United States Patent

[11] 3,608,930

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[21] Appl. No. **859,755**
[22] Filed **Sept. 22, 1969**
[45] Patented **Sept. 28, 1971**

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[32] Priority **Apr. 15, 1969**
[33] **France**
[31] **6911555**

[54] **HYDRAULIC CLAMPING APPARATUS FOR A SIDE-SHIFTABLE MECHANICAL DIGGER**
32 Claims, 6 Drawing Figs.

[52] **U.S. Cl.** ..... **280/456,** 214/138 C, 172/274, 37/103
[51] **Int. Cl.** **B60d 1/00**
[50] **Field of Search** 280/456; 172/274; 37/103; 214/138

[56] **References Cited**

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ABSTRACT: A mechanical digger support assembly has a boom-supporting slide frame mounted for transverse sliding on a tractor-supported, transverse main frame and hydraulically applied clamping apparatus are provided for securing the slide frame against movement at selected positions along the main frame.

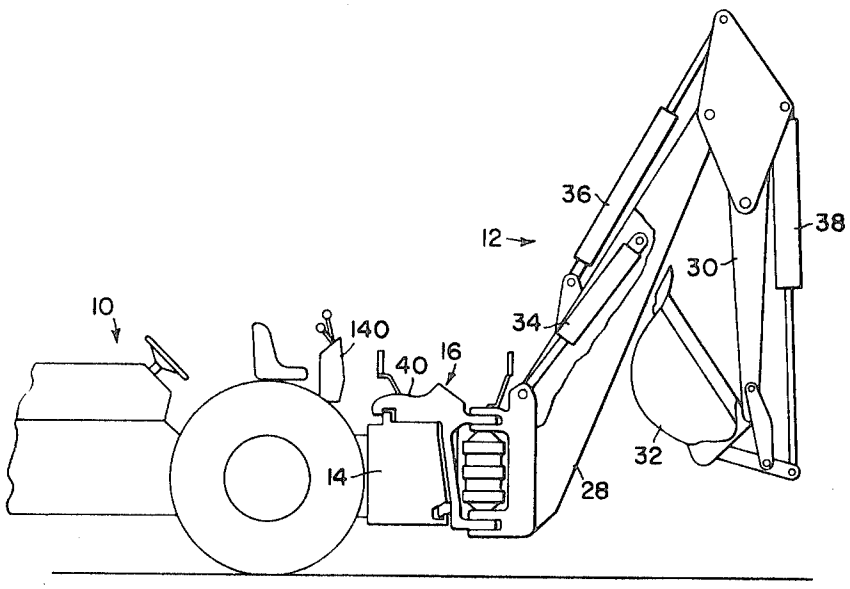
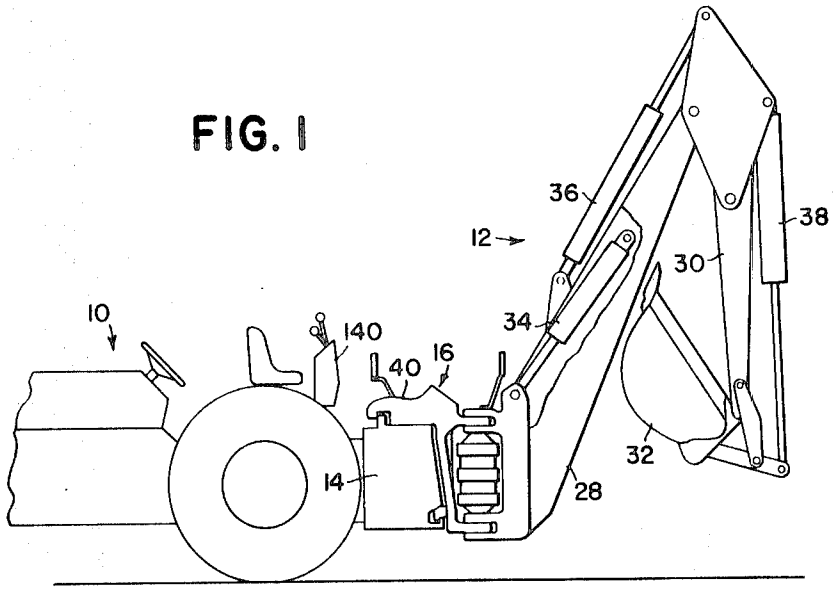


