United States Patent

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[54] **PRESSURE CONTROL SYSTEM FOR A GRINDING MACHINE AND ACTUATING UNIT THEREFOR**
4 Claims, 7 Drawing Figs.

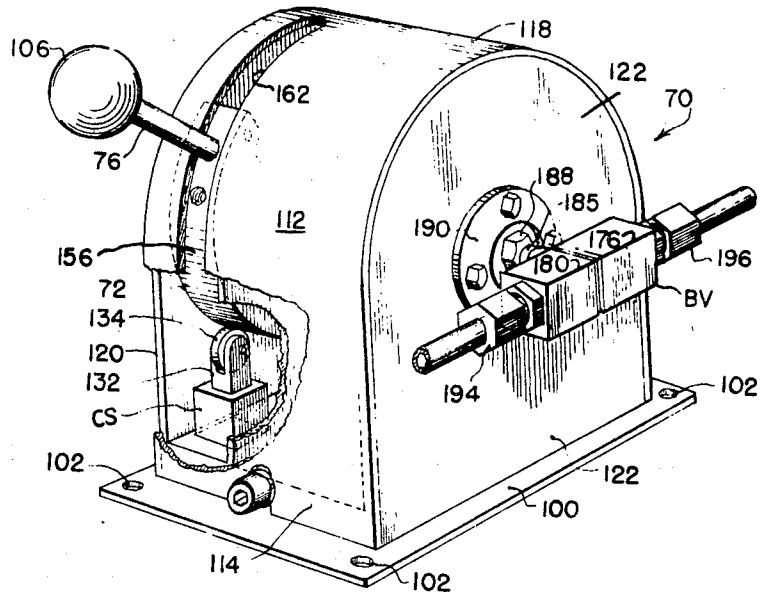
[52] **U.S. Cl.** **200/61.86,** 137/560
[51] **Int. Cl.** **H01h 9/06**
[50] **Field of Search** 200/61.86; 251/DIG. 4; 137/560

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ABSTRACT: A mechanically operable control unit for regularly bleeding a fluid line to relieve the pressure of fluid therein. A manipulating handle functions initially to establish an electric circuit through the solenoid winding of a directional valve, the handle functioning thereafter to regulate the flow of fluid through a bleed valve which reduces the pressure by an amount proportional to the forward throw of the handle.



