MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS - 1963 - A
APPLICATION FOR A STANDARD PATENT

I\We, AMCA INTERNATIONAL CORPORATION

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hereby apply for the grant of a standard patent for an
invention entitled:

DUAL LINEAR WINCHES

which is described in the accompanying complete specification

Details of basic application(s):

<table>
<thead>
<tr>
<th>Number of basic</th>
<th>Name of Convention country in which basic application was filed</th>
<th>Date of basic application</th>
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<tr>
<td>835660</td>
<td>US</td>
<td>28 FEB 86</td>
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My/our address for service is care of CLEMENT HACK & CO., Patent Attorneys, 601 St. Kilda Road, Melbourne 3004, Victoria, Australia.

DATED this 10th day of February 1987

AMCA INTERNATIONAL CORPORATION
CLEMENT HACK & CO.

TO: The Commissioner of Patents.
1. A dual linear winch system for hoisting/lowering a load comprising:
   a first linear winch connected by a cable to the load and having a powered reciprocating cable gripper,
   a second linear winch connected by a cable to the load and having a powered reciprocating cable gripper,
   power means to supply power for said reciprocating movement and said gripping action of said linear winches,
   a programmable controller connected to said winches and said power means to monitor said reciprocating movement of said winches and to control the output of said power means to said winches.

6. A dual linear winch system for hoisting/lowering a load comprising:
   a first linear winch connected by a cable to the load and having hydraulic cylinder means for providing reciprocating movement of a cable gripper,
(11) AU-A-68653/87

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a second linear winch connected by a cable to the load and having hydraulic cylinder means for providing reciprocating movement of a cable gripper,

power means for providing pressurized hydraulic fluid to said winches,

a programmable controller connected to said winches and said power means to monitor said reciprocating movement of said winches and to control the flow of pressurized hydraulic fluid to and from said power means.
Short Title:  
Int. Cl:  
Application Number: 68653/87  
Lodged:

Complete Specification-Lodged:  
Accepted:  
Lapsed:  
Published:

Priority:  
Related Art:

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TO BE COMPLETED BY APPLICANT

Name of Applicant: AMCA INTERNATIONAL CORPORATION

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Australia.

Complete Specification for the invention entitled: DUAL LINEAR WINCHES

The following statement is a full description of this invention including the best method of performing it known to me:-
DUAL LINEAR WINCHES

Technical Field

The present invention relates to the use of multiple linear winches as lifting winches and more particularly to the coordinated operation of multiple intermittent linear winches.

Reference to Microfiche Appendix,

A microfiche appendix containing three (3) microfiche and a total of eighty (80) frames is incorporated herein.

Prior Art

Intermittent linear winches such as that shown in U.S. Patent No. 4,427,180 have been used singularly to provide a pulling or hoisting function. The present invention relates to the coordinated use of a plurality of such winches.

Summary of the Invention

A dual linear winch system for hoisting/lowering a load includes a first linear winch connected by a cable to one end of the load and having a hydraulically powered reciprocating cable gripper.

In accordance with another aspect of the invention, a second linear winch is provided which is
connected to the other end of the load by yet another
cable. The second linear winch also has a hydrau-
lically powered reciprocating cable gripper. A power
unit is provided to supply pressurized hydraulic flu-
id to the hydraulic components of the linear winches.

In accordance with yet another aspect of
the invention, a programmable controller is provided
which monitors the reciprocating movement of the
winches and controls the output of the pressurized
hydraulic fluid from the power unit.

Thus, the present invention provides a dual
linear winch system in which the intermittent pulling
movement of the winches is coordinated so as to pro-
vide even lifting of the load.

**Brief Description of the Drawings**

The drawings illustrate the best mode pres-
ently contemplated of carrying out the invention.

In the drawings:

**FIG. 1** is a schematic showing the electri-
cal connections between a pair of intermittent linear
winches and the power unit utilized to coordinate
their operation;

**FIG. 2** is a schematic showing the position-
ing of the linear winches relative to the load; and
FIG. 3 is a front view of a linear hydraulic winch such as the one used in this dual winch system.

Description of the Preferred Embodiment

As shown in Figure 2, a dual linear winch system 10 includes a pair of linear winches 12 and 14 mounted on a bridge or support 16.

Also mounted on bridge 16 is power unit 18 which supplies the electrical and hydraulic power for linear winches 12 and 14.

A dual linear winch system also includes a pair of storage reels 20 and 22 which store the cable 24 and 26 for linear winches 12 and 14 respectively. Cables 24 and 26 run through linear winches 12 and 14 and through pulley systems 28 and 30 which are in turn attached to substantially opposite ends of load 32.

