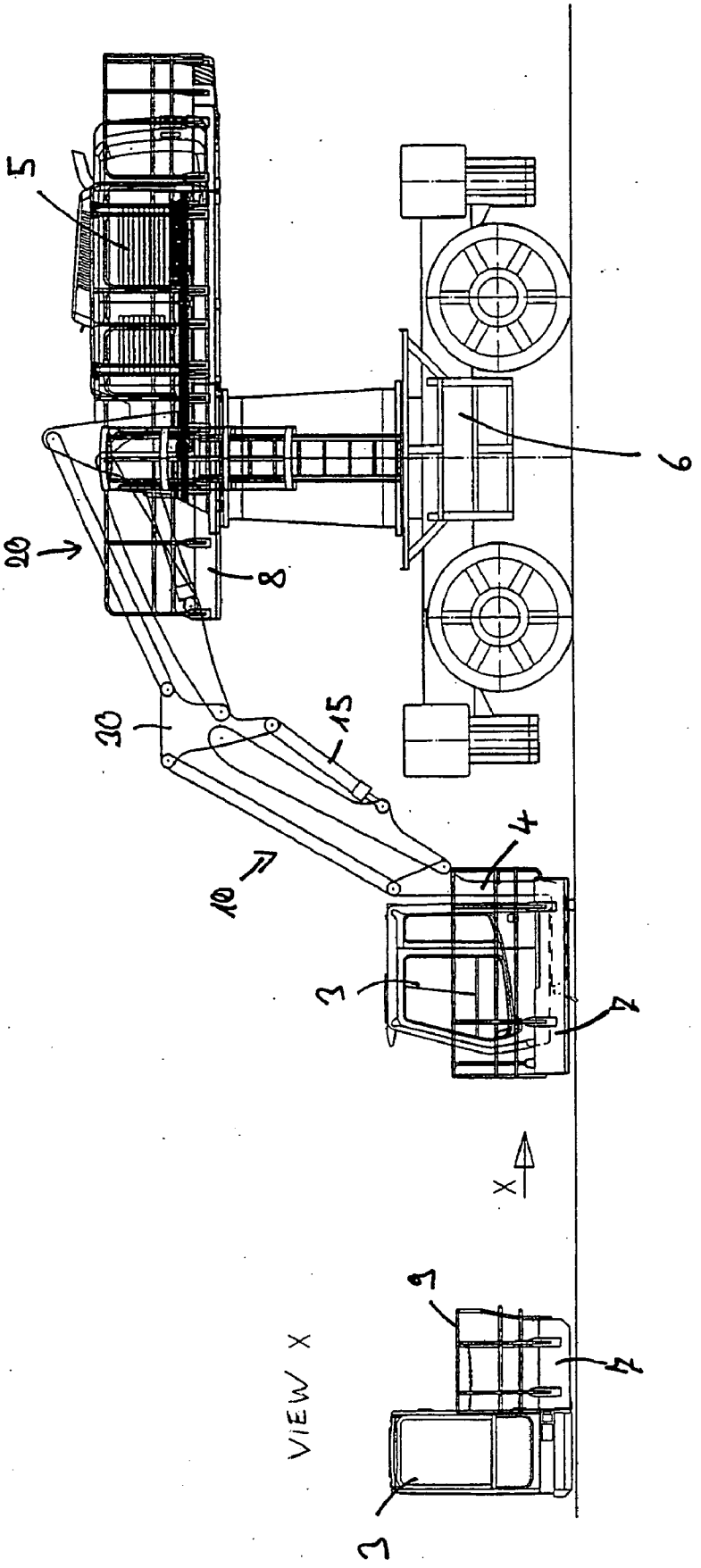


Fig. 2

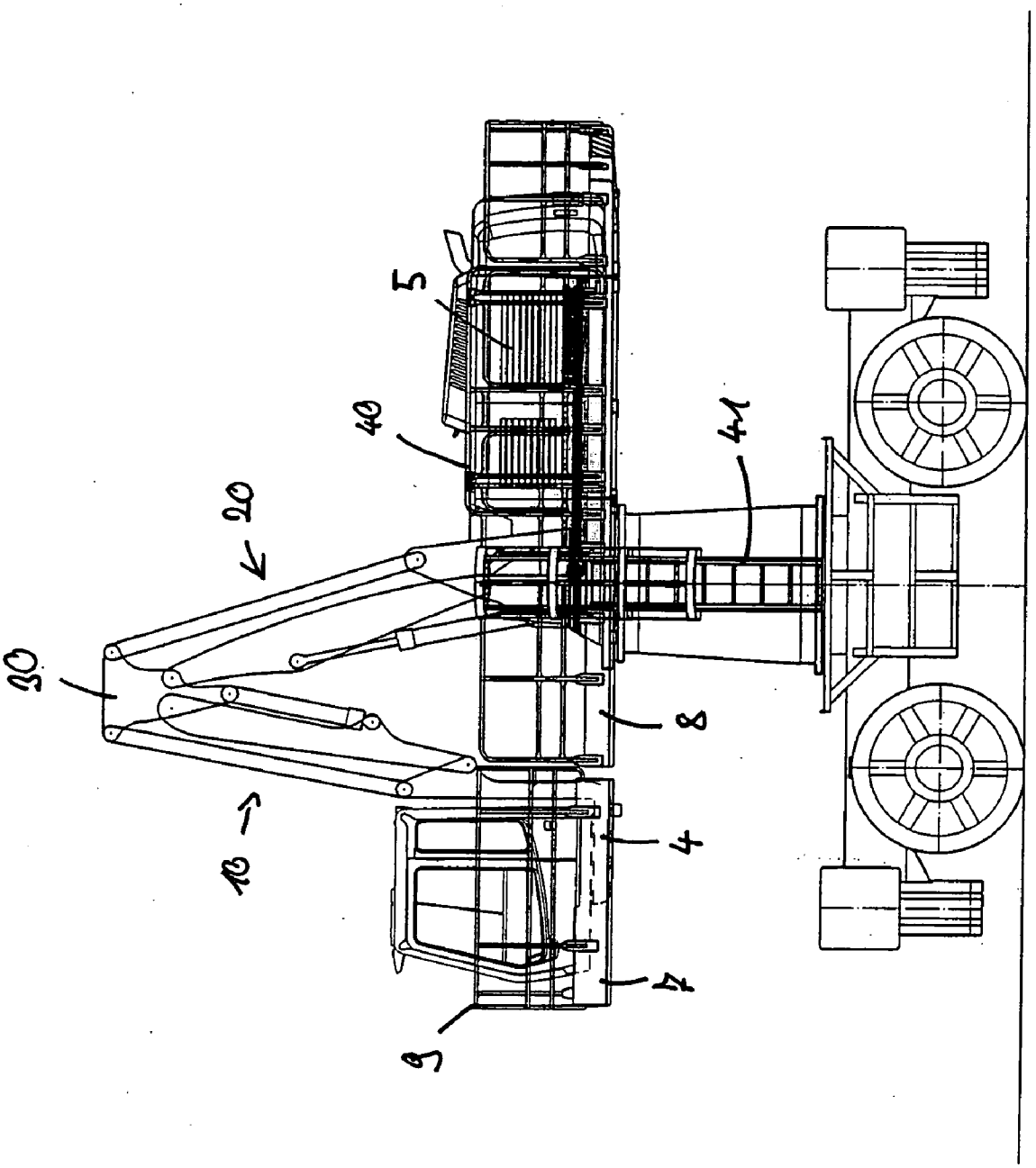


Fig. 4

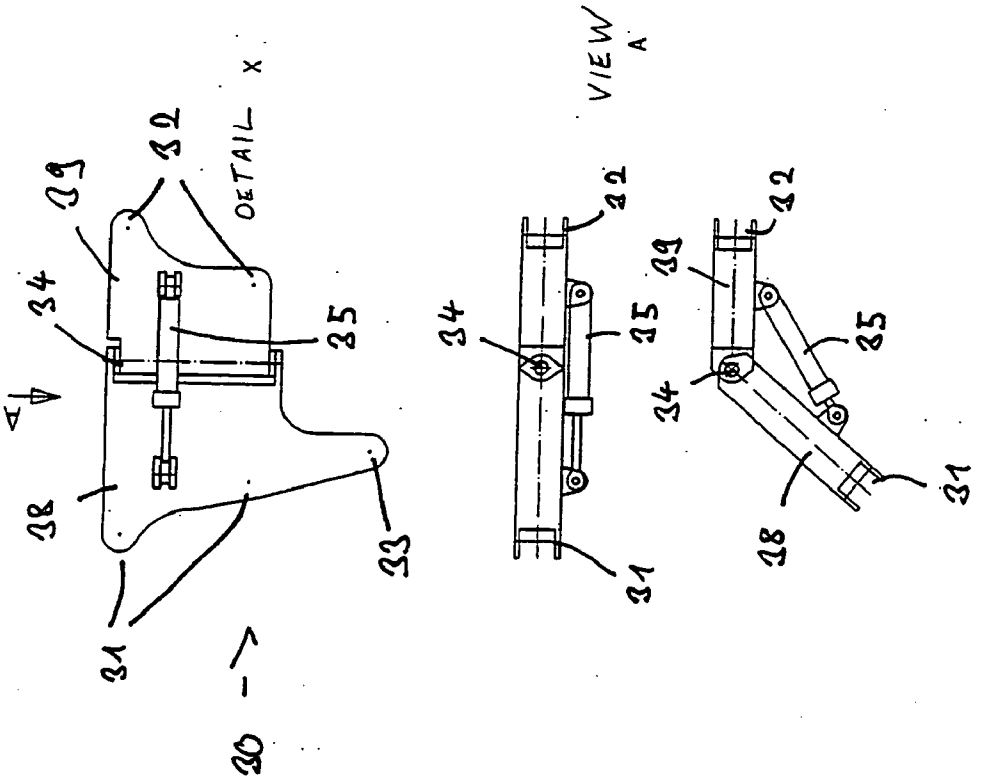
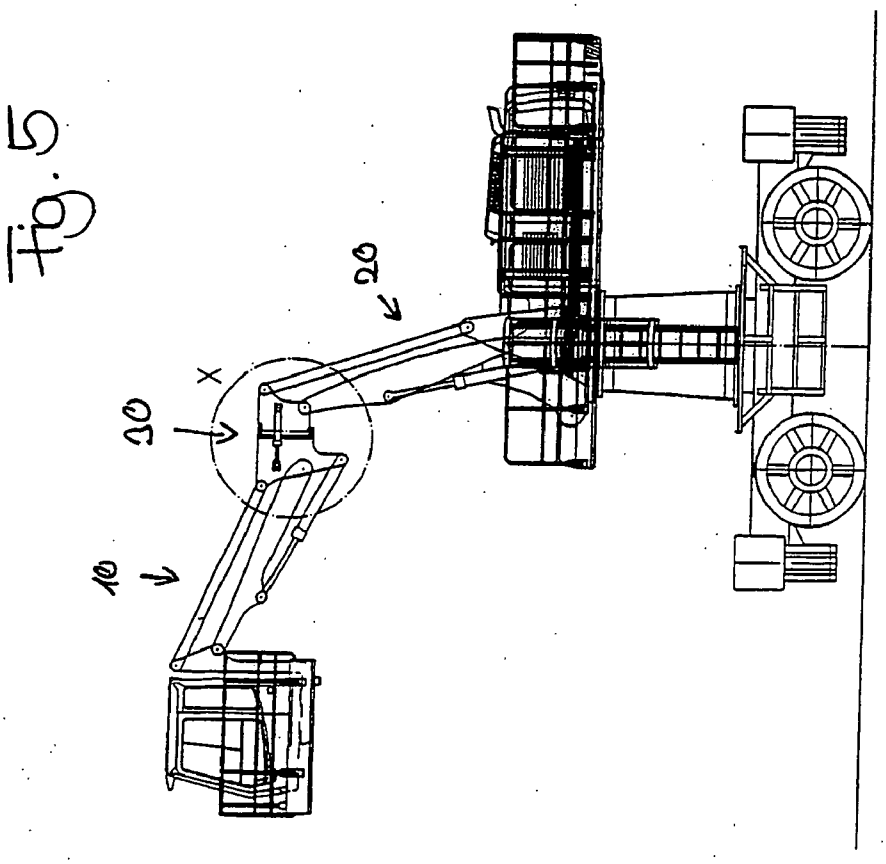


fig. 5



MATERIAL HANDLING MACHINE

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a material handling machine with a material handling boom and a cabin boom, wherein the cabin boom comprises first and second arms, which are pivotally connected with each other via a connecting element, and a first actuator for moving the first arm.