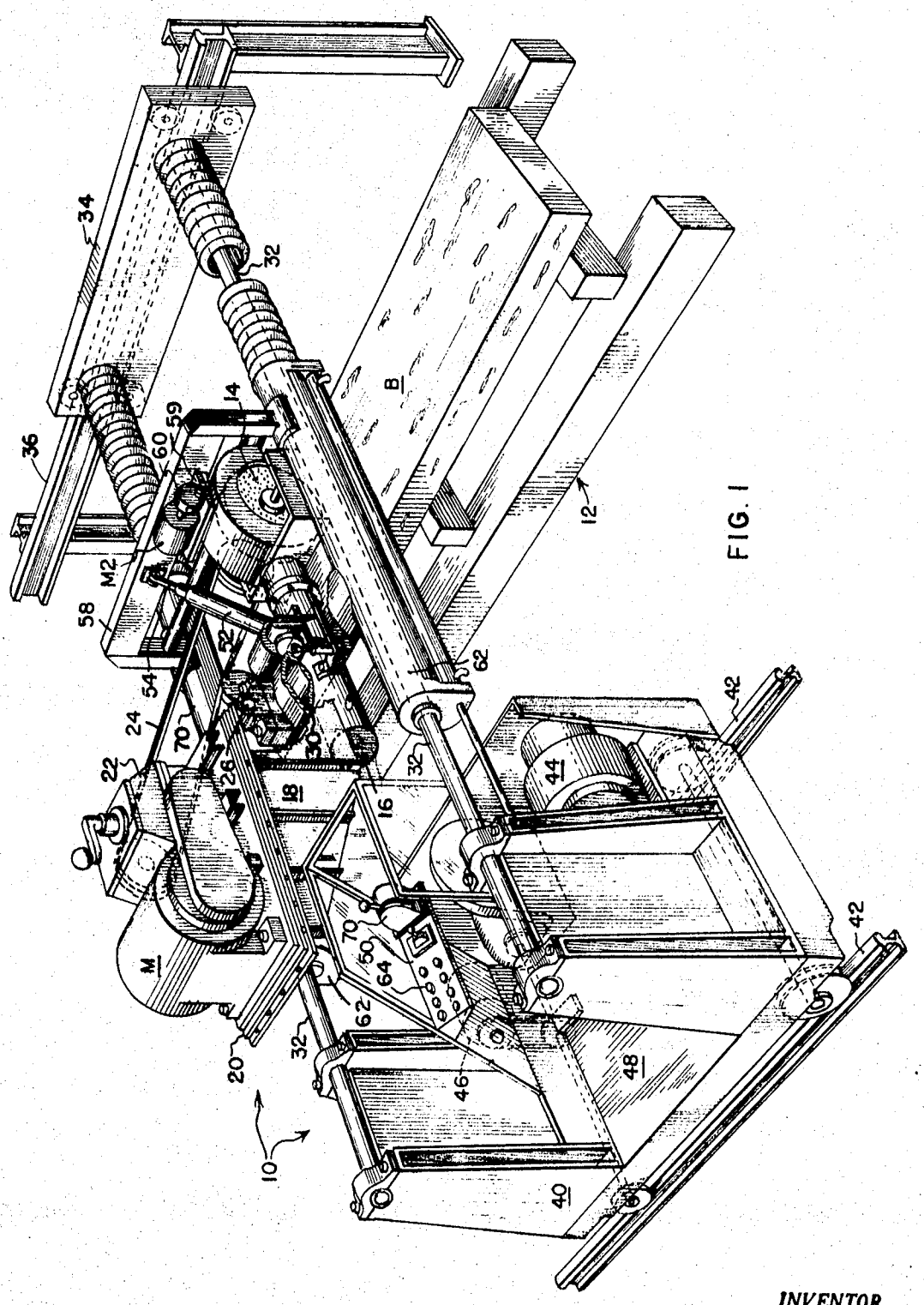


FIG. 1

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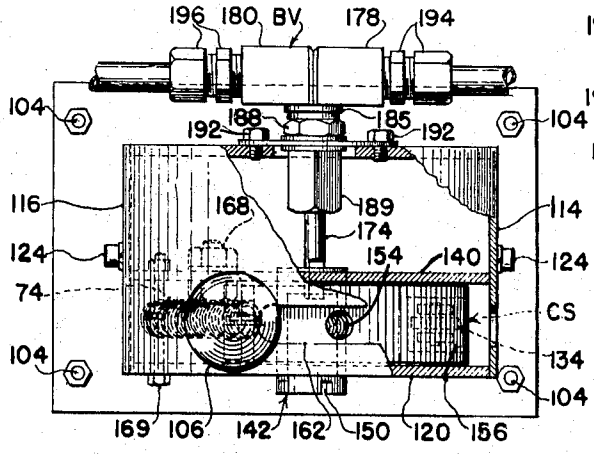


