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(54) MOBILE CRANE

(57) A mobile crane (10) comprising a column structure (120); a telescopic boom (12); a turning device (14) on which the column structure is mounted; at least two movable outriggers (16); a control system (18); at least one power source arrangement (20); and a crawler frame (22) for propelling the crane. The crane further comprises a counterweight arrangement (24) connected to the column structure and pivoting together with the boom; furthermore, the counterweight arrangement is configured to act as a counterweight. In an example, the horizontal distance between the counterweight arrangement and the column structure is adjustable. In an example, at least one power source apparatus (20) is placed in the counterweight arrangement. The power source arrangement may comprise at least one of: an electric generator (188), an electric motor (210), and a combustion engine (200), for generating the power required for the functions of the crane.

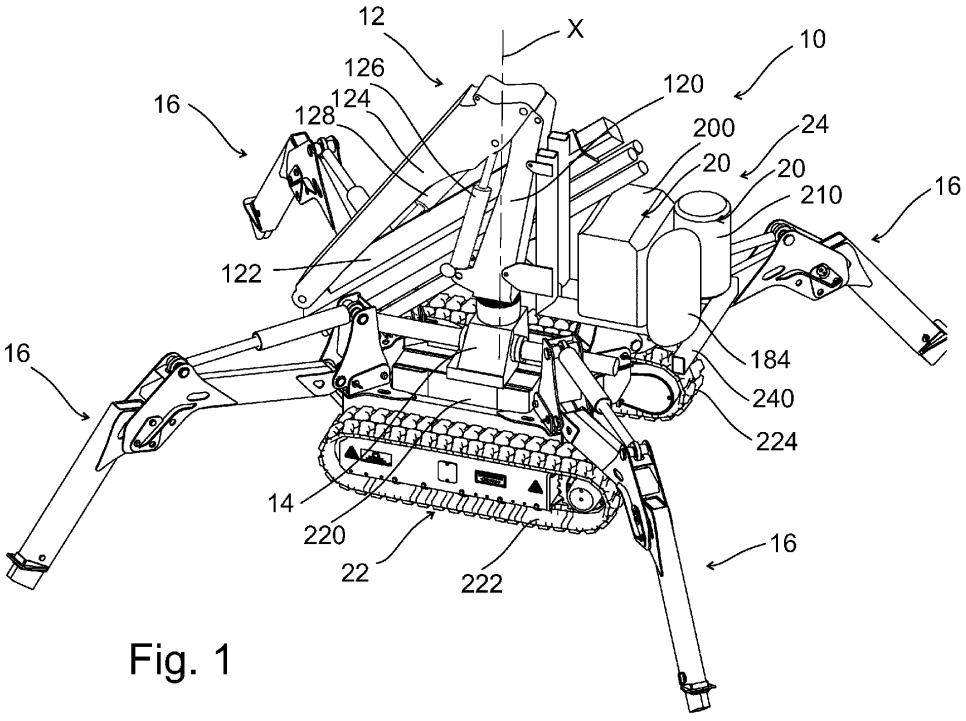

Fig. 1

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Description

Subject matter of the present solution

[0001] The solution to be presented relates to a mobile crane. In particular, it relates to a mobile crane having a telescopic boom intended for lifting and transferring loads connected to or suspended from it. Said crane is, for example, a so-called loading crane.

Background of the present solution

[0002] According to prior art, cranes are used which are swivelling and comprise telescopic booms. Cranes are mounted on vehicles, such as trucks, or on other self-propelled machines, such as forwarders. Cranes are used, for example, for loading, and as so-called loading cranes.

[0003] Said crane may also be placed in a towable trailer which is equipped with wheels and which also comprises a power source apparatus for the crane, for example a combustion engine, and a control system for controlling the functions of the crane. The control system is typically based on a hydraulic power generation system. In addition to the trailer, the crane typically also comprises outriggers which are connected to the trailer and may be placed in a position where they support and stabilize the crane during its operation. The control system may comprise a control device, by which the operator may remotely control the functions of the crane or its boom, for example in a wireless manner, so that there is no need to provide the trailer with a cabin, a seat, or a station with control devices for the operator.

[0004] The boom of the crane may consist of one or more boom sections. Typically, the end of the boom is equipped with a hook for suspending loads to be transferred, or a tool for transferring loads or objects. It is also possible to connect a man cage or a scaffold to the end of the boom, for a worker.