[0002] In this connection, material handling machines are understood to be material handling machines for instance for wood, scrap or any other goods, but also excavators and cranes. By means of the material handling boom, the corresponding goods can be handled, whereas the cabin boom serves to adjust the position of the operator cabin. This provides the operator with an improved vision of the working area, for instance cargo hatches, railway waggons or the like. For this purpose, the cabin boom includes the pivotally connected arms, by means of which the position of the cabin with respect to the material handling machine can be adjusted. Due to the improved vision, more precise and faster working cycles can be performed.

[0003] The material handling machine usually includes a material handling boom and a separate cabin boom, which can be moved independently. The material handling boom usually is disposed on the uppercarriage, which is rotatable with respect to the undercarriage. Usually, the cabin boom likewise is pivotally mounted on the uppercarriage of the material handling machine and is laterally offset with respect to the material handling boom. On its free end, the cabin boom carries the operator cabin, which thus is movable with respect to the uppercarriage.

[0004] Generic material handling machines are known from DE 44 43 170 C3, EP 960 982 B1 and DE 20 2004 019 708, in which both arms consist of parallel steering transmissions. The lower parallel steering elements of both arms, however, include a common pivot axis on the connecting element, which leads to an unfavorable distribution of forces and a greatly restricted sequence of movements. In addition, the actuators for moving the parallel steering arms either are disposed inside the parallelogram, so that they are under a tensile load, or the actuator for moving the first arm is disposed between the first arm and the second arm, which in turn means a restricted geometry of adjustment.

SUMMARY OF THE INVENTION

[0005] Therefore, it is the object of the present invention to provide a material handling machine, which includes an improved distribution of forces and geometry of adjustment.

[0006] This object is solved by a material handling machine according to the description herein.

[0007] In accordance with the invention, the actuator for moving the first arm is pivotally mounted on the connecting element via a pivot point, which is disposed below the pivot point(s) of the first arm. Thus, a considerably improved distribution of forces is obtained, in which the actuator merely is under a compressive load by the weight of the cabin. The effective area results from the bottom surface of the hydraulic cylinder and therefore is larger than in the prior art. There is also obtained an improved geometry of adjustment, in which the travel distances of the first and second arms can independently be designed as desired.

[0008] The present invention furthermore comprises a material handling machine, in which in accordance with the invention the first and second arms each are pivotally mounted on the connecting element via separate pivot axes. By omitting a common pivot axis of the first and second arms on the connecting element, the geometry of adjustment likewise is improved considerably and the path of movement of the cabin boom can be designed more flexibly.

[0009] For one of skill in the art it is quite obvious that the aspects mentioned herein independently are of great advantage. A particularly advantageous distribution of forces and geometry of adjustment are obtained, however, in particular by a combination of both features, in which the actuator for moving the first arm is pivotally mounted on a pivot point below the pivot points of the first arm on the connecting element, and the second arm is pivotally mounted on the connecting element via separate pivot axes. This provides for a maximum flexibility in the design of the geometry of adjustment and movement of the cabin boom and for an optimum dissipation of forces.

[0010] In addition, in the material handling machines of the invention, merely the arms must be lengthened or shortened, in order to achieve different reaching heights or widths, whereas the kinematics with the actuators always can remain the same. In this case, only the piston diameter of the hydraulic cylinders used as actuators must at best be adapted. Thus, the material handling machine of the invention can be adapted in terms of reaching height and width for different operating conditions with a minimum constructive effort.

[0011] Further advantageous aspects of the present invention can be taken from the sub-claims.

