

PATENT SPECIFICATION

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- (21) Application No. 39168/77
 (31) Convention Application No. 2642766
 (33) Fed. Rep of Germany (DE)
 (44) Complete Specification Published 15 Apr 1981
 (51) INT.CL.³ B66C 23/18
 (52) Index at Acceptance B8B R13

- (22) Filed 20 Sep 1977
 (32) Filed 23 Sep 1976 in (19)



(54) TRACTION DEVICE FOR REMOVAL OF DITCH SHORING ELEMENTS

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This invention relates to equipment for the extraction of shoring walls, shoring plates, floor shoring and like shoring elements used in trenching operations and particularly relates to apparatus including a tower-like housing approximately of the height of the shoring elements to be extracted. The housing is constructed to be connected to the boom of an excavating machine or of a crane and can be set on the ground with there being a fluid cylinder mounted within the housing and acting in the longitudinal direction of the housing, the fluid cylinder including a piston rod carrying at least one movable guide pulley for a cable which is guided over at least one other guide pulley carried by the housing and which supports a hoisting traverse for acting on the shoring element to be retracted.

In lieu of wooden shoring which is costly in labor and material, increasing use is made of modern steel shoring elements when shoring trenches and channels, in particular service trenches, whether pile-shoring with shaped trench sheets be used, or large-format self-supporting shoring walls or plates which may be interconnected by guide braces and mutually transversely braced.

Although the setting up of shoring elements is relatively simple and most of the time is carried out by means of excavating buckets or pile driving mechanisms, the extraction of the shoring elements subsequent to the filling of the trenches in part requires very high tractive forces in the order of 20 to 50 metric tons.

Extraction of the shoring elements generally takes place using traction means mounted on the boom of an excavator or a crane. However, the high tractive forces set forth above occur especially at construction depths of 3 to 8 meters and more and can just about be developed

by the heaviest excavators and cranes. Unfortunately, such heavy equipment usually is not owned by construction enterprises which perform this type of work and would be too expensive if utilized solely for such extraction work.

A known extraction system disclosed in French Patent No. 838 717 includes a tower-like housing forming at the same time an extensible cylinder. The reciprocating piston guide within the cylinder carries a double-boom frame similar to a balance-beam and is held by a ball joint and includes guide rollers at its free ends for an extraction cable passing over fixed guide rollers mounted to the housing base and ending in a hoisting traverse. Actuation of the piston lifts the double-boom frame and effects extraction of a sheeting element according to the hoisting stroke. This equipment requires re-tensioning of the extraction cable following each stroke and, therefore, requires excessive manual operation. Furthermore, it provides no force multiplication and, therefore, must be extremely heavy in design.

In U.S. Patent No. 1 719 021 there is disclosed another extraction system suspended from a crane boom. It consists of a tower-like housing which can be set on floor sheeting and a block-and-tackle suspended from the housing. This system includes a movable piston acting on the floor sheeting to be pulled. The equipment amounts to a simple block-and-tackle and requires actuation by the crane. It is, therefore, relatively costly and unsuited for small sheeting extraction operations.

Modern economic shoring extraction requires creating an extraction system of a simple design and of economical cost and operation even at small construction sites. Simultaneously, such an extraction system should allow easy set-up at the construction site, taking further into account that as a rule the soil near the trench is of lesser resistance than untouched terrain.

The invention provides, to solve this problem apparatus for extracting shoring walls, shoring panels, piles or like shoring elements used in trench shoring comprising a tower-like housing having a lower end portion adapted to be set on the ground and an upper end portion to be pivotally connected to a boom of a crane or the like, said housing being of approximately the

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height of an element to be extracted thereby, longitudinally acting extensible fluid cylinder-piston means within said housing and being defined by a cylinder and a piston rod, one of said cylinder and piston rod carrying a first movable guide pulley and the other of said cylinder and piston rod being connected to said housing, a second guide pulley projecting from one side of said housing at said upper end portion and being fixed thereat, traction means including a cable entrained about said pulleys and about a third pulley exteriorly of said housing connected to a hoisting beam, means for anchoring one end of said cable at upper end portion, means for guiding the movement of said first pulley, within said housing along a generally linear path of travel along the length of said housing, and said first through third pulleys and said cable means define a block-and-tackle system.

Equipment formed in accordance with this invention can be set down at the site utilizing a conventional excavator which is present at the site in the normal course of operation, and may be held in such a manner that it operates satisfactorily even on less firm ground. This equipment, if necessary or desirable, may assume an oblique attitude whereby the excavator boom need only absorb tilting forces. Because of the hollow housing foot construction, a local compaction takes place underneath the housing and prevents excessive penetration of the housing into the ground.

