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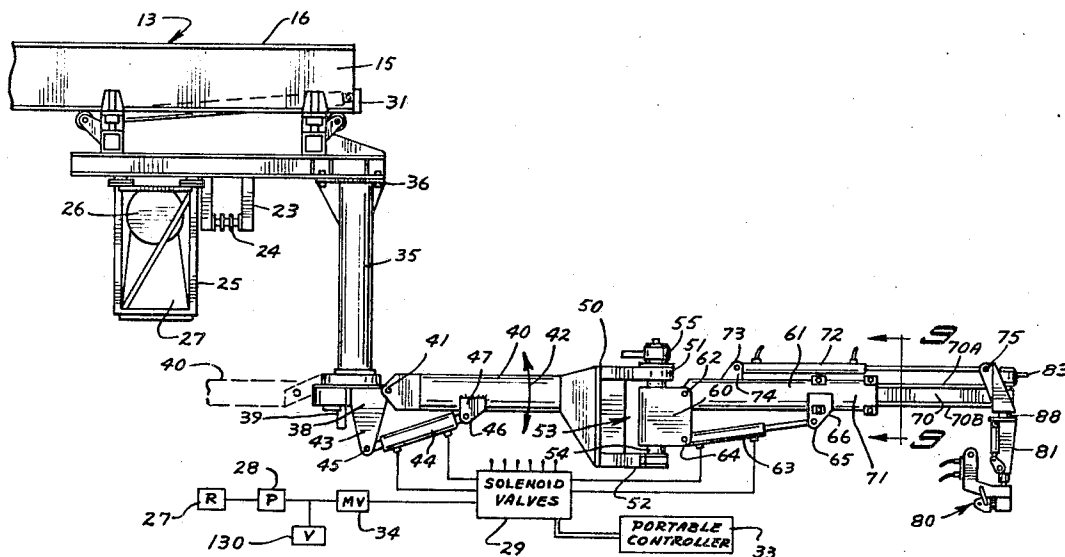
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[54] **MILL LINER HANDLING MACHINE**
 14 Claims, 13 Drawing Figs.

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 [51] Int. Cl. B66c 1/66
 214/1B,
 [50] Field of Search 214/1B,
 1B2, 1B3, 1B4, 1RCM, 147T; 212/17, 55, 59, 125,
 128, 129; 104/93, 95, 173; 105/30, 150, 152, 154,
 155

ABSTRACT: A machine for handling the heavy linings of mills, in particular taconite-grinding mills that have to be periodically changed after use. The machine can be utilized for a plurality of mills by removably mounting the machine on rails positioned adjacent the mill to be serviced. The machine has its base positioned outside of the mill, and has arms that will reach into all portions of the mill to remove and replace the liner sections. The arms can be folded back to make a compact unit for storage.