[0005] Cranes mounted on vehicles and machines become large, and thereby possibilities to use them in, for example, confined indoor spaces and buildings turn out to be very limited. Also, exhaust gases from the vehicles and machines may pose a problem. It may be difficult to move cranes mounted on trailers manually indoors, and it is not even possible to use a towing vehicle or machine in confined indoor spaces, buildings, or on different floors of a building. Furthermore, bringing a crane mounted on a trailer to the work site may be very difficult or impossible, for example due to the difficult terrain or location of the site.

Brief summary of the solution

[0006] The solution for a mobile crane is presented in claim 1. Other claims present some other, more detailed examples of said mobile crane according to the solution.

[0007] The presented mobile crane comprises a column structure and a telescopic boom configured to move up and down, whereby it is suitable for lifting and transferring loads connected to or suspended from the boom. The crane may be a so-called loading crane. The boom is connected to the column structure by articulation. The crane comprises a turning device, on which the column structure is mounted, and which is configured to turn the column structure and the boom together in two lateral directions, around a substantially vertical direction. The crane comprises at least two or preferably two movable outriggers which can be placed against the ground or a floor and which are configured to support and stabilize the crane.

[0008] The crane comprises a control system which is configured to control the functions of the crane and which comprises at least one control device, by which an operator may manually control the functions of the crane. The crane comprises at least one power source apparatus for generating the power needed for the functions of the crane.

[0009] According to the solution presented, the crane also comprises a crawler frame for moving the crane and comprising a frame structure and motorized first and second crawler tracks arranged on opposite sides of the frame structure. Furthermore, the crane comprises a turning device mounted on the frame structure of the crawler frame, and the above-mentioned outriggers are connected to the frame structure of the crawler frame.

[0010] In particular, the crane according to the presented solution also comprises a counterweight arrangement connected to the column structure. Thus, the counterweight arrangement is configured to turn together with the column structure and the boom around said direction, and furthermore, the counterweight arrangement is suitable for use as a counterweight for the boom and/or loads to be connected to or suspended from the boom.

[0011] The crawler frame has the advantage that the crane may move on a terrain and on difficult work sites. The terrain may have slopes or roughness which may be crossed by the crawler tracks. Because the crane comprises its own power source apparatus and a crawler frame for moving, it is self-propelled and movable by itself to or on the work site.

[0012] The crane becomes compact as it is not equipped with a cabin, a seat or a station for an operator. Preferably, the functions of the crane may be remote controlled. By means of the outriggers, the frame structure of the crawler frame can be kept compact, because the outriggers extending far from the frame structure stabilize the crane to a sufficient extent.

[0013] The counterweight arrangement connected to the column structure of the crane makes it possible that the counterweight arrangement swivels with the boom and acts as a counterweight irrespective of the direction of swivelling of the boom. Preferably, the counterweight arrangement is arranged primarily or entirely on the side of the column structure opposite to the boom, when their placement is seen in the horizontal direction.

[0014] In an example, the horizontal distance between the counterweight arrangement and the column structure is adjustable. Thus, the counterweight arrangement may be transferred farther away from and back towards the column structure, for example by means of at least one controllable actuator. Advantageously, the structure of the crane can be made compact, for example for transport, when the counterweight arrangement is retracted. The counterweight arrangement is more effective as a counterweight when it is moved away from the column structure, causing a torque which is opposite to the torque produced by the boom. In an example, the position of the counterweight arrangement is adjustable in the height direction.

[0015] In an example, at least one of the power source apparatuses of the crane is placed in the counterweight arrangement. In a first example, the power source apparatus comprises either an electric motor or a combustion engine, or both. In a second example, the power source apparatus further comprises an electric generator for generating an electric current. In a third example, the control system of the crane comprises at least one hydraulic pump configured to generate hydraulic power and hydraulic fluid flow, and connected to said power source apparatus; at least one controllable control valve configured to control the hydraulic fluid flow for implementing the functions of the crane; and at least one tank for containing hydraulic fluid. According to said example, one or more of: said hydraulic pump, said control valve, and said tank, is placed in the counterweight arrangement.

[0016] The above examples have the advantage that when said components are placed in the counterweight arrangement, their weight can be utilized as counterweight, to avoid adding such mass in the crane which acts as counterweight only. For example, by placing the power source apparatus in the counterweight arrangement, one avoids adding a corresponding weight in the crane, whereby it is possible to restrict increasing the weight of the crane. A corresponding principle also applies to the hydraulic manifold block of the control system, to which one or more of said control valves to be controlled is connected, as well as to the electrical center of the control system.