FIG. 1



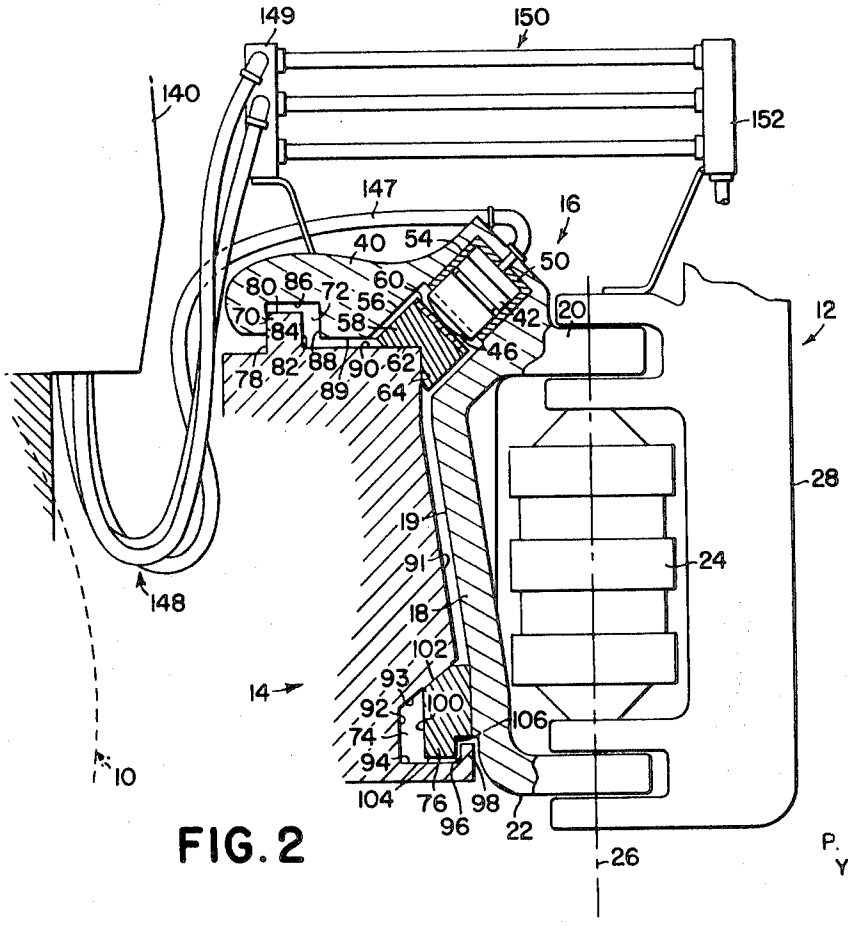


FIG. 2

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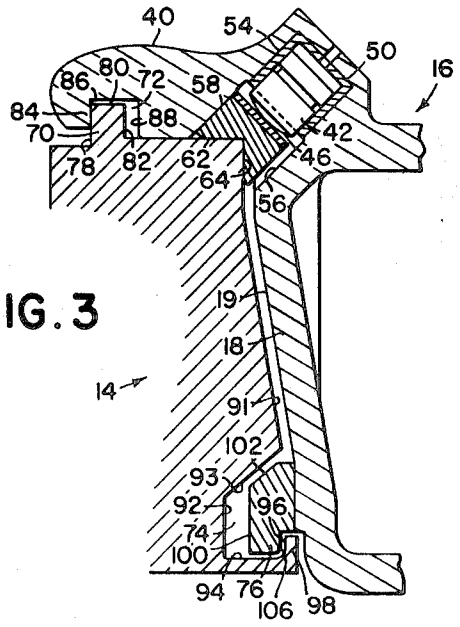