[0012] Advantageously, the actuator of the second arm is disposed on the lower surface of the second arm. Thus, this actuator also merely is under a compressive load by the weight of the cabin, so that here as well a larger effective surface is obtained. In addition, the cramped conditions inside the parallel steering arms are avoided.

[0013] Furthermore advantageously, the actuators of the first and/or second arm are under a compressive load by the weight of the cabin in accordance with the invention. This involves the advantages already mentioned above in terms of force dissipation and geometry of adjustment.

[0014] Furthermore advantageously, in the material handling machine of the invention, the operator cabin is forcibly guided parallel to or at a certain angle with respect to the ground by means of a positive connection. As a result, the alignment of the cabin need not be readjusted upon movement of the cabin boom, but is effected automatically by positive connection. Thus, the operator can move the cabin into the desired position without changing the angle of the cabin with respect to the ground.

[0015] For this purpose, the first and/or the second arm advantageously are configured as parallel steering arms. This provides for a forced parallel guidance of the operator cabin in a relatively simple way.

[0016] Advantageously, the first and/or the second arm of the cabin boom of the invention comprises at least one supporting element, which includes a closed box profile. This provides a stable construction, which at the same time is of light weight and nevertheless reacts stiff to bending and torsional load.

[0017] Furthermore advantageously, the first and/or the second arm is configured as a parallel steering arm and comprises a main supporting element disposed at the bottom, which includes a closed box profile. Thus, this main support-

ing element carries the main load, and the coupling rods and the connecting element can be configured more simple and optimized in terms of weight.

[0018] Furthermore advantageously, in the material handling machine of the invention, the first and/or the second arm of the cabin boom are configured as parallel steering arms, wherein the actuator associated to this arm engages the lower arm from outside the parallelogram. This results in the optimum dissipation of forces and geometry of adjustment already described above.

[0019] Furthermore advantageously, the first and/or the second arm includes at least one hollow section in its interior for receiving the cables or tubes extending to the operator cabin. In particular, the same advantageously can extend inside the closed box profile.

[0020] Furthermore advantageously, the connecting element of the invention includes a joint whose swivel axis is vertical to the pivot axes of the first and/or the second arm. Via this joint, the cabin thus can not only be adjusted in terms of height and boom reach, but can also be swivelled laterally. In this way, e.g. the lateral distance between the cabin boom and the material handling boom can be increased, which may become necessary especially with bulky goods, in order to nevertheless obtain an optimum vision of the loading site. Advantageously, the swivel axis of the joint extends in vertical direction.

[0021] Furthermore advantageously, an actuator is associated to the joint of the connecting element. Via this actuator, the cabin then can be swivelled correspondingly.

[0022] Furthermore advantageously, the joint of the connecting element pivotally connects a first part and a second part of the connecting element, wherein the first arm and the second arm each are pivotally mounted on the first or second part of the connecting element. Here, it is particularly advantageous that in accordance with the invention, the first and the second arm each are pivotally mounted on the connecting element via separate pivot axes and the actuator neither is disposed between the two arms.

[0023] Furthermore advantageously, the connecting element includes at least five separate pivot axes, namely two each for the arms of the cabin boom configured as parallel steering arms and one for the actuator of the first arm. In this way, the three bearing points for bearing and adjusting the first arm can be arranged as desired with respect to the two bearing points of the second arm, so that the geometry of movement and adjustment of the boom can be adapted to the respective application as desired.

[0024] Furthermore advantageously, the cabin boom includes a docking position on the material handling machine, in particular on the uppercarriage of the material handling machine. Thus, the operator can climb onto the material handling machine or the uppercarriage e.g. for maintenance work by moving the cabin into the docking position.

[0025] Furthermore advantageously, the cabin can be lowered to ground level by the cabin boom. Thus, the operator can get into the same either from the ground already or he can use the cabin boom for transporting spare parts onto the material handling machine or onto the uppercarriage.

[0026] For this purpose, the material handling machine advantageously includes a platform for the transport of material, which is disposed at the cabin. With this platform, larger elements also can be transported onto the material handling machine by means of the cabin boom.