FIG. 2

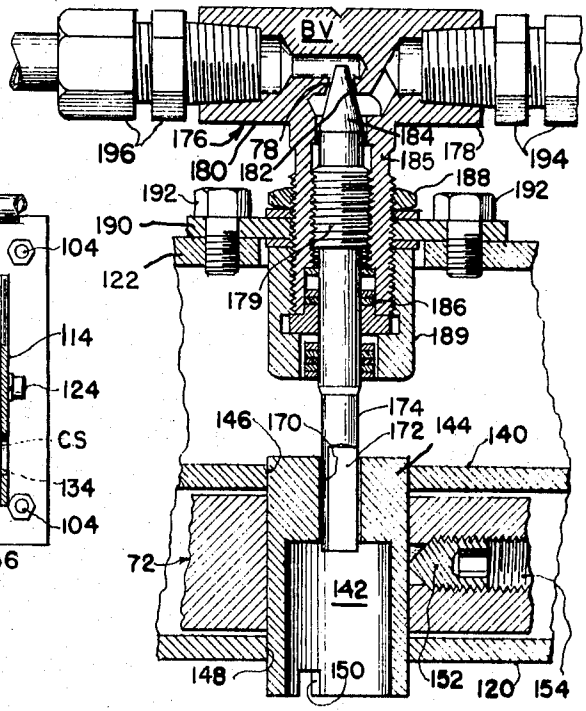


FIG. 5

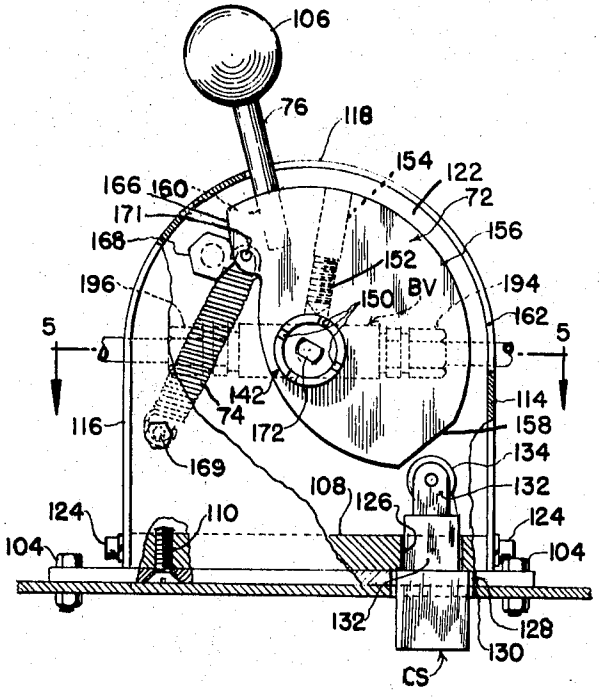


FIG. 3

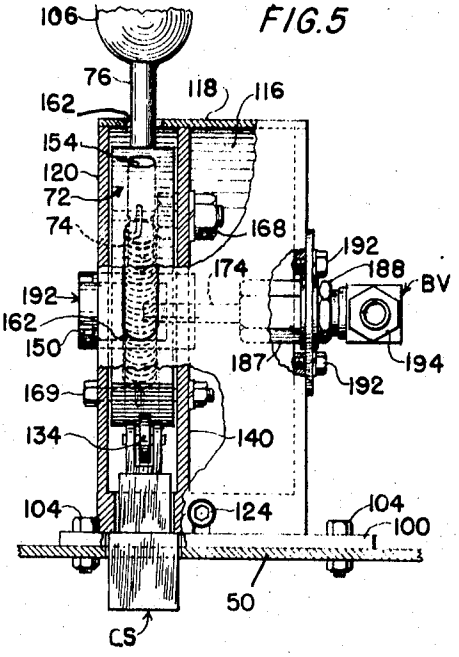


FIG. 4

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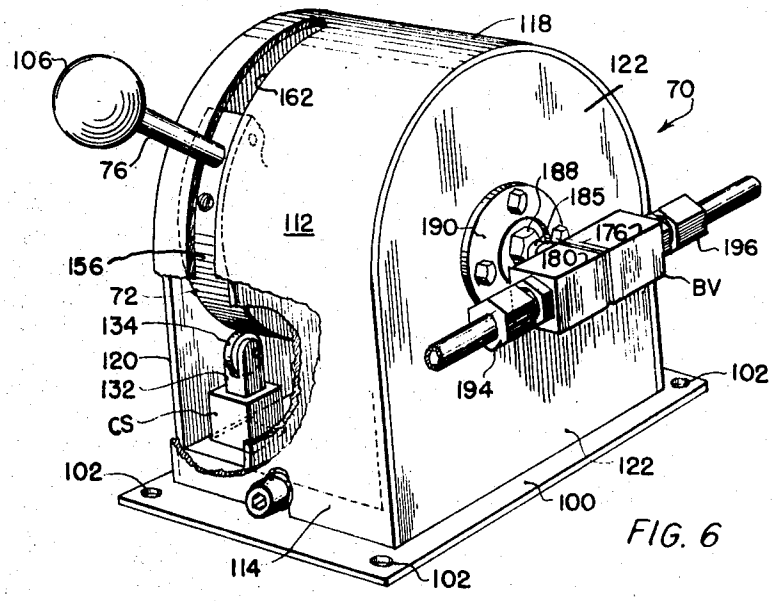


FIG. 6

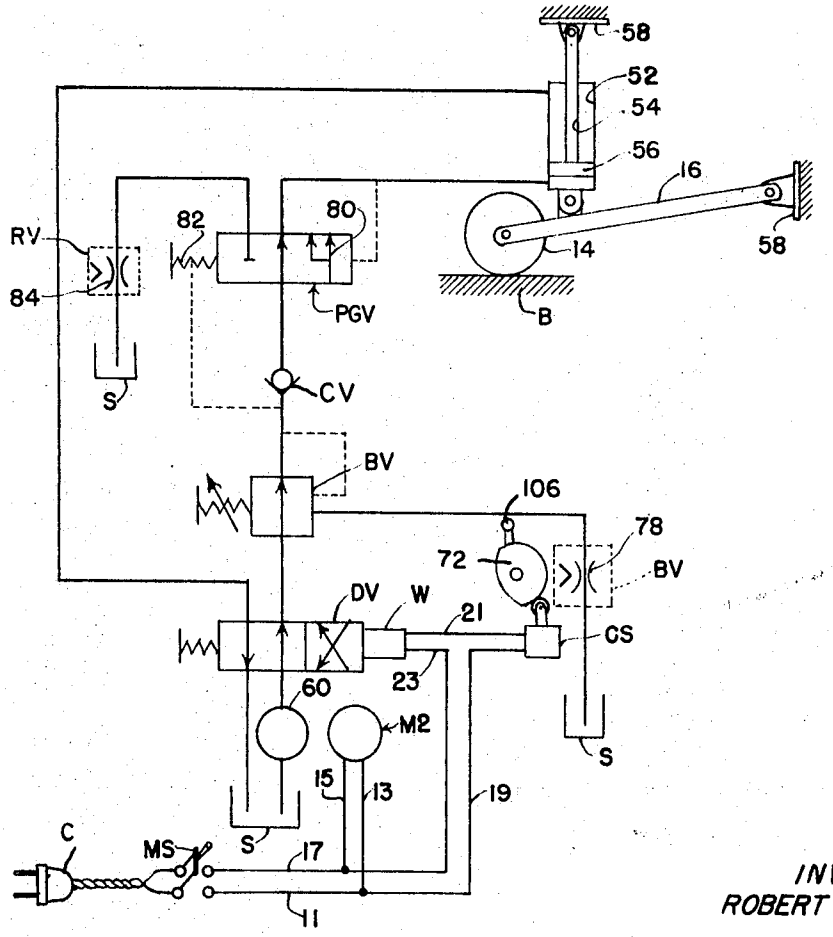


FIG. 7

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PRESSURE CONTROL SYSTEM FOR A GRINDING MACHINE AND ACTUATING UNIT THEREFOR

The present invention relates to a grinding machine of the type wherein the down-pressure which is applied to the grinding wheel is in the form of hydraulic pressure which is effective against the grinding wheel boom to force the latter downwardly and thus cause the grinding wheel to bear against the work with a contact pressure which is proportional to the applied hydraulic pressure. A grinding machine of this general type is shown and described in and forms the subject matter of U.S. Pat. No. 3,253,368, granted on May 31, 1966 and entitled "Surface Conditioning Grinding Machine." The invention is applicable to a wide variety of grinding machines which employ hydraulic pressure for pressing the grinding wheels against the work, but in the development thereof, its principles were specifically adapted to the grinding machine of the aforementioned patent and, accordingly, for exemplary purposes herein, the invention is disclosed in the accompanying drawings and described in this specification as being operatively associated with such machine for grinding wheel pressure control purposes.