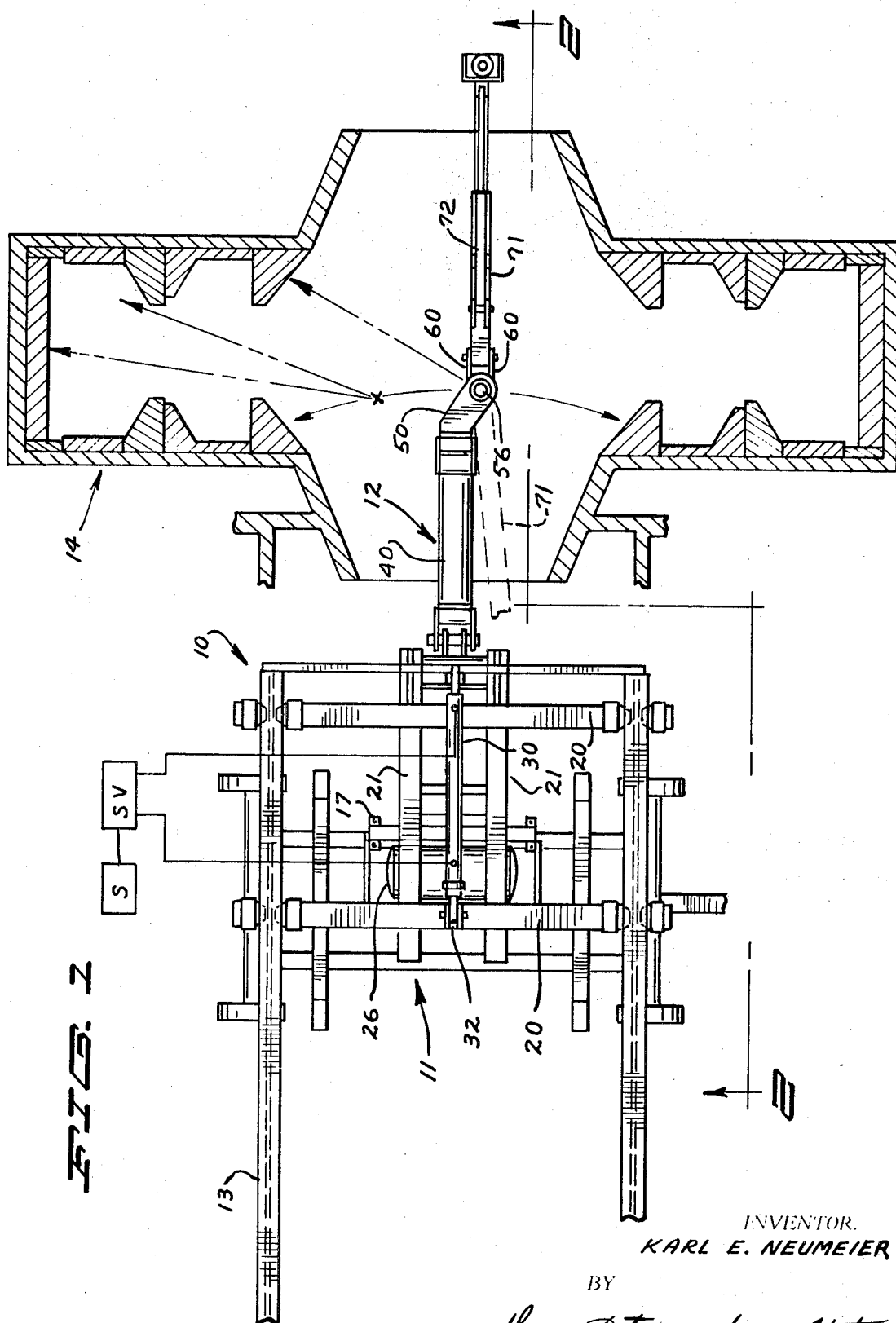
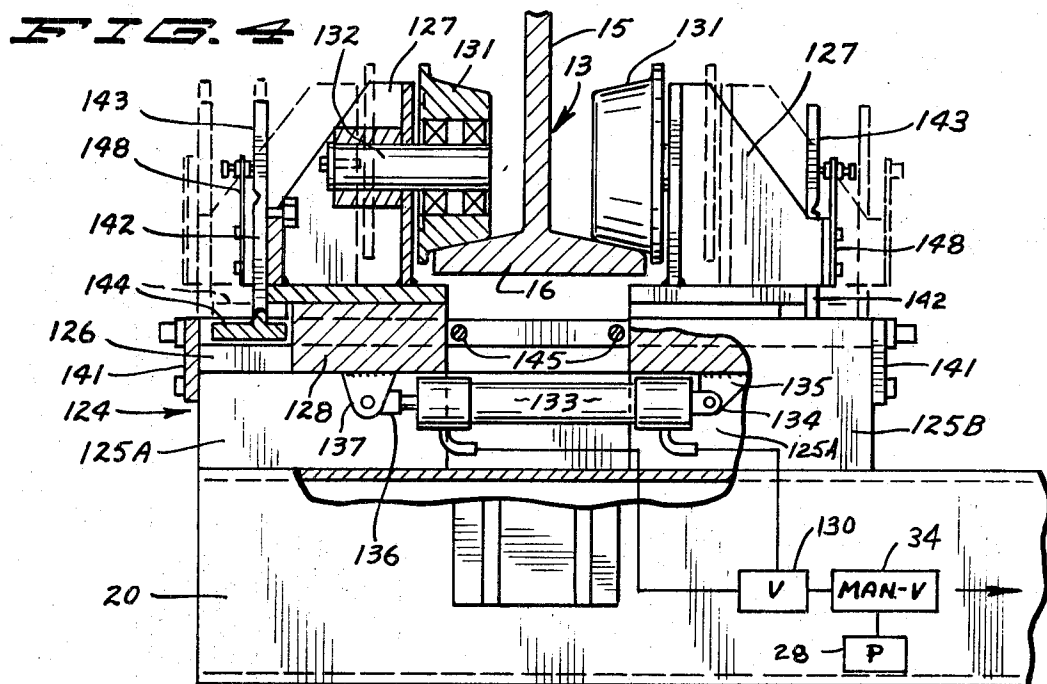
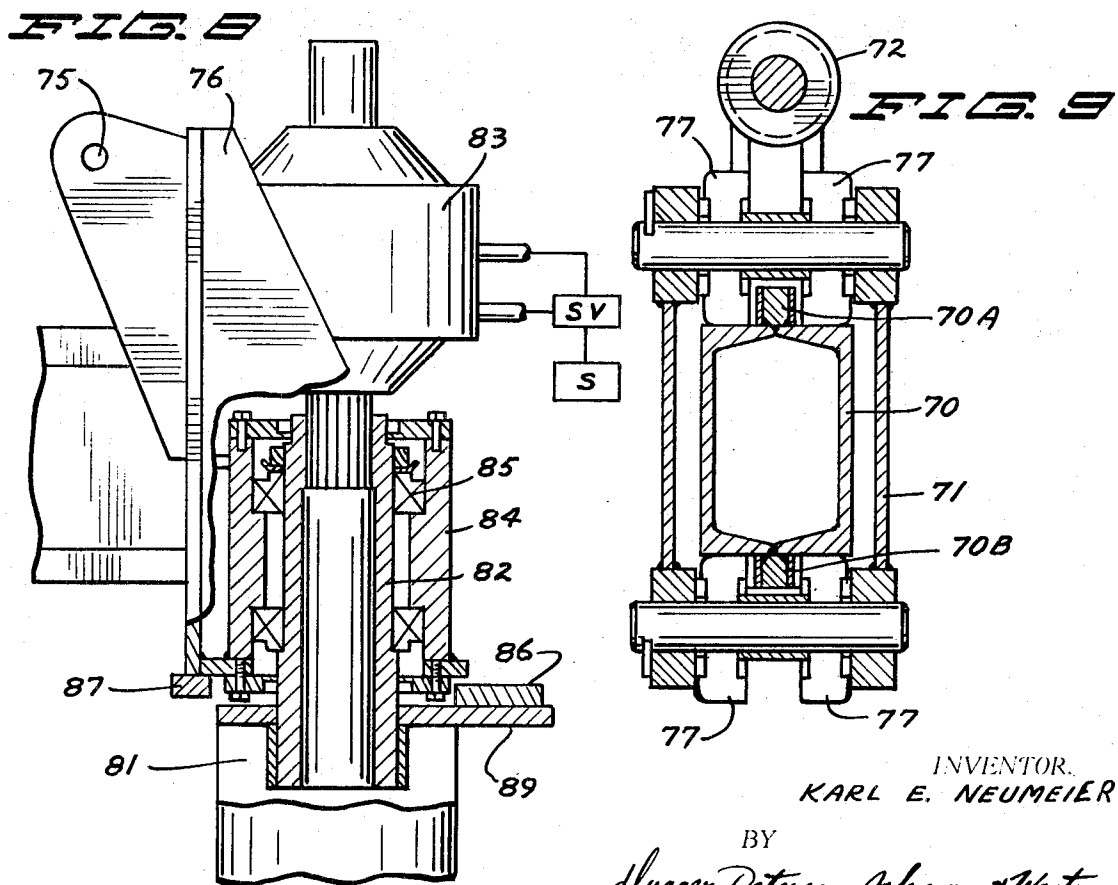
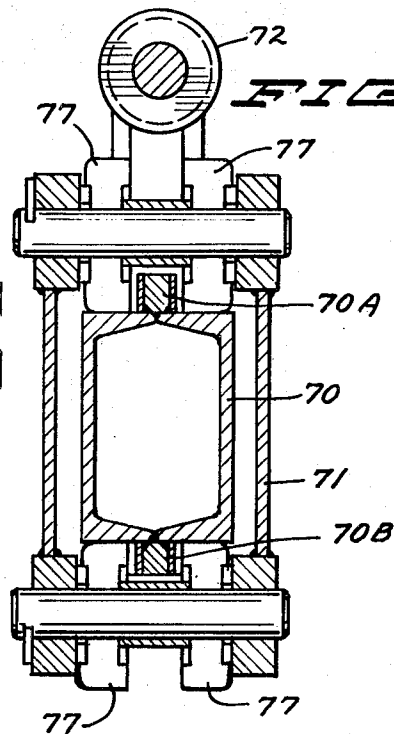