[0017] In an example, the crane further comprises at least one movable dozer blade which is configured e.g. to move up and down, and is connected to the crawler frame. In another example, the crane further comprises at least one motorized cable winch connected to the crawler frame.

Description of the drawings

[0018]

Figure 1 shows a mobile crane according to an example of the presented solution, seen in a slanted rear view and in a situation in which the outriggers are extended and placed against the ground or the floor to support the crane.

Figure 2 shows a simplified principle view of a counterweight arrangement according to an example which may be applied in a mobile crane according to the presented solution shown in in Fig. 1.

Figure 3 shows the mobile crane according to the example of Fig. 1 seen in a slanted rear view and in a situation in which the outriggers are retracted or turned into a position in which they do not support the crane.

Detailed description of the presented solution

[0019] In the following, the presented solution and its different alternatives or examples, as well as combinations of them, will be described with reference to the appended drawings.

[0020] A mobile crane 10 according to the presented solution and shown in Fig. 1 may comprise a column structure 120, a boom 12, a turning device 14, at least two movable outriggers 16, a control system 18 (see Fig. 2), at least one power source apparatus 20, a crawler frame 22, and a counterweight arrangement 24.

[0021] The boom 12 comprises one or more boom sections 122, 124. Two or more boom sections 122, 124 may be placed one after the other and be connected to each other by articulation. Thus, the boom may be a so-called articulated boom, which is foldable to a compact position. In an example and as shown in Fig. 1, the boom 12 comprises a first boom section 122 and a second boom section 124. In an alternative, the boom 12 comprises only one boom section 122. In this case, it may be a so-called straight boom.

[0022] The column structure 120 is substantially or almost vertical, or placed in a tilted position. The column structure 120 extends upwards from the top of the turning device 14.

[0023] The boom section 124 is connected on the column structure 120 by articulation and is configured to move up and down, for example by means of a linear actuator 126, such as a hydraulic cylinder. For example, the linear actuator 126 is connected between the column structure 120 and the boom section 124. The boom section 124 pivots about a substantially horizontal direction which is simultaneously transverse to the longitudinal direction of the boom section 124.

[0024] The boom section 122 is connected to the boom section 124 by articulation and is configured to move up and down, for example by means of a linear actuator 128, such as a hydraulic cylinder. For example, the linear actuator 128 is connected between the second boom section 124 and the first boom section 122. The boom section 122 pivots about a substantially horizontal direction which is simultaneously transverse to the longitudinal direction of the boom section 122.

[0025] According to the above-mentioned alternative

of the crane 10, the boom section 122 is directly connected to the column structure 120 by articulation and is configured to move up and down, for example by means of a linear actuator 126, such as a hydraulic cylinder. For example, the linear actuator 126 is connected between the column structure 120 and the boom section 122. The boom section 122 pivots about a substantially horizontal direction which is also transverse to the longitudinal direction of the boom section 122.

[0026] According to an example and Fig. 1, the boom section 122 is telescopic for increasing the reach of the boom 12. This may also be the case in the above-mentioned examples and alternatives. For implementing the telescopic feature, the boom section 122 may comprise one or more actuators utilizing hydraulic power, for example a linear actuator, such as a hydraulic cylinder. The boom section 122 may comprise several boom sections placed within each other and moving in a telescopic manner with respect to each other, for example assisted by an actuator.

[0027] The boom 12 is configured to lift and transfer loads connected to or suspended from it, for which purpose the end of the boom section 122 may be equipped with a hook, a tool, or a man cage or a scaffold for a worker.

[0028] The column structure 120 is mounted on top of the turning device 14. The turning device 14 is configured to turn the column structure 120 and thereby the boom 12 in two lateral directions having opposite directions of rotation. The turning device 14 turns the column structure 120 around a substantially vertical direction. The rotating movement effected by the turning device 14 defines an imaginary rotation axis X which is substantially vertical. Preferably, said rotation axis X extends through the turning device 14, substantially its center, and through the column structure 120.

[0029] In Fig. 3, broken lines illustrate the position of the boom 12 when the boom sections 122, 124 are in a use position and extend outwards from the column structure 120 and thereby outwards from the counterweight arrangement 24.

[0030] For implementing the rotation and in an example, the turning device 14 may comprise one or more actuators utilizing hydraulic power, for example a linear actuator, such as a hydraulic cylinder, or a hydraulic motor.

[0031] The crawler frame 22 is provided for moving the crane 10, and it may comprise a frame structure 220 and motorized first 222 and second 224 crawler tracks placed on opposite sides of the frame structure 220.