In the grinding machine of aforementioned U.S. Pat. No. 3,253,368, as well as in various other grinding machines wherein the down-pressure of the grinding wheel on the work is effected by fluid pressure, such pressure is substantially constant, at least during any given grinding operation, as, for example, during the surfacing of a particular steel billet or the like. The actual contact pressure which is maintained on the billet by the grinding wheel is a combination of two factors, namely, a gravitational force which is incident to the combined weight of the boom and the grinding wheel on the boom, and the hydraulic force which is applied to the boom in a downward direction. Except for the provision of an adjustable pressure regulating valve which determines the fluid pressure in the hydraulic system and against the boom and ordinarily is regulated prior to any given grinding operation, no means is provided for readily altering the down-pressure on the grinding wheel during actual grinding of a billet or other work. Although it is possible for a second operator to effect a change in the setting of the pressure regulating valve under the direction of the operator of the grinding wheel, such a procedure is not altogether satisfactory since there frequently is a need for an instantaneous pressure change when grinding the surface of a given billet. Even if the pressure regulating valve were to be positioned within reach of the grinding machine operator, the effect of a conventional pressure regulating valve is not rapid enough to produce the desired change in pressure of the grinding wheel in time to take effect on the particular location on the surface of the billet being ground where the greater or lesser pressure is to be applied, especially during a rapid traverse of the billet by the grinding wheel. Furthermore, the manual control knob, dial or other pressure regulating element which is ordinarily associated with a conventional pressure regulator is not sensitive enough that the operator may ascertain the necessary degree of manipulation which is required to produce the desired pressure change.

The pressure control system of the present invention embodies a regulable pressure bleeder valve which is capable of adjustment on the part of the operator of the grinding machine and by means of which a limited portion of the hydraulic pressure which is applied to the grinding wheel by way of the usual directional valve and boom cylinder may instantaneously be bled to the atmosphere or sump and at a rate commensurate with the desired down-pressure which is to be maintained by the grinding wheel on the billet or other work being conditioned or ground. The effect of thus bleeding the applied pressure is substantially instantaneous throughout the hydraulic system so that any adjustment of the pressure bleeding valve is effective immediately to reduce the down-pressure of the grinding wheel. Conversely, a reduction in the bleeding effect of the pressure regulating valve is substantially instantaneously translated into an increase in the down-pressure on the grinding wheel.

The present invention further embodies a novel control unit the function of which is initially to actuate both the usual directional valve by means of which fluid is supplied to the boom cylinder and the pressure bleeder valve. Such unit is electrically connected to the solenoid-actuated directional valve and is hydraulically connected to the pressure bleeder valve. The unit is provided with a relatively long control lever having a control knob at its distal end so that the throw of the lever may be regulated within very fine limits. The lever is spring-biased to a retracted position and the unit is positioned in front of the operator of the grinding machine and on the control panel thereof so that operation of the lever is effected by the simple expedient of pulling or swinging the lever rearwardly. After the lever has been thus advanced through a small angle, an internal cam serves to close the contacts which are associated with a control switch, such closure of the contacts serving to establish an electric circuit through the solenoid winding of the directional valve which supplies fluid under pressure to the boom cylinder for forcing the boom downwardly to apply pressure to the billet by the grinding wheel. Thereafter, further rearward movement of the control lever maintains the contacts of the limit switch in their closed condition and, as a consequence, maintains the directional valve energized. The same cam which actuates the limit switch also progressively actuates the pressure bleeder valve, the advancing forward movements of the lever serving progressively to increase the size of the bleeder valve orifice, thus increasing the bleeding effect and progressively reducing the down-pressure of the grinding wheel. The maximum throw of the control lever is on the order of 100° and, because the lever has a relatively long effective extent, the operator is afforded relatively wide increments of adjustment to effect small increments of pressure bleeding. After a small amount of experience, a competent operator is able to manipulate the lever by his sense of feeling and without visualization thereof so as to attain a desired grinding wheel pressure against the billet within very fine limits.

The provision of a pressure control system and actuating unit therefor such as has briefly been outlined above constitutes the principle object of the present invention.

The provision for a pressure bleeder valve of an actuating unit which is extremely simple in its construction and may, therefore, be manufactured at a relatively low cost; one which is rugged and durable and, therefore, will withstand rough usage; one which is comprised of a minimum number of parts, especially moving parts and, therefore, is unlikely to get out of order; one which is capable of ease of assembly and dismantlement for purposes of inspection of parts, replacement or repair thereof; one which is smooth and silent in its operation; one which when unattended either by accident or purposely will result in a raising of the grinding wheel from the billet or other work undergoing grinding; and one which, otherwise, is well adapted to perform the services required of it, are further desirable features which have been borne in mind in the production and development of the present invention.

Other objects of the invention and the various advantages and characteristics of the present control system and actuating unit therefor will be apparent from a consideration of the following detailed description.

The invention consists in the several novel features which are hereinafter set forth and are more particularly defined by claims at the conclusion hereof.

In the accompanying three sheets of drawings forming a part of this specification, one illustrative embodiment of the invention is shown.

In these drawings:

FIG. 1 is a front perspective view of a grinding machine having applied thereto a pressure control system and actuating unit embodying the machine being shown in operation upon a steel billet;

FIG. 2 is an enlarged top plan view of a pressure bleeding valve actuating unit which is employed in connection with the present invention, a portion of the unit casing being broken

away in order more clearly to reveal the nature of the associated valve control mechanism;

FIG. 3 is a side elevational view of the unit with a portion of the unit casing removed in the interest of clarity;

FIG. 4 is a front elevational view of the unit with a portion of the unit casing removed;

FIG. 5 is an enlarged sectional view taken on the line 5—5 of FIG. 3;

FIG. 6 is an enlarged rear perspective view of the actuating unit with a portion of the unit casing broken away; and

FIG. 7 is a combined electric and hydraulic circuit diagram of the improved pressure control system.

Referring now to the drawings in detail and in particular to FIG. 1 wherein an exemplary form of grinding machine which is capable of accommodating the pressure control system of the present invention is shown, this machine is designated in its entirety by the reference numeral 10 and is of the type which is shown and described in aforementioned U.S. Pat. No. 3,253,368. The disclosure of the grinding machine 10 is somewhat schematic in its representation, the illustration of FIG. 1 being made with a view toward establishing an exemplary environment for the present control system and, therefore, many of the details of the grinding machine which bear no relation to the invention have purposely been omitted. For a full understanding of the operation of the machine 10, reference may be had to said U.S. Pat. No. 3,253,268.