Except for minor moments, the extracting forces are absorbed by the housing, whereby an extremely short force path is achieved.

The fluid cylinder permits hoisting actuation when appropriate or necessary even from a distance allowing clear observation of the extraction process.

The equipment of the invention can be easily moved. If appropriate, it may also be moved to a new site with the sheeting elements still suspended from it. Because it is simple in design, it does not unduly burden the sheeting or sub-surface construction contractor.

In order to relieve the fluid cylinder load, and because deeply embedded sheeting elements provide only short extraction paths, the equipment in one of its embodiments provides at least a plurality of pulleys at the hoisting traverse to provide for a force multiplication block-and-tackle system.

In accordance with this invention, the extraction cables can be shortened after each lifting stroke.

The system offers further advantageous characteristics in that a winding drum is supported in the housing as the anchorage for one of the ends of the extraction cable and is associated with a locking device opposing the rotation of the winding drum in the pay-out direction.

In a preferred embodiment of the invention,

pairs of guide pulleys are mounted in the housing and on the hoisting traverse and interconnected by cables in block-and-tackle manner with extracting cables of which one end is fastened to the housing and the other end is guided around a movable guide pulley and fastened to a winding drum, there being means provided for alternating the locking of the extraction cable between the upper guide pulley and the movable pulley on the one hand and between the winding drum and the movable guide pulley on the other hand. This results in a further and significant force-relief of the fluid cylinder whereby the sheeting elements may be extracted using relatively low actuating forces. A preferred embodiment of apparatus according to the invention will now be described by way of example, with reference to the accompanying drawings, wherein:-

Figure 1 is a schematic perspective view illustrating the features of the extraction system;

Figure 2 is a side elevational view, with parts broken away and shown in section, of a more specific form of the extracting system; and

Figure 3 is an end elevational view taken from the right of Figure 2 with parts of the housing broken away and shown in section.

Referring first to the schematic illustration of Figure 1, it will be seen that the extractor system includes a fixed upper guide pulley 31 mounted on a shaft 30. It is to be understood that the shaft 30 and the pulley 31 are to be mounted in a tower-like housing (not shown) as discussed with respect to a further embodiment of the invention. The system also includes a hoisting traverse 32 which is disposed outside of such housing and includes a guide pulley 33. The system further includes an extensible fluid cylinder 34 which is intended to have its upper end fixedly secured to the tower with the cylinder being within the tower and including a piston rod 35 supporting a movable guide pulley 36. The pulley 36 is movable between two remote positions through the extension of the piston rod 35. The shaft 30 also carries a winding drum 37.

One end of an extraction cable 38 is wound on the winding drum 37. The extraction cable 38 passes from the winding drum down around the pulley 36 and then up and over the upper guide pulley 31, then down and around the guide pulley 33 of the hoisting traverse 32. The cable 38 then extends upwardly from the pulley 33 and is fixedly anchored as at 39 at a suitable point on the housing.

Portions of the cable 38 between the movable pulley 36 and the winding drum 37 on the one hand and the upper guide pulley 31 and the pulley 36 on the other hand are provided with locking systems 40, 41, respectively, which are actuatable to lock the cable 38 alternately at the forward and return strokes of the

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piston rod 35. It is to be understood that each of the locking systems 40, 41 is in the form of a hydraulically actuated clamp.

During operation, the movable guide pulley 36 is moved by the piston rod 35 to the lower point position which is shown in dashed lines. In the process of movement of the pulley 36, locking system 40 is locked and locking system 41 is released. The cable 38 being clamped against unreeling from the winding drum 37 is foreshortened with the result that the hoisting traverse 32 is lifted one step.

During the return stroke of piston rod 35, locking system 41 is closed and locking system 40 is opened. Winding drum 37, which is provided with drive means either in the form of a winding spring or motor, takes up the loose portion of the cable between the winding drum 37 and the locking system 41 with very little expenditure of force. Upon a new stroke of the cylinder 34, there is a reversal of the actuation of the locking systems 40, 41.

Reference is made to Figures 2 and 3 wherein a more specifically illustrated embodiment of the invention of Figure 1 is illustrated. The extraction system of Figures 2 and 3 include a hollow tower-like housing 1 which may be readily formed from shaped sheet metal stock or shaped steel sections. The housing 1 includes an upper cover plate 52 which serves as a support for components of the system located within the housing 1. As will be described hereinafter, these components include guide rollers, a fluid cylinder and the like which are carried by a bearing block 51 which depends from the cover plate 52.

