A mill liner handler for operating on a track placed inside the mill and having sufficient movements to permit relining the mill under power actuation.
MILL LINER HANDLER

CROSS REFERENCE TO RELATED APPLICATION

This application is a continuation of our copending patent application Ser. No. 69,529, Filed Sept. 4, 1970 for MILL LINER HANDLER now abandoned.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to handling equipment for use inside large mills for replacing mill liner sections.

2. Prior Art

Various mill liner handlers have been advanced prior to this time, as well as other manipulating equipment. For example, the assignee of the present application has developed a mill liner handler that operates from outside of the mill. This is shown in U.S. Pat. No. 3,540,603, Issued Nov. 17, 1970. In many instances the exterior positioning is satisfactory, but in large long roller mills, it becomes almost an impossible job to handle the mill liners effectively from outside the mills.

The present device operates on the principle of putting the handler equipment inside the mill, and having a conveyor for delivering the new liner sections to the handler equipment and removing the old liner section. The device is made so that it is on the center line of the mill and one half of the mill is lined first and then the mill is rotated to reline the second half.

SUMMARY OF THE INVENTION

The present invention relates to a mill liner handler machine which can be placed into large rotary mills, such as those for crushing tantalum, and can be utilized for replacing liner sections in the mill. The device operates on a track that is placed into the interior of the mill and is supported at its ends. This track forms a pathway for a trolley that moves back and forth on the track, and which has a remote handling arm mounted thereon.

The track is located so that the up and down pivot axis of the arm is on a plane with the rotational center of the rotary mill. The arm has operable motions to permit the lining of the upper half of the mill. Then, the handler is removed, and the mill is rotated 180°, the handler replaced, and the other half of the mill is lined. The supports for the track are such that the mill can be rotated when the handler is in place, to permit this method of relining mills. A grapple for handling a mill liner section is also a feature of the invention as is a conveyor which is used to carry the new liner sections into the mill, and also used to remove the old liner sections. The carriage for the mill liner handler can be powered in and out along its track with a winch. A portable controller unit utilized with the device is another feature. The operator can carry the controller unit with him inside the mill to be adjacent the mill liner sections being handled.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a vertical sectional view of a typical mill liner installation utilizing a handler mechanism made according to the present invention shown inside a mill;
and then passes over a drive sheave set 28. The other end of the cable passes under the trolley between the tracks, over an idler sheave 31 at the inner end of the track and then the other end of the cable is attached to the opposite end of the trolley as at 30. Thus when the sheave set 28 is driven, the cable will either move the trolley toward the inner end wall 12 of the mill, or back toward the throat 13, depending on the direction of drive, when the runway is once in position. The sheave and cable drive 26 may be of any desired design, and will be driven from a variable speed hydraulic motor.

The trolley 23 is used to mount a boom assembly illustrated generally at 35 (FIG. 5). The boom assembly is mounted for rotation about a vertical axis on the trolley. As shown, the trolley frame 24 is made up with an open center portion, and an open center ring 36 is mounted on top of the bed, and fixed thereto. The ring 36 in turn mounts a ring gear 37 that is bolted thereto and extends around the periphery thereof. Further, a thrust ring 38 is then rotatably mounted on the interior of the ring gear 37 and the thrust ring is held with respect to the ring gear with suitable ball bearings 39 that extend partially into a groove on the ring gear and partially into the thrust ring, so that the thrust ring will take load both in up and down directions. The thrust ring, ring gear assembly, is a commercially available unit. The two parts are held together by the ball bearings 39, but will rotate with respect to each other about their common rotational axis. The thrust ring in turn mounts a mounting plate 40 to move therewith, and the mounting plate 40 is used for the support for the boom assembly 35.

The mounting plate 40 mounts an output drive housing 41 for a hydraulic motor 42. The hydraulic motor 42 has an output shaft that is coupled to a spur gear 43 that engages the ring gear 37, and the hydraulic motor 42 is powered, the motor gear will react against the fixed ring gear 37, and the entire motor assembly 42, plate 40 and ring 38 will rotate with respect to the ring gear 37, and thus will rotate about an upright axis with respect to the trolley. The design is made so that it will rotate approximately 370° about the upright central axis.