FIG. 3

FIG. 4

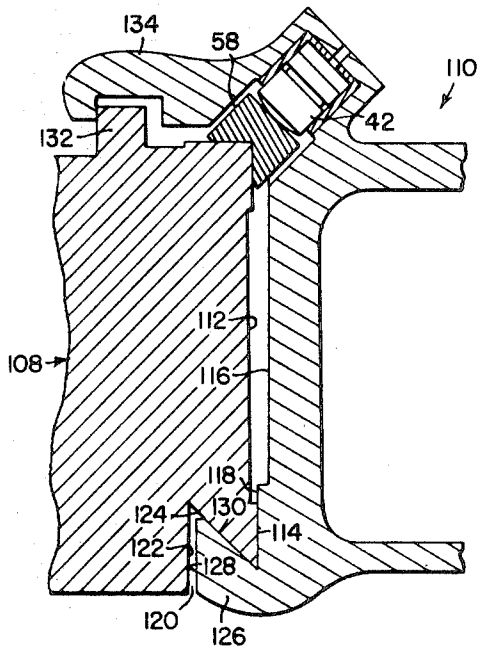

FIG. 5

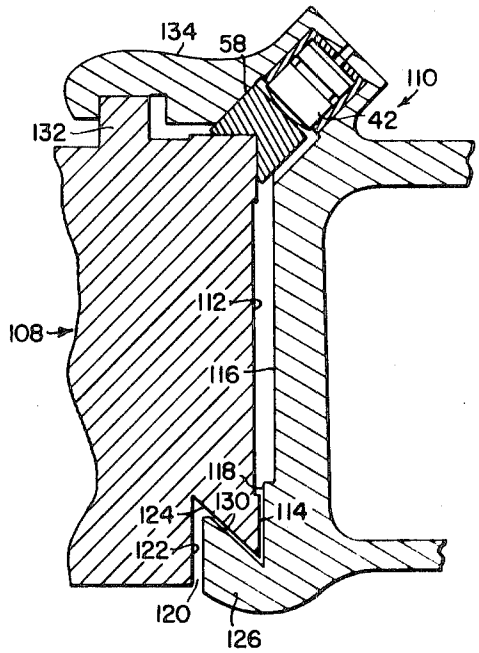

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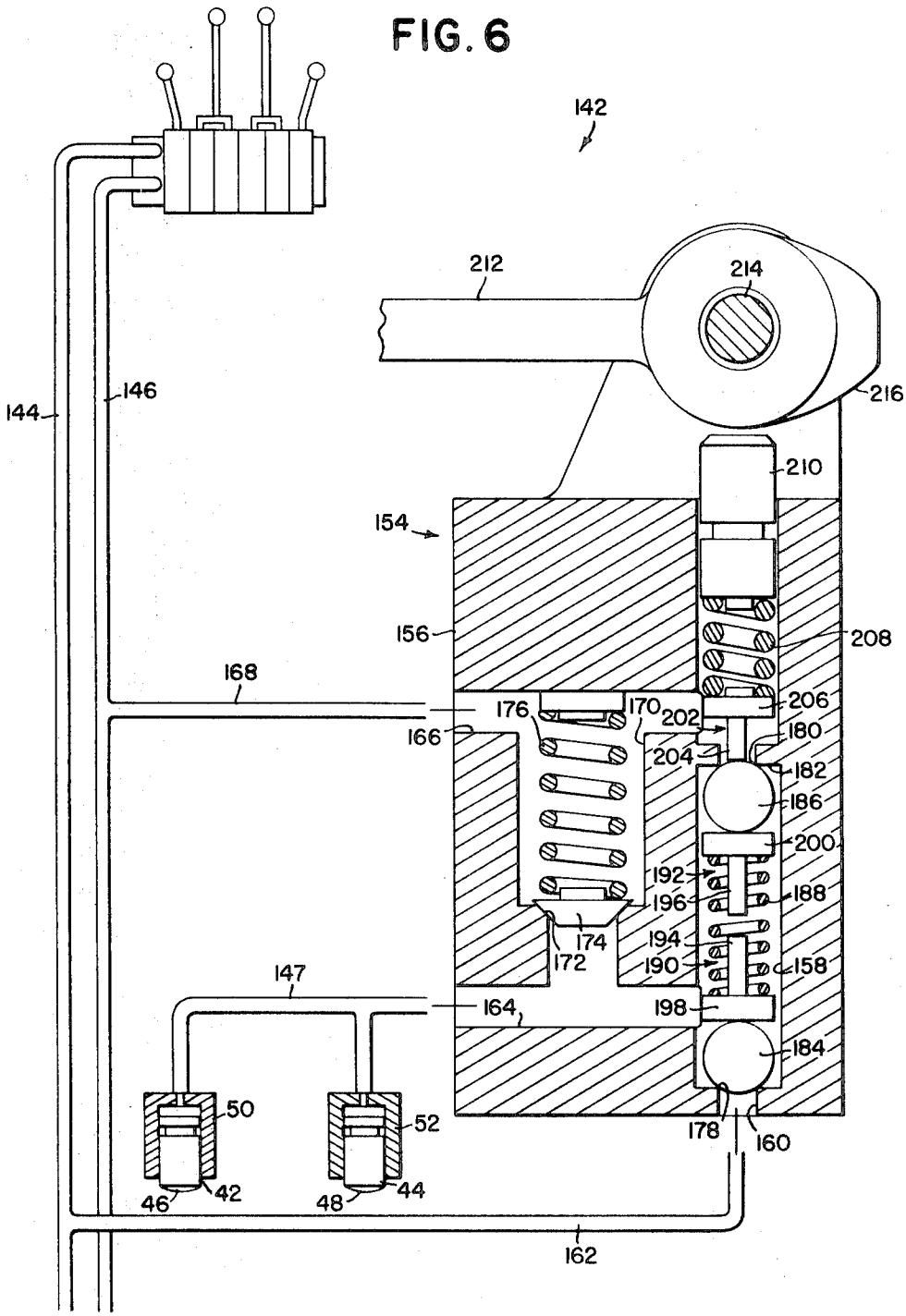
FIG. 6



