Sept. 4, 1962 J. H. DILKS 3,052,067

HYDRAULIC COUNTERBALANCE AND LIFT FOR SLAB GRINDER

Filed Sept. 9, 1960 4 Sheets-Sheet 1

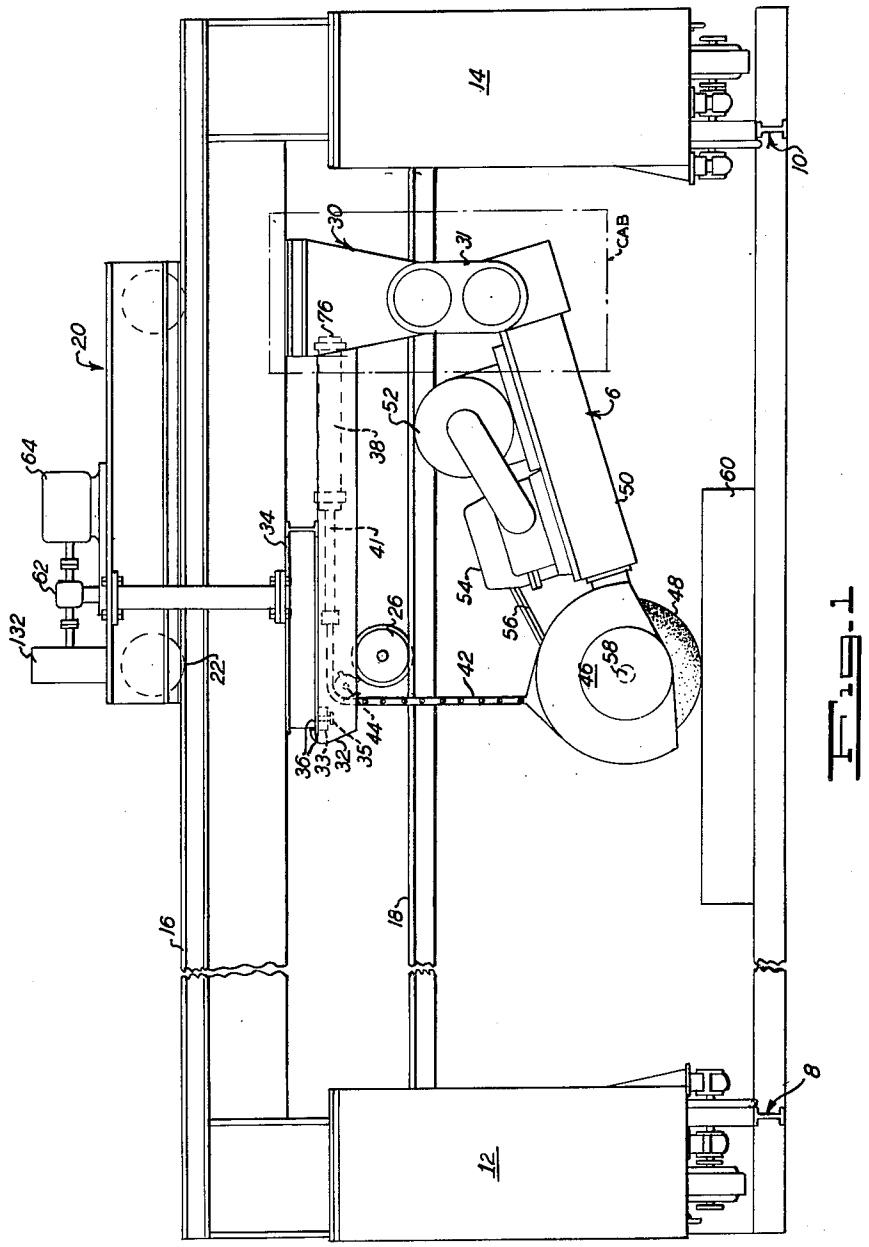


Fig. 1

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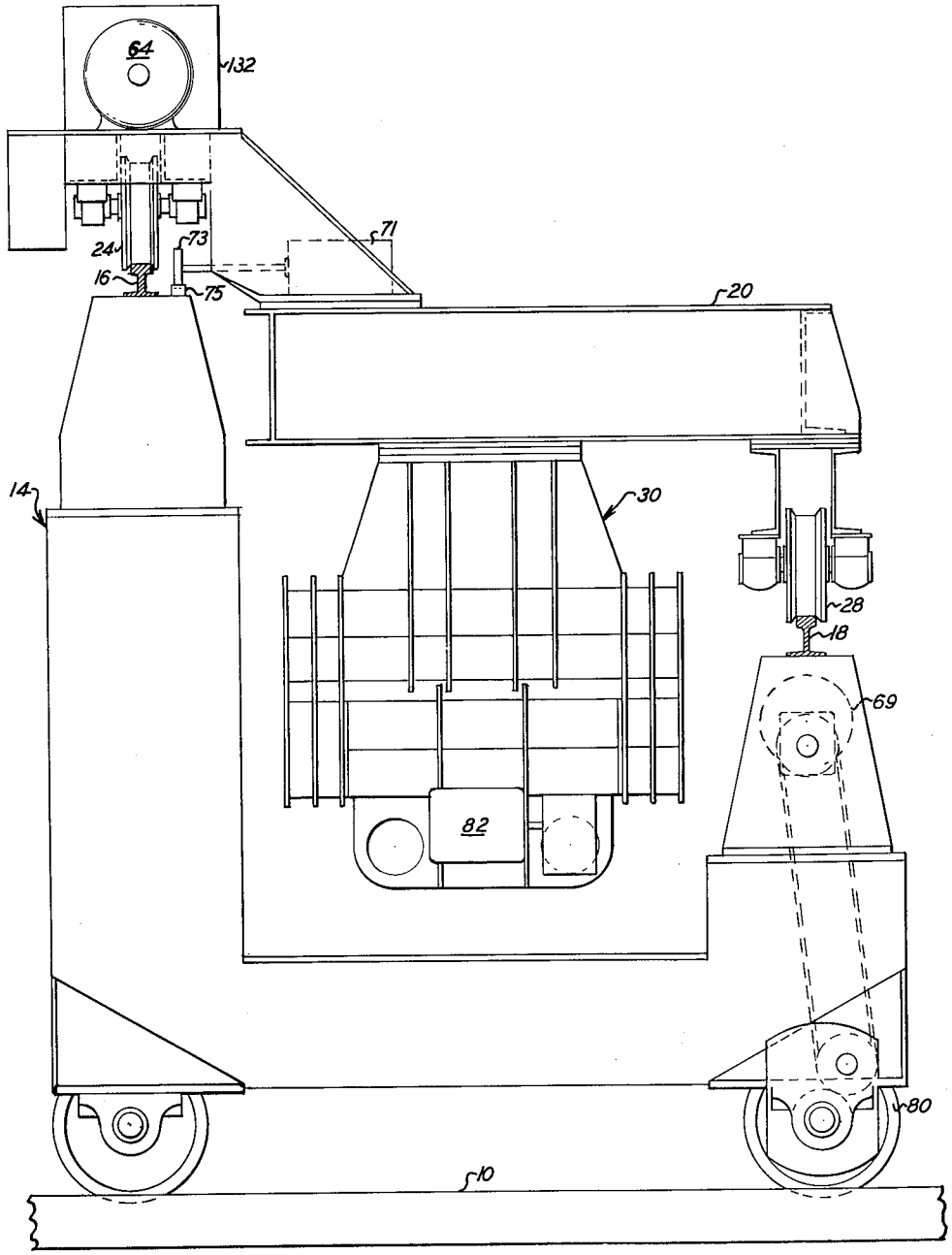