FIG. 2

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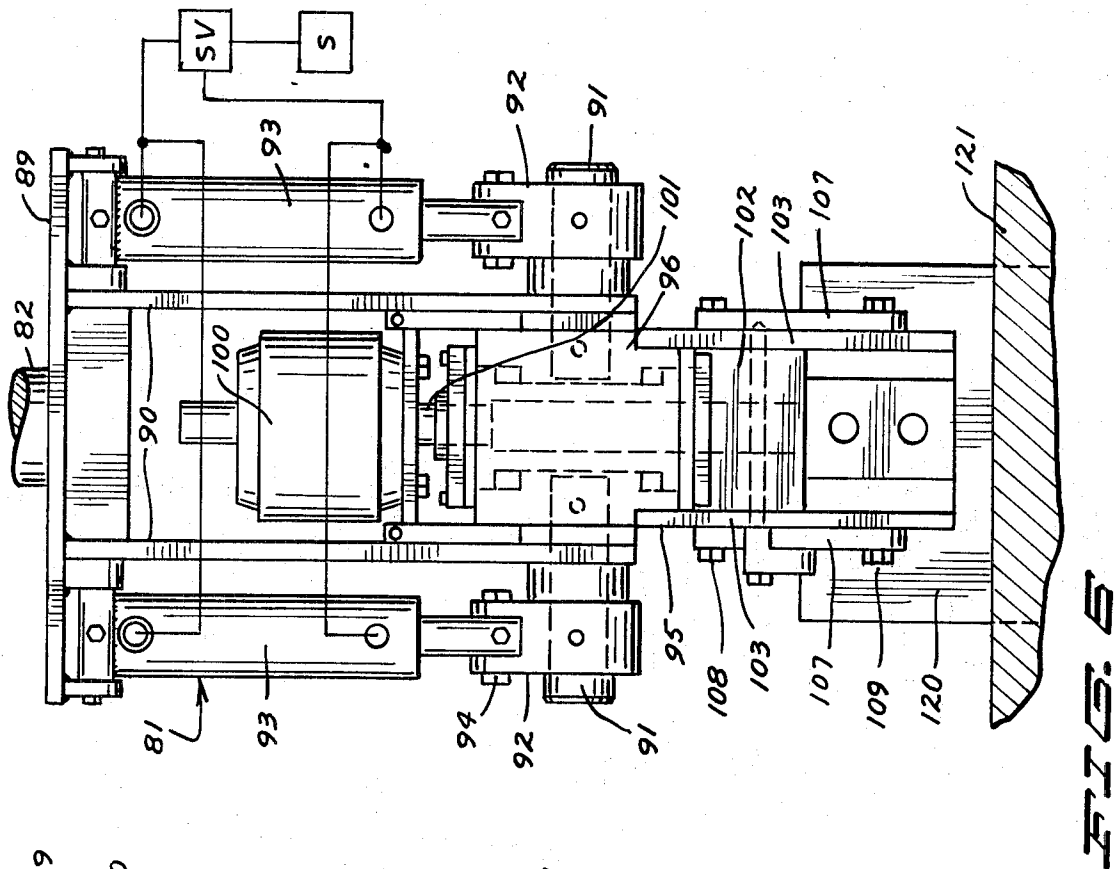
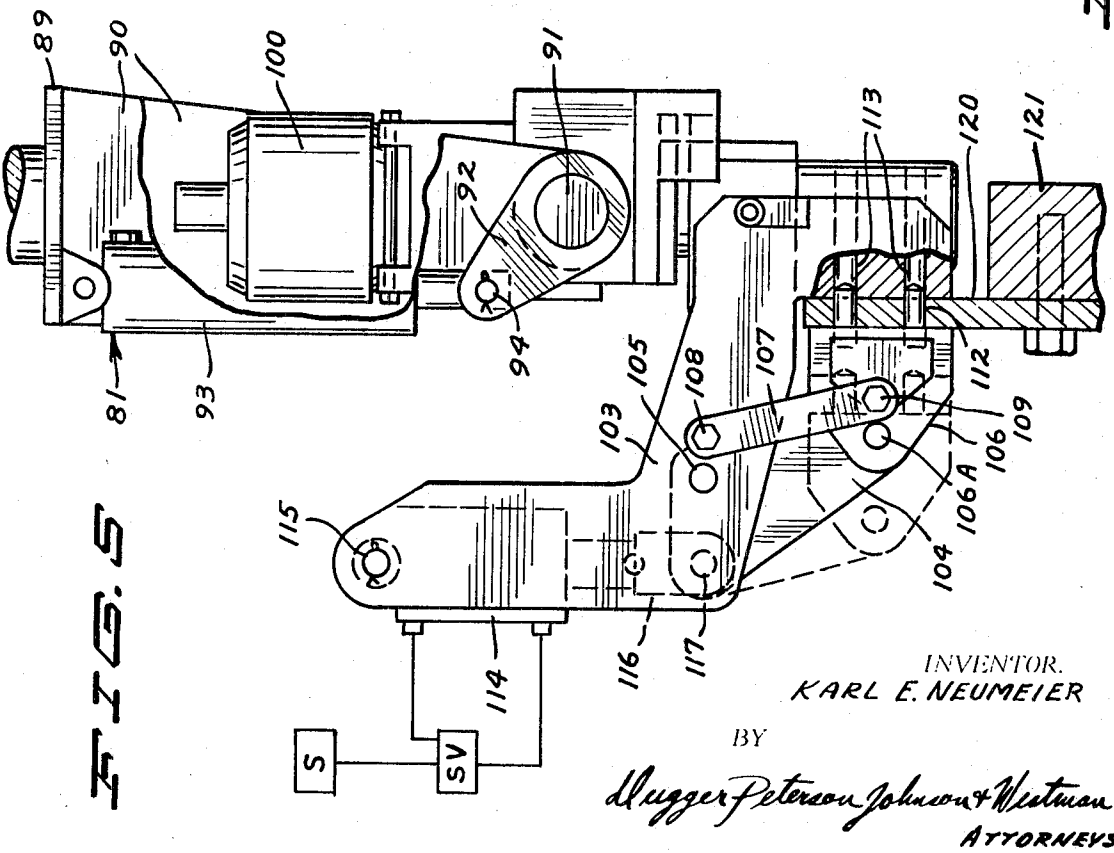
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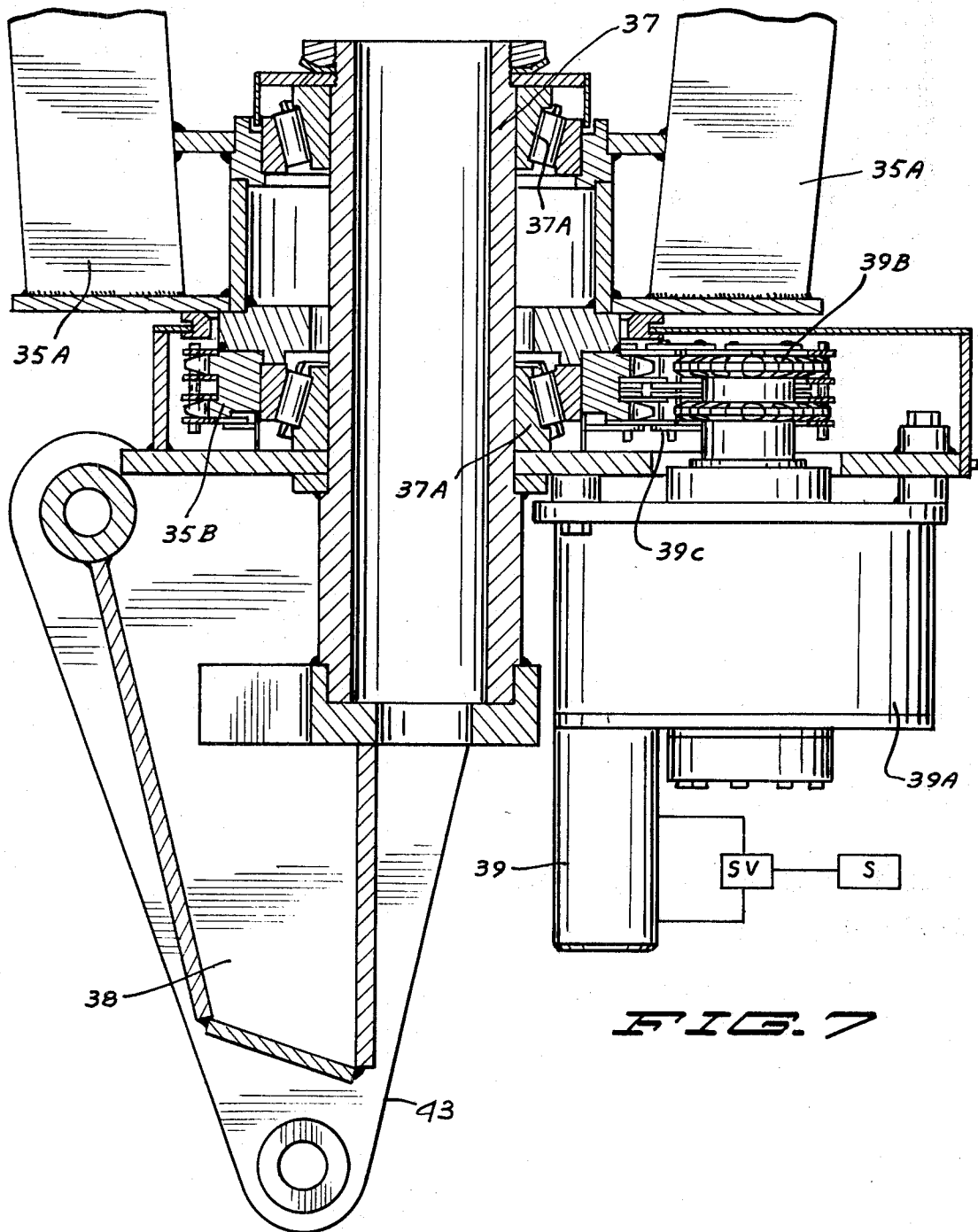
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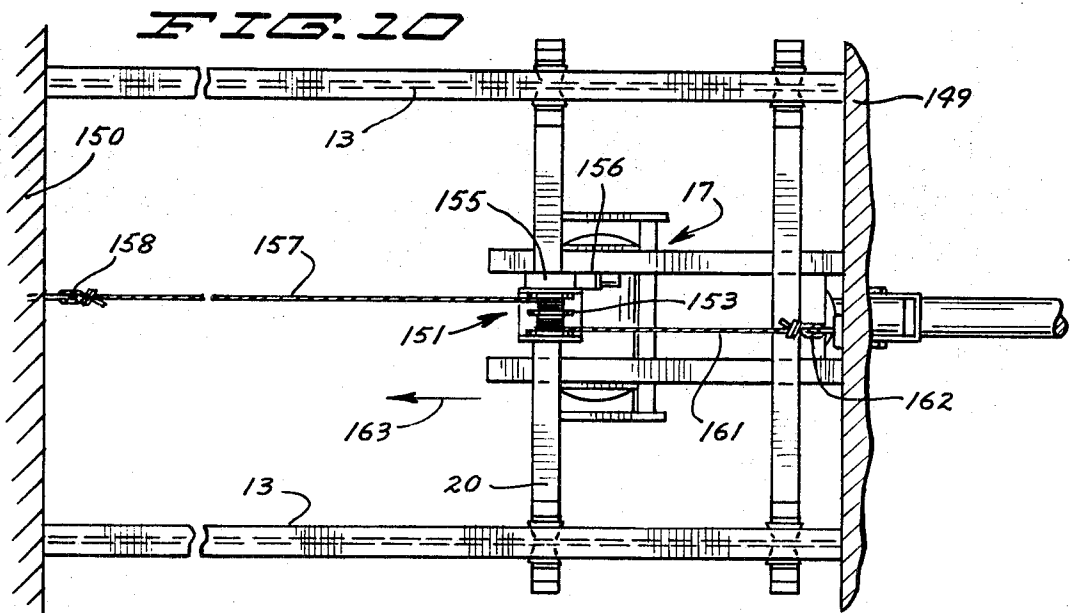