[0027] Access to the operator cabin either is effected from the ground, when the cabin has been lowered to ground level, or in the docking position on the uppercarriage. It is likewise conceivable that the cabin boom has a further access position, which provides for easy access to the operator cabin.

BRIEF DESCRIPTION OF THE DRAWINGS

[0028] The present invention will now be explained in detail with reference to embodiments and the drawings, in which:

[0029] FIG. **1**: shows a side view of an embodiment of the material handling machine of the invention,

[0030] FIG. **2**: shows a further side view of the embodiment of the material handling machine of the invention,

[0031] FIG. **3**: shows a side view of the embodiment of the material handling machine of the invention with lowered cabin,

[0032] FIG. **4**: shows a side view of the embodiment of the material handling machine of the invention with the cabin in the docking position on the uppercarriage, and

[0033] FIG. **5**: shows a side view of a further embodiment of the material handling machine of the invention with three detailed views.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0034] FIG. **1** shows an embodiment of the material handling machine of the invention with a material handling boom **1** and a cabin boom **2**, which are disposed on the uppercarriage **5** of the material handling machine of the invention. The material handling machine is a mobile excavator, which can be moved via the undercarriage **6**. However, the present invention likewise can be used for crawler excavators and other material handling excavators. In this case, the material handling boom **1** includes two pivotally connected arms, which can be moved via corresponding actuators. On the tip of the material handling boom, a corresponding grab then is mounted depending on the application, with which the material to be handled can be grabbed.

[0035] Material handling boom **1** and cabin boom **2** are disposed one beside the other on the uppercarriage **5** such that the planes of movement of the two booms are substantially parallel to each other. However, it is likewise conceivable to position the plane of movement of the cabin boom slightly inclined with respect to the plane of movement of the material handling boom, so that with increasing boom reach of the cabin boom the distance from the material handling boom will increase as well.

[0036] In the illustrated material handling machine, the uppercarriage **5** is rotatably mounted on the undercarriage **6**, so that both the material handling boom and the cabin boom, which both are pivotally mounted on the uppercarriage **5**, are equally rotated by rotating the uppercarriage **5**.

[0037] To ensure that the operator of the material handling machine has an optimum vision of the material handling site, the cabin boom **2** of the invention comprises a first arm **10** and a second arm **20**, which are pivotally connected with each other via a connecting element **30**. The first arm **10** carries the operator cabin **3** of the material handling machine. For this purpose, a bracket **4** is disposed on the first arm **10**, which is of L-shaped configuration and on which the operator cabin **3** is mounted. The second arm **20**, however, is pivotally mounted on the material handling machine, here on the

uppercarriage **5**. The first arm **10** is moved via an actuator **15**, the second arm **20** via an actuator **25**. Both actuators are configured as hydraulic cylinders.

[0038] In accordance with the invention, the first actuator **15** for moving the first arm **10** is pivotally mounted on the connecting element **30** via a pivot point **33**, which is disposed below the pivot points **31** of the first arm **10**. As a result, the first actuator **15** merely is under a compressive load. In addition, an improved geometry of adjustment is obtained, in which the first and second arms can be moved independently.

[0039] Furthermore, in the material handling machine of the invention, the first arm and the second arm **20** each are pivotally mounted on the connecting element via separate pivot axes **31** and **32**. Due to the fact that the first arm **10** and the second arm **20** have no common pivot axes, the geometry of adjustment and movement of the cabin boom **2** can in turn optimally be adjusted.

[0040] The actuator **25** of the second arm **20** also is disposed below the second arm **20**, so that the same likewise only is under a compressive load.

[0041] The first and second arms of the cabin boom **2** both are configured as parallel steering arms, so that the operator cabin is forcibly guided parallel to the ground by means of a positive connection. Due to this configuration as parallel steering arms, only the position of the operator cabin **3**, but not its inclination, thus is changed by adjusting the cabin boom **2**.