The boom assembly 35 includes an outer box section (square) boom member 45, which has a bracket 46 at the base end thereof. The bracket has an ear portion 47 extending downwardly through an opening in the plate 40 into the opening of ring 38. Side mounting brackets 48 are in turn fixed to the plate 40, and the bracket 46 fits between these mounting brackets 48. There are two of the mounting brackets 48 spaced apart to receive the bracket 46 between them. A pin 51 is then mounted between the mounting brackets 48 and the provided receptacle in the ear portion 47 of the boom bracket to pivotally mount the boom 45 for movement up and down about a horizontal axis. The axis of the pin 51 is positioned so that it substantially aligns with the rotational axis of the mill 10 in a longitudinal direction when the boom is extending laterally in normal working position. The jack 15 and the bracket for holding the track in position can be adjusted to get this axis coincidental, or nearly so. The movement of the boom about the axis of the mill makes the boom work as a radius member which can be moved along this axis by the trolley. The swiveling of the boom about the upright axis permits operation on the end walls and also lifting sections from a conveyor used.

It should be noted that the ear portion 47 and the mating parts of the bracket 48 extend into the openings in the ring gear 37 and the ring 36, and rotate inside this open center.

The position of the boom 45 about the axis of pin 51 is controlled through the use of a pair of hydraulic cylinders 52, 52. These hydraulic cylinders 52 are positioned above the boom, on opposite sides of the boom, and have base members that are attached between the brackets 48, which extend above the plate 40 and outer brackets 53 respectively that are spaced outwardly from the respective brackets 48 to permit the cylinders 52 to fit therebetween. (See FIGS. 1, 2 and 5.) The cylinders 52 comprise cylinder-piston assemblies of a double acting hydraulic type, and are of usual design, each having an extendable rod 54 attached to an internal piston.

There are a pair of inverted U-shaped brackets 55, 55 at the outer ends of the main boom tube 45, and extending outwardly on opposite sides thereof. These brackets 55 in turn each mount a pair of spaced apart pins 56. The outer end member of the rods 54 extend between their respective ears 56 and are mounted thereto with suitable pins. Then, the cylinders 52, which are hydraulically in parallel, can be actuated to extend or retract the rods 54, and create a moment about the axis of pin 51 which will rotate the main boom tube 45 about this axis. The outer brackets 53 for the cylinders are positioned above the plate 40, so that there is no interference with the ring gear 37.

The main boom tube 45, which is square or rectangular in cross section, in turn is used to slidably mount an extension boom portion that is slidably mounted on suitable fastening and guide means inside the main boom 45. A boom extension portion 60, as shown perhaps best in FIG. 6, is used to mount a grapple assembly shown generally at 61. The grapple assembly includes a grapple mounting bracket 62 that is fixed to the inner boom member and forms a box type section or open U section that will support the entire grapple. The bracket 62 has a pair of ears 66 on the back wall thereof, and these ears are used for controlling the in and out movement of the slide extension portion 60 of the boom assembly as well as the grapple.

As shown, a double acting hydraulic cylinder 63 is mounted on the top above the main boom 45 with suitable ears 64 that are positioned near the member 46 and are spaced apart to receive the base end of the cylinder assembly 63. The cylinder assembly, of course, has an internal piston and extendable rod 65. The outer end of the rod has a rod end that fits into the ears 66 and are attached to the bracket 62. Then, a suitable pin is used for holding the rod end in position, and when the cylinder 63 is extended or retracted, the inner or extension boom section 60 will extend outwardly from the base boom section 45 so that the reach of the boom can be changed.

This is shown in dotted lines in FIG. 2 where it shows that the sections can be extended outwardly, and also is shown in FIG. 6. The boom acting as a radius member can thus be extended or retracted to move sections toward or away from the walls of the mill.