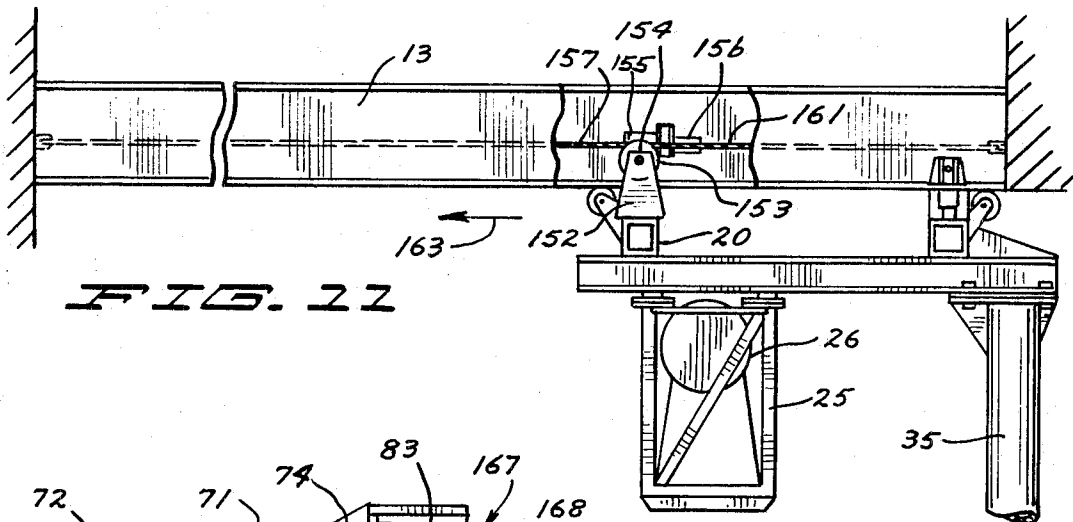
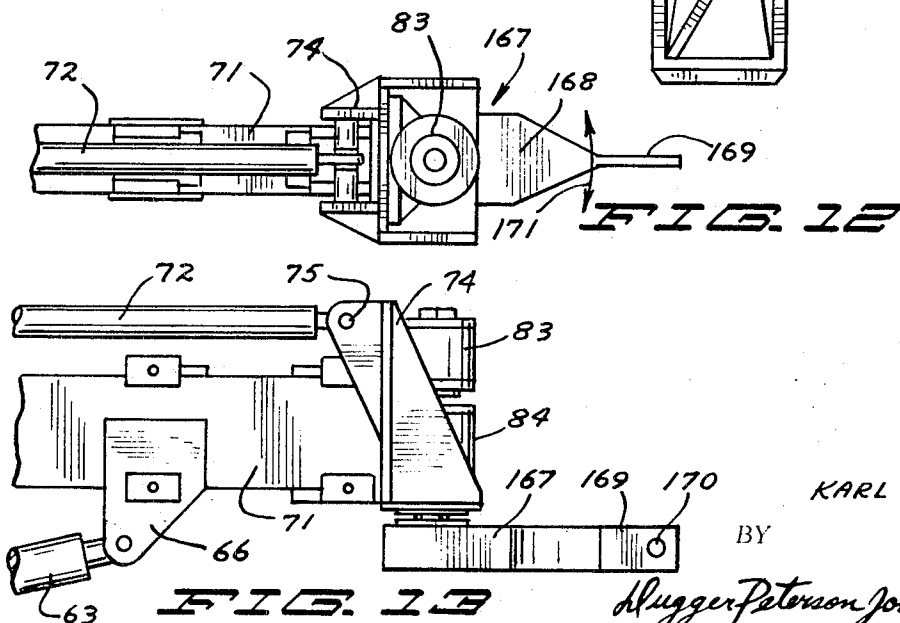
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MILL LINER HANDLING MACHINE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to handling booms or arms for handling the linings of large mills.

