invention makes it possible to dispense with the time-consuming implementation of a sampling phase. A method according to the invention also makes it possible for example to easily take account of ageing and wear phenomena of the lifting apparatus in determining a load which is lifted or is to be lifted by the lifting apparatus.

The possibility of carrying out the measurement phase substantially as often as desired after carrying out the reference phase is not to be excluded.

It is advantageous in that respect that the reference position corresponds to a freely selectable position of the lifting apparatus. Implementation of the method can thus be effected starting from substantially any position of the lifting apparatus. That can make it possible that the lifting apparatus does not have to be moved into a predetermined position specifically before carrying out the reference phase.

It can generally be advantageous if the measurement position corresponds to a position of the lifting apparatus after a load pickup or a load setdown. In that case the measurement position can correspond to a position of the lifting apparatus immediately after picking up or setting down a load. The measurement position can also correspond to a position of the lifting apparatus which occurs by a (possibly slight) change in position directly after a load is picked up or set down.

It can be advantageous if the measurement position corresponds to a position of the lifting apparatus, approximated to the reference position of the lifting apparatus. By virtue thereof differences occurring in the comparison phase in respect of the detected forces can be for a large part attributed to a change in the loading state of the lifting apparatus by virtue of the load which is lifted or is to be lifted. Changes in the detected forces by virtue of a change in the geometry, for example caused by a change in extension, can in that case provide a smaller proportion. An approach of the measurement position to the reference position can occur for example by the lifting apparatus for picking up or setting down a load being moved out of the reference position and by the position of the lifting apparatus

CLAIMS

1. A method of determining a load (21) which is lifted or is to be lifted by a hydraulic lifting apparatus (2), preferably a hydraulic loading crane, wherein the lifting apparatus (2) for determining the load (21) which is lifted or is to be lifted is moved into a reference position in a reference phase in a first loading state of the lifting apparatus (2), characterised in that

- in the reference position a first detection of the forces currently acting on the lifting apparatus (2) and the current geometry of the lifting apparatus (2) is effected, wherein the reference position corresponds to a freely selectable position of the lifting apparatus (2),

- in a measurement phase the lifting apparatus (2) is moved into a measurement position in a second loading state and in the measurement position a second detection of the forces currently acting on the lifting apparatus (2) and the current geometry of the lifting apparatus (2) is effected, and

- in a comparison phase the lifted load (21) is characterised by a comparison of the respective detected forces currently acting on the lifting apparatus (2) and the respective detected current geometry of the lifting apparatus.

2. A method according to claim 1 wherein the measurement position corresponds to a position of the lifting apparatus (2) after a load pickup or a load setdown.

3. A method according to at least one of the preceding claims wherein the measurement position corresponds to a position of the lifting apparatus (2), approximated to the reference position of the lifting apparatus (2).

4. A method according to at least one of the preceding claims wherein the measurement position of the lifting apparatus (2) substantially corresponds to the reference position.

5. A method according to at least one of the preceding claims wherein the reference position corresponds to a position approximated to an intermediate position, wherein the intermediate position is a position of the lifting apparatus (2), that is suitable for load pickup or load setdown.

6. A method according to the preceding claim wherein transfer of the lifting apparatus (2) out of the reference position into the intermediate position and transfer of the lifting apparatus (2) out of the intermediate position into the measurement position is effected with a change in position of the lifting apparatus (2), that is within a tolerance range.

7. A method according to at least one of the preceding claims wherein prior to each implementation of the measurement phase for detection of the forces currently acting on the lifting apparatus (2) in the second loading state and the current geometry of the lifting apparatus (2) an implementation of the reference phase is effected for detecting the forces currently acting on the lifting apparatus (2) in the first loading state and the current geometry of the lifting apparatus (2).

8. A method according to at least one of the preceding claims wherein detection of the forces currently acting on the lifting apparatus (2) and the current geometry of the lifting apparatus (2) is effected with involvement of parameters characteristic of the respective position of the lifting apparatus (2) and the respective loading state of the lifting apparatus (2), and a calculation model.

9. A method according to at least one of the preceding claims wherein the lifting apparatus (2) has at least one crane column rotatable about a vertical axis of rotation (v1) and a main arm (4) mounted to the

crane column (3) pivotably about a first horizontal pivot axis (h1), wherein the lifting apparatus (2) further has at least one hydraulic main cylinder (15) for the pivotal movement of the main arm (4), wherein in the reference phase and the measurement phase the moment is detected in relation to the first horizontal pivot axis (h1).

10. A method according to the preceding claim wherein the lifting apparatus (2) has a rotary mechanism (18) for rotation of the crane column (3) and an articulated arm (5) mounted to the main arm (4) pivotably about a second horizontal axis of rotation (h2) and with preferably at least one crane extension arm (6), wherein the lifting apparatus (2) further has a first hydraulic articulation cylinder (16) for the pivotal movement of the articulated arm (5) and preferably at least one first hydraulic extension cylinder for actuation of the at least one crane extension arm (6).