[0032] The turning device 14 is mounted on top of the frame structure 220 of the crawler frame 22.

[0033] The crawler tracks 222, 224 may be implemented by means of flexible and elastic rubber rollers. Alternatively, the crawler tracks 222, 224 may be implemented by means of steel track pads.

[0034] For propelling the crane 10, the crawler tracks 222, 224 may be provided with one or more hydraulic motors driven by hydraulic power and rotating the crawler tracks 222, 224.

[0035] At least two, or preferably four, movable outriggers 16 are mounted on the frame structure 220. Each outrigger 16 can be placed against the ground or the floor to constitute a point of support between the outrigger 16 and the ground/floor, the outrigger 16 being configured to support and stabilize the boom 12. Preferably, at least one pair of outriggers 16 can be placed so that at least one point of support is provided on either side of the frame structure 220, at a distance from the frame structure 220 and the crawler tracks 222, 224. Said points of support are preferably placed on that side of the frame structure 220, on which the boom 12 is working. Said four outriggers 16 may be placed on different sides of the frame structure 220, for example at its corners.

[0036] Each outrigger 16 is connected to the frame structure 220, for example by articulation. According to an example and Fig. 1, the outrigger 16 may consist of two or more sections connected to each other by articulation. To increase the reach of the outrigger 16, the outrigger 16 may function in a telescopic manner, as shown in the example of Fig. 1. Each outrigger 16 may be transferred to a first position (see Fig. 3) in which it is not placed against the ground or floor, and locked into a second position (see Fig. 1) in which the outrigger 16 is placed against the ground or floor. Said first position is used, for example, during transfer or transportation of the crane 10.

[0037] For implementing the movements and the locking of the outrigger 16, the outrigger 16 may comprise one or more actuators driven by hydraulic power, for example a linear actuator, such as a hydraulic cylinder, as shown in the example of Fig. 1.

[0038] According to an example and Fig. 1, one or more outriggers 16 may be removed from the frame structure 220, for example by quick release members. In this way, the mass of the crane 10 becomes lighter and the structure becomes more compact, in case this is necessary for transporting or moving the crane 10.

[0039] The control system 18 is configured to control the functions of the crane 10, and the control system 18 comprises at least one control device 186, by which the operator of the crane 10 may manually control the functions of the crane 10.

[0040] Said functions include, for example, at least the lifting and lowering of one or more boom sections 122, 124, the turning of the boom 12 by the turning device 14, the movement of the outriggers 16, and the movement of the crane 10 by means of the crawler frame 22.

[0041] The control system 18 may be based on components, control means and control circuits utilizing at least partly electric energy or hydraulic energy for implementing said functions. If necessary, the control system 18 may also monitor said functions, for example by means of signals given or measurements taken by sensors in the crane 10. The control system 18 may comprise a computer based implementation based on control im-

plemented by a stored computer program, programmable logics, or alternatively electronic control based on a computer processor, a memory, and stored algorithms.

[0042] The control system 18 may comprise at least one hydraulic pump 180, at least one controllable control valve 182, and/or at least one tank 184 for containing hydraulic fluid.

[0043] The hydraulic pump 180 generates hydraulic power and hydraulic fluid flow, and it is connected to the power source apparatus 20. The control valve 182 controls the flow of hydraulic fluid for implementing the functions of the crane 10. According to some examples, the flow of hydraulic fluid is utilized in at least one hydraulic cylinder and/or hydraulic motor for the boom 12, the turning device 14, at least one outrigger 16, and/or the crawler frame 22.

[0044] At least one control device 186 which is available to the operator of the crane 10 is connected to the control system 18. The control device 186 is e.g. a control panel, a control stick, or a computer based control device. The data transmission between the control system 18 and the control device 186 may be based on wireless communication and be implemented by *e.g.* radio control. The wireless communication is implemented by means of e.g. transmitters and receivers.

[0045] The crane 10 comprises at least one power source apparatus 20 configured to generate power needed by the functions of the crane 10. Said power is one or more of the following: mechanical power, electric power, or hydraulic power.

[0046] Preferably, the power source apparatus 20 is configured to generate at least hydraulic power which is utilized in at least one hydraulic cylinder and/or hydraulic motor for the boom 12, the turning device 14, at least one outrigger 16, and/or the crawler frame 22. For generating the hydraulic power, the power source apparatus 20 comprises, for example, a combustion engine, such as a diesel engine, and/or an electric motor.