2. Description of the Prior Art

Various types of booms have been advanced for doing many different jobs. However, in the use in taconite plants, in particular, there has been a need for an extremely heavy-duty machine which can handle heavy lining members of the mill, which are bolted into place on the mill frame, and which can remove these liner members, and then replace them with new liner members. In doing so, the boom has to work around corners and be able to reach the remote corners of the mill.

SUMMARY OF THE INVENTION

The present invention relates to a jointed boom having a base removably mounted on rails. The base can be moved along the rails. The arm or boom is jointed so that it can go into remote corners of a mill, for example, and can be used for removing lining members and replacing them with new liners. The boom is removable from the rails for transport to other locations for relining other mills. The boom inner section is offset to permit the boom to be folded back upon itself for storage. The boom has a section that is rotatable about vertical axis, an outer section which is longitudinally extendable and also has portions that are rotatable about a substantially horizontal section. The mill includes a gripping device which is rugged duty, and will rotate fully around a vertical axis, as well as a limited amount about a horizontal axis to facilitate the grasping of the mill liners through the use of an adaptor for this purpose.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a top plan view of a mill liner handling machine made according to the present invention;

FIG. 2 is a side elevational view of the device of FIG. 1 taken as on line 2-2 in FIG. 1;

FIG. 3 is a fragmentary enlarged side elevational view of a support carriage for the mill liner handling machine with parts in section and parts broken away;

FIG. 4 is a view taken as on line 4-4 in FIG. 3;

FIG. 5 is a fragmentary enlarged side elevational view of a gripping member used with the device of FIG. 1 with parts in section and parts broken away;

FIG. 6 is a side elevational view of the device of FIG. 5;

FIG. 7 is a vertical sectional view of the bracket for mounting the base portion of the boom viewed in opposite directions from FIG. 2;

FIG. 8 is a view showing the mounting of a gripping assembly with parts in section and parts broken away;

FIG. 9 is a sectional view taken as on line 9-9 in FIG. 2;

FIGS. 10 and 11 are top and side views of an alternate device for moving the base assembly; and

FIGS. 12 and 13 are top and side views of a handler device to replace the grip member.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The mill liner handling machine illustrated generally at 10 includes a main mounting section 11, and a boom or arm section 12 which moves with the main mounting section. A pair of spaced apart support rails 13,13 are fixedly mounted with respect to the building in which the mill shown generally at 14 is positioned. These beams would have independent mounting members to suspend the beams the required distance from the floor or ceiling and adjacent to the mill 14. The rails 13,13 are comprised as "I" beams having a center web 15 and top and bottom flanges 16. The "I" beam section is shown partially in FIG. 4. A support carriage assembly 17 is mounted onto these beams and is positioned for movement back and forth in

direction along the "I" beams. The carriage assembly comprises a pair of main crossmembers 20,20 mounted onto and fixedly attached to a pair of spaced apart support members 21,21 which hold the crossmembers 20,20 in an assembly. The support members 21 extend parallel to and are below the rails 13,13.

The crossmembers 20,20 are supported on the rails 13,13 with roller hangers 22. There is one of the roller hangers at each end of the crossmembers 20. The hangers in this instance are made in a unique manner so that they can be released from the rails when the assembly is to be moved to a different location, or during storage when the machine is not being used.

A hoisting framework 23 is also supported by the members 21, 21 and has a device or support bar 24 on which a hook or other hoisting device can be placed for raising and lowering the carriage and mill handler machine assembly into place or removing it from the rails 13.

A framework 25 is utilized for mounting an electric motor 26 and hydraulic reservoir 27 and pump 28 (schematically shown) which are used for powering the components of the mill liner handling machine. The electric motor 26 is powered through a conventional source of power. The motor moves right along with the machine.

Once installed, the assembly is moved back and forth along the rails 13 through the use of a hydraulic cylinder 30 which can be extended or retracted. The base end of the cylinder 30 is attached to a bracket 31 that is mounted into a suitable support on the building, or on the rails 13, and the rod end, which extends and retracts is attached with the brackets 32 to one of the crossmembers 20, and upon extension or retraction of the cylinder 30 the entire carriage will be moved back and forth along the rails.

A main support tube 35 is fixedly attached with a base member 36 to the support members 21 at one side of the carriage, and extends downwardly therefrom. A support bracket assembly 35A is fixed to the tube 35. A shaft 37 (see FIG. 7) is rotatably mounted on suitable bearings in the support bracket assembly. The shaft 37 supports a boom-mounting bracket 38. A hydraulic motor 39 drives through a gear box 39A that has an output shaft drivably mounting a small sprocket 39B. A large sprocket 35B is fixed to the bracket assembly 35A. When the motor 39 drives the small sprocket 39B, a chain 39C between the sprockets causes the small sprocket, the gear box, and the bracket 38 to orbit, or in other words, to rotate about the bracket 35A and thus about the axis of tube 35. The shaft 37 rotates on bearings 37A with respect to the bracket 35A.

A base boom section 40 is pivotally mounted about an axis 41 to the bracket 38, and the base boom section will move back and forth about this pivot in direction as indicated by the double arrow 42 a preselected number of degrees (see FIG. 2). A pair of support arms 43 extend downwardly from the main part of the bracket 38 and a hydraulic cylinder 44 is mounted as at 45 to and between the arms 43. The rod end of the cylinder 44 is attached as at 46 to brackets 47 welded directly to the base boom section 40. Brackets 47 are on the underside of the boom, as is the cylinder 44, and upon extension and retraction the boom can be raised or lowered. As shown, the boom will not move downwardly below a substantially horizontal position, and in this manner, which is the usual working position, the cylinder 44 offers its maximum support for the inner boom section, which has to carry a tremendous amount of load because of the heavy mill liner sections.

The outer end of the main or inner boom section 40 has a bifurcated offset housing 50 at the outer end thereof. The bifurcated section includes an upper arm 51 and a lower arm 52. These sections are offset so that they extend laterally from the axis of the inner boom section. A mounting housing 53 is mounted between the arms 51 and 52 on a shaft 54 mounted in suitable bearings in the arms 51 and 52. A hydraulic motor 55 is mounted on arm 51 and has an output or drive shaft directly coupled to the shaft 54 to rotate it about its upright

axis indicated at 56. The mounting housing 53 can thus be rotated under power. The housing 53 has two spaced apart side plates 60,60, and an outer boom assembly 61 is pivotally mounted about an axis 62 on a suitable pin. The movement of the outer assembly 61 about pivot axis 62 is controlled through the use of a hydraulic cylinder-piston assembly 63 which is mounted at its base end as at 64 between the plates 60,60. The rod end of the cylinder is mounted as at 65 to a bracket 66 attached to the outer boom assembly 61.

The outer boom assembly 61 has two sections and is longitudinally extendable and retractable. A boom slide member 70 is slidably mounted in the base section 71 of the outer boom assembly on suitable rollers. As shown in FIG. 9, the slide member and base section 71 are rectangular in cross section. The slide member 70 has guide ribs 70A and 70B on the top and bottom thereof, and rollers 77 are rotatably mounted on the base section and guide against the member 70 on opposite sides of these ribs to keep the slide member from twisting about its longitudinal axis. This gives great stability to the extending boom. The hydraulic cylinder 72 is mounted as at 73 to brackets 74 attached to the top of the base section 71 of the outer boom assembly 61 and the rod end of the cylinder is attached as at 75 to a support bracket 76 fixedly attached to the outer end of the slide member 70.

