The machine, for lifting and handling loads, in particular containers, comprises a first (4) and a second (5) vertical structures sliding on the ground, a scaffold frame (6) mounted substantially horizontally on the vertical structures, lifting means (10, 12) associated with the scaffold frame and suitable for lifting/lowering a load, a plurality of wheels (13) for making the vertical structures slide on the ground in a sliding direction, the wheels being mounted on wheelboxes (16) associated with the vertical structures by interposition of a hydraulic cylinder (21) connected to a hydraulic circuit controlled by a control unit suitable for regulating the hydraulic pressure in the hydraulic cylinder and evenly distributing the weight of the whole structure onto the wheels. The wheelboxes are mounted on equalizers (17, 18) connected to carrier beams (4b, 5b) via pivots (20) and the hydraulic cylinders.
MACHINE FOR LIFTING AND HANDLING LOADS, IN PARTICULAR CONTAINERS

Technical Field

The present invention relates to a machine for lifting and handling loads, in particular containers.

Background Art

It is well known that the main activities of loading and unloading containers off and on ships take place on port docks. These docks are equipped with large dock cranes that roll on rails longitudinally and parallel to the ships.

Two handling systems or work cycles for unloading and loading a ship are known for container handling activities. In particular, as far as the unloading or loading operations of a ship are concerned, the handling of containers starts only after the mooring of the ship has been terminated.

Once moored, the dock cranes are moved into position in order to prepare for the actual loading or unloading. These cranes are positioned on the dock in front of the ship with their jibs up. With the dock cranes side by side, the jibs are then lowered and positioned over the hold of the ship to be unloaded in order to start handling the containers both to be unloaded and loaded.

The cranes are each equipped with their own spreaders. For some years now so-called "twin-lift" spreader models have been utilized. These are able to handle one 40 foot container or two 20 foot ones per cycle, and unload up to 35/40 forty-foot containers or about 60/70 twenty-foot containers per hour.

Once the dock cranes have started to perform their work cycles, the port is activated for all the successive sorting and distribution activities of the containers from the inbound dock to the yard or vice versa.

The unloading of containers is done:

- directly by the dock crane onto trailers (towed by a prime-mover, or tractor) for their transfer to the storage yards, where they are then placed under yard cranes in the yard for further stacking;
or
- directly on the ground, if the port is equipped with self-loading and self-unloading equipment such as fork-lift trucks, reach-stackers or straddle carriers that can transfer the unloaded containers to the yard where they are then stacked. With this method of unloading, the dock cranes are able to increase their productivity. The reason for this is because by placing the container directly on the ground rather than having to place it on a trailer they can work more quickly and securely.

Once the containers reach the yard, they are stacked one on top of the other by a series of yard cranes of the so-called RTG (rubber tired gantry) or RJVIG (rail mounted gantry) type.

The high daily layover costs of a ship in a port, in particular for large ships, also have to be taken into account.

For this reason, ports that are able to release ships in a shorter time are the ones which will be able to acquire more and more traffic and attract new shipping companies.

Therefore it is of great importance for ports to increase their productivity during all phases of the container handling, so that port operators can release ships as soon as possible.

In order to guarantee a faster turnaround time, it is necessary that the big dock cranes, yard cranes and other means of transport of the containers from dock to yard are able to load and unload as many containers as possible in the shortest feasible period, thus avoiding any downtime and manoeuvres that can lead to a loss of time.

In order to achieve all this, however, it is necessary that all the machines are built adequately strong enough and are able to transfer an overall greater weight to the ground without excessively increasing the overall dimensions of the machines themselves.

In this regard it must be pointed out that traditional machines usually mounted on a wheel system are not able to adequately meet the abovementioned essential need.

Object of the Invention
The main object of the machine according to the invention is to handle a greater number of containers with respect to the more commonly used machines in the same amount of time and with the same comparable dimensions.

This and other objects have been achieved by the present machine for lifting and handling loads, in particular containers, comprising at least a first and a second vertical structures sliding on the ground, at least one scaffold frame mounted substantially horizontally on said vertical structures, and lifting means associated with said scaffold frame and suitable for lifting/lowering at least one load, characterized in that it comprises a plurality of wheels for making said vertical structures slide on the ground in a sliding direction, said wheels being mounted on wheelboxes associated with said vertical structures by interposition of at least one hydraulic cylinder connected to at least one hydraulic circuit controlled by at least a control unit suitable for regulating the hydraulic pressure in said hydraulic cylinder and evenly distributing the weight of the whole structure onto said wheels.