The grinding machine 10 is shown in FIG. 1 as being in operation upon the upper surface of a steel billet B which is operatively supported upon a suitable pallet structure 12. Said grinding machine employs a single grinding wheel 14 which preferably but not necessarily rotates about a horizontal axis extending parallel to the longitudinal axis of the billet B and is carried at the forward or outer end of a boom 16. The latter is mounted on a boom housing 18 to which there is secured a motor carriage 20 which supports an electric motor M. Said motor operates through a speed reducing transmission 22 to drive the grinding wheel 14 by means of a belt and pulley connection 24. The boom housing 18 is pivoted at its medial regions for rocking movement in a fore-and-aft direction on a shaft 26 which is carried by a boom carriage 30. The latter is in the form of an H-shaped casting which is slidable in a fore-and-aft direction on two spaced apart horizontally extending guide rails 32 certain portions of which overlie and are spaced above the billet supporting pallet structure 12. The guide rails 32 have their front ends supported on a tail stock carriage 34 which travels on a fixedly mounted, horizontally extending, elevated rail 36. The rear ends of the guide rails 32 are supported on the upper region of a machine base assembly 40 which travels on a pair of spaced apart, horizontal rails 42 and is driven by a reversible combined hydraulic motor and gear reduction device 44, the latter being supplied with fluid from a pump 46. The machine base assembly 40 embodies an operator's control cab 48 within which there is disposed a control panel 50 having manually operated control instrumentalities by means of which the above-mentioned traction drive instrumentalities for the machine base assembly 40 may be actuated in order selectively to move the same in either direction along the rails 42, and also by means of which various other grinding machine functions may be controlled.

In order to impart tilting movements to the boom housing 18 for the purpose of raising and lowering the grinding wheel 14 from the billet B undergoing grinding or conditioning, an hydraulic boom cylinder 52 is pivotally connected to the forward end of the boom 16. An upstanding plunger 54 carrying a piston 56 (see FIG. 7) at its lower end projects upwardly from the upper end of the cylinder and is pivoted to a horizontal crosshead 58 on the boom carriage 30. Operating fluid is adapted to be selectively applied to the opposite ends of the cylinder 52 from a pump 60 (see also FIG. 7) which is driven by a reversible electric motor M2, the pump and motor being mounted on a platform 59 which is carried by the crosshead 58. When fluid under pressure is supplied to the lower end of the cylinder 52 so as to extend the cylinder downwardly, the boom housing 18 will be swung bodily as a unit in one direction to lower the grinding wheel 14. Conversely, when pressure fluid is supplied to the upper end of the cylinder 52 so as to retract the cylinder upwardly, the boom housing 18 will be swung in the opposite direction to raise the grinding wheel. The means for selectively supplying fluid to the boom cylinder 52 to effect such swinging movements of the boom housing and for bleeding the pressure of fluid supplied to the cylinder during down-pressure of the grinding wheel on the billet B constitutes the subject matter of the present invention and will be described in detail presently.

The fore-and-aft movements of the boom carriage 30 are effected under the control of two hydraulic cylinders 62 which are secured to and move with said boom carriage. Fluid under pressure for operating the cylinders 62 is supplied by the previously mentioned pump 60 which also supplies pressure fluid for actuating the boom cylinder 52 as previously described. Hydraulic mechanism is provided for the selective admission of fluid under pressure to the opposite ends of the cylinders 62 for actuating the same, such mechanism bearing no relation to the present invention and consequently being not illustrated herein, it being sufficient to state that such mechanism is operated under the control of certain of the previously mentioned manually operated control instrumentalities on the control panel 50. Various other operating mechanisms and control devices for effecting certain grinding machine functions appear in FIG. 1 but have not been described herein since they likewise bear no relation to the present invention.

It will be understood that during the grinding operation on a given billet B, the operator in the cab 48 is able to traverse the billet with the grinding wheel 14 in a longitudinal direction by causing the machine base assembly 40 to travel on the rails 42, the grinding wheel to move over the upper surface of the billet in a longitudinal direction. By selectively supplying pressure fluid to the cylinders 62, the grinding wheel 14 may be brought into register with any selected transverse region of the billet. The attainment of a desired grinding pressure of the grinding wheel 14 upon the upper surface of a billet B is effected by causing energization of the motor M2 so as to actuate the pump 60 and thereafter causing the fluid under pressure which is generated by the pump to be conducted to the cylinder 52 while simultaneously bleeding such fluid to the atmosphere or a sump at a selected rate of bleeding, all in a manner that will now be set forth in detail.

In FIG. 7, the electric and hydraulic circuitry by means of which the grinding pressure of the grinding wheel on the billet B is attained is disclosed and the functioning of the electric and hydraulic instrumentalities is effected under the control of a single actuating unit 70, the details of which are illustrated in FIGS. 2 to 6, inclusive. The actuating unit 70 will be described in detail subsequently but for purposes of discussion of the circuit diagram of FIG. 7, it is deemed sufficient to state that this actuating unit embodies a manually operable cam 72 which is yieldingly biased by means of a helical tension spring 74 to the retracted position in which it is shown in full lines in FIGS. 3 and 7. Said cam is capable of being shifted in a clockwise direction as viewed in FIGS. 3 and 7 from such retracted position to a fully advanced position. A manually operable control lever 76 is provided for manually actuating the cam 72. After a short initial idle movement of the cam 72, a control switch CS is actuated to cause energization of a solenoid-actuated directional valve DV which then directs pressure fluid to the boom cylinder 52 from the pump 60 thus causing lowering of the boom 16 and its associated grinding wheel 14 to the end that sand grinding wheel contacts the billet B. At the time of initial actuation of the switch CS and consequent energization of the solenoid-actuated directional valve DV, a bleeder valve BV in associated relation with the actuating unit 70 has its orifice opening 78 (see FIG. 5) fully opened and serves to bleed the applied pressure fluid in the boom cylinder to such an extent that a predetermined minimum pressure on the billet B is maintained by the grinding wheel 14. Further movement of

the cam 72 serves to maintain the directional valve DV energized, while at the same time the bleeder valve BV progressively decreases the size of its orifice opening so that the pressure of fluid under pressure acting on the grinding wheel is progressively increased from the minimum pressure to a maximum pressure for which the bleeder valve BV is predeterminedly set.