Fig. 2

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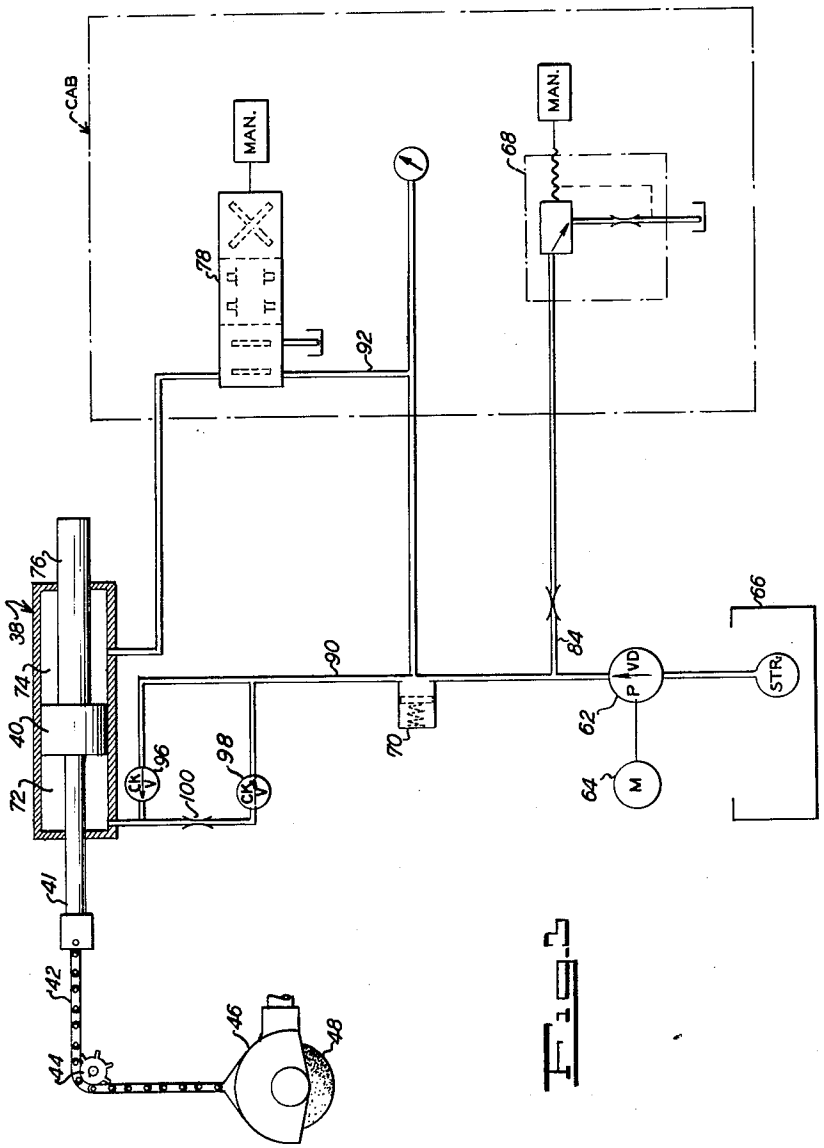


