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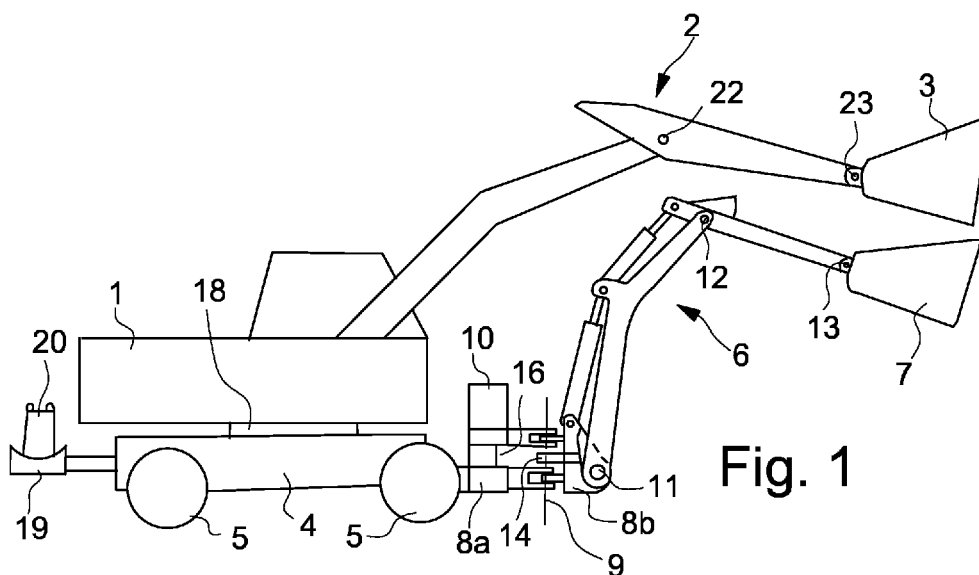


Fig. 1

(57) Abstract: A self-propelled work machine, such as an excavator, comprising an undercarriage (4) equipped with wheels (5) or track chains, and a top carriage (1) supported onto the undercarriage for 360° rotation about a vertical axis. A first articulating boom (2) is pivotably attached to the top carriage (1), and a first implement (3) is attached to the free end thereof. The undercarriage (4) is fitted with a mounting and pivoting adapter (8) to which a second articulating boom (6) is attached. The adapter (8) comprises a mounting part (8a) attached to the undercarriage and a pivoting part (8b) attached to the mounting part (8a) such that it is pivotable at least 120° about a vertical axis (9) and having said second articulating boom (6) attached thereto such that it is pivotable about a horizontal axis (11). A second implement (7) is attached to the free end of the second articulating boom (6).

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## Self-propelled work machine

The object of the invention is a self-propelled work machine comprising an undercarriage equipped with wheels or track chains, a top carriage supported onto the undercarriage for 360° rotation about a vertical axis, and a first articulating boom pivotably attached to the top carriage and having a first implement attached to the free end thereof, and wherein the undercarriage is fitted with a mounting and pivoting adapter (hereinafter referred to as the adapter) to which a second articulating boom having a second implement attached to the free end thereof is attached, and wherein the adapter comprises a mounting part attached to the undercarriage and a pivoting part attached to the mounting part such that it is pivotable about a vertical axis and having said second articulating boom attached thereto such that it is pivotable about a horizontal axis. Typically, the work machine is an excavator, and the implement is a bucket.

Backhoe loaders having an excavator boom at one end of the work machine and a wheel loader boom at the other are previously known. They enable carrying out the work of both machines on the same construction site, i.e., first one and then the other in turn, and only one machine and one driver are required. Combined use of booms for simultaneous work is not possible.

Hitachi's prototype machines, in which two separate excavator booms controlled by one operator are attached to the rotating top carriage of an excavator, are also known. The problem with this Hitachi is that when pivoting only one of the booms to pick up something from behind, for example, the other boom turns along with it. This placement of the two booms allows them to be used separately only to a limited extent, and the other cannot be programmed to perform its own set of tasks.