The bracket 62 for the grapple assembly 61 is used to mount a hydraulic rotary actuator. The rotary actuator is of the usual type having a through shaft 70 and
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Actuating vanes that will rotate the shaft relative to the outer housing. The through shaft 70 is rotatably supported on a top plate of bracket 62 with a nut. The shaft axis 68 of the actuator is shown. The actuator housing is held from rotation with respect to the bracket 62, and thus operation of the rotary actuator rotates the shaft 70.

The lower assembly on the bracket 62 includes a thrust assembly 69 which also rotatably supports shaft 70. The shaft 70 in turn supports a pivot bracket 73 so that the pivot bracket 73 will rotate about the axis 68 when the actuator is powered. The pivot bracket mounts a grapple member 74 through the use of a bolt 75 which forms a pivot pin to permit pivoting of the grapple member 74 about a transverse axis at right angles to the shaft axis 68.

The grapple member has a pair of side plates 76 that are held together with cross pieces 77 at the forward end thereof. It is the cross pieces 77 that pivot on opposite sides of the pivot bracket 73 on the pin 75. The members 76 in turn mount a hydraulic cylinder 80 with a suitable pin 81 at the base end of the hydraulic cylinder. The member 76 form a grapple bracket and are joined with a cross wall 78. The cylinder 80 is a double acting fluid pressure actuated cylinder assembly having an internal piston and an output rod 82. A link chain 83 is mounted onto the output or end of the cylinder rod, and passes through provided openings in the bracket 77 toward the front end of the grapple assembly. The members 76 are further used to rotatably support a chain sheave or pulley 84 that supports the chain 83, and which will rotate about its mounting pin 85 when the chain is extended or retracted. As shown, it is octagonal shaped in cross section transverse to its axis, and has a groove shaped to let the links of chain 83 rest thereon as it rotates. A hook 86 is used at the outer end of the chain.

Further, a pair of spaced plates 88 are mounted at the outer sides of the side members 76, and form a U-shaped housing or buck plate assembly 87 with cross pieces holding the side plates 88 together. The forward or outer edge of the side plates are formed into a curve to fit a mill liner section 11, as shown in FIG. 5, and the spaced apart plates 88 fit against the inner edge of the mill liner sections 11.

As shown, the plates 88 each have a relief or recess 89 defined therein to permit the ends of the liner sections to fit properly. Side plates 88 are mounted on the same pin 85 as the chain sheave, and move independently of the chain sheave. A stop pin 90 is provided for preventing rotation of the buck plate assembly in direction as indicated by arrow 91 past a predetermined position.

Thus, the unit can be used for lifting or holding liner sections 11. As shown, the liner sections 11 have eye bolts 95 provided therein in the center portions. These eye bolts 95 are made so that they can be removed from the mill sections, and could be threaded into place or fastened in other desired ways.

When a liner section 11 is to be lifted, the cylinder rod 82 for cylinder assembly 80 is extended, and the hook 86 and the buck plate assembly 87 will go to the dotted line position as shown in FIG. 5. Then the hook can be mounted onto the eye bolt of the liner section 11 shown in dotted position.

Then, the cylinder rod 82 is retracted. This will pull the front surface of the liner section against the buck plate assembly 87 under force from the cylinder (ten-

sion in the chain) and will firmly pull the liner section against the buck plate. Further retraction of the rod will cause the buck plate to pivot upwardly in direction of arrow 91 substantially 90° so that the liner section is held as shown in solid lines in FIG. 5. The cylinder 80 now firmly locks the buck plate against its stop and rigidly holds the liner section.

The pivot about pin 75 or in other words the side pivot of the grapple assembly is manual, and the grapple can be swung manually to align with a liner section to be lifted. The hydraulic rotary actuator 67, of course, can be powered to rotate the grapple assembly about upright axis 68.