Fig. 5

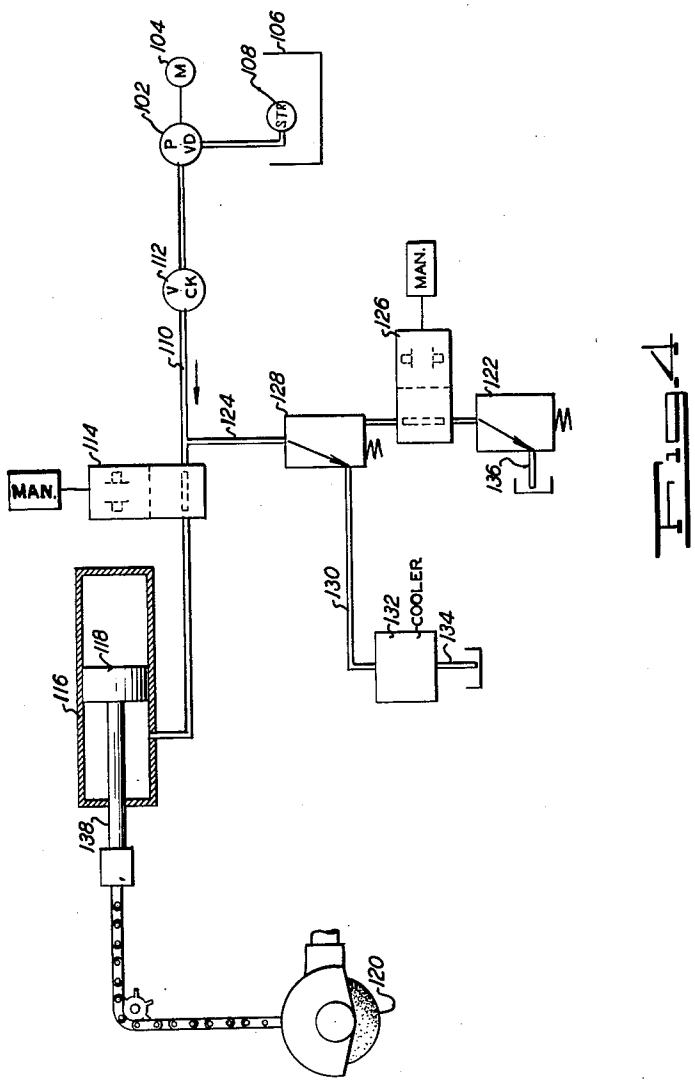
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HYDRAULIC COUNTERBALANCE AND LIFT FOR SLAB GRINDER

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HYDRAULIC COUNTERBALANCE AND LIFT FOR SLAB GRINDER

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4 Claims. (Cl. 51—35)

This invention relates to slab grinders and more particularly to a hydraulic counterbalance and lift for the slab grinder head. Slab grinders are primarily used for the preparation of grinding surfaces of semi-finished steel slabs in preparation for rolling the slabs into plate. Prior to this invention, slab grinders of this nature employed mechanical counterbalance of weights with cables and pulleys being used. Also pneumatic counterbalance with a mechanical lift has been suggested.

This invention consists of such a grinder which includes a hydraulic pumping unit with controls to a double-end hydraulic cylinder having a piston with unequal diameter piston rods for lifting the grinding head from the slab's surface with one valve setting and for adjusting the pressure of the grinding wheel on the slab with another valve setting. Alternatively, the invention involves a single rod cylinder with increased variable hydraulic pressure acting on only one side of the cylinder.

It is an object of this invention to provide a mechanism which will be lighter in weight, occupy less space, and be more convenient to operate than other comparable mechanisms of other slab grinders.

In addition, the float, comprising the length of stroke, can be increased very substantially over a construction which includes a mechanical counterbalance. This particular construction allows the grinder head to follow the contours of the slab with a more constant grinding pressure, and at the same time adjustment for the slab gauge or for inclined ingots is possible within broader limits. Also, the grinding wheel can be run off of the edge of the slab without falling and returned to the slab for the next cut. Pressure of the grinding wheel can be regulated from a cab. Vibration is practically eliminated and the practicable speed of operation is more than doubled. Since the hydraulic counterbalance combines the float with the head lift, the operation is simplified.

To these and other ends the invention resides in the improvements and combinations as will hereinafter be more fully described, the novel features being pointed out in the claims forming a part hereof, at the end of the specification.

In the drawings:

FIGURE 1 is a side elevational view of the slab grinder;

FIGURE 2 is a rear elevational view of the slab grinder;

FIGURE 3 is a diagrammatic view of the hydraulic system for the slab grinder; and

FIGURE 4 is a diagrammatic view of a modified hydraulic system for the slab grinder.

The slab grinder **6** is mounted so as to be movable fore and aft on a pair of spaced parallel rails **8** and **10**. The spaced end trucks **12** and **14** which ride on the foregoing rails are transversely connected by a further pair of spaced parallel rails **16** and **18** which provide the support for the carriage frame or overhead trolly **20** of the grinder.