[0047] The power source apparatus 20 may comprise a combustion engine 200, such as a diesel engine, and/or an electric motor 210. According to an example and Fig. 1, the power source apparatus 20 comprises both a combustion engine 200, such as a diesel engine, and an electric motor 210, so that the possibilities of using the crane 10 would be versatile and the crane could be used indoors as well, thanks to the electric motor 210. For driving the electric motor 210 of the crane 10, the electric motor 210 can be connected to an external electric power source separate from the crane 10, for example to an electric network.

[0048] According to an example and Fig. 2, the power source apparatus 20 may comprise an electric generator 188 for producing an electric current. The electric generator 188 may comprise an output for electric current, which may be utilized on the site where the crane 10 is placed. In addition or alternatively, the electric current produced by the electric generator 188 is utilized in the electric motor 210, to which a hydraulic pump 180 may be coupled.

[0049] The electric generator 188 may be connected to the power source apparatus 20 placed in the counterweight arrangement 24, the electric generator 188 thus constituting a part of the counterweight arrangement. The electric generator 188 may be connected to the combustion engine 200.

[0050] According to the presented solution and Fig. 1, the counterweight arrangement 24 of the crane 10 is connected to the column structure 120 of the boom 12, whereby the counterweight arrangement 24 is configured to pivot together with the boom 12 about the rotation axis X. The counterweight arrangement 24, particularly its mass including parts, devices, structures, and components therein, acts as a counterweight for the boom section 122 and/or loads to be connected to or suspended from it, which may also include various tools.

[0051] The counterweight arrangement 24 is placed, preferably and primarily, on the side opposite the column structure 120 and the rotation axis X, that is, on the rear side in relation to the boom section 122 placed on the front side, seen in the horizontal direction. The mass of the counterweight arrangement 24 causes a first torque effective on the column structure 120 and opposite to a second torque effective on the column structure 120 and caused by the mass of the boom section 122. The first and second torques may be unequal, and the first torque may compensate for the second torque, at least partly. The loads suspended from the boom section 122 increase said second torque.

[0052] In an example, the horizontal distance between the counterweight arrangement 24 and the column structure 124 is adjustable, whereby the counterweight arrangement 24 can be transferred farther away from the column structure 124, in which case said first torque increases, and back towards the column structure 124, in which case said first torque decreases, or the structure of the crane 10 can be made compact, for example for transport. When said distance increases, the counterweight arrangement 24 moves rearwards, away from the boom section 122. For adjusting and setting said distance, the counterweight arrangement 24 may comprise at least one controllable actuator, for example a linear actuator, such as a hydraulic cylinder driven by hydraulic power.

[0053] According to an example and Fig. 1, the counterweight arrangement 24 may comprise a scaffold 240, to which the parts, devices, structures, and components of the counterweight arrangement 24 are fastened and which, in turn, is fastened to the column structure 124. Said scaffold 24 may be movable, for example for adjusting the distance, or it may have a subassembly by means of which said parts, devices, structures, and components can be moved farther away from the column structure 124.

[0054] In an example and Fig. 1, at least one above mentioned power source apparatus 20 is placed in the counterweight arrangement 24. Said power source ap-

paratus 200 comprises a combustion engine 200, such as a diesel engine, or an electric motor 210, or both, as described in the different examples relating to the power source apparatus 20 in the above description.

[0055] According to another example and Fig. 2, one or more of: at least one hydraulic pump 180, at least one control valve 182, at least one tank 184 for containing hydraulic fluid - as described in the different examples relating to the control system in the above description - are placed in the counterweight arrangement 24.

[0056] The control valve 182 may be fastened to a valve manifold block comprising channels for hydraulic fluid. Said valve manifold block may be placed in the counterweight arrangement 24.

[0057] According to an example and Fig. 2, one hydraulic pump 180 is connected to a combustion engine 200 and another hydraulic pump 180 is connected to an electric motor 180, and furthermore, they are all placed in the counterweight arrangement 24.

[0058] An example of the counterweight arrangement 24, shown in Fig. 2, may be applied in the crane 10 of Fig. 1 in ways presented in the above description. According to the different examples and alternatives, at least some of the parts, apparatuses, structures, and components of the counterweight arrangement 24 of Fig. 2 may also be placed elsewhere in the crane 10, for example in the frame structure 220. For example, control valves 182 controlling the function of the outriggers 16 may be placed in the frame structure 220 or in the outrigger 16. One part of the control system 18 may be placed in the counterweight arrangement 24 and another part elsewhere in the crane 10. In some cases, the control device 186 may be remote from the crane 10 during the control of its functions.