[0042] As can also be taken from FIG. **2**, in which the material handling boom **1** is not shown for better clarity, the first arm **10** consists of a main supporting element **12** and a coupling rod **10**, which each are pivotally mounted via pivot points **11** on the bracket **4** and via pivot points **31** on the connecting element **30**. The second arm **20** likewise consists of a main supporting element **22** and a coupling rod **23**, which are pivotally mounted via pivot points **21** on the uppercarriage **5** and via pivot points **32** on the connecting element **30**. The alignment of the pivot points **21** of the second arm **20** on the uppercarriage **5** with respect to each other is obtained automatically from the desired boom reach or height of the cabin boom. If especially a great boom height is important, the pivot points **21** therefore rather are arranged on a horizontal line, but if a great boom reach is required, the pivot points **21** will be arranged more on a vertical line. The oblique arrangement shown here therefore represents a compromise of boom height and boom reach. Moreover, the radius of movement of the boom of the invention also can be adjusted correspondingly via the alignment of the pivot points **31** of the first arm **10** on the connecting element. In the present invention, the use of separate pivot axes **31** and **32** of the first and second arms on the connecting element **30** here provides an increased flexibility, with which the desired radii of movement can easily be achieved.

[0043] In accordance with the invention, the main supporting elements **12** and **22** are configured as closed box profiles, which provides them with an increased stability with a light construction. Cables and tubes to the operator cabin likewise can be passed through the hollow sections in the main supporting elements **12** and **22**.

[0044] As described already, the first actuator **15** associated to the first arm **10** is pivotally mounted on the connecting element **30** via a pivot point **33**, which is located below the pivot points **31** of main supporting element **12** and coupling rod **13**. As a result, the first actuator **15** is disposed below the first arm **10** and only is under a compressive load. For this purpose, the first actuator **15** still is pivotally mounted on the first arm **10** via a pivot point **14**, namely on the main supporting element **12** of the parallel steering arm disposed at the bottom. The second actuator **25** associated to the second arm **20** is pivotally mounted on the main supporting element **22** of the second arm **20** likewise configured as a parallel steering arm via a pivot point **24** and via a further pivot point on the uppercarriage of the material handling machine **5**. Thus, in contrast to the prior art, the actuators are not disposed inside the parallel steering arms, but engage one of the two parallel steering elements from outside, here the main supporting element disposed at the bottom. This provides the advantages already described above in terms of force dissipation and geometry of adjustment.

[0045] In FIG. **3**, the cabin **3** has been lowered to ground level by the cabin boom and now is located at the level of the undercarriage **6**. As a result, the operator either can get into the cabin or material can be loaded onto the platform **7**, which is disposed beside the cabin **3**. The platform **7** likeweise is disposed on the bracket **4**, which is connected with the first arm **10** of the cabin boom. The platform **7** has a railing **9** with an access opening to be closed by a chain. The cabin **3** with the platform **7** is shown again on the left in a front view.

[0046] In the embodiment shown in FIG. **3**, the actuators **15** and **25** of the first and second arms **10** and **20** of the cabin boom are within their minimum length in the illustrated position. By means of a different configuration of the actuators, the arms or the pivot points, it would, however, likewise be possible to configure the cabin boom lowerable below ground level, so that it can be positioned e.g. below a quay wall. The cabin boom can be designed correspondingly depending on the application, wherein an increased reach is possible in particular by simply lengthening the arms **10** and **20**, without having to change the geometry of adjustment of the actuators **15** and **25**.

[0047] FIG. **4** now shows the cabin boom in its docking position on the material handling machine, in which the platform **7** docks onto a platform **8** disposed on the uppercarriage **5**. On the one hand, this provides for directly getting from the operator cabin to the uppercarriage, e.g. for maintenance work. It is likewise possible to transport material onto the uppercarriage **5** and thus use the cabin boom as a material elevator. The platform **8** on the uppercarriage **5** likewise has a railing **40** and can also be reached from the undercarriage **6** via a ladder **41**.

[0048] FIG. **5** shows a second embodiment of the material handling machine of the invention, which differs from the first embodiment merely in the configuration of the connecting element **30**. The connecting element **30**, which on the right is shown again on an enlarged scale in separate views, includes a joint **34** whose swivel axis is vertical to the pivot axes **31** and **32** of the first and second arms. Via this joint **34**, whose swivel axis **34** is arranged vertically, the first arm **10** of the cabin boom and hence the operator cabin itself can laterally be swivelled against the second arm **20**, so that the cabin can be swivelled away from the material handling boom not shown in FIG. **5**, which in the Figure would be disposed behind the cabin boom. For this purpose, the connecting element includes an actuator **35**, by means of which the joint **34** can be moved.