Each of intermittent linear winches 12 and 14 is of the type which is shown in Figure 3. The linear winch of this type provides an intermittent pulling action and the operation and construction of such a linear winch is described in detail in U.S. Patent No. 4,247,180. Therefore, the construction and operation of this linear winch will only be discussed in this application in general terms.
The linear hydraulic winch 12 shown in Fig. 3 utilizes two sets of wedges 34 and 36 for clamping cable aligned one above the other; and it comprises a fixed frame 38 to which are fixed the outer fixed elements 40 of the upper clamping wedge, comprising truncated cylinders 42 between the oblique parallel faces of its fixed elements 40 and its inner movable elements 44. These truncated cylinders 42, when they pivot during relative movement of the elements of the clamping wedge, are interlocked with each other by means of pairs of studs 46, engaged in corresponding holes of bars 48, parallel to the oblique bearing faces of the outer 40 and inner 44 elements of the clamping wedge.

With the two double-acting hydraulic cylinder 50, disposed parallel to the cable on each side thereof and on each side of the two aligned clamping wedges 34 and 36, these two clamping wedges may be moved towards or away from each other, one being interlocked in translation with the cylinders thereof and the other with the pistons thereof.

Means are further provided so that, for lifting the load, corresponding to the retraction of the cylinders, the lower clamping wedge 36 is locked on to the cable and the upper clamping wedge 34 released, when the two clamping wedges are moved towards each other, and conversely whereas, for lowering the load, corresponding to the extension of the cylinders, the lower clamping wedge 36 is locked.
on to the cable and the upper clamping wedge 34 released, and conversely.

Two friction plates 52 are inserted symmetrically, on each side of the cable, between the lateral faces of the inner movable elements 44 and 54 of the upper 34 and lower 36 clamping wedges and the flanges 56 and 58 of these clamping wedges; these friction plates 52 are resiliently pressed against said lateral faces by means of springs.

Assuming that the winch is in the position shown in Fig. 3 and that the lower clamping wedge 36 is locked on to the cable and the upper clamping wedge 34 released, if the double-acting cylinders 50 are operated to cause extension thereof and consequently to move the lower clamping wedge 36 away from the upper clamping wedge 34, the outer elements 60 of the lower clamping wedge 36 are pushed downwardly, which causes unclamping thereof; simultaneously, the friction plates 52 are driven downwards by the inner elements 54 of the lower clamping wedge 36 and so urge the inner elements 44 of the upper clamping wedge 34 downwardly which lock on to the cable.

The lower clamping wedge 36 may thus move freely away from the upper clamping wedge 34; this latter, clamped on to the cable, holds this latter fixed and the load which is suspended therefrom at the level previously reached, until the lower clamping wedge 36 arrives in its endmost position corres-
ponding to the maximum extension of the double-acting cylinders 50.

If, at this moment, with the upper clamping wedge 34 locked on to cable 1 and the lower clamping wedge 36 released, the double-acting cylinders 50 are operated in the reverse direction, so as to retract them and consequently to bring the lower clamping wedge 36 closer to the upper clamping wedge 34, the outer elements 60 of the lower clamping wedge 36 are drawn upwardly and exert a pressure on the inner elements 54 of said lower clamping wedge 36 which lock on to the cable; simultaneously, the raising of the inner elements 54 of the lower clamping wedge 36 causes, via the friction plates 52, an upward thrust on the inner elements 44 of the upper clamping wedge 34 which is thus unlocked.

The cable may then freely slide in the upper clamping wedge 34 and the lower clamping wedge 36, drawn upwardly by the two double-acting cylinders 50 drags along the cable to which it is locked as well as the load suspended from this cable, and this until it reaches the initial position shown in Fig. 3; this cycle may then be repeated as often as necessary so as to gradually raise the load, each time by a height corresponding to the maximum extension of the double-acting cylinders, until it has reached the desired level.
The linear hydraulic winch shown further comprises hydraulic locking jacks 62 and 64 which lock the movable inner elements 44 and 54 of the upper 34 and lower 36 clamping wedges in their inactive position. They are used during lowering of the load and their action, synchronized with the reciprocal movements of the pistons of the double-acting cylinders, may be controlled by means of electric circuits which the pistons of the double-acting cylinders may switch on or off automatically during their reciprocating movements.

The pressurized hydraulic fluid needed for the operation of cylinders 50 and locking jacks 62 and 64 is provided by a power unit 18 which supplies pressurized hydraulic fluid to the cylinders via outlets 68 and to the locking jacks via outlets 70.