[0059] The presented solution is not limited solely the alternatives and examples presented above and disclosed in the above description, but combinations of them are possible as well, for the purpose of versatile functions of the crane 10. Said alternatives and examples cannot be considered to limit the solution, but applying the presented solution will be presented more closely in the appended claims.

Claims

1. Mobile crane, comprising:

a column structure;
a boom which is telescopic, connected to the column structure by articulation, and configured to move up and down, wherein the crane is suitable for lifting and moving loads connected to or suspended from the boom;
a turning device, on which the column structure is mounted and which is configured to swivel the column structure and the boom together in two lateral directions, around a substantially vertical direction;
at least two movable outriggers which can be placed against the ground or a floor and which are configured to support and stabilize the crane;
a control system which is configured to control the functions of the crane and which comprises at least one control device, by which an operator may manually control the functions of the crane; and
at least one power source apparatus for generating the power needed by the functions of the crane;
characterized in that the crane further comprises:

a crawler frame for moving the crane and comprising a frame structure and motorized first and second crawler tracks placed on opposite sides of the frame structure; and
in which crane the turning device is further mounted on the frame structure of the crawler frame, and the above-mentioned outriggers are connected to the frame structure of the crawler frame; and
the crane further comprises:

a counterweight arrangement connected to the column structure, wherein the counterweight arrangement is configured to swivel together with the column structure and the boom and is further suitable for acting as a counterweight for the boom and/or for loads to be connected to or suspended from the boom.

2. The crane according to claim 1, wherein the horizontal distance between the counterweight arrangement and the column structure is adjustable, wherein the counterweight arrangement is movable farther away from and back towards the column structure.

3. The crane according to claim 2, wherein the counterweight arrangement comprises at least one controllable actuator for adjusting and setting said horizontal distance.

4. The crane according to any one of the claims 1 to 3, wherein at least one of said power source apparatuses is placed in the counterweight arrangement.

5. The crane according to claim 4, wherein said power source apparatus comprises either an electric motor or a combustion engine, or both, for generating the power needed for the functions of the crane.

6. The crane according to any one of the claims 4 to 5, wherein the control system comprises:

at least one hydraulic pump configured to generate hydraulic power and hydraulic fluid flow, and connected to said power source apparatus;
at least one controllable control valve configured to control the hydraulic fluid flow for implementing the functions of the crane; and
at least one tank for containing hydraulic fluid;
wherein at least one of said hydraulic pump, said control valve, and said tank is placed in the counterweight arrangement.

7. The crane according to any one of the claims 4 to 6, wherein said power source apparatus further comprises an electric generator for generating electric current, wherein said electric generator is placed in the counterweight arrangement.

8. The crane according to any one of the claims 4 to 6, wherein said control system comprises at least one control device which can be brought remote from the crane and by which an operator may remotely control the functions of the crane manually.

9. The crane according to any one of the claims 1 to 8, wherein the boom comprises only one boom section which is telescopic and mounted on the column structure by articulation; or
the boom comprises at least two successive boom sections which are connected to each other and to the column structure by articulation, one of them being telescopic.

10. The crane according to any one of the claims 1 to 9, which further comprises at least one movable dozer blade connected to the crawler frame, and/or the crane comprises at least one motorized cable winch connected to the crawler frame.