When the trolley and boom have been positioned inside a mill, a conveyor assembly 100 is then mounted onto the tracks 20, with suitable wheels, and is merely rolled into the mill. The conveyor as shown is a roller type conveyor having rollers rotatably mounted about a transverse axis as shown in FIGS. 1 and 2, and the conveyor is manually moved into the mill in the desired position and can be held there with its wheels and can be moved with the trolley 23. The conveyor assembly 100 is inclined at about a 1° slope so that it slopes from the outer end, which protrudes outside the mill, toward the inner end which is inside the mill. Thus, the outer end portion 101 can be positioned outside of the throat 13 of the mill a sufficient distance so that the mill liner sections 11 can be laid onto the conveyor with a lift truck or other power operated handling device and then rolled into the interior of the mill adjacent the end of the support portion for the conveyor. A stop ledge 102 prevents the mill liner sections from rolling off the conveyor. Then the sections are thus positioned adjacent the inner end of the conveyor, and then positioned so that the grapple can be utilized. As shown in FIG. 1, a mill liner section 11 is on the conveyor 100 and can be lifted by moving the trolley and the boom and grapple to proper position so that the buck plate assembly is overlying the mill liner section. The cylinder 80 is then extended so that the rod 82 loosens the chain, to position substantially like that shown in FIG. 5, and the hook 86 is engaged with the mill liner eye bolt. Then the cylinder 80 is retracted pulling the mill liner section 11 up against the buck plate assembly 87.

The 90° rotation of the buck plate then takes place, and the mill liner can be held up against the vertical end walls of the mill, or can be positioned against the cylinder walls of the mill above the center line. All of the side walls are then properly relined with new sections, above the center line of the mill. It should be remembered again that the center line of the mill lies along the pivot axis of the boom and the boom can pivot as a radius member and move along the axis to reline all of the side walls above the center line. The mill, after the upper half of it has been rotated, is then powered and rotated 180°, and the second half of the mill is relined as desired.