The overhead trolley **20** consists of an overhead frame supported by four wheels **22**, **24**, **26** and **28**, two engaging each transverse rail. A grinding unit support **30** is rotatably secured to the underside and at one end of the trolley **20**. A beam **32** extends horizontally from the upper portion of support **30** to an arcuate I-beam **34**

secured to the underside of the carriage frame opposite support **30**. The beam **32** embraces the lower portion of the I-beam **34** in slot **36** so as to be slidably supported thereby. The I-beam **34** is curved to permit the beam **32** to slide along it in an arc so as to be supported thereby at all times. A lug **33** is rigidly secured within beam **32** adjacent to I-beam **34**. Lug **33** has a threaded hole to receive a bolt **35** which may be screwed against I-beam **34** to secure the relative position of I-beam **34** and beam **32** at any desired angle of operation.

Secured within this beam is a double-end loading control cylinder **38** as illustrated in FIGURE 3. A piston **40** is provided with two unequal diameter opposing piston rods **41** and **76** which reciprocate within the cylinder **38**. Attached to the smaller piston rod **41** is a linkage member comprising a chain **42**, which rides over a sprocket pulley **44** secured to the beam **32**, and which is connected at its opposite end to the guard **46** for the abrasive wheel **48**. An arm **50** is pivoted at one end to the lower portion of the support **30** through a connecting link **31** directly underneath the aforementioned beam **32**. Mounted on the arm **50** is a driving unit **52** which will normally be an electric motor which utilizes pulleys and a belt to drive a speed controller **54** mounted adjacent thereto on the arm **50**. The variable speed controller **54** which may comprise a gear box transmits rotary motion through a belt **56** to the abrasive wheel **48**, the same being rotatably mounted on a transverse axle **58** secured within the guard **46**. The guard **46** is in turn mounted on the end of the arm **50** opposite the support **30** and link **31**.

The abrasive wheel **48** is raised and lowered from the slab **60** by movement of the piston rod **41** which is linked thereto through chain **42**. In practice, the weight of the abrasive wheel **48**, guard **46** and the other structure which is supported by the chain **42** is substantial. For example, the combined weight may approximate two tons. However, in this invention it is possible to adjust finely the actual force which the abrasive wheel **48** has on the slab **60**, i.e., from the full combined weight of the grinding head structure to practically zero pounds. This is accomplished by varying the hydraulic pressure of the fluid within the cylinder **38**. In practice, it is preferred to vary the downward force from somewhat less than one-half of the normal weight of the grinding head structure to zero pounds. In order to accomplish this purpose a variable volume pump **62** is provided (see FIGURE 3). The variable volume pump **62** is mounted appropriately on the trolley **20** and is driven by any suitable driving means such as an electrical motor **64**. A cooler **132** which may be used in a modification of the hydraulic system is also shown in FIGURE 1 on trolley **20**. The pump **62** draws from a reservoir **66** which is also mounted on the trolley **20** directly under pump **62**. An outlet line **84** leads from the pump and has two main branches **90** and **92**. Branch **90** leads to a first chamber **72** on one side of the cylinder **38**, and the branch **92** leads to a chamber **74** on the opposite side of the cylinder **38**.

The pressure in the system is controlled by the operator of the grinder by means of a manually controlled unloading valve **68**. An accumulator **70** may be placed in this system to prevent sudden and unwanted pressure changes. With equal pressure applied to each pressure chamber **72** and **74** of the cylinder **38** it will be apparent that the total force applied against the piston in the first chamber **72** will exceed that applied against the piston in the opposite direction in the second chamber **74**. This force will closely equal the square inch difference in cross-sectional area of the opposite side of piston **40** (with the cross-sectional area of the corresponding piston rods **41** and **76** subtracted from each) multiplied by the pressure per square inch applied to the fluid from the

pump 62. Thus when it is desired to ease the force of the abrasive wheel 48 on the slab 60, it is only necessary for the operator to control manually the discharge pressure of the pump 62. With a high discharge pressure, the downward force of the abrasive wheel 48 will be relatively slight as compared with a low discharge pressure. Check valves 96 and 98 are incorporated in line 90 together with a flow control valve 100 through which flow from chamber 72 can be controlled. When valve 100 is closed or substantially restricted, wheel 48 may be run off the edge of slab 60 without falling and be returned for the next cut. It will be understood that valve 100 and valve 68 as well as other control valves may be remotely controlled from the operator's cab.