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HYDRAULIC CLAMPING APPARATUS FOR A SIDE-SHIFTABLE MECHANICAL DIGGER

BACKGROUND OF THE INVENTION

This invention relates to clamping apparatus and more specifically relates to clamping apparatus embodied in 9 side-shiftable mechanical digger or backhoe.

Such mechanical diggers ordinarily have a rigid upright main frame which can be attached to the rear of a mobile vehicle, such as a tractor, in a position transverse to the longitudinal central plane of the vehicle. The frame carries a boom for supporting the digging implement and the inner end of the boom is pivoted to an upright swivel post or swing cylinder carried by a slide frame mounted on the frame. The mechanical digger is generally operated by hydraulic actuators which are connected to and pressurized by the hydraulic system of the vehicle.

In order to operate the boom and digging implement in such a manner as to work closely alongside an obstruction, such as a foundation or a structural frame, the slide frame may be mounted for movement along guide means, which form an integral part of the main frame, so that the swivel post or swing cylinder may be moved to selected positions along the frame. It is of course necessary to lock the slide frame to the main frame to prevent sliding during operation and for this purpose it is known to provide hydraulically applied clamping means (see French Pat. No. 1,330,860 to Faucheux and U.S. Pat. No. 3,405,823 to Williams In these known clamping means, a clamping block is connected directly to a piston carried by the slide frame and the piston is hydraulically shiftable to apply the block against the main frame. Thus, forces tending to shift the slide frame act through the clamping block crosswise to the axis of the piston and such forces are undesirable. Also, it has been found that the overall main frame and slide frame configurations of these known mechanical diggers do not permit fluid hose placements allowing unobstructed transverse displacement of the slide frame. Neither do they allow the main frame to be mounted closely to the rear axle of the supporting vehicle so as to reduce the moment arm tending to rotate the vehicle about its rear support wheels.

SUMMARY OF THE INVENTION

According to the present invention, there is provided improved clamping apparatus for a side-shiftable mechanical digger.

An object of the invention is to provide a clamping block which is applied by a hydraulically actuated piston which acts through an intermediate bearing plate.

Another object of the invention is to arrange the piston and clamping block on the slide frame for action at an angle of approximately 45° to the horizontal.

A further object is to provide respective complementary surfaces for horizontal and vertical clamping in the form of a transverse guide rail on top of the main frame which is received in a recess on the slide frame and a transverse guide groove in the rear of the main frame that receives a projection on the slide frame.

Still a further object is to provide a substantially right-angle corner along the upper rear portion of the main frame and to provide the clamping block with a complementary right-angle recess.

Another object is to provide a control valve for the hydraulic clamping means which may be used with tractors having either open or closed center hydraulic systems.

These and other objects will become apparent from the following description and accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side view of the tractor-mounted mechanical digger in which the invention is embodied.

FIG. 2 is a sectional view of the main and slide frames clamped together.

FIG. 3 is a view similar to FIG. 2 but showing the main and slide frames in the unclamped condition.

FIG. 4 is a view similar to FIG. 2 but showing a modification of the main and slide frames.

FIG. 5 is a view similar to FIG. 4 but showing the main and slide frames in the unclamped condition.

FIG. 6 is a partial schematic and sectional view of the control circuit and valve for controlling the clamp-applying pistons.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, FIG. 1 shows a tractor 10 which supports, adjacent the rear end thereof, a mechanical digger 12 through means of a transverse main frame 14 and a slide frame 16 supported at the rear of and on the main frame 14.

The slide frame 16 is generally U-shaped and has a web 18 with a forwardly and upwardly inclined front face 19 and respective upper and lower generally horizontal rearwardly extending arms 20, 22 which provide a mounting for a swing cylinder 24 which operates about a vertical axis 26 and to which is connected one end of a digger boom 28. A dipper stick 30 is pivotally connected to the other end of the digger boom 28 and a bucket 32 is pivotally connected to the digger stick 30. Hydraulic actuators 34, 36 and 38 are provided for adjusting the boom, dipper stick and bucket relative to each other.