Publication JP S 5980563 U discloses a work machine of the type mentioned at the outset, wherein the location of the vertical axis of the adapter between the track chains below the top carriage limits the pivot angle of the second articulating boom about the vertical axis. This makes combined use of the booms for simultaneous work difficult, and the publication makes no such suggestion.

Furthermore, publication US 6032094 A discloses a work machine equipped with two articulating booms and comprising a system for preventing the work machine from toppling over. This system is equipped with sensors for detecting the position and load of the booms. If the system detects a danger of toppling based on signals  
5 from the sensors, the movement of the boom is stopped and an alarm is given, or the boom along with its load is moved to a new position where there is no danger of toppling over. The machine does not comprise a separate pivoting and mounting adapter that could be removably attached to the undercarriage for removing the second boom. Instead, the second boom is attached to a rotating mechanism be-  
10 tween the top carriage and the undercarriage, wherein the pivot axis of the rotating mechanism coincides with the pivot axis of a rotating mechanism in the top carriage.

The aim of the invention is to provide a work machine, such as an excavator, that  
15 can be used in a more versatile way than before, and that is operable to perform tasks that were not previously possible or to substantially speed up and facilitate the performance of some tasks.

This aim is achieved by the invention by way of the features presented in the accompanying claim 1. Preferred embodiments of the invention are presented in the  
20 dependent claims.

Next, an exemplary embodiment of the invention is described in more detail with reference to the accompanying drawings.

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Fig. 1 is a side view of the work machine according to the invention, and

Fig. 2 is a top view of the undercarriage and the lower articulating boom of the work machine of Fig. 1.

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Fig. 1 and 2 show a self-propelled work machine, such as an excavator, comprising an undercarriage 4 equipped with wheels 5 or track chains, and a top carriage 1 supported via a turntable 18 onto the undercarriage for 360° rotation about a vertical axis. A first articulating boom 2 is attached to the top carriage 1 such that it is

pivotable about a horizontal axis and has a first implement 3 attached to the free end thereof.

The undercarriage 4 is fitted with a mounting and pivoting adapter 8 (hereinafter adapter), to which a second articulating boom 6 is attached such that it is pivotable about a horizontal axis 11. The adapter 8 comprises a mounting part 8a attached to the undercarriage 4 and a pivoting part 8b attached to the mounting part 8a such that it is pivotable by means of hydraulic cylinders 15 at least 120°, preferably at least 180° about a vertical axis 9. In other words, the pivoting part 8b and the second articulating boom 6 along with it can be pivoted at least 120°, preferably at least 180° about the vertical axis 9 of the mounting part 8a. The piston rods of the cylinders 15 engage the lugs 14 in the pivoting part 8b on opposite sides of the vertical axis 9. The reference number 16 denotes the space within the mounting part 8a where the cylinders 15 are able to pivot.

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As an alternative to the hydraulic cylinders 15, the rotational movement of the articulating boom 6 about the vertical axis 9 may be achieved by means of a toothed rim surrounding the vertical axis 9 in the pivoting part 8b and rotated by a hydraulic motor (not shown) in the mounting part via a gearwheel.

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The term articulating boom refers to a boom comprising at least two boom parts connected to each other with a pivot joint 12 or 22. There may be more than two boom parts and, correspondingly, more than one pivot joint. This allows for the work machine to have a greater operating range. In addition, the articulating boom may comprise an extension piece enabling the reach of the boom to be extended. A second implement 7 is attached to the free end of the second articulating boom 6. The implements 3 and 7 may be buckets, screening devices, crushing and screening devices, grippers such as tongs or jaws, an impact hammer, crushing jaws or a cutter crusher. The implements 3 and 7 may be connected to the articulating boom by means of pivot joints 23 and 13, respectively. The pivot cylinders of the implements 3 and 7 are not shown, nor are the hydraulic hoses or the pivot cylinders of the upper boom, as they are well-known equipment in work machines.