A directional valve 78 is placed in branch 92 of the fluid conduit leading to the second chamber 74. When the operator desires to control the pressure of the abrasive wheel 48 on the slab 60 this directional valve 78 will be so set as to permit application of the pressure to the second chamber 74. However, when it is desired to raise the grinding wheel 48 altogether from the slab 60, this may be accomplished most easily by setting the directional valve 78 to secure the discharge of pump 62 to chamber 72 and to permit fluid from the second chamber 74 to discharge back to the pump's reservoir 66. When this is done, all the fluid pressure is exerted against the piston 40 from the first chamber 72 thereby permitting it to move without significant opposing pressure.

The slab grinder 6 is propelled on rails 8 and 10 by means of a motor 69 connected through belts and pulleys to the wheels 80 in one of the end trucks. The trolley 20 is similarly propelled back and forth by a motor 71 which drives a sprocket 73 which in turn engages a chain rack 75 secured along rail 16. The grinder head structure may be oscillated by a motor 82 and gear reducer located upon the rear of the arm near the support.

An operator's cab secured to trolley 20 is normally included in the slab grinder whereby the operator can observe the action of the abrasive wheel and containing manual controls for the pressure of the pump, flow control, and for the directional valve heretofore described for lifting the abrasive wheel.

FIGURE 4 discloses an important modification of a hydraulic system for the slab grinder. In this form of the invention the variable volume pump 102 is driven by an electrical motor 104. The pump 102 draws from a reservoir 106 through a strainer 108. Hydraulic fluid is delivered through the outlet line 110, which incorporates a check valve 112, through electrically controlled stop valve 114 into cylinder 116 where it exerts force against piston 118 contrary to the force exerted by the weight of the grinder head 120. The outlet pressure of the hydraulic fluid is controlled by a pressure control valve 122 wherein the pressure within the system is controlled as desired to counterbalance the downward force of grinder head 120. Valve 122 is in branch 124 which branches from line 110 between valves 112 and 114 as shown in FIGURE 4. Located prior to the control valve 122 in line 124 are a lift stop valve 126 and a venting relief valve 128. The relief outlet 130 of valve 128 leads into cooler 132. The outlet 134 from cooler 132 as well as outlet 136 from control valve 122, returns to reservoir 106. Valves 122, 126 and 114 will normally be remotely controlled from the cab.

In operation of the modification shown in FIGURE 4, valves 114 and 126 are normally open. Control valve 122 is set to control the pressure within the system as desired—as, for example, at a pressure between 400 and 700 pounds per square inch. The pressure on piston 118 will equal the pressure times the area of the piston in square inches less, of course, the area of the piston rod 138. The relief pressure of valve 128 is set sufficiently high so when the hydraulic pressure through the system is equal to this pressure, say 720 pounds per square inch, the force against the piston 118 will exceed the weight of the grinder head 120 which, as a result, will be lifted. This may be accomplished by closing the stop valve 126. Fluid from the relief valve 128 is then returned to reservoir 106 via line 130, cooler 132, and cooler outlet 134. When desired, the piston 118 can be substantially locked in place by closing valve 114.

The above description and drawings disclose two embodiments of the invention, and specific language has been employed in describing the several figures. It will, nevertheless, be understood that no limitations of the scope of the invention are thereby contemplated, and that various alterations and modifications may be made such as would occur to one skilled in the art to which the invention relates.