Of course, the handler can be utilized for moving the mill liner sections already installed on the mill. The positioning of the grapple is quite simple because of the rotation by actuator 67 about axis 68, the tilt about the axis of pin 75 which is manual, and the ability of the chain to be moved around to properly engage the mill liner section eye bolt. When the cylinder 80 is retracted the mill liner is then rigidly held in position so that the bolts holding the mill liner section can be removed and the boom will be used to handle the mill liner sections
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back onto the conveyor and thus can be pulled out along the roller conveyor out of the mill. The control of the mill is central to the present invention is accomplished through the use of a portable controller illustrated generally at 125, which can be carried inside the mill through the throat 13 and handled by an operator there. A carrying handle 126 can be provided if desired, or a shoulder strap from which the controller can be suspended can also be used. A hydraulic power supply comprising a pump, a reservoir, and other related components is illustrated generally at 127 and is positioned exterior of the mill as shown in FIG. 2, and also is shown schematically in FIG. 8. The power supply 127 receives power from a cord 128 connected to a suitable power source, and this in turn is connected through a junction box 129 which houses the actual control valves and the like for the hydraulic power source and through a cable 130 to the portable controller. Suitable hydraulic lines 131, lead from the supply to the various hydraulic components in the mill itself. The valve controls for the hydraulic power are variable rate servo valves, controlled by variable rate switches on the controller. As shown schematically in FIG. 8, each of the various components has a control hydraulic line leading to it. For example, the winch 26 has a line 26A leading from a servo valve that is operated by a switch 26B. The winch has a reversible, variable speed hydraulic drive motor so that the trolley 23 can be moved back and forth along the tracks on the interior of the mill. Liner sections can then be replaced at the remote end of the mill and along the sides of the mill merely by moving the trolley back and forth. The hydraulic motor 42 for rotating the handler is supplied with hydraulic power through a line shown schematically at 42A, and is operated by a control member 42B that operates a servo valve to control fluid under pressure through suitable lines to power the motor 42 in proper direction. The hydraulic cylinders 52 (only one is shown in FIG. 8, but they are hooked in parallel) are supplied through hydraulic lines shown schematically at 52A from the portable controller 125, and are controlled with a switch 52B that supplies electrical power to rotate the hydraulic motor. The boom extend cylinder 63 is provided with fluid under pressure through a hydraulic line 63A, and the servo valve for controlling fluid under pressure is powered through a switch 63B on the portable controller so that the boom can be moved in and out as desired. The rotary actuator 67 for the grapple is powered through hydraulic line 67A, from valves controlled by switch 67B on the portable controller so that the rotary actuator will rotate the grapple assembly in the proper direction. The hydraulic cylinder 80 for the grapple buck plate is supplied with fluid under pressure through lines 80A controlled by a switch 80B operating a servo valve which will extend or retract the cylinder 80 and operate the chain to pull liner sections into the proper place or release them as desired. The servo valves are controlled at variable rates to permit different speed of operation of the units. Thus all the controls can be conveniently carried by an operator right adjacent the interior of the mill where the liner sections are being replaced so that the operator can be very close to the liner sections and see what operations are taking place, and what movements of the liner handler are necessary in order to put the old liners in proper position, and to place the new liner sections in proper position. It should be noted that attachment to the old liner sections through the eye bolts and the buck plate assembly is quite simple because the mill liner handler can merely be placed adjacent the unit so that the chain hook can be hooked onto the eye bolt on the liner section (alignment is not critical) and then as cylinder 80 is retracted and the chain tightens the buck plate against the mill liner section, the liner handler will move and give somewhat to permit this alignment. Of course, the manual about pin 75 insures alignment in this direction, and slight movements of the grapple pivot actuator 67 and the cylinders on the booms movements will insure proper alignment. Then the liner section is loosened (they are bolted in place) and is moved onto the conveyor and pulled out of the mill. A new liner section is put on the conveyor, conveyed into the mill, and the buck plate is again put into operation. It should be noted again that the buck plate initially starts with the liner section engaging portions facing downwardly under the pull of gravity and then when the chain is tightened, the liner section is pulled against the buck plate contour. As the cylinder 80 is retracted further, the liner is lifted and the buck plate then rotates 90° to make a rigid assembly. There is a very loose or flexible assembly for initial connection to the liner sections, and then a very rigid connection for accurate handling when the cylinder 80 is retracted. This makes alignment for connecting much more simple. Once the liner section is nearly aligned, drift pins can be used for final alignment while the cylinder 80 is gradually released. The main runway includes the tubular member which is torsionally stiff to resist the moments developed by the boom and any liner section that is being handled by the boom. The I beam stock are stiff in bending and provide runways for the trolley wheels. The outer cross piece can be bolted with bolts 19 to the mill throat to absorb the torsional load from the tubular member of the track. When the liner sections are being changed, the mill is locked against rotation by external means that are not shown at the control center.

With the boom axis on the center line of the mill or the pivot axis of the mill, the motions required on the handler in order to pick up a liner on the conveyor and place it on the inner surface of the mill are minimized. The movement is symmetrical to the sides of the mill, and the top of the mill. The movements are along an X axis (in and out), an angle θ for movements of the boom and along the radius R of the mill. The movable conveyor can follow the trolley and handler into the far end of the mill if desired and then can be moved partially out of the mill. The boom is moved to position parallel to the tracks when being inserted into the mill opening, and then can be swung laterally for relining. The pivoting buck plate is extremely helpful in picking up liner sections from the conveyor or placing them on the conveyor. The 90° rotation eliminates complex extra motions that would otherwise be necessary. The pivot motion of the buck plate is reversed when the buck plate is holding a liner section and cylinder 80 is loosened. The boom telescopes a sufficient distance, approximately 16 inches, at a desired rate with the cylinder used for telescoping, to move toward or away from the side walls of the mill. The boom can be elevated about
the axis of pin 51, and rotated 370° about the upright axis of the trolley through the use of the hydraulic motor 42. The grapple can be pivoted side to side manually about pin 75, and can rotate about axis 68 with the hydraulic rotary actuator. The trolley is held securely on the tracks by having the wheels on the inside of the tracks and held in place, and the unit can reach any place overhead or 90° to either side. The mill is re-lined one half section at a time and then the handler is removed, the mill is rotated and the handler replaced to reline the other half of the mill.