Specifically, and with reference to FIG. 7, upon closure of a master switch MS, an electric circuit is established for the motor M2, this circuit extending from a suitable electrical source C which may be a commercial power line, through the master switch MS, leads 11, 13, the motor M2, leads 15 and 17, and the master switch MS, back to the aforementioned electrical source C. Energization of the motor M2 serves continuously to drive the pump 60.

Upon actuation of the control switch CS by the cam 72, an electric circuit is established so as to actuate the directional valve DV, this circuit extending from the current source C, through the master switch MS, the lead 11, a lead 19, the switch CS, a lead 21, the solenoid winding *w* of the directional valve DV, a lead 23, the lead 17 and the master switch MS, back to the electrical source C. Energization of the winding *w* actuates the directional valve DV so that hydraulic fluid flows from the sump S, through the pump 60, the bleeder valve BV, a check valve CV, a pressure grading valve PGV into the lower end of the cylinder 52, thus forcible moving the latter downwardly and applying pressure to the boom 16 so as to cause the grinding wheel 14 to be forced against the billet B. At this time, the orifice 78 of the bleeder valve BV is at its maximum opening as previously set forth so that the pressure maintained by the grinding wheel 14 on the billet B is at its minimum.

As the cam 72 is turned in a clockwise direction as viewed in FIGS. 3 and 7 by pulling the control lever 76 toward the operator of the grinding machine, the orifice opening 78 is proportionately decreased, thus resulting in a gradual decrease of the bleeding action and a consequent gradual increase in the pressure of fluid in the lower region of the cylinder 52. By the time that the cam 72 has attained its fully advanced position, the orifice opening 78 of the bleeder valve BV is at its minimum and the bleeding action is such that maximum fluid pressure is maintained in the lower region of the cylinder 52 while the grinding wheel 14 is caused to bear against the billet with maximum grinding pressure.

By means of the electric and hydraulic circuitry which is shown in FIG. 7 and described above, the operator of the grinding machine may, by proper manipulation of the control lever 76, cause the grinding wheel 14 to exert varying grinding pressure upon the billet B during any given traverse of the wheel longitudinally over the billet. During spot grinding operations as explained in aforementioned U.S. Pat. No. 3,253,368, the necessary initial heavy pressure, followed by increasingly lighter pressures, may be applied to any given area of the billet undergoing treatment, lighter pressures being attained by moving the control lever 76 away from the operator (counterclockwise as viewed in FIGS. 3 and 7) and heavier pressures being attained by moving the lever in the reverse direction (clockwise as viewed in FIGS. 3 and 7). If at any time the operator releases the control lever 76, The tension spring 74 will restore the cam 72 to its retracted position wherein the control switch CS is disengaged from the cam 72 and the circuit for the solenoid winding of the solenoid-actuated directional valve DV is deenergized, so that the directional valve DV is shifted to its normal position wherein the upper end of the cylinder 52 is bled to the sump S and substantially full pump pressure is applied to the upper end of the cylinder. Under such a condition, consequent upward movement of the cylinder 52 will restore the boom 16 and the grinding wheel 14 to their raised positions.

The pressure grading valve PGV is provided for the purpose of allowing the grinding wheel 14 to follow the contour of the upper surface of a billet B undergoing grinding in the event that such surface is not truly planar, as, for example, when the surface is of an undulatory nature or character. The valve PGV is provided with a piston slide 80 which is biased by way of a helical spring 82, the valve being so disposed that in its normal position it conducts fluid under pressure from the check valve CV into the lower end of the cylinder 52. At such time as a marked increase in the pressure occurs in the lower end of the cylinder due to upward movement of the grinding wheel 14 and the boom 16 when the former rides upwardly on a given undulation in the upper surface of the billet B, the position of the piston slide 80 is changed so that a portion of the pressure is discharged to the sump S through a regulating valve RV having a manually controlled valve orifice 84. The function of the pressure grading valve PGV and the regulating valve RV, therefore, is, broadly speaking, to maintain a substantially constant down-pressure on the grinding wheel 14 commensurate with the position of the control lever 76 of the actuating unit 70 despite the presence of undulations in the upper surface of the billet being ground or conditioned. In the operation of the pressure grading valve PGV, as soon as a given undulation has been traversed by the grinding wheel 14 and the latter is restored to its normal level, the piston slide 80 of the valve PGV is returned to its normal position by means of the spring 82.

Considering now the mechanical organization of the actuating unit 70, and referring to FIGS. 2 to 6, inclusive, this unit embodies a flat rectangular baseplate 100 having corner bolt holes 102 by means of which it may be fixedly secured by bolts such as are indicated at 104 in FIGS. 2, 3 and 4 to the control panel 50 (see FIG. 1) in such a manner that the aforementioned control lever 76 assumes a position remote from the operator of the grinding machine and is capable of being pulled toward the operator to effect progressive narrowing of the valve orifice 78 (see FIGS. 5 and 7). To facilitate manipulation of the control lever 76, a knob 106 is disposed on the outer or distal end of said lever.