The housing 1 is closed at its bottom by housing foot 4 which extends transversely of the housing proper to opposite sides thereof. As is best shown in Figure 2, the housing foot 4 is of an angular cross section so as to define a higher chamber 5 which opens downwardly. The housing foot 4 is primarily formed by an arched shaped plate 28 which due to its configuration causes a local compaction of the soil beneath the housing foot 4 when the housing 1 is supported on the ground and is in operation. It will be seen that the size and configuration of the housing foot 4 prevents the equipment from sinking excessively into the ground. It also permits the mounting of the housing 1 in its tilted or oblique position shown in Figure 2.

In order that the housing 1 may be mounted in the oblique, tilting position of Figure 2, the cover plate 52 carries a spherical ball or head 6 which is seated in a corresponding bearing carried by a boom of an excavator or similar device.

An extensible fluid cylinder 42 is supported along a plane or symmetry of the housing 1 from the bearing block 51 and includes a downwardly projecting piston rod 43. The piston rod 43 carries a pin or shaft 48 which has mounted on opposite ends thereof movable guide pulleys 44. The pulleys 44 may be

moved in the direction shown by the arrow 45 in Figure 2 between a top dead position shown in solid lines and a bottom dead position shown in dash-dot lines. In order that the lower end of the piston rod 43 may be suitably guided with respect to the housing 1, the pin 48 may carry a guide lead 46 provided with rollers 47 which engage the inside wall of the housing 1.

The bearing block 51 mounts in the upper part of the housing 1 a pair of shafts 49, 50 which are disposed in parallel relation to one another and to the pin 48. Two independently rotating winding drums 53, each equipped with a clutch-type free wheel mechanism 54 are carried by the shaft 49. The free wheel mechanism 54 for each of the winding drums 53 is effective in the take-up direction unless engaged (pay-out of cables associated therewith as will be described hereinafter).

The shaft 50 also carries two groups, generally identified by the numeral 55, of guide pulleys. Each group 55 of guide pulleys preferably includes two pulleys 56, 57 although one pulley could suffice. One of the guide pulleys, pulley 56, is equipped with a free wheel mechanism 58 acting in the direction of take-up of the winding drums 53.

The mechanism also includes a hoisting traverse 59 mounted outside of the housing 1. The hoisting traverse 59 carries a shaft 60 on which there are mounted two groups, generally designated by the numeral 65, of guide pulleys. It is to be understood that the number of guide pulleys in each group 65 corresponds to the number of guide pulleys in each group 55. Accordingly, each group of guide pulleys 65 is illustrated as including two guide pulleys 66, 67.

The system also includes two extracting cables 61, each of which has a terminal end fastened to a respective one of the winding drums 53. It is to be understood that each winding drum will be conventionally equipped with a winding mechanism of the spring or motor type (not specifically shown).

Each of the cables 61 passes down and around one of the two movable guide pulleys 44 and then to a respective one of the upper guide pulleys 56. Each cable 61 passes from the associated guide pulley 56 down to a respective guide pulley 66 of the hoisting traverse 59 and then up and around the respective guide pulleys 57. Each cable then passes down around the respective guide pulleys 67 and up once again to an anchoring ring 63 on the housing 1.

It is to be understood that each cable 61 is provided with a clamping system 64 between respective movable pulley 44 and the respective upper guide pulley 56. It is to be understood that the clamping system 64 is so actuated that it blocks extraction of the respective cable 61 during the upward stroke of the fluid cylinder 42.

The groups 55, 65 of guide pulleys, together

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with appropriate portions of the cables 61, form a block-and-tackle system of a conventional type and may include an arbitrary number of guide rollers, depending upon the force multiplication factor desired. It is to be understood that the block-and-tackle system permits relatively high traction forces utilizing a relatively small capacity fluid cylinder 42.

When the movable guide pulleys 44 are moved downwardly by the extension of the fluid cylinder 42, the hoisting traverse 59 is raised a certain amount depending upon the multiplication factor of the block-and-tackle system. On the return stroke of the cylinder 42, the locking systems 64 stop the traction cables 61 and allow rotation of the winding drums 53 in the direction of the arrow thereon in Figure 2. Winding drums 53 are locked by the free wheel 54 during the extension stroke of the cylinder 42 with the locking system 64 being open.

The symmetric arrangement of the traction units inside of the housing 1 prevent additional cross forces and inaccuracies in guidance.

