

SPECIFICATION

A device for lifting loads, especially heavy loads, in a stepwise manner by means of one or several jacks

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The present invention concerns a device for lifting loads, especially heavy loads, in a stepwise manner by means of one or several jacks.

In earlier known devices of this kind one or several
10 so-called climbing jacks are used, i.e. a jack which co-operates with an elongated vertical carrying member and upon retraction and elongation alternately lifts the load and is stepwise moved along the carrying member. An example of such a device is
15 shown in the Swedish Patent Specification 363 798.

However, devices including climbing jacks are burdened with great disadvantages. The necessity to provide the carrying member with a great number of support means for the jack as well as for the load and
20 the need to dimension the carrying member so that it can support the load entails substantial costs. The fact that the jack during the lifting procedure is moved upwards along the carrying member furthermore makes it necessary to provide long supply
25 conduits for the hydraulic fluid, when the jack is of a hydraulic type, which apart from increasing the costs clutters up the work site and may cause accidents and also increases the risks for damages of the conduits. The greatest disadvantage is, however,
30 that the workmen on account of the construction of the known devices must accompany the load which results in great risks for the men. Said condition has also brought about strict safety regulations and insurance demands which forms a serious economical drawback.
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The aim of the present invention is therefore to provide a device of the kind stated by means of which the above stated disadvantages are set aside. According to the invention this is achieved by means
40 of a device of the construction which is defined in the attached patent claims.

A number of embodiments of the invention will be described below under reference to the attached schematical drawings, in which

45 *Figure 1* in elevation shows a portion of a device according to the invention,

Figure 2 is a plan view of a support plate forming a part of the device.

Figure 3 is an isometric view of two devices or units
50 according to the invention while lifting a load, and

Figure 4 is a view corresponding to *Figure 1* and showing a second embodiment according to the invention.

As shown in the drawings the device or unit for a
55 stepwise lifting of the load comprises a jack 1 and an elongated, vertically upright mast 2. The jack 1 is of conventional construction including a support portion 3 and a lifting portion 4 which is extendable out of and retractable into said support portion 3. The
60 jack 1 is preferably actuated by means of hydraulic fluid, but a mechanically operated jack may also be used. At the top end the lifting portion 4 can be provided with a head 5, which has a special construction known per se and is intended to prevent an
65 unintentional retraction of the jack, e.g. upon a

failure of the hydraulic conduits as will be further described later on. The top side of the head 5 is furthermore provided with a central projection or a stud 6 having a smaller cross section than the head
70 5. The function of the projection or stud will be described below.

The elongated vertically upright mast 2 includes a scaffold or frame which is not shown in detail, since
75 it does not form any part of the invention and may be designed in a manner suitable for the prevailing conditions, e.g. in the form of a frame-work construction. The object of the scaffold is to retain the remaining portion of the mast in rigid vertically
80 upright position. Said remaining portion comprises at first hand a support member 7 in the form of a tube, preferably of square cross-section, or a U-beam which by said scaffold is held in vertical position, whereby the bottom end of the support
85 member 7 rests on a bed 8 or the like, which is rigid enough to support the device and the load lifted thereby. The support member 7 is meant to surround said jack 1 at some distance therefrom, whereby the support portion 3 of the jack 1 rests on
90 said bed 8. The support member 7 is of a length which is somewhat smaller than the maxim length of the jack 1 in its fully extended lifting position, so that at least a portion of the projection or stud 6 in this position protrudes up over the top plane edge
95 surface 9 of the support member 7.

A support member 7 formed by a U-beam is open along one side and if the support member 7 consists of a tube it is provided with a lateral opening 7' extending from the top end of said support member
100 at least to a plane flush with the top end of the projection 6 of the jack head 5.