Integral with the upper forward corner of the web 18 of the slide frame 16 is a forward projection 40 which overlies the main frame 14 and carries a clamping mechanism. The clamping mechanism includes a pair of identical, side-by-side mounted clamp-applying pistons 42 and 44, having spherical ends 46 and 48, respectively, received in a respective cylinder 50 and 52. Only the mounting for the cylinder 50 is shown and it includes a bore 54 inclined upwardly and rearwardly at approximately 45° from the horizontal at the juncture of the projection 40 with the web 18 of the slide frame, the cylinder 50 being tightly received in the bore 54. The bottom of the bore 54 opens into a recess 56 that loosely receives a clamping block 58. The block has a planar upper surface on which lies a bearing plate 60, against which bears the spherical end 46 of the piston 42, the piston 42 being permitted to shift crosswise relative to the bearing plate 60 and the clamping block 58. The lower surface of the clamping block 58 has a right-angle recess 62 which is slidable along and selectively clampable against a right-angle corner 64 which forms a transverse guide at the upper rear of the main frame 14.

The slide frame 16 is retained for sliding along and for clamping engagement with the main frame 14 by means of complementary counterfaces on the respective frames. These counterfaces take the form of a transverse guide rail 70 at the top front of the main frame 14 which is received in a recess 72 in the underside of the projection 40 of the slide frame 16 and a guide groove 74 in the lower rear of the main frame 14 into which is disposed a forward projection 76 of the slide frame 16.

The guide rail 70 is generally rectangular in cross section with forward top and rear surfaces 78, 80 and 82 respectively, which are opposed by forward, top and rear surfaces 84, 86 and 88 of the recess 72. The guide rail 70 and recess 72 are dimensioned such that a horizontal under surface 89 which extends from the recess 56 of the projection 40 to the recess 72 will rest upon a horizontal surface 90 which extends from the corner 64 of the main frame 14 to the guide rail 70, when the clamping block 58 is not applied as shown in FIG. 3. Alternatively, the guide rail 70 and recess 72 may be dimensioned so that the opposed upper surfaces 80 and 86 bear against each other when the clamping block is not applied.

The groove 74 in the main frame 14 is joined to the corner 64 by a rear surface 91 which generally parallels the front surface 19 of the slide frame 16. The groove 74 has a generally vertical front surface 92, a top surface 93 which inclines upwardly at approximately 45° to the horizontal to the rear vertical surface 96 which is in turn the front surface of an upright retainer lip 98 at the groove entrance. The slide frame projec-

tion 76 has a front, top, bottom and rear surfaces 100, 102, 104 and 106 respectively, which are opposed to the like surfaces of the groove. The projection 76 is releasably secured to the web 18 so that the main frame 14 and slide frame 16 can be more easily assembled. This connection can be made by screws (not shown) for example, and, alternatively, the retainer lip 98 may be releasably secured to the main frame 14 in a similar manner.

In a modified form of the invention illustrated in FIGS. 4 and 5, a main frame 108 and a slide frame 110 are shown which are shaped slightly differently and have differently disposed counterfaces at their respective lower rear and lower front portions than the main frame 14 and slide frame 16. Specifically, the main frame 108 has a generally vertical rear surface 112 which merges into a lower vertical bearing pad 114 and the slide frame 110 has a generally vertical front surface 116 which merges into a lower vertical bearing pad 118. A downwardly opening groove 120 at the lower rear corner of the main frame 108 has a vertical front surface 122 which forms an included angle of 45° with a downwardly and rearwardly inclined surface 124, that terminates at the bearing pad 118. The surfaces 122, 124 and the bearing pad 114 form a generally N-shape and a hooklike projection 126 at the bottom corner of the slide frame 110 has an opposed N-shaped outline formed by a vertical front surface 128, a downwardly and rearwardly inclined surface 130 and the bearing pad 118.

The main and slide frames 108 and 110 respectively, have a guide rail 132 and upper forward projection 134 which are similar in construction to the guide rail 70 and projection 40 of the main and slide frames 14 and 16 and no further description is thought necessary.