**Brief Description of the Drawings**

Other characteristics and advantages of the present invention will become more evident from the description of a form of preferred, but not sole, embodiment, of a machine for lifting and handling loads, in particular containers, illustrated purely as an example but not limited to the annexed drawings in which:

- figure 1 is a perspective view of a possible form of embodiment of the machine according to the invention;
- figure 2 is a partial and front view, on an enlarged scale, of the machine's wheelboxes according to the invention;
- figure 3 is a partial and front, further simplified, view of one of the wheelboxes of figure 2;
- figure 4 is a side, schematic and partial view of the wheelbox of figure 3;
- figure 5 is a plan, schematic and partial view, of the wheelbox of figure 3.

**Embodiments of the Invention**

With particular reference to such figures, a machine for lifting and handling loads, in particular containers has been globally indicated by 1. In the form of embodiment of the invention as shown in Figure 1, the machine 1
consists of a dock crane for loading/unloading a plurality of containers 2 on/off a ship 3; this does not exclude, however, alternative forms of embodiment in which the machine 1 is of the yard crane type, e.g. a RTG or a RMG, or consists of means of transport for the containers 2 from dock to yard, and vice versa, e.g. a straddle carrier type or the like.

The crane 1 as shown in Figure 1 comprises a first vertical bearing structure 4a, 4b and a second vertical bearing structure 5a, 5b to support a scaffold frame 6a, 6b, substantially horizontal and connected to them.

From the scaffold frame 6a, 6b two jibs 7a, 7b extend overhanging substantially horizontal on each of which lifting means 8 for lifting the containers 2 are mounted; this does not exclude, however, alternative forms of embodiment in which the crane 1 is equipped with a single jib, or three or more.

In detail, the first vertical structure 4a, 4b is composed of a plurality of vertical legs 4a mounted on a carrier beam 4b which connects the legs 4a and which extends in an orthogonal direction with respect to the jibs 7a, 7b.

The first vertical structure 4a, 4b is positioned at the median portion of the jibs 7a, 7b.

Similarly, the second vertical structure 5a, 5b is composed of two or more vertical legs 5a mounted on a carrier beam 5b which connects the legs 5a and which extends in an orthogonal direction with respect to the jibs 7a, 7b.

The second vertical structure 5a, 5b is positioned at the median portion of the space defined between the first vertical structure 4a, 4b and one end of the jibs 7a, 7b.

In effect, the first vertical structure 4a, 4b is located near the edge of the dock 9 for loading/unloading the containers 2 on/off the ship 3 with the jibs 7a, 7b that extend to completely cover the hold of the ship 3 in order to carry out the lifting and placing of the containers 2 off and on said hold.

At the top of vertical legs 4a, 5a the scaffold frame 6a, 6b is mounted. This consists of a perimeter structure formed by cross beams 6a, which are parallel to the carrier beams 4b, 5b, and by longitudinal beams 6b, which connect the cross beams 6a and which are parallel to the jibs 7a, 7b.

The cross beams 6a are associated with the jibs 7a, 7b, which are parallel to
each other, of equal length and side-by-side to each other.

Each jib 7a, 7b is formed by a moving front section oriented towards the sea which can be raised and, when lowered, can protrude completely over the hold of the ship 3, and by a rear section oriented towards the land, which is fixed and integral with the cross beams 6a, which in turn are connected to the vertical legs 4a, 5a.

The length of the rear sections is almost equal to that of the front sections of the jibs 7a, 7b. This allows the containers 2 to be unloaded also from the rear part of the crane 1 as well as from the part between the vertical bearing structures 4a, 4b and 5a, 5b, in order to distribute the containers 2 rationally and efficiently with an optimization of space that permits their rapid sorting in the yard by appropriate means of transport A.

In effect, in a working configuration, the front section of the jibs 7a, 7b is intended to be positioned over the ship 3 once this has tied up at the dock 9.

The lifting means 8, e.g., consist of two sliding trolleys 10 on each jib 7a, 7b and of a series of lifting units connected to the trolleys 10 which are suitable for working contemporarily to lift and/or lower a plurality of individual containers 2.