A reinforcing plate 108 overlies the base plate 100 and is secured in position thereon by screws 110. An inverted cup-shaped housing 112 having front and rear walls 114 and 116 and an arched top wall 118 which may be integrally formed with the walls 114 and 116, is further provided with side walls 120 and 122. The lower edge regions of the various walls 114, 116, 120 and 122 4The secured by screws 124 to the sides of the plate 108, the latter plate constituting a bottom wall for the housing 112. The aforementioned control switch CS is secured in an opening 126 in the plate 108 and the lower region thereof projects through aligned openings 128 and 130 (see FIG. 3) in the plate 108 and the panel 50, respectively. The control switch CS is provided with a vertically slidable, depressible, contact-actuating plunger 132 which carries at its upper end a roller 134. The latter is normally disposed in the path of movement in the aforementioned cam 72 for actuation thereby as will be described in detail presently. A medially disposed, vertically extending, partition wall 140 extends transversely between the front and rear walls 114, 116 of the housing as best seen in FIG. 2 and serves to support one end of a hollow, horizontally extending rock shaft 142, the shaft being provided at its inner end with a thickened hub portion 144 (see FIG. 5) which is rotatably mounted in a bearing opening 146 in the partition wall 140. The outer end of the rock shaft is rotatably disposed in a bearing opening 148 in the side wall 120 of the housing 112. The rim of the outer end of the hollow rock shaft 142 has formed therein an annular series of adjusting slots 150 the function of which will be set forth presently.

The cam 72 is operatively mounted on the rock shaft 142 and is fixedly secured thereto for movement bodily therewith by means of a set screw 152 which is disposed in a threaded radial bore 154 in said cam. The latter is in the form of a relatively thick flat platelike member having an arcuate cam surface 156 of uniform curvature, and a flat surface 158. The control lever 76 has its proximate end threadedly received in a socket 160 in the cam 72, and this lever projects outwardly of the housing 112 through an arcuate clearance slot 162 in the

arched top wall 118, as well as in a portion of the front wall 114 of the housing 112. The cam 72 is further provided with a contact edge 166 which is designed for contact with a limit stop in the form of a bolt 168. The latter is carried by the partition wall 140 of the housing 112. The helical tension spring 74 which normally maintains the cam 72 in its retracted position has one end thereof anchored on a cross rod 169 and has its other end secured to a transverse pin 171 on the cam 72. The cross rod 169 extends horizontally and has its ends disposed in holes in the housing walls 120 and 140 and also provided with nuts in order to hold it in place and against lateral displacement.

The thickened hub portion 144 of the rock shaft 142 is provided with an axially disposed, noncircular opening 170 and thus receives the correspondingly shaped or flattened end portion 172 of a rotatable valve stem 174 which is associated with and forms a part of the aforementioned bleeder valve BV. This bleeder valve is shown in detail in FIG. 5 and it involves in its general organization a valve body 175 which is of generally T-shaped design and has a fluid inlet leg 178 and a fluid outlet leg 180 in alignment therewith. The two legs communicate with each other internally of the valve body 176 through a valve seat 182 which, in combination with a valve needle 184 on the adjacent end of the valve stem 174, defines the aforementioned adjustable orifice 78 (see FIG. 7). The medial region of the valve stem 174 is threadedly received as at 179 in a third leg 185 of the valve body 176 of the bleeder valve BV. The rotatable valve stem 174 projects through a conventional packing gland 186 in the leg 185 of the valve body 176, and the bleeder valve BV as a unit is fixedly mounted on the sidewall 122 of the housing 112 by an assembly 188 which comprises a nut and also a pair of washers on opposite sides of a mounting plate 190, the latter being secured by screws 192 to the sidewall 122. The packing gland 186 is held in place by way of a nut 189 on the third housing leg 185. A conventional nipple fitting 194 connects the housing leg 178 to a fluid line leading to the pressure side of the pump 60 and a conventional nipple fitting 196 connects the outlet leg 180 to the pressure grading valve PGV, in the manner and for the purpose heretofore set forth in connection with the circuit diagram of FIG. 7.

In the operation of the grinding machine 10 and with the bleeder valve BV operatively connected to the pump 60 and the pressure grading valve PGV as previously described, the flat clearance surface 158 of the cam 72 (see FIG. 3) normally opposes but does not engage the roller 134 of the control switch CS inasmuch as the helical tension spring 174 serves to maintain the cam in its retracted position. At such time the grinding wheel 14 remains elevated above the level of the billet B. After the operator has brought the machine base assembly 40 and the tail stock carriage 34 to a position wherein the grinding wheel is in proper register with the billet, and at the desired location for commencement of grinding operations, the control lever 76 of the actuating unit 70 is pulled rearwardly towards the operator and positioned at an angle which, from previous experience, the operator has found will yield a desirable and normal grinding pressure for the grinding wheel on the upper surface of the billet B. Assuming for purposes of description that such a position of the control lever 76 is one wherein the lever projects radially outwardly through the slot 162 (see FIG. 3) at the midpoint of the latter, the consequent rotational movement of the cam 72 and the valve stem 174 will have positioned the valve needle 184 (see FIG. 5) so that the valve orifice 78 will yield a bleeding action through the bleeder valve BV which is adequate to reduce the otherwise excessive grinding pressure in the lower end of the cylinder 52 and also to attain the desired normal grinding pressure. It will be understood that during this pulling of the control lever 76 to its midposition in the slot 162, the clearance between the roller 134 of the control switch CS and the flat surface 158 on the cam 72 will have initially been taken up and the roller will have moved onto the arcuate cam surface 156 of the cam, thus causing the contacts of the limit switch to become closed so as to energize the electric circuit for the winding *w* of the directional valve DV which is disposed in the circuit in series with the control switch CS as previously described. Energization of the directional valve DV directs fluid under pressure to the lower end of the cylinder as likewise described. The extent of the bleeding action of the bleeder valve BV is, of course, a function of the size of the orifice 78 which, in turn, is a function of the position of the control lever 76. As previously stated, with the lever in its midposition, the size of the orifice 78 is such that precisely the correct rate of cylinder bleeding will take place to maintain the pressure of fluid in the lower end of the cylinder 52 constant and at the optimum pressure for normal billet grinding. While maintaining the control lever 76 thus positioned, the operator may effect the necessary traverse operations to effect progressive grinding of the entire upper surface of the billet. If the grinding machine is equipped with automatic traverse facilities, it is merely necessary for the operator to maintain the control lever 76 in its midposition and the carriage movements will be such as eventually to complete the grinding of the entire upper surface of the billet B without further attention on his part.