Support bracket 76 is used for mounting a gripping assembly illustrated generally at 80. The gripping assembly includes a yoke 81 which is U-shaped, and which is fixedly attached to a shaft 82 that is rotatably mounted in a housing 84 on suitable bearings 85. The housing 84 is fixed to the support bracket 76. The shaft 82 is driven with a hydraulic motor 83 mounted on the bracket 76. The hydraulic motor is splined to shaft 82 and rotates the gripping assembly about its upright axis with respect to the support bracket 76 280°. Stop members 86 and 87 are used to limit rotation of the gripping assembly (see FIG. 8).

Referring specifically to FIGS. 5 and 6, it can be seen that the yoke member 81 includes a base plate 89 to which the shaft 82 is attached, and a pair of depending legs 90,90 which are spaced apart. At the lower end of the legs coaxial shafts 91,91 are rotatably mounted. At the outer ends of the shafts 91 there are drivably mounted arms 92,92 each of which is controlled through the use of a hydraulic cylinder 93. The hydraulic cylinders 93 are mounted at their base ends to the bracket or plate 89 and at their rod ends to the outer ends of the arms 92, with suitable pins 94. Extension or retraction of the two cylinders 93 (which operate in parallel) will cause the arms to be rotated, thereby rotating the shafts 91.

A grip member 95 is mounted on shafts 91,91 between the legs 90,90. The grip member 95 includes a mounting block 96. The inner ends of the shafts 91 are drivably mounted to this mounting block 96 so that the mounting block 96 rotates about the axis of the shafts 91 when the shafts are rotated. The mounting block 96 has a hydraulic motor 100 mounted thereon and this motor 100 in turn drives a shaft 101. The shaft 101 supports for rotation therewith a grip base 102. The grip base 102 extends downwardly, and has a pair of offset arms 103,103 mounted along the sides thereof below the legs 90,90.

A bell crank 104 is positioned between the arms 103 and is pivotally mounted to these arms about an axis 105 on a suitable pin. At the lower end of the bell crank a gripping jaw 106 is pivotally mounted as at 106A, to the bell crank 104 on suitable brackets. In addition, a pair of links 107 (one on each side of the assembly) are pivotally mounted as at 108 to the arms 103 and has at 109 to the gripping jaw 106.

The gripping jaw 106 has a pair of gripping pins 112,112 mounted there, and these pins fit into receptacles 113,113 on the grip base 102. The gripping jaw 106 is controlled for movement toward and away from the grip base through the use of a hydraulic cylinder 114 mounted as at 115 to an outer end of arms 103,103, and positioned between these arms and which has a rod end 116 mounted as at 117 to one end of the bell crank 104. Thus, by extension or retraction of the

cylinder 114, the bell crank will be moved about its pivot and the gripping jaw 106 will move in and out with respect to the grip base. The links 107 are pivotally mounted in relation to the pivots 105 and 106A so that it acts like a parallel link member so that the gripping jaw 106 moves back and forth and remains parallel to its original position. This means that the pins 112 will move in and out with respect to the grip base in a parallel relation. A bracket 120 is bolted to a section of mill liner 121 when the liner is to be removed, and the grip member then can be used for attaching or gripping the bracket, and handling the liner section 121.

The gripping assembly which is a heavy-duty unit, has sufficient movements to get into the odd corners of the mill and can be positioned at different angles in order to grasp the mill liner sections. It will rotate about an upright axis through the operation of motor 83, and this moves the yoke supporting the grip member itself. The grip member tilts about an axis at right angles to this axis through the use of the hydraulic cylinders 93,93. The grip member also is rotatable about an axis at right angles to the tilting axis. Thus, by tilting the axis of rotation of the grip member, with respect to the axis of rotation of the grip assembly, the position of the gripping jaws can be moved to many different positions in order to grasp the mill liner sections. The opening of the gripping jaws operates through a hydraulic cylinder which gives exceedingly large force and good holding force. The fact that the pins for supporting the mill liners enter receptacles in the jaw base also ensures that adequate strength is achieved for supporting the heavy loads from the mill liners.

Referring specifically to FIGS. 3 and 4, the unique hanger member assemblies for the machine are shown. The hanger members each comprise base sections 124 which are attached directly to the crossmembers 20 at opposite ends thereof. (There are four hanger members). The base section 124 each have two portions 125A and 125B. As shown in FIG. 3, the two portions 125A and 125B forming each section 124 are spaced apart. The portions 125A and 125B have slots 126 defined therein near the upper edges thereof and these slots face each other, as shown, to form a slide, guideway in which roller supports 127 are slidably mounted. There are two roller supports 127 supported by each of the base members 125, one roller on each side of the web 15 of the channels. The roller supports have a T-shaped lower section 128. The outer edges of the T section are made so that they fit within the slots 126 and slide in these slots. Each of the roller supports 127 mounts a separate guide roller 131 adjacent the upper portions thereof on a shaft 132 that is fixed to the roller support and has bearings thereon which the rollers 131 rotate. The movement of the roller supports 127 and consequently the rollers 131 along the slots 126 is controlled through the use of a hydraulic cylinder 133. One end of the cylinder is attached as at 134 to brackets 135 that are attached to the roller support 127 on a first side of the associated beam 13, and the rod end of the cylinder 133 is attached as at 136 to brackets 137 fixed to the roller support 27, roller support 127 on the opposite side of the beam 13.

The cylinder 133 is positioned between the portions 125A and 125B of each base section 124. By directing fluid under pressure to the cylinder 133 the rollers 131 can be either spaced apart to their dotted positions shown in FIG. 4, or moved together to position shown in solid lines wherein the outer surfaces of the rollers mate with the lower flange 16 of the beam 13.

Stop members 141 are provided on opposite ends of the base sections 124. These stop members are bolted into the ends of portions 125A and 125B and close the ends of slot 126. A detent safety lock member 142 is positioned at each end of the slots. The safety lock members have a shank portion 143 slidably mounted on the roller supports, and a foot member 144 that will move into and out of interfering relationship with stop member 141. When the rollers are positioned on the beam 13, the safety stop members are positioned in locked position as shown in FIG. 4 in solid lines. The foot

member 144 will abut against stop member 141 if the roller support 127 moves outwardly. This will prevent the roller support from moving sufficiently far to let the roller release from the flange of the beam. This then prevents the entire machine from coming off the beam if the cylinders 133 should fail.

When the machine is to be removed from the rails 13 the lock members 142 are slid upwardly so the foot member clears the stop member 141. This position is shown in dotted lines in FIG. 4. Then the rollers 131 can be moved to clear the flange 16 of the beams. The lock members are held in the lifted position with a spring latch 148 which has a bolt or pin that fits into a notch or detent on the shank when the shank is lifted. A large hole 143A is formed adjacent the top of the shank 143 as seen in FIG. 3, and a pole can be placed in this hole and used to lift the lock members up to released positions or lower them to locked position. The operator can stand on the floor to actuate these lock members with the pole.

A pair of bolts 145, 145 are used to hold the portions 125A and 125B together. These bolts 145 pass through the space between the roller support members of each hanger.

A separate bottom guide roller 146 is mounted onto brackets 147 attached to each end of each of the crossbeams 20. The rollers position the carriage assembly properly with respect to the bottom of the web 16. The rollers 131 ride on top of the web 16 of the beams.

The lengths of the inner boom section 40 and the outer boom section 61 are selected so that they can substantially equal in length when the outer boom is retracted.