11. A method according to claim 8 and one of claims 9 and 10 wherein the characteristic parameters include at least the pressure in the at least one main cylinder (15) and/or the pressure in the articulation cylinder (16) and/or the rotary angle of the rotary mechanism (18) and/or the articulation angle (a1) of the main arm (4) relative to the crane column (3) and/or the articulation angle (a2) of the articulated arm (5) relative to the main arm (4) and/or the extension position of the at least one crane extension arm (6).

12. A method according to at least one of claims 8 to 11 wherein the lifting apparatus (2) further has an attachment articulated arm (7) mounted to the articulated arm (5) pivotably about a third horizontal pivot axis (h3) and having at least one crane extension arm (11), wherein the lifting apparatus (2) further has at least one second hydraulic articulation cylinder (17) for the pivotal movement of the attachment articulated arm (7) and the characteristic parameters further include the pressure in the second articulation cylinder (17) and/or the articulation angle (a3) of the

attachment articulated arm (7) relative to the articulated arm (5) and/or the extension position of the at least one crane extension arm (11) of the attachment articulated arm (7), wherein in the reference phase and the measurement phase the moment is detected in relation to the first horizontal pivot axis (h3) and the moment is detected in relation to the third horizontal pivot axis (h3).

13. A method according to at least one of preceding claims 8 to 12 wherein the lifting apparatus (2) further has at least one fly jib (13) arranged on a crane extension arm (6, 11) – preferably at a predeterminable angle – and the additional displacement of the at least one fly jib (13) is incorporated in the calculation model.

14. A method according to at least one of preceding claims 8 to 13 wherein the lifting apparatus (2) further has a working device (14) arranged on the lifting apparatus (2), in particular on a crane extension arm (6, 11), and the additional loading due to the working device (14) is incorporated in the calculation model.

15. A method according to at least one of preceding claims 8 to 14 wherein the deformation of the lifting apparatus (2) is incorporated in the calculation model.

16. A method according to the preceding claim and at least one of claims 9 to 15 wherein the deformation of the crane column (3) and/or the main arm (4) and/or the articulated arm (5) and/or the attachment articulated arm (7) and/or the at least one crane extension arm (6, 11), of the lifting apparatus (2) and/or the at least one fly jib (13) and/or the influence of seal frictions of the hydraulic cylinders (15, 16, 17, 20) are incorporated in the calculation model.

17. A method according to the preceding claim wherein in the calculation model the deformation in the form of a correction to detected

articulation angles and/or in the form of a correction to detected extension positions is applied, and/or the influence of the seal frictions is applied in the form of a correction to detected pressures.

18. A method according to the preceding claim wherein the correction is effected in dependence on the detected forces currently acting on the lifting apparatus (2) and/or detected articulation angles and/or the detected extension positions.

19. A method according to one of the two preceding claims wherein the correction for the deformation is effected in linear dependency in respect of the detected pressure and/or in linear dependency in respect of the detected extension position and/or the correction for the seal frictions is effected inversely proportionally to the detected pressure and in dependence on a direction of a change in position.

20. A method according to at least one of the preceding claims wherein the first loading state corresponds to a loading state without a load (21) lifted by the lifting apparatus (2) and the second loading state corresponds to a loading state with a lifted load (21).

21. A method according to at least one of claims 1 to 19 wherein the first loading state corresponds to a loading state with a first load (21) lifted by the lifting apparatus (2) and the second loading state corresponds to a loading state with a second lifted load (21) preferably differing from the first.

22. A control means (1) for a hydraulic lifting apparatus (2), preferably a hydraulic loading crane, which is adapted for carrying out a method according to at least one of the preceding claims for determining a load which is lifted or is to be lifted, wherein by the control means (1)

- in a first operating mode the reference phase can be carried out in a first loading state in the reference position of the lifting apparatus (2) for

the first detection of the forces currently acting on the lifting apparatus (2) and the current geometry of the lifting apparatus (2),

- in a second operating mode the measurement phase can be carried out in a second loading state in the measurement position of the lifting apparatus (2) for the second detection of the forces currently acting on the lifting apparatus (2) and the current geometry of the lifting apparatus (2), and

- in a third operating mode the comparison phase can be carried out for characterising the lifted load (21) by a comparison of the respective detected forces currently acting on the lifting apparatus (2) and the respective detected current geometry of the lifting apparatus (2).

23. A control means according to the preceding claim wherein the load (21) characterised in the comparison phase can be displayed at a display means communicating with the control means in units corresponding to the load (21).

24. A hydraulic lifting apparatus (2) – preferably a loading crane for a vehicle (19), particularly preferably an articulated arm crane – having a control means (1) according to one of claims 22 and 23.