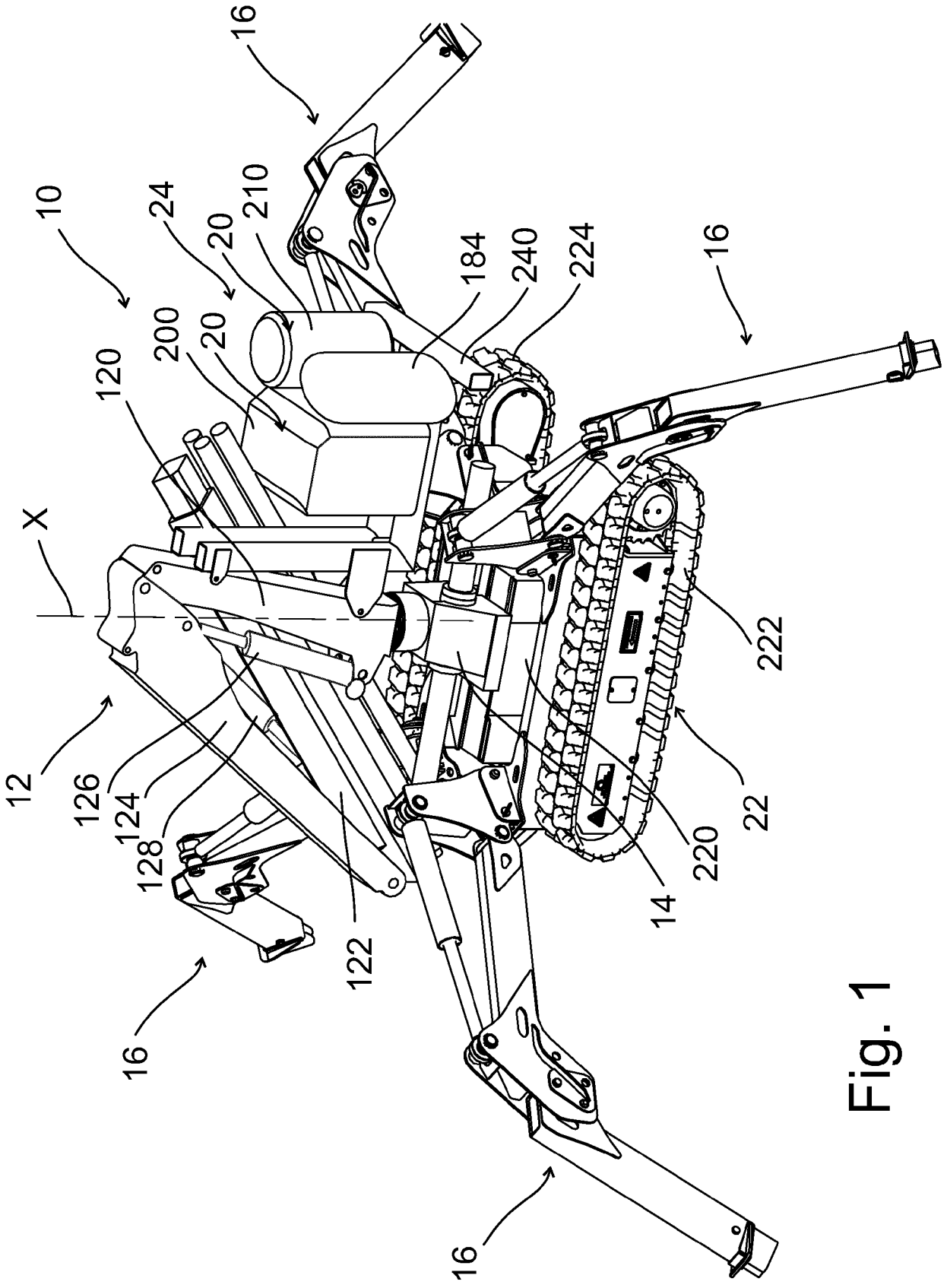
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Fig. 1