I claim:

1. In a slab grinder which includes a grinding wheel, a hydraulic system for controlling the working pressure of the grinding wheel of said slab grinder comprising a main cylinder, piston in said cylinder, a first chamber and a second chamber of said cylinder divided by said piston, a first piston rod extending from said piston through the end of said first chamber of said cylinder, a second piston rod extending from the side of the piston opposite said first piston rod through the end of said second chamber in said cylinder, said first piston rod having less cross-sectional area than said second piston rod, a fluid pump including outlet pressure control means, a first fluid conduit line leading from the outlet of said pump into said first chamber, a second fluid conduit line connected to the outlet of said pump and leading to said second chamber, connecting linkage linking said first piston rod to said grinding wheel whereby when fluid pressure is applied from said pump into said first chamber and said second chamber there is greater force against said piston from said first chamber than said force being exerted against the weight of said grinding wheel.

2. In a slab grinder having a grinding wheel, a cylinder, a piston in said cylinder, a first piston rod extending from said piston through one end of said cylinder, a second piston rod extending from the side of the piston opposite said first piston rod through the opposite end of said cylinder, said first piston rod having less cross-sectional area than said second piston rod, a fluid pump, an outlet conduit leading from said group, a fluid pressure control valve interconnected with said outlet conduit, a first cylinder fluid conduit extending into said first-mentioned end of said cylinder and interconnected to said outlet conduit, said first cylinder fluid conduit being split into two pathways for a distance, each of said pathways having check valves, one of said check valves checking the flow of fluid from said cylinder, the other of said check valves checking the flow of fluid to said cylinder, a volume control valve interposed in said pathway with said second-mentioned check valve, a second cylinder fluid conduit extending into the opposite end of said cylinder and interconnected to said outlet conduit, a directional valve interposed in said second cylinder fluid conduit, and linkage means linking said first piston rod to said grinding wheel whereby when fluid pressure is applied from said pump into both ends of said cylinder a greater force is exerted to act against the weight of piston supporting the grinding wheel, and whereby the pressure in the opposite end of said cylinder may be occluded to lift the grinding wheel, and further whereby fluid may be prevented from escaping from the first-mentioned end of said cylinder to prevent the grinding wheel from dropping when run off the end of a slab.

3. In a slab grinder which includes an abrasive wheel, a cylinder affixed to said grinder substantially above said abrasive wheel, a piston in said cylinder, flexible means interconnecting said piston to said abrasive wheel and extending over a pulley, said abrasive wheel depending from said means below said pulley; whereby the weight of said abrasive wheel is substantially carried by said piston, a sump tank, hydraulic fluid in said tank, a pump

which includes a suction line into said sump tank, an outlet line connecting the discharge side of said pump and said cylinder whereby hydraulic fluid pressure is exerted against the side of said piston in said cylinder to which said means is connected whereby said pressure reacts against the weight of said abrasive wheel, a manually adjustable pressure control relief valve interconnecting said outlet line and said sump tank, whereby the pressure of the hydraulic fluid on said piston may be selectively varied from less than to more than the weight of said abrasive wheel.

4. A slab grinder which comprises a pair of spaced trucks, substantially horizontal parallel rails connecting said trucks, trolley means carried by said rails, a beam pivotally depending from one of its ends from said trolley, an abrasive wheel rotatably mounted on the other end of said beam, power means operatively connected to said abrasive wheel, a cylinder fixed to said trolley above said beam, a piston in said cylinder, means connecting said beam to said piston whereby the weight of said abrasive wheel is substantially carried by said piston, a sump tank, hydraulic fluid in said tank, a pump which includes a suction line into said sump tank, an outlet line connecting the discharge side of said pump and said cylinder whereby hydraulic fluid pressure is exerted against said piston in said cylinder to react against the weight of said abrasive wheel, a locking stop valve in said outlet line for

locking hydraulic fluid in said cylinder whereby said piston is maintainable in a static position, a venting relief valve interconnected to said outlet line between said locking stop valve and said pump, a manually adjustable pressure control valve also interconnected to said outlet line between said locking stop valve and said pump, a lift stop valve intervening between said pressure control valve and said outlet line, said venting relief valve set to relieve fluid pressure when said lift stop valve is closed at a pressure sufficient to cause said piston to lift said beam, and said pressure control relief valve selectively controlling the pressure of the hydraulic fluid exerted against said piston to counterbalance the weight of said abrasive wheel.

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