The track and trolley can be inserted and removed through the mill opening and also carried from mill to mill with overhead cranes. The power controllers are mounted on a frame that may be attached to the track when the handler is not in use.

What is claimed is:

1. A mill liner handler device for operating inside of a rotary mill having interior surface liner sections and being rotatable about an elongated longitudinal central axis and having a central door opening of smaller size then the mill cross section at one end thereof, said handler device comprising removable track means extending in longitudinal direction in the interior of said mill and insertable and removable in direction along the longitudinal axis through said opening and being supported at its opposite ends with respect to said mill, a trolley member movably mounted on said track means, means to move said trolley member along said track means longitudinally back and forth inside said mill, movable arm means, support means between said trolley member and said arm means to support said arm means for rotation of said arm means about a first axis substantially perpendicular to the longitudinal axis, power means to rotate said arm means about the first axis from position substantially parallel to the longitudinal direction of said track means to a position transverse to said track means whereby said trolley member can be inserted into said mill through said opening with the arm means extending in longitudinal direction and said arm means subsequently being movable about said first axis while said trolley member is supported by said track means to reach side walls of said mill, means to pivotally mount said arm means to the support means about a second axis substantially perpendicular to the first axis, power means to pivot the arm means about the second axis, and grapple means at the outer end of said arm means, said grapple means including means to receive and hold liner sections from said mill.

2. The combination as specified in claim 1 and support means for said track means to position said track means so that the second axis for said movable arm substantially coincides with the rotational axis of said mill when the arm is transverse to said track means.

3. The combination as specified in claim 1 wherein said track means comprises a pair of spaced apart tracks each having spaced apart top and bottom flanges facing inwardly toward the other track, and wheel means for said trolley member fitting between said top and bottom flanges whereby said wheel means are held from moving out of said track, the space between said flanges being unobstructed to permit said wheels to roll along said flanges.

4. The combination as specified in claim 3 wherein said track means includes a central torsionally rigid member comprising a tube supported at its ends with respect to said mill and cross members extending from said torsionally rigid member and supporting said tracks.

5. The combination as specified in claim 4 and adjustable support means for supporting said track means at the inner end of said mill for adjusting said track means in vertical direction.

6. The combination as specified in claim 4 and means to bolt one of said cross members extending from said torsionally rigid member to said mill, whereby torsion load will be transferred to said mill.

7. The combination as specified in claim 1 wherein said grapple means comprises a buck plate assembly, said buck plate assembly having forward edge surfaces of size and configuration to conform to the outer surface of a mill liner section, power means on said grapple means, a flexible tension carrying member attached to said power means at one end, means to attach said tension carrying member to one of said mill liner sections at the other end, said power means loading said flexible member in tension whereby tension loading of said power means will pull a mill liner section attached to said flexible member toward said buck plate assembly to force the attached section against said buck plate assembly and form a rigid unit with said grapple means and attached section.

8. The combination as specified in claim 7 wherein said power means comprises a retractable fluid pressure actuated cylinder.

9. The combination as specified in claim 8 and means pivotally mounting said buck plate assembly to said grapple means, said cylinder being attached to said grapple means on a side of the pivotal mounting of said buck plate assembly opposite from the forward edge of the buck plate assembly, said buck plate moving under the force of gravity about its pivotal mounting to a first position, and when said cylinder is retracted to pull said flexible member and a mill liner section held thereby against said buck plate, said buck plate assembly will rotate to a second position substantially at 90° to said first position, and stop means to retain said buck plate from pivoting past said second position when under load from said cylinder.

10. The combination as specified in claim 1 and conveyor means separate from said track means and said trolley member mounted on said track means for movement along said track means, said conveyor means being of length to extend outwardly beyond the opening to said mill when the inner end of said conveyor means is inside said mill.

11. The combination as specified in claim 1 and control means for said handler device comprising a portable controller manually operable and having means to permit it to be carried by an operator, said controller being operable inside said mill adjacent said mill liner handler device.