As can be seen from the above description, the linear winch provides an intermittent pulling force i.e., the cables 24 and 26 are intermittently pulled and then held in position, while the cylinders 50 move the wedges back to their initial position. In order to provide as smooth a lifting operation as possible, it is necessary to coordinate the movement of cylinders 50 on each of the linear winches 12 and 14. Without this coordination, one end of load 32 would be lifted while the other end was stationary and vice versa.
In order to accomplish this coordinated lifting, each of linear winches 12 and 14 is provided with a set of limit switches contained within one of the cylinders 50. Limit switches 72 and 74 are placed at the extreme ends of the cylinder so that these switches are tripped only when the hydraulic cylinder is in its fully extended or fully retracted position.

The hydraulic cylinders are also provided with limit switches 76 and 78 which are placed slightly ahead of limit switches 72 and 74. In the present embodiment hydraulic cylinders 50 typically have a stroke of approximately 27 inches and thus limit switches 74 and 72 are approximately 27 inches apart. In this situation, limit switches 76 and 78 would be placed approximately 3-1/2 inches before limit switches 72 and 74. Thus, limit switches 76 and 78 are tripped slightly before the tripping of limit switches 72 and 74.

The electrical signal generated by these limit switches is relayed to programmable controller 80 which controls the power unit 18 and thus controls the flow of hydraulic fluid to linear winches 12 and 14. Power unit 18 is a hydraulic power unit purchased from GT Hydraulique of Sannois, France. Power unit 18 contains the valves and hydraulic pump utilized for powering the dual winch system including storage reels 20 and 22. Programmable controller 80 is a PC 49 available from Giddings and Lewis and is
programmed to control the power unit by means of the software attached hereto as an appendix. According to this program, programmable controller 80 operates the solenoids that control the valves which in turn control the flow of pressurized hydraulic fluid to and from linear winches 12 and 14. Upon receiving a signal from either limit switch 76 or 78, programmable controller 80 will decrease the flow of fluid to hydraulic cylinder 50 so that the cylinder begins to decelerate. Then, upon receiving a signal from either limit switch 72 or 74, programmable controller 80 will stop the flow of fluid to hydraulic cylinder 50. Prior to supplying hydraulic fluid to the opposite side of cylinder 50 so that it may begin its return trip, programmable controller 80 will wait for an identical stop signal from the other linear winch so that neither winch is allowed to commence another cycle without the other winch having completed its cycle. Thus, the pulling motion of winches 12 and 14 is maintained substantially in unison and neither end of load 32 is moved without corresponding movement of the other end.

While the invention has been particularly shown and described with respect to a preferred embodiment thereof, it will be understood by those skilled in the art that the foregoing and other changes in form and details may be made therein without departing from the spirit and scope of the invention.
THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A dual linear winch system for hoisting/lowering a load comprising:
   a first linear winch connected by a cable to the load and having a powered reciprocating cable gripper,
   a second linear winch connected by a cable to the load and having a powered reciprocating cable gripper,
   power means to supply power for said reciprocating movement and said gripping action of said linear winches,
   a programmable controller connected to said winches and said power means to monitor said reciprocating movement of said winches and to control the output of said power means to said winches.

2. The dual linear winch system of claim 1 wherein said linear winches are hydraulically powered and said power means provides pressurized hydraulic fluid to said winches and said programmable controller controls the flow of pressurized hydraulic fluid to and from said power means.
3. The dual linear winch system of claim 1 further comprising hydraulic cylinder means for providing the reciprocating movement of said linear winches.

4. The dual linear winch system of claim 3 further comprising position indicator means associated with said hydraulic cylinder means for sensing the position of the hydraulic cylinder means during its stroke and said programmable controller connected to said position indicator means and controlling said power means in response to the sensed position of said hydraulic cylinder means.

5. The dual linear winch system of claim 1 wherein said programmable controller provides the reciprocating movement of said winches in substantial unison with each other.

6. A dual linear winch system for hoisting/lowering a load comprising:
   a first linear winch connected by a cable to the load and having hydraulic cylinder means for providing reciprocating movement of a cable gripper,
   a second linear winch connected by a cable to the load and having hydraulic cylinder means for providing reciprocating movement of a cable gripper,
   power means for providing pressurized hydraulic fluid to said winches,
a programmable controller connected to said winches and said power means to monitor said reciprocating movement of said winches and to control the flow of pressurized hydraulic fluid to and from said power means.

7. The dual linear winch system of claim 6 further comprising position indicator means associated with said hydraulic cylinder means for sensing the position of the hydraulic cylinder means during its stroke and said programmable controller connected to said position indicator means and controlling said power means in response to the sensed position of said hydraulic cylinder means.

DATED THIS 10TH DAY OF FEBRUARY 1987

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