With respect to the embodiments of Figures 1, 2 and 3, it is to be understood that the hydraulic system of the piece of excavating equipment of which the housing 1 is a part may be utilized for the operation of the retraction system. It is first of all particularly pointed out here that the cylinder 42 is a double acting cylinder and has fluid connections 15, 16. In accordance with this invention, a pump and a reservoir of the piece of excavating equipment may have coupled thereto a conventional rotary valve which selectively connects the pump and the reservoir to the fittings 15, 16. In addition, the clamping system 64 may include a small double acting hydraulic cylinder which is so interconnected with the extensible cylinder 42 that the opening and closing of the clamping system is automatically effected in accordance with the aforescribed operation description.

It is to be understood that the system allows fully automatic extraction operation without any manual adjustment of the suspension of the extracting mechanism. The equipment will be generally of the same height or higher than the sheeting elements to be extracted and may be moved without any difficulties to the construction site and, furthermore, may be also stored there in a convenient manner.

WHAT WE CLAIM IS:-

1. Apparatus for extracting shoring walls, shoring panels piles or likeshoring elements used in trench shoring comprising a tower-like housing having a lower end portion adapted to be set on the ground and an upper end portion to be pivotally connected to a boom of a crane or the like, said housing being of approximately the height of an element to be extracted thereby, longitudinally acting extensible fluid cylinder-piston means within said housing and being defined by a cylinder and a piston rod, one of said cylinder and piston rod carrying a first movable guide pulley and the other of said

cylinder and piston rod being connected to said housing, a second guide pulley projecting from one side of said housing at said upper end portion and being fixed thereat, traction means including a cable entrained about said pulleys and about a third pulley exteriorly of said housing, connected to a hoisting beam, means of anchoring one end of said cable at upper end portion, means for guiding the movement of said first pulley, within said housing along a generally linear path of travel along the length of said housing, and said first through third pulleys and said cable means define a block-and-tackle system.

2. Apparatus as claimed in Claim 1 wherein said device anchoring one end of said cable includes a winding drum receiving said cable one end and a locking mechanism for regulation of cable pay-out from said winding drum.

3. Apparatus as claimed in Claim 2 wherein said locking mechanism is in the form of a one-way clutch-brake coupled to said winding drum.

4. Apparatus as claimed in Claim 3 wherein said one-way clutch-brake is of the ratchet and pawl type.

5. Apparatus as claimed in Claim 2 wherein a releasable cable clamp is disposed between said winding drum and said movable guide pulley for regulation of pay-out from said winding drum.

6. Apparatus as claimed in any one of Claims 2, 3, 4 or 5 together with an additional locking mechanism for locking said cable in a withdrawn position.

7. Apparatus as claimed in either Claim 2 or 6 wherein a locking mechanism includes a one-way clutch-brake for said fixed guide pulley.

8. Apparatus as claimed in any one of Claims 2, 6 or 7 wherein a locking mechanism in the form of a releasable cable clamp is disposed between said movable guide pulley and said fixed guide pulley.

9. Apparatus as claimed in any one of the preceding Claims wherein there are pairs of said anchoring device, said fixed guide pulley, said movable guide pulley and said cable, and said pair of said movable guide pulleys is carried by said fluid cylinder simultaneously for withdrawal of both of said cables.

10. Apparatus as claimed in Claim 9 having pairs of plural guide pulleys carried by said hoisting traverse and plural fixed guide pulleys for each of said cables, said cables being entrained over said plural guide pulleys to form plural block-and-tackle systems.

11. Apparatus as claimed in any of the preceding Claims wherein said housing has a downwardly opening hollow chamber within an elongated foot portion.

12. Apparatus as claimed in Claim 11 wherein said housing foot includes an arched cover plate.

13. Apparatus as claimed in any of the preceding Claims wherein said housing includes a spherical head at its upper end for joining said

(18)



with appropriate portions of the cables 61, form a block-and-tackle system of a conventional type and may include an arbitrary number of guide rollers, depending upon the force multiplication factor desired. It is to be understood that the block-and-tackle system permits relatively high traction forces utilizing a relatively small capacity fluid cylinder 42.

When the movable guide pulleys 44 are moved downwardly by the extension of the fluid cylinder 42, the hoisting traverse 59 is raised a certain amount depending upon the multiplication factor of the block-and-tackle system. On the return stroke of the cylinder 42, the locking systems 64 stop the traction cables 61 and allow rotation of the winding drums 53 in the direction of the arrow thereon in Figure 2. Winding drums 53 are locked by the free wheel 54 during the extension stroke of the cylinder 42 with the locking system 64 being open.

The symetric arrangement of the traction units inside of the housing 1 prevent additional cross forces and inaccuracies in guidance.