In the particular form of embodiment of the invention as shown in Figure 1, each jib 7a, 7b normally has two sliding trolleys 10 that move along the jib and an engine room 11 with two lifting units (hoisting winches), one for each trolley 10.

The lifting units are not described in detail in the figures.

Each trolley 10 supports at least two "twin-lift" type spreaders 12 and since the crane 1 is equipped with two jibs 7a, 7b with four trolleys 10, there is a total number of eight spreaders 12 that can be handled simultaneously and independently, in order to load or unload eight 40 foot containers or sixteen 20 foot container.

The machine 1 as shown in the figures, therefore, is intended to move and handle a decisively much higher number of containers 2 with respect to the traditional cranes and consequently must be capable of supporting a substantially higher overall weight.
The weight of the crane is transferred to the ground through a series of wheels 13, 14 associated with the carrier beams 4b, 5b in a sliding way on respective tracks (rails) 15 to move the crane in an orthogonal sliding direction with respect to the jibs 7a, 7b, and parallel to the edge of the dock 9.

The wheels 13, 14 are made of steel and are mounted in double pairs on appropriate supports or wheelboxes 16. The wheelboxes 16 are anchored along the whole length of the carrier beams 4b, 5b and are associated with them through an equalizer 17, 18. Each equalizer 17, 18 is composed of two levers 17 positioned opposite to each other and associated by means of a series of connecting brackets 18.

In effect, the equalizers 17, 18 have a substantially median portion hinged to the wheelboxes 16 by means of a first joining pin 19, an end hinged to the carrier beams 4b, 5b by means of a second joining pin 20 and the opposite end associated with the carrier beams 4b, 5b by interposition of a hydraulic cylinder 21.

Each hydraulic cylinder 21 is associated with an equalizer 17, 18 and has one end hinged to the respective equalizer 17, 18 with a third joining pin 22 and the opposite end hinged to one of the carrier beams 4b, 5b by means of a fourth joining pin 23.

The hydraulic cylinders 21, in effect, act as a hydraulic suspension and are connected together so as to distribute the load equally and in fact create a single body piece between the wheelboxes 16 and the carrier beams 4b, 5b. The cylinders (hydraulic jacks) 21 are connected together by a hydraulic circuit 24 which allows the transfer of the same level of oil and pressure between one cylinder and another and which is controlled by a control unit that constantly maintains the preset pressure depending on the load in any movement.

Conveniently, the wheels 13, 14 are associated with handling means 25 suitable for making the entire crane mobile.

The handling means 25 are composed, e.g., of motorized gearboxes mounted in a number to meet the necessary power requirement for handling the crane on its tracks 15.

In particular, a motorized gearbox 25 is provided mounted on every wheelbox
16 and arranged substantially coaxial to one of the two wheels 13, 14 associated with the wheelbox.

Advantageously, the motorized gearboxes 25 are made integral to each other in pairs in a single device 26 arranged astride of two consecutive wheelboxes 16; in this way, one motor gearbox 25 of the device 26 drives the rear wheel 13, 14 of a wheelbox 16 while the other motorized gearbox 25 drives the front wheel 13, 14 of the adjacent wheelbox.

It has in point of fact been ascertained how the described invention achieves the proposed objects.

In this respect the particular innovation of the invention is to provide a series of wheelboxes mounted on a system of hydraulic suspensions according to the invention to allow for a reduction and perfectly even distribution of the weight of the structure on both the wheels and rails, and therefore also on the dock.

This allows for the construction of machines of considerable weight and sturdiness which are able to simultaneously handle many containers and, in any case, pass through to the ground suitable and tolerable loads with the resistance offered by the ground.

With particular reference to the dock crane shown in the figures, for example, the present invention allows to make one crane with two jibs which can be positioned perfectly centred over the two container holds of the ship to be loaded or unloaded, allowing them to work simultaneously with four trolleys and eight spreaders and up to 36 wheels per side, all contained within a maximum overall dimensions of 40 meters.

The invention thus conceived is susceptible to numerous modifications and variations, all of which falling within the scope of the inventive concept.

Furthermore all the details can be replaced with others that are technically equivalent.