12. The combination as specified in claim 1 wherein said mill is cylindrical and said arm means moves about its second axis as a radius member when the second axis of said arm means and the longitudinal axis of the mill coincide and wherein said arm means includes an extendable and retractable outer section, and power means to extend and retract said outer section to change the length of said arm means and permit moving said grapple means toward and away from the mill walls.

13. The combination as specified in claim 1 and rotary actuator means at the outer end of said boom,
means connecting said grapple means to said rotary actuator means, said rotary actuator means being movable about an actuator axis substantially normal to the second pivot axis of said arm means, and said means attaching said grapple means to said rotary actuator means including means permitting limited movement about a separate axis at right angles with respect to said actuator axis.

14. The combination as specified in claim 13 wherein said buck plate assembly pivots about a buck plate axis substantially parallel to the boom pivot axis.

15. A mill liner handler device for operation inside a rotary mill having an interior surface lined with removable liner sections, means to support said handler device on the interior of said mill, said handler comprising a boom means mounted on said handler about a pivot axis, power means for actuating said boom means about its axis, a grapple at the outer end of said boom means, said grapple comprising a buck plate assembly having outwardly facing edge surfaces formed complementary to the outer surface of said mill liner section, power means on said grapple, a flexible tension carrying member attached at one end thereof to said power means, means to attach a second end of said flexible member to one of said mill liner sections, said power means loading said flexible member in tension under power whereby tension loading from said power means will pull a mill liner section attached to the second end of said flexible member and said buck plate together.

16. In a handler device for lifting heavy objects such as mill liner sections, means to support said handler device, a boom member mounted on said handler device for movement with respect thereto, first power means for actuating said boom member with respect to said handler device, a grapple at the outer end of said boom member, said grapple comprising a frame, a buck plate assembly having outwardly facing edges configured to engage a member to be lifted, means pivotally mounting said buck plate assembly to said frame, second power means mounted with respect to said frame, a flexible tension carrying member coupled at one end thereof to said second power means and movable by said second power means in opposite directions with respect to said frame and buck plate assembly, said power means being mounted on a side of the pivotal mounting of said buck plate assembly opposite from the outwardly facing edges of said buck plate assembly, means to attach a second end of said flexible member to an object to be lifted, said power means being actuable to load said flexible member in tension and to pull said buck plate assembly and said object to be lifted together and to cause said buck plate assembly to pivot to a second position under tension loading from said power means while said outwardly facing edges engage said object to be lifted.

17. The combination of claim 16 and stop means to hold said buck plate from rotating past said second position under loading from said flexible member and power means.

18. The combination as specified in claim 16 wherein said buck plate assembly includes a pair of spaced members defining spaced edges and being positioned apart a sufficient distance to engage the member to be lifted at spaced locations and stabilize said member, said tension carrying member being positioned between said spaced members.

19. The combination as specified in claim 18 and guide means for guiding said tension carrying member in position between said spaced members.

20. The combination as specified in claim 16 wherein said grapple is rotatably mounted with respect to said boom about a first axis, and power means to rotate said grapple means about said first axis.

21. The combination as specified in claim 20 and second pivot means to permit said grapple to pivot about an axis substantially perpendicular to said first mentioned axis.

22. The combination as specified in claim 18 wherein said means to attach the second end of said flexible member to said object to be lifted comprises a hook member, and a hook receiving member on said object to be lifted, and wherein said second power means comprises an extendable and retractable fluid pressure actuated cylinder mounted on said grapple.
UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,802,150 Dated April 9, 1974

Inventor(s) Donald F. Melton et al.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 10, line 34 after "buck plate" (Second Occurrence) insert--assembly--; Column 10, line 38 after "buck plate" (First Occurrence) insert--assembly--; Column 10, line 40 after "buck plate" insert--assembly--. Column 11, line 17 for "power" read--powered--. Column 12 in each of lines 2, 6, 11 and 16 before "power" insert--second--; Column 12, line 31 after "grapple" delete--means--.

Signed and sealed this 17th day of September 1974.

(SEAL)

Attest:

McCoy M. Gibson, Jr.
Attesting Officer

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Commissioner of Patents