The fact that the upper surface of the billet B may be of an undulatory nature requires no change in the setting of the control lever 76 inasmuch as the previously described pressure grading valve PGV will function as previously set forth to shift the piston slide 80 to the left as viewed in FIG. 7 each time an automatic pressure increase is encountered in the lower end of the cylinder 52 due to the upward movement of the grinding wheel 14 as the wheel enters a region of raised billet surface elevation. Under such circumstances, a constant grinding wheel pressure will be maintained against the billet. However, if a particular billet has been marked at the spotting station prior to presentation to the grinding machine, the operator, upon encountering the crest region of a given undulation, may shift the control lever 76 in a rearward direction, thereby decreasing the size of the orifice opening 78 and thereby decrease the bleeding action of the bleeder valve BV and increase the pressure in the lower end of the boom cylinder 52 to the end that a more efficient grinding pressure on the raised surface of the billet will be attained. Conversely, if during a given traverse of the billet by the grinding wheel 14, a soft spot or region is encountered, the operator may shift the position of the control lever 76 forwardly to decrease the size of the orifice 78 and thereby increase the bleeding action of the bleeder valve BV, thus attaining a lighter grinding pressure of the grinding wheel on the surface of the billet B. Manipulation of the control handle 76 of the actuating unit 70 will be found particularly useful in connection with spot grinding operations inasmuch as during the oscillatory movement of the grinding wheel in the vicinity of a given area of the upper surface of the billet as described in previously mentioned U.S. Pat. No. 3,253,368, an optimum grinding pressure of the grinding wheel on the billet during grinding wheel oscillation may be maintained at the discretion of the operator by shifting the control lever 76 in one direction or the other.

The biasing spring 74 not only maintains the control lever 76 in its retracted position with the cam 72 out of contact with the roller 134 of the control switch CS so that the grinding machine cannot be left in operation if the operator leaves the cab 48, but it also functions in the manner of a "dead man's stick" to terminate operation of the grinding machine in the event that the operator becomes incapacitated due to an accident or for any other reason.

The invention is not to be limited to the exact arrangement of parts shown in the accompanying drawings or described in this specification as various changes in the details of construction may be resorted to without departing from the spirit or scope of the invention. For example, if desired the pressure grading valve PGV may be omitted and the bleeder valve BV connected directly to the cylinder 52.

Having thus described the invention what I claim as new and desire to secure by Letters Patent is:

1. In an actuating unit of the character described, in combination, a housing having a bottom wall, a rear wall, a front wall, upstanding sidewalls, a top wall, and a partition wall extending between said front and rear walls, a horizontally disposed rock shaft projecting between said partition wall and one of the side walls and rotatably journaled therein, a cam secured to said rock shaft and confined between said partition wall and said one sidewall, said top wall being formed with a slot therein, a control lever projecting radially outwardly from said cam and extending through said slot for manipulation exteriorly of the housing, a fluid valve mounted on the other sidewall and having a valve body establishing a pair of communicating legs which are disposed exteriorly of the housing and a third leg which projects through the other sidewall, a valve seat defining a valve orifice through which the legs of said pair of legs communicate, a valve stem threadedly disposed within said third leg for movement toward and away from said seat upon rotation of the stem in opposite directions to vary the effective size of said orifice, said stem projecting inwardly of the housing and being coaxial with said rock shaft, means establishing a driving connection between the rock shaft and the valve stem whereby rotational movement of the rock shaft in either direction will effect corresponding turning movements of said stem, said cam being provided with an arcuate cam surface thereon, and a control switch having a depressible

actuating plunger positioned in the path of movement of said arcuate cam surface, said cam and rock shaft being movable between a fully retracted position wherein said valve orifice is of maximum size and said cam surface is out of engagement with said plunger, and a fully advanced position wherein the valve orifice is of minimum size and the actuating plunger is engaged and depressed by said cam surface.

2. In an actuating unit of the character described, the combination set forth in claim 1 and wherein said cam is formed with a clearance surface thereon which is effective to maintain the cam surface out of engagement with said plunger until the cam has been moved from its fully retracted position toward its advanced position throughout a small angular extent of turning movement.

3. In an actuating unit of the character described, the combination set forth in claim 2 and including, additionally, spring means yieldingly biasing said cam and rock shaft toward their fully retracted positions.

4. In an actuating unit of the character described, the combination set forth in claim 3 and wherein said cam is capable of rotational adjustment with respect to the rock shaft and is secured thereto in adjusted relationship by a set screw which projects radially through the cam.