In practice, the materials used, as well as the contingent shapes and dimensions, may be any according to requirements without because of this moving outside the protection scope of the following claims.
CLAIMS

1) Machine for lifting and handling loads, in particular containers, comprising at least a first and a second vertical structures sliding on the ground, at least one scaffold frame mounted substantially horizontally on said vertical structures, and lifting means associated with said scaffold frame and suitable for lifting/lowering at least one load, characterized in that it comprises a plurality of wheels for making said vertical structures slide on the ground in a sliding direction, said wheels being mounted on wheelboxes associated with said vertical structures by interposition of at least one hydraulic cylinder connected to at least one hydraulic circuit controlled by at least a control unit suitable for regulating the hydraulic pressure in said hydraulic cylinder and evenly distributing the weight of the whole structure onto said wheels.

2) Machine according to the claim 1, characterized in that at least one of said vertical structures comprises a plurality of substantially vertical legs mounted on a carrier beam elongated substantially horizontal along said sliding direction.

3) Machine according to one or more of the preceding claims, characterized in that at least one of said wheelboxes is associated with said vertical structures through at least an equalizer.

4) Machine according to one or more of the preceding claims, characterized in that said equalizer has at least a substantially median portion hinged to at least one of said wheelboxes.

5) Machine according to one or more of the preceding claims, characterized in that said equalizer has at least one end hinged to said vertical structures and the opposite end associated with said vertical structures by means of said hydraulic cylinder.

6) Machine according to one or more of the preceding claims, characterized in that said equalizer comprises at least two levers positioned opposite to each other and associated by means of at least one connecting bracket.

7) Machine according to one or more of the preceding claims, characterized in that it comprises a plurality of said equalizers, said wheelboxes being associated with said vertical structures by means of a corresponding equalizer.

8) Machine according to one or more of the preceding claims, characterized in
that said wheels are slidable on tracks.

9) Machine according to one or more of the preceding claims, characterized in that said wheels are mounted in double pairs on said wheelboxes.

10) Machine according to one or more of the preceding claims, characterized in that said wheelboxes are associated along the whole length of said carrier beams.

11) Machine according to one or more of the preceding claims, characterized in that it comprises handling means of said vertical structures along said sliding direction.

12) Machine according to one or more of the preceding claims, characterized in that said handling means comprise at least a motorized gearbox associated with at least one of said wheels.

13) Machine according to one or more of the preceding claims, characterized in that said handling means comprise a plurality of said motorized gearboxes, each of said motorized gearboxes being associated with one of said wheelboxes.

14) Machine according to one or more of the preceding claims, characterized in that it comprises at least a substantially horizontal jib that extends overhanging from said scaffold frame.

15) Machine according to one or more of the preceding claims, characterized in that it comprises a plurality of said jibs.

16) Machine according to one or more of the preceding claims, characterized in that said jibs are parallel to each other.

17) Machine according to one or more of the preceding claims, characterized in that said jibs are side-by-side to each other.

18) Machine according to one or more of the preceding claims, characterized in that said lifting means comprise at least a trolley sliding along said jib and at least a load lifting unit connected to said trolley.

19) Machine according to one or more of the preceding claims, characterized in that said trolley comprises at least one spreader for gripping said loads.

20) Machine according to one or more of the preceding claims, characterized in that said lifting means comprise at least two trolleys, each connected to respective load lifting units suitable for working contemporarily to lift and/or
21) Machine according to one or more of the preceding claims, characterized in that said trolleys are independent from each other.

22) Machine according to one or more of the preceding claims, characterized in that said lifting units are independent from each other.

23) Machine according to one or more of the preceding claims, characterized in that it is a dock crane.

24) Machine according to one or more of the preceding claims, characterized in that it is a yard crane.

25) Machine according to one or more of the preceding claims, characterized in that it is a means of transport for said loads from dock to yard, and vice versa.
A. CLASSIFICATION OF SUBJECT MATTER
INV. B66C9/12 B66C19/00

According to International Patent Classification (IPC) or to both national classification and IPC.

B. RELDS SEARCHED
Minimum documentation searched (classification system followed by classification symbols)
B66C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<td>Y</td>
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Further documents are listed in the continuation of Box C
See patent family annex

Special categories of cited documents

'A' document defining the general state of the art which is not considered to be of particular relevance
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'X' document of particular relevance, the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
'Y' document of particular relevance, the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
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Date of the actual completion of the international search
4 August 2009

Date of mailing of the international search report
12/08/2009

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Sheppard, Bruce
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