The other remaining portion of the mast 2 comprises a guiding tube 10 which is supported by the mast scaffold in a vertically upright position coaxially
105 above the support member 7, whereby the bottom end edge thereof is situated at a distance from the top edge surface 9 of said support member 7, so that a slot 11 is formed between said surfaces. The guiding tube 10 preferably has the same cross
110 section form as the support member 7, and the internal cross section form and area thereof correspond to those of the support member 7 so that a guide passage 12 is formed which runs through the support member 7 and the guiding tube 10. One side
115 wall of the guiding tube 10 is provided with a slot 14 extending over the entire length of said guiding tube. The guiding tube 10 may for instance consist of a U-beam of the same cross section form as the support member 7, rails 10' being secured to the
120 internal longitudinal edges of the flanges of the U-beam, so that the slot 14 is defined by said rails 10'. A second slot 14 may possibly be provided along the opposite side wall of the guiding tube.

The device according to the invention also comprises a number of supporting elements 15. Each
125 supporting element 15 consists of an end plate 16 of such form and dimension that it with some play is displaceable through the guide passage 12 formed by said support member 7 and said guiding tube 10.
130 A column 17 is arranged centrally on one side

surface of said end plate 16 and extends perpendicularly out therefrom. The cross section of said column 17 furthermore is smaller than the cross section of said end plate 16. The end plate 16 and the column 17 are rigidly inter-connected or integral with each other and the overall length of the supporting element 15 is somewhat smaller than the length of a stroke of said jack 1.

Finally, the device according to the invention includes a support plate 18 which is insertable into the slot 11 between the top end of the support member 7 and the adjacent end of the guiding tube 10. The support plate 18 has such dimensions that it in inserted position firmly rests on the top edge surface 9 of the support member 7 and it is provided with an edge indentation 19 which is of such form and dimension that it in inserted position of the support plate 18 loosely embraces the column 17 of a supporting element 15 situated within the guiding passage 12 but does not allow the end plate 16 of said supporting element to pass.

However, it is not absolutely necessary that the edge surface 9 of the support member 7 forms the abutment for the support plate 18. In the embodiment shown in Figure 4 the walls of the support member 7 defining the lateral opening 7' are provided with horizontal grooves or incisions which together define the gap 11 and the bottom edges 11' of which form the abutment for the support plate 18. Said edges 11' may thereby incline downwardly and outwardly, the downwardly directed side face of the support plate 18 being provided with a corresponding chamfer at cooperating edges to prevent the side walls of the support member 7 from being forced apart under the influence of the load.

When the invented device is to be used to lift a load, a number of masts 2 of the kind described is erected on the work site and thereafter a jack 1 is placed in the support member 7 of each mast so that it rests against the bed 8. It may for instance be assumed that the load is to be lifted by means of four units or devices according to the invention. Said units are then placed in the corners of a rectangle with the slots 14 of the guiding tubes 10 pairwise turned towards each other, whereafter a carrying beam 20 is placed with its ends inserted into said slots 14 to rest on the support plate 18 of the corresponding unit. The load 21 is thereafter placed on the two parallel carrying beams 20. Such a pair of units is shown in Figure 3.

From this start position the lifting of the load 21 is commenced in that the lifting portions 4 of the four jacks 1 are completely retracted within the support portions 3 thereof, whereafter a supporting element 15 is inserted into each support member 7 through the lateral opening 7' thereof in such a manner that the end plate 16 of the supporting element 15 rests on the top end of the lifting portion 4 of the cooperating jack 1.

A suitable number of supporting elements 15 may preferably be placed on a horizontal slide way 15' arranged beside each mast 2 at such a level that said supporting element 15 one after the other can be inserted into each corresponding support member 7. By simultaneous and controlled supply of hydraulic

fluid to the jacks 1 their lifting portions 4 are synchronously forced upwards so that the columns 17 of the supporting elements 15 are pushed upwards through the edge indentations 19 of the