The various hydraulic functions of the mechanical digger 12 are selectively actuated from a control console or valve housing 140 that is supported on the tractor 10 and covers a valve block 142 to which is connected a feedline 144 and a return line 146. The manner in which fluid is transferred from the valve block 142 to the various functions is by connection means including a fluid hose 147 extending between the valve block 142 and the clamp-applying pistons 42 and 44. A first set of hoses 148 interconnects the valve block 142 with a first manifold block 149 carried by the slide frame 16 and a second set of hoses 150 interconnects the block 149 with a second manifold block 152 carried by the boom 28. Further hoses (not shown) connect the first manifold block 149 with the swing cylinder 24 and the second manifold block 152 with the hydraulic actuators 34, 36 and 38.

The valve block 142 includes a control valve 154 which may be used with either closed or open center hydraulic systems, as is more fully explained in the operation below. The control valve 154 is provided for controlling the clamp-applying pistons 42 and 44, and includes a valve body 156 in which is a valve bore 158 having an inlet 160 to which is connected the feed line 144 via a conduit 162. Axially spaced along and intersecting the valve bore 158 are a supply bore 164, connected to the hose 147, for supplying fluid to the clamp-applying pistons 42 and 44, and an exhaust bore 166, connected to the return line 146 via conduit 168. The supply and exhaust bores 164 and 166, respectively, are interconnected by a bore 170 in which is a valve seat 172 against which a safety or relief valve 174 is biased, by a spring 176, to prevent flow from the supply bore to the exhaust bore.

The valve bore 158 has a first valve seat 178 at the inlet 160. A second valve seat 180 is defined by an annular shoulder 182 upstream from the intersection with the exhaust bore 166. A pair of spherical check valves 184 and 186 are oppositely biased against the seats 178 and 180, respectively, by a spring 188. Pistons 190 and 192 have respective stems 194 and 196, encircled by the spring 188, and head ends 198 and 200 against which the opposite ends of the spring 188 are seated.

To exhaust fluid pressurizing the pistons 42 and 44, it is necessary to prevent further fluid from entering the supply bore 164 by seating the check valve 184 while simultaneously permitting flow from the supply bore 164 to enter the exhaust bore 166 by unseating the check valve 186. This is accomplished by structure which includes a third piston or ram 202 having a head end 206 and a stem 204 bearing against the check valve 186. A spring 208 has opposite ends bearing against the head end 206 and a plunger 210 that is pivoted on a pin 214 normal to the axis of the valve bore 158. The lever includes a cam 216 engaging the plunger 210. To function properly, the spring 208 must exert a force greater than the feed pressure in order that plunger movement will be transferred through the spring 208 to the piston 198 to unseat the check valve 186, which in turn acts through the piston 206 to compress the spring 188 until the stem 196 engages the stem 194 of the piston 190, which urges the check valve 184 tightly against the valve seat 178.

In operation of the embodiment illustrated in FIGS. 2 and 3, upon exhausting the fluid pressure from the top of the cylinders 50 and 52, in a manner set forth below, the slide frame 16 will assume the unclamped position of FIG. 2 wherein the undersurface 89 of the projection 40 rests upon the upper surface 90 of the main frame 14. The slide frame may then be displaced to a selected transverse position by placing the bucket 32 on the ground and actuating the actuator 38 in a manner well known in the art. Once the slide frame 16 is at a desired location, it may be secured by pressurizing the top of the cylinders 50 and 52 by placing the control lever 212 in the position illustrated in FIG. 6 wherein fluid under pressure in the feed line 144, the conduit 162 and the inlet 160 holds the check valve 184 off the seat 178 and at the same time securely seats the check valve 186 against the seat 180, thus there is fluid under pressure in the supply bore 16, the hose 147 and the cylinders 50 and 52 and the pistons 42 and 44 are extended. If the tractor 10 is provided with a closed center hydraulic system, as soon as equal fluid pressure exists on the opposite sides of the check valve 184, the spring 188 will act to seat the check valve 184 to interrupt flow through the inlet 160, the equal pressure being possible due to the fact that in a closed center system the delivery pump disconnects automatically as soon as a predetermined pressure exists in the system. On the other hand, if the tractor 10 is provided with an open center hydraulic system, a system wherein the pump delivers fluid pressure continuously, the safety or relief valve 174 opens at a predetermined pressure to connect the supply bore 164 with the exhaust bore via the bore 170.