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The hydraulic drive power required for moving the second articulating boom 6 is taken from the same motor in the work machine as the drive power required for moving the work machine or the drive power required for moving the first articulating boom 2. The same applies to the drive power input to the implements 7 of the second articulating boom 6.

For example, for an excavator to be used in the usual way with one boom, the mounting part 8a of the adapter 8 is attached removably to the frame of the undercarriage 4 so that the second articulating boom 6 may be detached from the work machine. Any known fastening solutions may be used for attaching the mounting part 8a, such as, for example, fastening lugs and hooks and/or pins engageable thereto and lockable in their sockets. In this embodiment, it is preferred that the undercarriage 4 has hydraulic oil quick-connect couplers to which the inlet pipes of the adapter are guided and connected when the adapter 8 is mounted to the undercarriage 4. Alternatively, the adapter 8 has hydraulic oil quick-connect couplers to which the supply pipes connected to the hydraulic hoses of the work machine are guided and connected when the adapter 8 is mounted to the undercarriage.

As can be seen in Fig. 1 and 2, the axis line of the vertical axis 9 of the adapter is at a distance from the undercarriage 4 in the direction of travel of the work machine.

In a preferred embodiment of the invention, the first and second articulating booms 2, 6 along with the implements 3, 7 can be moved to a mutual position in which the first implement 3 is directly above the second implement 7. In this embodiment, the implements 3, 7 are typically screening devices or crushing and screening devices. In this case, the material screened by the upper screening device flows directly into the lower screening device for screening the next (smaller) fraction. This enables, for example, for three different fractions, for example aggregates, to be screened in one work step and with one work machine using two different screening devices, in which case the combination replaces a separate three-fraction sieve and the machine that feeds it, as well as the machine that moves the finished fraction away from under the sieve conveyors.

The adapter 8 according to the invention is preferably equipped with a valve housing 10 with hydraulic valves that can be remotely controlled by an electronic control unit with which the movements of the second articulating boom 6 and/or the second implement 7 can be remotely controlled.

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Furthermore, the work machine is preferably equipped with a programmable processor programmed to automatically control predetermined movements of at least the second articulating boom 6 and/or the second implement 7. When a programmable or teachable processor is used to control some or all the paths of one or both articulating booms, productivity increases significantly.

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For some tasks, it is advantageous from the standpoint of support and stability of the work machine that the mounting part 8a of the adapter is equipped with removable support legs 17 to be pressed against the ground and extending to a desired distance from the center line of the work machine as seen in its direction of travel.

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For lifting or supporting long pieces, it is advantageous that the first and second articulating booms 2, 6 along with the implements 3, 7 are moveable to a mutual position in which the implements are side by side at a distance from one another, and that the implements are grippers. The implements of the two articulating booms can be used to hold onto a long piece at two points, for example to install it in the correct position. Furthermore, in the demolition of structures, removing pieces using implements of two articulating booms could in many cases be safer and possible.

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On the side opposite to the adapter 8, the undercarriage 4 is fitted with a rack 19 with which implements 20 suitable for use with the work machine can be transported to the construction site along with the work machine. The implement 20 shown in Fig. 2 is an impact hammer. The rack 19 can be fitted with suitable mounting parts for different implements and work equipment. There are no other requirements for the shape of the rack 19, as long as it is possible to attach implement-specific mounts to it. While in the rack 19, the implements are in a position from which they can be directly installed to and put into use by the rotating articulating boom 2. Particularly when using a hydraulic quick-connect coupler, in which case all oil flow is also connected at the same time, the implement transport rack 19

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proves useful, as several implements can be utilized quickly. If the articulating boom 6 has quick-connect couplers for hydraulic drive of the implement 7, the rotating articulating boom 2 may be used to bring the implement 7 of the second articulating boom 6 within its reach for replacement.