cooperating support plates 18 to lift the carrying beams 20 and the load 21 thereon. When the carrying beams 20 have been lifted away from the support plates 18 these can be pulled out of their gaps 11 since the edge indentations 19 will play accommodate the columns 17 of the supporting elements 15. A retainer or the like (not shown) may be arranged at the top end of each support member 7 slidably to receive the support plate 18 thereof when the same is pulled out of the gap 11. In this position the carrying beams 20 and the load 21 are completely supported by the jacks 1 and the supporting elements 15 and can be lifted further by means of extension of the jacks 1, until the supporting elements 15 have been completely pushed out of the corresponding support members 7 and into the guiding tubes 10 with the bottom end surfaces of the end plates 16 a short distance above the top border surface of the gaps 11. In this position the support plates 18 are reinserted into their corresponding gaps 11, whereby the projections or studs 6 of the jack heads 5, which preferably have the same cross section dimension as the columns 17 of the supporting elements 15, are accommodated in the edge indentations 19 of the support plates 18. By reversing the supply of hydraulic fluid to the jacks 1 which preferably are double-acting, the jacks 1 are retracted so that the supporting elements 15 together with the carrying beams 20 and the load 21 are lowered until the end plates 16 of the supporting elements 15 rest against said support plates 18. When the jacks 1 have been completely retracted, a new supporting element 15 is inserted into each support member 7 through the lateral opening 7' thereof, whereafter the above described procedure is repeated. In this way the load 21 may be lifted by steps up to the required level, the height of each lifting step corresponding to the length of the supporting elements 15 used.

The axial length of the end plate 16 of each supporting element 15 is preferably greater than the width of the gap 11, so that the top end of the end plate 16 is inserted into the guiding tube 10 before the bottom end thereof is pushed out of the corresponding support member 7. Each supporting element is thereby effectively guided in the guiding passage 12 during the whole lifting step. Each supporting element 15 can also be provided with a central blind hole 22 in the end surface of the end plate 16 and a corresponding pin 23 can be arranged on the top surface of the column 17 for engagement in the blind hole 22 of the overlying supporting element 15 in order to maintain the consecutive supporting elements 15 centered. A similar pin 23 is for the same purpose preferably arranged on the top surface of the projection 6 of the jack head 5.

By means of one or several units of this kind very great loads may thus be lifted to considerable heights. In this connection it should be pointed out that the guiding tube 10 does not have any load supporting function, but only serves as a guide for

the supporting elements 15 stacked on top of each other. The guiding tube 10 may therefore be of comparatively weak dimensions, while the support member 7, the jacks 1 and the supporting elements 15 as well as the support plates 18, which carry the whole load, must be dimensioned for the actual load to be lifted.

As a safety measure to prevent an unintentional lowering of the load, if a jack 1 should be retracted for instance on account of a rupture in a conduit for supply of hydraulic fluid, the head 5 of each jack 1 may in a known manner as shown in Figure 4 be provided with two jaws 24 arranged horizontally in a common plane, which jaws 24 are displaceable towards and from each other by means of resilient forces, whereby the force to drive said jaws 24 apart may be derived from a compression spring tensioned between said jaws 24. The outer edges of said jaws 24 are formed to cooperate with horizontal grooves 25, arranged in the side surfaces of the support member 7 facing each other. The grooves are pairwise situated opposite each other and the top edges thereof are preferably chamfered to coact with corresponding chamfered edges of the jaws 24. When the jack 1 is extended, the jaws 24 are thereby forced towards each other by means of the cooperation between said chamfered edges, so that said jaws are automatically forced out of one pair of grooves and engages the next higher situated pair of grooves under the influence of the compression spring. Should a rupture occur in the supply conduit, the jack head 5 can thus only sink a distance corresponding to the distance between two consecutive pairs of grooves. During an intentional retraction of the jack 1, the jaws 24 are maintained in a position displaced towards each other, for instance by means of a hydraulic cylinder acting between said jaws. The lower edges of the grooves 25 and the corresponding edges of the jaws 24 may also be chamfered in the same way and for the same purpose as the bottom edges 11' of the gap 11 and the corresponding edges of the support plates 18.

The above described device according to the invention must only be regarded as an example of several possible embodiments which lie within the scope of the inventive idea. It is thus for instance not necessary to place the jack 1 of the device within the support member 7. Said support member 7 may instead be provided with a lifting member, preferably having the same form as the jack head 5 with the projection 6, shown in the drawings, which lifting member by means of a jack arranged outside of the support member is displaced up and down in said support member to lift and lower one or several supporting elements 15 in the manner described above. Said lifting member may also be provided with jaws 24 as shown in Figure 4 to prevent unintentional lowering of the load as also stated in the description.