Only the operation of the piston 42 is described, it being understood that the operation of the piston 44 is identical. As the piston 42 is extended, the spherical end 46 of the piston bears against the bearing plate 60 to force the clamping block 58 against the right-angle corner 64 of the main frame 14. The clamping force being applied at approximately 45° is divided into substantially equal horizontal and vertical forces. The reaction to the force applied by the piston 42 will cause the slide frame to shift upwardly and rearwardly to the clamped position illustrated in FIG. 2 wherein the respective forward surfaces 78 and 84 of the guide rail 70 and recess 72 are in bearing engagement and the respective top surfaces 93, 102 and rearward surfaces 96, 106 are in engagement. It should be noted that as the slide frame 16 shifts upwardly and rearwardly, the piston 42 moves crosswise relative to the bearing plate 60 and the clamping block 58.

The main and slide frames 108 and 110 in the embodiments illustrated in FIGS. 4 and 5 are clamped in a manner quite similar to that described above, the only difference being that additional clamping surface area is presented by the respective upper surfaces 124 and 130 of the groove 120 and the projection 126 and the vertical bearing pads 114 and 118.

The clamping pressure to the pistons 42 and 44 may be released by rotating the control lever 212 of the control valve 154 clockwise whereupon the cam 216 will engage the plunger 206 and move the plunger axially to urge the relatively stiff spring 208 against the piston 202 and unseat the check valve 186 which will in turn be moved axially enough to move the piston 192 against the piston 190 to seat the check valve 184, thus simultaneously preventing fluid pressure into the

supply bore 164 while allowing communication between the supply and exhaust bores 164 and 166 via the valve bore 158.

We claim:

1. In a mechanical digger including a mobile vehicle, a transverse main frame supported on the vehicle and having guide means extending transversely therealong and a slide frame mounted for movement along said guide means, the improvement comprising: said guide means including first and second transverse surface means at the upper forward and lower rear portions of said main frame, said slide frame including first and second complementary surface means respectively positioned for abutting engagement with said first and second transverse surface means upon moving said slide frame to a clamped position located upwardly and rearwardly relative to said main frame and releasable clamping means mounted between said slide frame and guide means and oriented for moving said slide frame to said clamped position.

2. The invention defined in claim 1 wherein said clamping means is oriented for moving the slide frame upwardly and rearwardly at an angle of approximately 45°.

3. The invention defined in claim 2 wherein the clamping means includes a clamping block having an angular recess at one end and said guide means includes a complementary angular part received in said recess.

4. The invention defined in claim 3 wherein the recess is right angular.

5. The invention defined in claim 4 wherein the clamping means includes hydraulic loading means.

6. The invention defined in claim 5 wherein the hydraulic loading means includes a hydraulic piston having one end positioned for applying a bearing force to said clamping block.

7. The invention defined in claim 6 wherein the clamping block and hydraulic piston are mounted for relative crosswise movement.

8. The invention defined in claim 1 wherein said first and second surface means of said guide means respectively include a transverse rail at the upper forward portion of the main frame and a transverse groove in the lower rear portion of the main frame and said first and second complementary surfaces of said slide frame respectively including a recess receiving said rail and a projection received in said groove.

9. The invention defined in claim 8 wherein said groove opens rearwardly and has a lip at its entrance and said projection has a portion extending into said groove and over said lip, the lip acting to retain the projection within the groove.

10. The invention defined in claim 9 wherein the projection is removably fastened to the slide frame whereby it may be easily disposed within the groove when assembling the main and slide frames together.

11. The invention defined in claim 9, wherein said groove and lower projection have complementary upper surfaces inclined upwardly and rearwardly at approximately 45° to the horizontal and the lip has a vertical front surface.

12. The invention defined in claim 8 wherein said groove opens downwardly and the projection is hooklike and projects upwardly into the groove.

13. The invention defined in claim 12 wherein said main frame and slide frame have complementary, vertical bearing pads at their respective lower rear and lower front portions and wherein said groove has a vertical front surface and a downwardly and rearwardly inclined top surface which intersects the vertical surface and main frame bearing pad to form an N-shape in cross section and wherein the hooklike projection has complementary vertical front and downwardly and rearwardly inclined top surfaces.

14. The invention defined in claim 13 wherein the respective bottom and top surfaces of the groove and projection define an included angle of approximately 45° with the respective vertical surfaces.

15. The invention defined in claim 8 wherein the rail is generally rectangular in cross section and the recess is shaped complementary to said rail.

16. The invention defined in claim 15 wherein said groove opens rearwardly and has a lip at its entrance and said projection has a portion extending into said groove and over said lip, the lip acting to retain the projection within the groove.

17. The invention defined in claim 16 wherein the projection is removably fastened to the slide frame whereby it may be easily disposed within the groove when assembling the main and slide frames together.