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The boom combination according to the invention may also be used effectively in applications where large quantities of concrete and aggregate must be processed in a small space into a form where they can be utilized on site or easily transported away with typical transport equipment. An example of this is breaking large pieces

10 with an impact hammer and then crushing the resulting smaller pieces with crushing jaws or a bucket crusher.

## Claims

1. A self-propelled work machine, such as an excavator, comprising an undercarriage (4) equipped with wheels (5) or track chains, a top carriage (1) supported  
5 onto the undercarriage for 360° rotation about a vertical axis, and a first articulating boom (2) pivotably attached to the top carriage and having a first implement (3) attached to the free end thereof, and wherein the undercarriage (4) is fitted with a mounting and pivoting adapter (8) (hereinafter adapter) to which a second articulating boom (6) having a second implement (7) attached to the free end thereof is at-  
10 tached, and the adapter (8) comprises a mounting part (8a) attached to the undercarriage and a pivoting part (8b) attached to the mounting part (8a) such that it is pivotable about a vertical axis (9) and having said second articulating boom (6) attached thereto such that it is pivotable about a horizontal axis (11), **characterized in that** the axis line of the vertical axis (9) of the adapter is at a distance from the  
15 undercarriage (4) in the direction of travel of the work machine and the pivoting part (8b) along with the articulating boom (6) is able to pivot at least 120° about the vertical axis (9) of the adapter, and that the work machine is equipped with a programmable processor programmed to automatically control predetermined movements of the second articulating boom (6) and/or the second implement (7),  
20 and/or wherein the adapter (8) is equipped with a valve housing (10) with hydraulic valves that can be remotely controlled by an electronic control unit, and with which the movements of the second articulating boom (6) and/or the second implement (7) can be remotely controlled.
- 25 2. The work machine according to claim 1, **characterized in that** the hydraulic drive power required for moving the second articulating boom (6) is taken from the same motor in the work machine as the drive power required for moving the work machine or the drive power required for moving the first articulating boom (2).
- 30 3. The work machine according to claim 1 or 2, **characterized in that** the mounting part (8a) of the adapter (8) is attached removably to the frame of the undercarriage (4) for detaching the second articulating boom (6) from the work machine.

4. The work machine according to any of claims 1 to 3, **characterized in that** the first and second articulating booms (2, 6) along with the implements (3, 7) are moveable to a mutual position in which the first implement (3) is directly above the second implement (7).

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5. The work machine according to any of claims 1 to 4, **characterized in that** the implements (3, 7) are screening devices or crushing and screening devices.

6. The work machine according to any of claims 1 to 5, **characterized in that** the undercarriage (4) has hydraulic oil quick-connect couplers to which the inlet pipes of the adapter are guided and connected when the adapter (8) is mounted to the undercarriage (4), or that the adapter (8) has hydraulic oil quick-connect couplers to which the supply pipes connected to the hydraulic hoses of the work machine are guided and connected when the adapter (8) is mounted to the undercarriage.

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7. The work machine according to any of claims 1 to 6, **characterized in that** the mounting part (8a) of the adapter is equipped with removable support legs (17) to be pressed against the ground and extending to a desired distance from the center line of the work machine as seen in its direction of travel.

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8. The work machine according to any of claims 1 to 7, **characterized in that** the pivoting part (8b) and the second articulating boom (6) along with it are pivotable at least 180° about the vertical axis (9) of the mounting part (8a).

9. The work machine according to any of claims 1 to 3, **characterized in that** the first and second articulating booms (2, 6) along with the implements (3, 7) are moveable to a mutual position in which the implements are side by side at a distance from one another, and that the implements are grippers.

10. The work machine according to any of claims 1 to 3, **characterized in that** on the side opposite to the adapter (8), the undercarriage (4) is fitted with a rack (19) with which implements (20) suitable for use with the work machine can be transported to the construction site along with the work machine.