With respect to the embodiments of Figures 1, 2 and 3, it is to be understood that the hydraulic system of the piece of excavating equipment of which the housing 1 is a part may be utilized for the operation of the retraction system. It is first of all particularly pointed out here that the cylinder 42 is a double acting cylinder and has fluid connections 15, 16. In accordance with this invention, a pump and a reservoir of the piece of excavating equipment may have coupled thereto a conventional rotary valve which selectively connects the pump and the reservoir to the fittings 15, 16. In addition, the clamping system 64 may include a small double acting hydraulic cylinder which is so interconnected with the extensible cylinder 42 that the opening and closing of the clamping system is automatically effected in accordance with the aforescribed operation description.

It is to be understood that the system allows fully automatic extraction operation without any manual adjustment of the suspension of the extracting mechanism. The equipment will be generally of the same height or higher than the sheeting elements to be extracted and may be moved without any difficulties to the construction site and, furthermore, may be also stored there in a convenient manner.

WHAT WE CLAIM IS:-

1. Apparatus for extracting shoring walls, shoring panels piles or likeshoring elements used in trench shoring comprising a tower-like housing having a lower end portion adapted to be set on the ground and an upper end portion to be pivotally connected to a boom of a crane or the like, said housing being of approximately the height of an element to be extracted thereby, longitudinally acting extensible fluid cylinder-piston means within said housing and being defined by a cylinder and a piston rod, one of said cylinder and piston rod carrying a first movable guide pulley and the other of said

cylinder and piston rod being connected to said housing, a second guide pulley projecting from one side of said housing at said upper end portion and being fixed thereat, traction means including a cable entrained about said pulleys and about a third pulley exteriorly of said housing connected to a hoisting beam, means of anchoring one end of said cable at upper end portion, means for guiding the movement of said first pulley, within said housing along a generally linear path of travel along the length of said housing, and said first through third pulleys and said cable means define a block-and-tackle system.

2. Apparatus as claimed in Claim 1 wherein said device anchoring one end of said cable includes a winding drum receiving said cable one end and a locking mechanism for regulation of cable pay-out from said winding drum.

3. Apparatus as claimed in Claim 2 wherein said locking mechanism is in the form of a one-way clutch-brake coupled to said winding drum.

4. Apparatus as claimed in Claim 3 wherein said one-way clutch-brake is of the ratchet and pawl type.

5. Apparatus as claimed in Claim 2 wherein a releasable cable clamp is disposed between said winding drum and said movable guide pulley for regulation of pay-out from said winding drum.

6. Apparatus as claimed in any one of Claims 2, 3, 4 or 5 together with an additional locking mechanism for locking said cable in a withdrawn position.

7. Apparatus as claimed in either Claim 2 or 6 wherein a locking mechanism includes a one-way clutch-brake for said fixed guide pulley.

8. Apparatus as claimed in any one of Claims 2, 6 or 7 wherein a locking mechanism in the form of a releasable cable clamp is disposed between said movable guide pulley and said fixed guide pulley.

9. Apparatus as claimed in any one of the preceding Claims wherein there are pairs of said anchoring device, said fixed guide pulley, said movable guide pulley and said cable, and said pair of said movable guide pulleys is carried by said fluid cylinder simultaneously for withdrawal of both of said cables.

10. Apparatus as claimed in Claim 9 having pairs of plural guide pulleys carried by said hoisting traverse and plural fixed guide pulleys for each of said cables, said cables being entrained over said plural guide pulleys to form plural block-and-tackle systems.

11. Apparatus as claimed in any of the preceding Claims wherein said housing has a downwardly opening hollow chamber within an elongated foot portion.

12. Apparatus as claimed in Claim 11 wherein said housing foot includes an arched cover plate.

13. Apparatus as claimed in any of the preceding Claims wherein said housing includes a spherical head at its upper end for joining said

(19)

- housing in supported relation to a boom of a piece of excavation equipment.
14. Apparatus as claimed in any of the preceding Claims wherein said fixed guide pulley, said fluid cylinder and said anchoring device are all suspended from a cover plate of said housing.
15. Apparatus for extracting sheeting walls, sheeting plates, floor sheeting and the like trench shoring elements from trenches substantially as described with reference to and as illustrated in the accompanying drawings.
16. A method of extracting trench shoring elements from the ground comprising the steps of moving apparatus as claimed in any of the preceding Claims thereto, attaching said hoisting traverse to the sheeting or like elements and applying fluid under pressure to said cylinder.
17. A method as claimed in Claim 16 accompanied by winding-in a predetermined length of said cable on said winding drum or reel once said element has been elevated by a predetermined amount relative to the housing.
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