Upon retracting the outer boom section, the grip assembly will be supported thereon close to the base portion 71. Then, when the outer boom section is folded back against the inner boom section, it will be seen that this grip member will be close to the support tube 35. The entire carriage can be moved out of the mill with cylinder 30 along the rails 13 so that this folding can take place.

Once the outer boom section is folded back against the inner boom, the inner boom is rotated about the axis of tube 35. The grip assembly, which is relatively heavy, will stay adjacent to the tube 35 and the pivot between the inner boom and the outer boom will be positioned substantially below the motor 26 and reservoir 27 for hydraulic fluid. It should be noted that the length of the outer boom when it is rotated will approximate that of the rails 21 of the carriage so that for storage the entire boom will fold to substantially the same length as the carriage used for supporting it. The heavy grip assembly is on the side of the support 24 opposite from the heavy motor 26 and reservoir 27. The positioning of the hydraulic reservoir is intentional to balance the weight of the grip assembly so that the entire unit can be lifted conveniently at a point within the confines of the carriage.

Thus, the storage of the unit becomes simple, and space is kept to a minimum. The boom folds to a length substantially equaling that of its support carriage, and the heavy grip assembly is balanced by the motor and hydraulic reservoir which are carried right with the unit.

When the carriage unit is to be removed from the rails 13, the unit is picked up by a support bar 24 with a suitable crane or other mechanism until the weight is off the hanger assemblies. The lock members 142 are then lifted to their release position. The cylinders 133 for each of the roller assemblies are extended by actuating the valves, releasing the rollers 131 from the flange 16. Then the unit can be dropped down and placed in storage, if desired. When the unit is to be replaced, it is merely lifted upwardly until the rollers 146 contact the cross bars 120, and then the cylinder 133 (which has been extended to move the roller supports to their dotted position shown in FIG. 4) are retracted, pulling the rollers up onto the bottom flange of the rail 13. The lock members 142 are then placed in locked position. It will be noted that the rollers 131 have part conical outer surfaces mating with the upper surface of the flanges 16 of the ordinary "I" beams. This will tend to pull the carriages up into a tight position so that they are firmly supported on the rails. After that, the unit is ready to use, and the

inner boom can be rotated about its pivot from its folded condition, the outer boom assembly unfolded, and the carriage rolled along the rails 13 to put the boom into the interior of the mill. By proper manipulation the liner sections, even in the remote corners of the mill, can be lifted out for replacement.

All of the hydraulic cylinders and components, with the exception of the cylinders 133 used for controlling the position of roller 131 on the support rail 13 utilize remote controls. The flow of hydraulic fluid from the pump shown schematically at 28 in FIG. 2 is controlled through individual solenoid valves which are shown in a group schematically at 29. Individual solenoid valves are shown schematically for the individual components and these are labeled SV in the drawings. A portable controller 33 comprises a handheld control box that has electrical switches for controlling the solenoid valves. The switches are shown in the copending U.S. Pat. application of Karl E. Neumeier, Ser. No. 725,617, filed May 1, 1968. In FIG. 5 of U.S. Pat. application Ser. No. 725,617, the typical circuit utilized with the present device is shown. The solenoid coil 41 in U.S. Pat. application Ser. No. 725,617 would control individual solenoid valves of the present device, and there is one separate finger switch for each of the different movements or motions. This would include the rotary motions utilizing hydraulic motors, as well as cylinders 30, 44, 63, 72, 93 (which operate in parallel) and 114.

A manual valve 34 is used for closing off flow of fluid under pressure to the solenoid valves when the unit is first installed, and this still permits fluid to flow from the pump 28 to a control valve 130 used for operating the cylinders 133 in opposite directions. The unit is self-contained and the motor has to be only connected to power to obtain hydraulic pressure. The valve 130 is manually controlled so that it is positive acting, and it is connected in separately so that the solenoid valves are deactivated and valve 130 will still work. Then, there will not be any accidental movement of the various components controlled by the solenoid valves before the unit is properly installed on rail 13.

Once the cylinders 133 have been properly positioned so that the rollers 131 are securely in place on the rails 13, and the roller lock members are in place as well, the manual valve 34 is opened, and then the solenoid valves can be controlled through the individual switches in the portable controller 33. These individual switches are indicated by the letter S schematically in several of the drawings.

Referring specifically to FIGS. 10 and 11, a modified carriage-propelling mechanism is shown. The rails 13, 13 are shown supported on walls 149 and 150 respectively. The wall 150 of course would be a support or wall adjacent the mill, and the carriage 17 is mounted as before on the rails 13, 13 for movement back and forth in directions along the rails. The details of the carriage and the supporting mechanism is exactly the same, but in this instance, a winch assembly or member 151 is mounted onto the top of the rear crossmember 20. The winch assembly has a support member 152 that is fixed to this crossmember 20 and the support member 152 rotatably mounts a double-sided winch drum 153. The winch drum has a center shaft 154 that is driven with a conventional worm gear set illustrated at 155. The worm of the worm gear set 155 is rotatably driven through the use of a hydraulic motor 156 that obtains power from the source or pump 28 and that is controlled through a suitable control valve.

A first side of the winch drum 153 has a cable length 157 mounted thereon, and the end of cable length 157 is fastened as at 158 to the wall 150. The second side of the winch drum 153 has a cable length 161 mounted thereon and the end of this cable length in turn is fastened as at 162 to the wall 149. The cable lengths are wound on the drum in opposite directions (one clockwise and one counterclockwise).

The cable lengths are adjusted at their fastening means so that they are taut when the unit is in place on the rails 13, and by powering the motor 156 in a first direction, the cable lengths 157 will be wound up onto the drum 153 and the carriage 17 will move in direction as indicated by the arrow 163.

The length 161 will feed out as the carriage moves. When the motor 156 is rotated in the opposite direction by operation of its control valve, the cable length 161 will be wound onto the drum 153 and the cable length 157 will be paid out, so that the carriage will move in opposite direction from that indicated by arrow 163. The use of the cable lengths permits fastening the propulsion means for the carriage at remote points, and the cable length can be any desired length, and can extend out beyond the limits of the support rails 13 if desired. The rest of the unit will operate exactly the same, but the cylinder 30 is now replaced with the winch assembly.

In FIGS. 12 and 13 a replacement for the gripping assembly 80 is shown. In this instance, the motor 83 drives the shaft 82 that is rotatably mounted on the housing 84, as before, but the outer end of the shaft 82 has a stub beam 167 drivably mounted thereon. The beam, as shown, merely extends at right angles to the shaft and has a wide base portion 168 and a narrow fastening portion 169 which in turn has an opening 170 therein. The beam will rotate in both directions of rotation about an upright axis as indicated by the arrow 171, and by using the opening 170, a chain or hook can be extended down to a fastening bracket on the mill liners, and the unit can be used for lifting the sections without operating the gripping mechanism. A stub beam 167 does result in some additional effort, because the positioning can be more exact with the gripping device. However, the stub beam can get into many corners and operate satisfactorily in most situations. The support beam assemblies are all the same as before, and can be extended, retracted and pivoted as explained previously. The stub beam forms a means for lifting and supporting the mill liners on the outer beam.

By using the portable controller, an operator can carry the controller with him up to the gripping end of the boom where the liners are to be handled, and can control the positioning of the boom, and the operation of the grip, while he stands right next to it to see where the grip is being placed. The controller can be carried by the operator with a shoulder strap or harness so both hands are free to operate the controls.