CLAIMS

1. A device for lifting loads, especially heavy loads, by means of a jack, characterised in that said device comprises:

- a) a vertically upright, tubular support member which rests on a rigid bed and accommodates a lifting member which by means of said jack is displaceable in said support member between a lowered position and a raised position, the top end surface of said support member being situated somewhat below the top end surface of said lifting member in its raised position;
- b) a number of supporting elements the length of which is somewhat less than the length of displacement of said lifting member, said supporting elements being insertable one at a time into said support member above the top end surface of said lifting member in the lowered position of same and being insertable into a vertical guiding tube, which is aligned with said support member at a distance above the top end surface thereof;
- c) a support plate which is insertable between said guiding tube and said support member in engagement with the top end surface of the latter, said support plate being formed in such a manner that it in its inserted position does not prevent upward displacement of the lowermost supporting element resting on said lifting member, when said supporting element is partly situated in said support member, but prevents downward displacement of said supporting element when the same is completely introduced into said guiding tube, whereby the load is carried by the top end surface of the uppermost supporting element in the guide tube.
2. A device as claimed in Claim 1, characterized in that said lifting member is provided by a head of a jack, arranged within said support member.
3. A device as claimed in Claim 1, characterized in that said support member comprises a tube or a U-beam which is open at one side from the top edge thereof over a length which at least corresponds to the length of stroke of the jack.
4. A device as claimed in any one of the preceding claims, characterized in that each supporting element comprises an end plate which is freely displaceable in said support member and guiding tube, and a vertical column arranged centrally in said end plate and having a substantially smaller cross section than said guiding tube, said support plate having an edge indentation which loosely embraces said column.
5. A device as claimed in any one of the preceding claims, characterized in that each supporting element at one end is provided with a recess and at the other end with a projecting pin for mutual centering of two supporting elements situated adjacent each other.
6. A device as claimed in any one of the preceding claims, characterized in that horizontal grooves are arranged on the inside of the support member at least within the top portion thereof, said grooves being arranged opposite each other in pairs, and that said lifting member is provided with two jaws, situated opposite each other and being vertically displaceable into and out of engagement with an optional pair of grooves.



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b) a number of supporting elements the length of which is somewhat less than the length of displacement of said lifting member, said supporting elements being insertable one at a time into said support member above the top end surface of said lifting member in the lowered position of same and being insertable into a vertical guiding tube, which is aligned with said support member at a distance above the top end surface thereof;

c) a support plate which is insertable between said guiding tube and said support member in engagement with the top end surface of the latter, said support plate being formed in such a manner that it in its inserted position does not prevent upward displacement of the lowermost supporting element resting on said lifting member, when said supporting element is partly situated in said support member, but prevents downward displacement of said supporting element when the same is completely introduced into said guiding tube, whereby the load is carried by the top end surface of the uppermost supporting element in the guide tube.

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3. A device as claimed in Claim 1, characterized in that said support member comprises a tube or a U-beam which is open at one side from the top edge thereof over a length which at least corresponds to the length of stroke of the jack.

4. A device as claimed in any one of the preceding claims, characterized in that each supporting element comprises an end plate which is freely displaceable in said support member and guiding tube, and a vertical column arranged centrally in said end plate and having a substantially smaller cross section than said guiding tube, said support plate having an edge indentation which loosely embraces said column.

5. A device as claimed in any one of the preceding claims, characterized in that each supporting element at one end is provided with a recess and at the other end with a projecting pin for mutual centering of two supporting elements situated adjacent each other.

6. A device as claimed in any one of the preceding claims, characterized in that horizontal grooves are arranged on the inside of the support member at least within the top portion thereof, said grooves being arranged opposite each other in pairs, and that said lifting member is provided with two jaws, situated opposite each other and being vertically displaceable into and out of engagement with an optional pair of grooves.

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7. A device substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

Printed for Her Majesty's Stationery Office, by Croydon Printing Company Limited, Croydon, Surrey, 1983.
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

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SPECIFICATION NO 2053150B

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THE PATENT OFFICE
3 June 1983

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