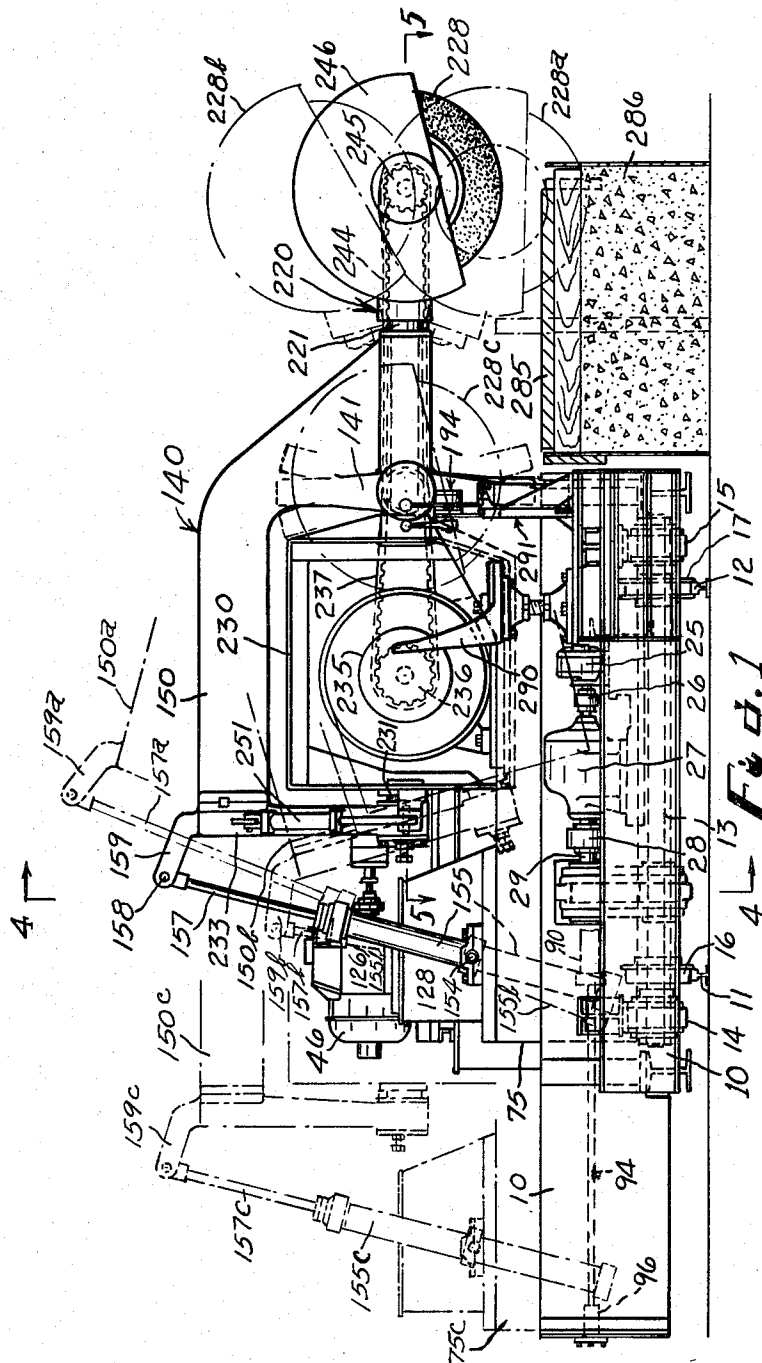


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SNAGGING GRINDER

6 Sheets-Sheet 1



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Oct. 11, 1960

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2,955,388