[0049] The connecting element **30** has a first part **38** and a second part **39**, which are pivotally connected with each other via the joint **34**. On the first part **38**, the pivot points **31** of the first arm **10** and the pivot point **33** of the first actuator **15** are

located. On the second part **39**, the pivot points **32** of the second arm **20** are located. The actuator **35** of the joint **34** is pivotally connected with the first part **38** and the second part **39** of the connecting element **30** via pivot points and thus can adjust the slewing position.

[0050] The joint **34** on the connecting element **30** thus provides for adjusting the boom height and reach and also the lateral position of the operator cabin, so that almost any desired three-dimensional positioning of the operator cabin becomes possible, which provides for an optimum vision of the material handling site without the material handling boom being impaired in its function. In particular, even with bulky goods to be handled, in which the operator cabin must have a certain distance from the material handling boom, an optimum vision can still be ensured.

1. A material handling machine with a material handling boom and a cabin boom, wherein

the cabin boom comprises first and second arms, which are pivotally connected with each other via a connecting element, and a first actuator for moving the first arm, and

the actuator is pivotally mounted on the connecting element via a pivot point, which is disposed below the pivot point(s) of the first arm.

2. The material handling machine in particular according to claim **1**, wherein the first and second arms each are pivotally mounted on the connecting element via separate pivot axes.

3. The material handling machine according to claim **1**, wherein the actuator of the second arm is disposed on the lower surface of the second arm.

4. The material handling machine according to claim **1**, wherein the actuators of the first arm and/or of the second arm are under a compressive load by the weight of the cabin.

5. The material handling machine according to claim **1**, in which the operator cabin is forcibly guided parallel to or at a specific angle with respect to the ground by means of a positive connection.

6. The material handling machine according to claim **1**, wherein the first arm and/or the second arm is configured as a parallel steering arm.

7. The material handling machine according to claim **1**, wherein the first arm and/or the second arm comprises at least one supporting element which has a closed box profile.

8. The material handling machine according to claim **1**, wherein the first arm and/or the second arm is configured as a parallel steering arm and comprises a main supporting element disposed at the bottom, which has a closed box profile.

9. The material handling machine according to claim **1**, wherein the first arm and/or the second arm is configured as a parallel steering arm and the actuator associated to this arm engages the lower arm from outside the parallelogram.

10. The material handling machine according to claim **1**, wherein the first arm and/or the second arm has at least one hollow section in its interior for receiving the cables or tubes extending to the operator cabin.

11. The material handling machine according to claim **1**, wherein the connecting element includes a joint whose swivel axis is vertical to the pivot axes of the first arm and/or of the second arm.

12. The material handling machine according to claim **11**, wherein an actuator is associated to the joint of the connecting element.

13. The material handling machine according to claim **11**, wherein the joint of the connecting element pivotally connects a first part and a second part of the connecting element, and the first and second arms each are pivotally mounted on the first or second part of the connecting element.

14. The material handling machine according to claim **1**, wherein the connecting element has at least five separate pivot axes, namely two each for the arms configured as parallel steering arms and one for the actuator of the first arm.

15. The material handling machine according to claim **1**, wherein the cabin boom has a docking position on the material handling machine, in particular on the uppercarriage of the material handling machine.

16. The material handling machine according to claim **1**, wherein the cabin can be lowered to ground level by the cabin boom.

17. The material handling machine according to claim **1**, wherein a platform for transporting material is arranged at the cabin.

18. The material handling machine according to claim **2**, wherein the actuator of the second arm is disposed on the lower surface of the second arm.

19. The material handling machine according to claim **18**, wherein the actuators of the first arm and/or of the second arm are under a compressive load by the weight of the cabin.

20. The material handling machine according to claim **3**, wherein the actuators of the first arm and/or of the second arm are under a compressive load by the weight of the cabin.

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