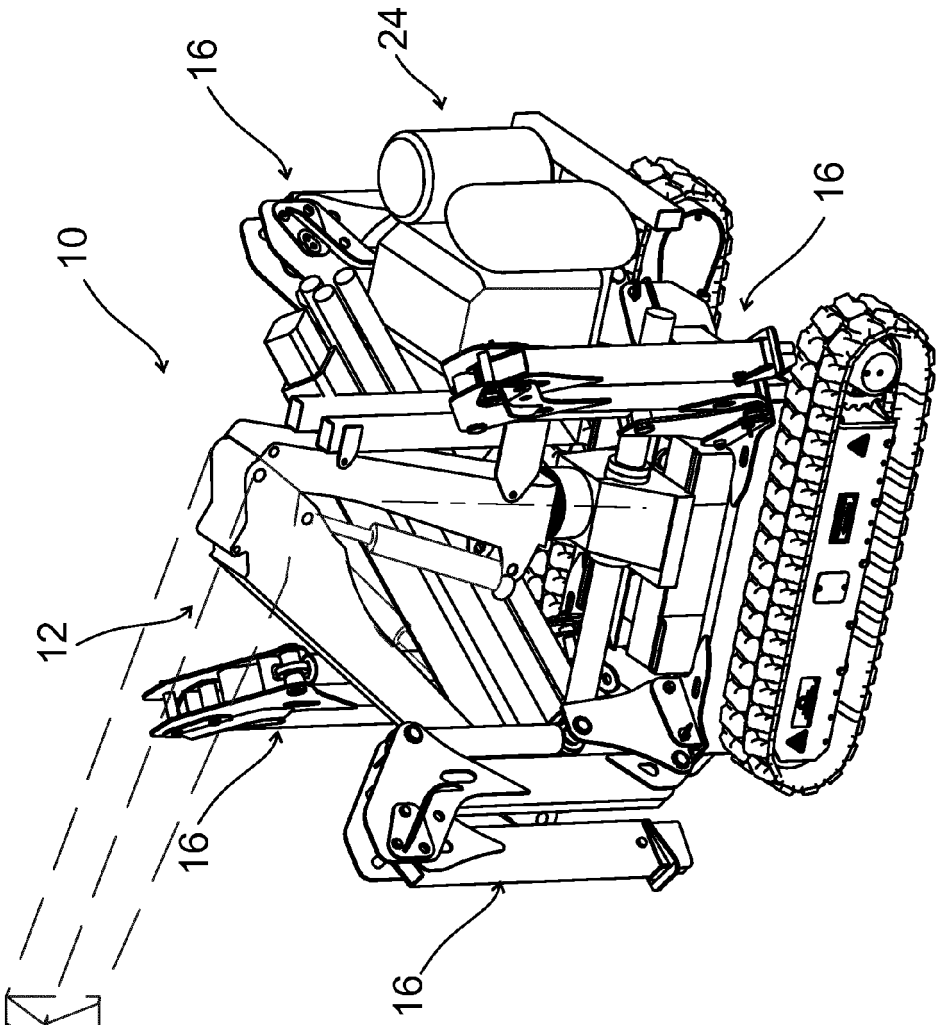

Fig. 3

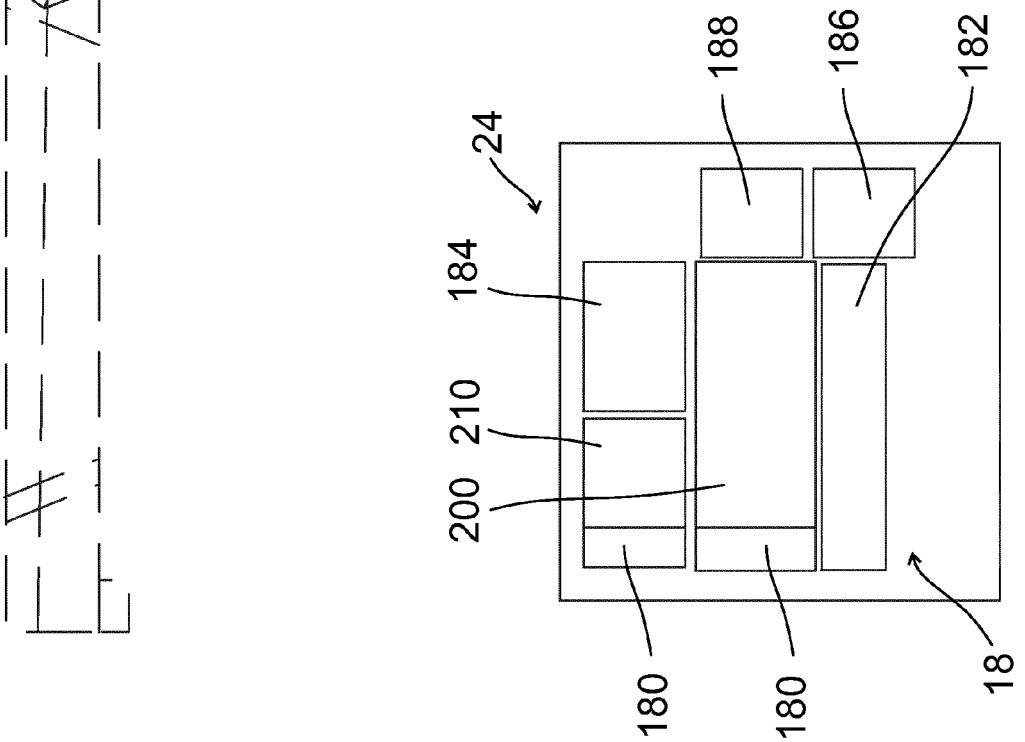

Fig. 2

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EUROPEAN SEARCH REPORT

Application Number
EP 17 39 7528

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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Y	* column 1, line 66 - column 2, line 1 * * column 3, lines 5, 17 * * column 4, lines 29-32, 64 * * claim 8 * * abstract * * figures *	3-8,10	B66C23/62 B66C23/76 B66C23/00

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A	* paragraphs [0026] - [0028] * * abstract * * figures *	1,10	

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	29 March 2018	Colletti, Roberta

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 17 39 7528

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