18. The invention defined in claim 17 wherein said groove and lower projection have complementary upper surfaces inclined upwardly and rearwardly at approximately 45° to the horizontal and the lip has a vertical front surface.

19. The invention defined in claim 15 wherein said groove opens downwardly and the projection is hooklike and projects upwardly into the groove.

20. The invention defined in claim 19 wherein said main frame and slide frame have complementary, vertical bearing pads at their respective lower rear end and lower front portions and wherein said groove has a vertical front surface and a downwardly and rearwardly inclined top surface which intersects the vertical surface and main frame bearing pad to form an N-shape in cross section and wherein the hooklike projection has complementary vertical front and downwardly and rearwardly inclined top surfaces.

21. The invention defined in claim 20 wherein the respective bottom and top surfaces of the groove and projection define an included angle of approximately 45° with the respective vertical surfaces.

22. In a mechanical digger including a mobile vehicle, a transverse main frame supported on the vehicle and having guide means extending transversely therealong and a slide frame mounted for movement along said guide means, the improvement comprising: releasable clamping means for selectively clamping the slide frame to said main frame including a hydraulic cylinder and piston carried by said slide frame, said piston being positioned for axial movement towards and crosswise to said transverse main frame, a clamping block carried by said slide frame having one side in engagement with said guide means and the opposite side in axial alignment with said piston and a bearing plate being positioned between said clamping block and piston whereby pressurized extension of said piston will result in a force being applied to said clamping block to force it into clamping engagement with said guide means.

23. The invention defined in claim 22 wherein the force-applying end of said piston is spherical and wherein the mounting of the clamping block and bearing plate permits the piston to move crosswise relative to the clamping block and bearing plate.

24. The invention defined in claim 23 wherein the hydraulic piston and cylinder is oriented at an acute angle with reference to the horizontal.

25. The invention defined in claim 24 wherein said acute angle is approximately 45°.

26. The invention defined in claim 24 wherein the clamping block has an angular recess at said one side and said guide means includes a complementary angular part received in said recess.

27. The invention defined in claim 26 wherein the recess is right angular.

28. In a mechanical digger including a mobile vehicle, a transverse main frame supported on the vehicle and having guide means extending transversely therealong, and a slide frame mounted for movement along said guide means, the improvement comprising releasable clamping means for selectively clamping the slide frame to said main frame including at least one hydraulically loadable piston carried by said slide frame, control valve means for selectively connecting said piston to a source of fluid pressure or to a fluid return including a valve bore intersected by axially spaced supply and exhaust bores and having an inlet for connection to a source of fluid pressure, said supply and exhaust bores being respectively in fluid communication with said piston and return, a first

valve seat and check valve in said valve bore between said inlet and supply bores and a second valve seat and check valve in said valve bore between said supply and exhaust bore, bias means urging said first and second check valves against the first and second valve seats for preventing slow between the inlet and supply bores and the supply and exhaust bores, respectively, said bias means having a force lesser than the inlet pressure whereby the first check valve will be unseated when subjected to inlet pressure and means for simultaneously unseating said second check valve and seating said first check valves whereby clamping fluid pressure is exhausted from the piston.

29. The invention defined in claim **28** wherein the last-mentioned means includes a pair of pistonlike members having opposed stems and having head ends positioned against said first and second check valves, said bias means including a coil-spring disposed about said stems and urging said pistonlike members oppositely, a check valve unseating member positioned for engagement with that side of the second check valve opposite said second pistonlike member, a plunger axially shiftable in said bore and being operatively associated with said valve unseating member for selectively shifting it to unseat said second check valve and lever means operatively associated with said plunger for selectively shifting it axially toward said valve unseating member.

30. The invention defined in claim **29** wherein a coil spring having a stiffness greater than the inlet pressure is positioned with opposite ends in bearing relationship with the valve unseating member and said plunger.

31. The invention defined in claim **30** wherein the lever means includes a pivoted lever having a cam surface positioned so as to contact and move the plunger axially after a predetermined rotation of the lever.

32. The invention defined in claim **28** and further including a bore joining said supply and exhaust bores and a relief valve means in said bore for allowing escape of fluid pressure over a predetermined value from the supply bore to the exhaust bore.

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,608,930 Dated 28 September 1971

Inventor(s) Pierre Moriceau and Yves Loranchet

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

Column 6, line 18, delete "end"; line 65, after "comprising" insert a colon.

Column 7, line 5, change "slow" to -- flow --.

Signed and sealed this 14th day of March 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

FORM PO-1050 (10-69)

USCOMM-DC 60376-P69
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