The liner sections weigh up to 2,000 pounds, and because of the large size of the mill, it can be seen that there are tremendous forces placed on the boom at its mounting. However, the rugged construction, and the reliable positioning through the hydraulic control members permits the boom to be moved even out to the lateral sections of the mill, or in other words quite far laterally offset from its mounting member, without damage.

I claim:

1. An articulated boom assembly having lifting means for operating inside a structure having a relatively narrow opening, and greater lateral width than said opening and in which the lifting means have to work, including support means exterior of said structure adjacent said opening, carriage means movably mounted on said support means for movement in direction toward and away from said opening, means to attach said carriage means to said support means, a first boom section, means to pivotally mount said first boom section about a first pivot axis to said carriage means, a second boom section, means to pivotally mount said second boom section to the outer end of said first boom section about two mutually perpendicular axes, one of which is parallel to the first pivot axis, said first boom section being offset adjacent its outer end so that one pivot axis of said second boom section is offset laterally of a plane defined by the longitudinal axis of said first boom section sufficiently so that said second boom section will fold back toward said first boom section about its one pivot axis to a position substantially parallel to and in alignment with said first boom section.

2. The combination as specified in claim 1 wherein said second boom section comprises an inner member and an outer member, and wherein said outer member is slidably mounted within said inner member for longitudinal axial movement, and power means to move said outer member axially with respect to said inner member.

3. The combination as specified in claim 1 wherein said support means comprise rail members having a central web extending substantially upright, and flanges extending substantially horizontal and on opposite sides of said rail members, said carriage means having pairs of rollers rotatably mounted thereon and adapted to roll along the flanges of said rail members on opposite sides of the web, separate roller carrier means for carrying each of said rollers of each pair, hydraulic cylinder means connected between said separate roller carrier means for each pair of said rollers, said hydraulic cylinder means being mounted to said separate roller carrier means for each pair so that upon extension or retraction of each of said hydraulic cylinder means, said roller carrier means of the associated pair will move toward and away from said web.

4. The combination as specified in claim 3 and safety mechanical stop means for preventing said roller carrier means from moving past position where they engage the flanges of said support means.

5. An articulated boom assembly having lifting means for operating inside a structure having a relatively narrow opening, and greater lateral width than said opening, and in which the lifting means have to work, including support means exterior of said structure adjacent said opening, carriage means movably mounted on said support means for movement in direction toward and away from said opening, means to attach said carriage means to said support means, a first boom section, means to pivotally mount said first boom section about a first pivot axis to said carriage means, a second boom section, means to pivotally mount said second boom section to the outer end of said first boom section about two mutually perpendicular axes, one of which is parallel to the first pivot axis, said first boom section being offset adjacent its outer end so that one pivot axis between said first boom section and said second boom section is offset to the side of the longitudinal axis of said first boom section to permit folding said second boom section back toward said first boom section, said lifting means comprising gripping means, an outer end of said second boom section supporting said gripping means, said gripping means comprising a grip assembly, means to rotatably support said grip assembly adjacent the outer end of said second boom section about a first grip axis, means to rotatably drive said grip assembly about the first grip axis, an openable and closable grip member, means to rotatably mount said grip member to said grip assembly about a second grip axis substantially perpendicular to said first grip axis, power means to control movement of said grip member around its second grip axis, means to rotatably mount said grip member about a third grip axis at substantially right angles to said second grip axis, and for movement independently of movement of said grip assembly about the first grip axis, power means to rotate said grip member about its third grip axis, and power means to open and close said grip member to provide for grasping of objects to be moved.

6. The combination as specified in claim 5 wherein said grip member comprises a main mounting block, a movable member movable toward and away from said main mounting block, said main mounting block having receptacles thereon, pin members on said movable member and adapted to fit within said receptacles on said mounting block, said pin members being of length so they will enter said receptacles while supporting a load.

7. The combination as specified in claim 6 wherein said movable member has parallel link members connecting it to the grip member, said movable member moving in a parallel relationship with respect to said mounting block from a full opened to a closed position.

8. The combination as specified in claim 7 wherein one of said link members for mounting said movable member comprises bell crank means, said bell crank means being pivotally mounted with respect to said grip member about a first pivot and pivotally mounted to said mounting block about a second pivot, a hydraulic cylinder mounted to said bell crank member at a point spaced from a line drawn through the first and

second pivots, and means to control movement of said hydraulic cylinder thereby to move said bell crank about its second pivot and move said movable member toward and away from said mounting block.

9. The combination as specified in claim 2 wherein said outer member has guide ribs on the top and bottom thereof and roller means which engage said outer section on opposite sides of said guide ribs.

10. An articulated boom assembly having lifting means for operating inside a structure having a relatively narrow opening, and greater lateral width than said opening and in which the lifting means have to work, including support means exterior of said structure adjacent said opening, carriage means movably mounted on said support means for movement in direction toward and away from said opening, means to attach said carriage means to said support means, a first boom section, means to pivotally mount said first boom section about a substantially horizontal pivot axis to said carriage means, a second boom section, means to pivotally mount said second boom section to the outer end of said first boom section about a substantially upright axis, said first boom section being offset adjacent its outer end so that the axis between said first boom section and said second boom section is offset to the side of a plane defined by the longitudinal axis of said first boom section and a line perpendicular to the pivot axis of said first boom section to permit the second boom section to be folded back parallel to and adjacent the first boom section, said first and second boom sections being substantially the same length when folded, means to rotatably mount the first boom section about an upright axis adjacent one end of the carriage means, said first and second boom sections in folded condition being rotatable about the upright axis of rotation of the first boom section to position aligned with said carriage means.

11. The combination as specified in claim 10 wherein movement of said boom sections is controlled by hydraulic power means including a pump and fluid reservoir, means to mount said pump and fluid reservoir on said carriage means in position so the center of gravity of said carriage means and boom assembly is within the confines of said carriage means.

12. The combination as specified in claim 11 and a hydraulic cylinder, means to connect the last-mentioned hydraulic cylinder to said carriage and to a fixed support, and hydraulic power means to extend and retract the last-mentioned hydraulic cylinder to cause said carriage to move along said support means.

13. The combination as specified in claim 12 and a winch member mounted on said carriage, said winch member having a rotatable drum and two lengths of cable wound thereon in opposite directions, said cable lengths extending in opposite directions and being fastened to fixed supports independent of said carriage, said lengths of cable being operatively connected to said drum so that as said drum rotates one of said lengths is shortened and the other of said lengths is lengthened, and means to selectively rotate said drum in opposite direction to cause said carriage to move with respect to said fixed supports.

14. An articulated boom assembly having lifting means for operating inside a structure having a relatively narrow opening, and greater lateral width than said opening and in which the lifting means have to work, including support means exterior of said structure adjacent said opening, carriage means movably mounted on said support means for movement in direction toward and away from said opening, means to attach said carriage means to said support means, a first boom section, means to pivotally mount said first boom section about a first pivot axis to said carriage means, a second boom section, means to pivotally mount said second boom section to the outer end of said first boom section about a second axis which is perpendicular to the first pivot axis, said first boom section being offset adjacent its outer end so that the second axis is offset to the side of a plane defined by the longitudinal axis of said first boom section and a line perpendicular to the first pivot axis of said first boom section, said lifting means comprising a short lift beam, means to rotatably mount said short lift beam to the outer end of said outer beam section adjacent one end of the short lift beam, and about an upright axis, and power means to rotate said short beam about its upright axis.

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