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6 Sheets-Sheet 2

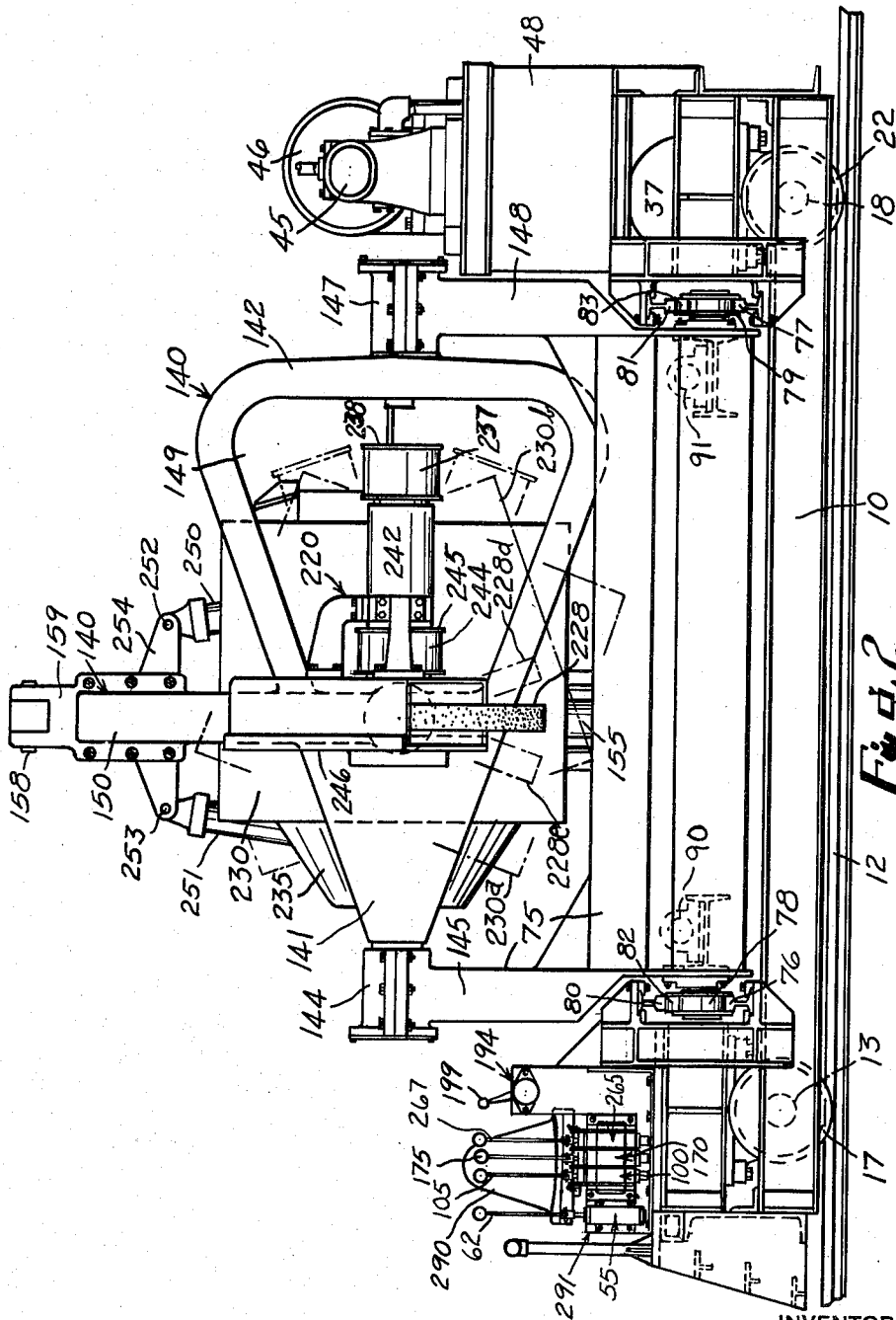


Fig. 2

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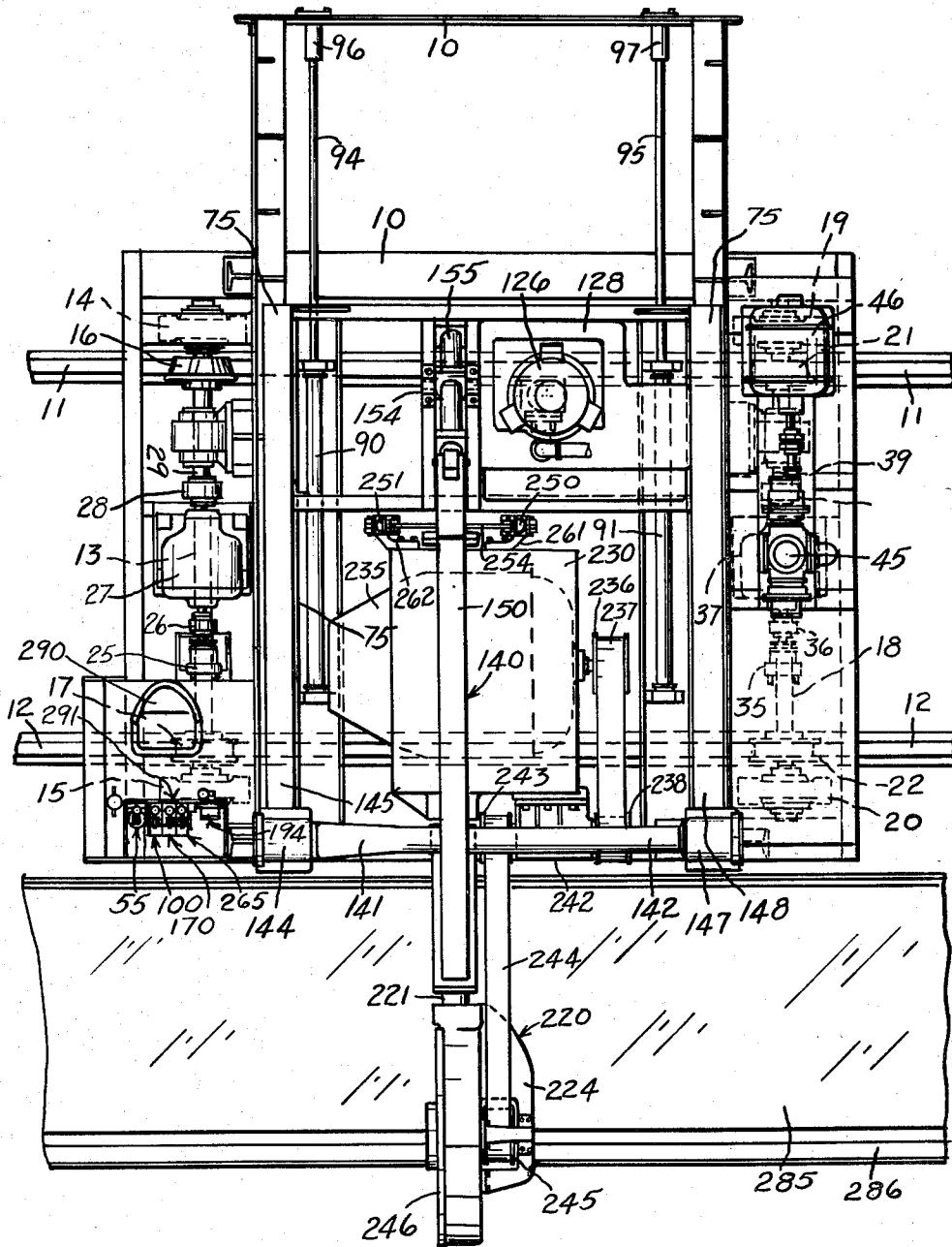


Fig. 3

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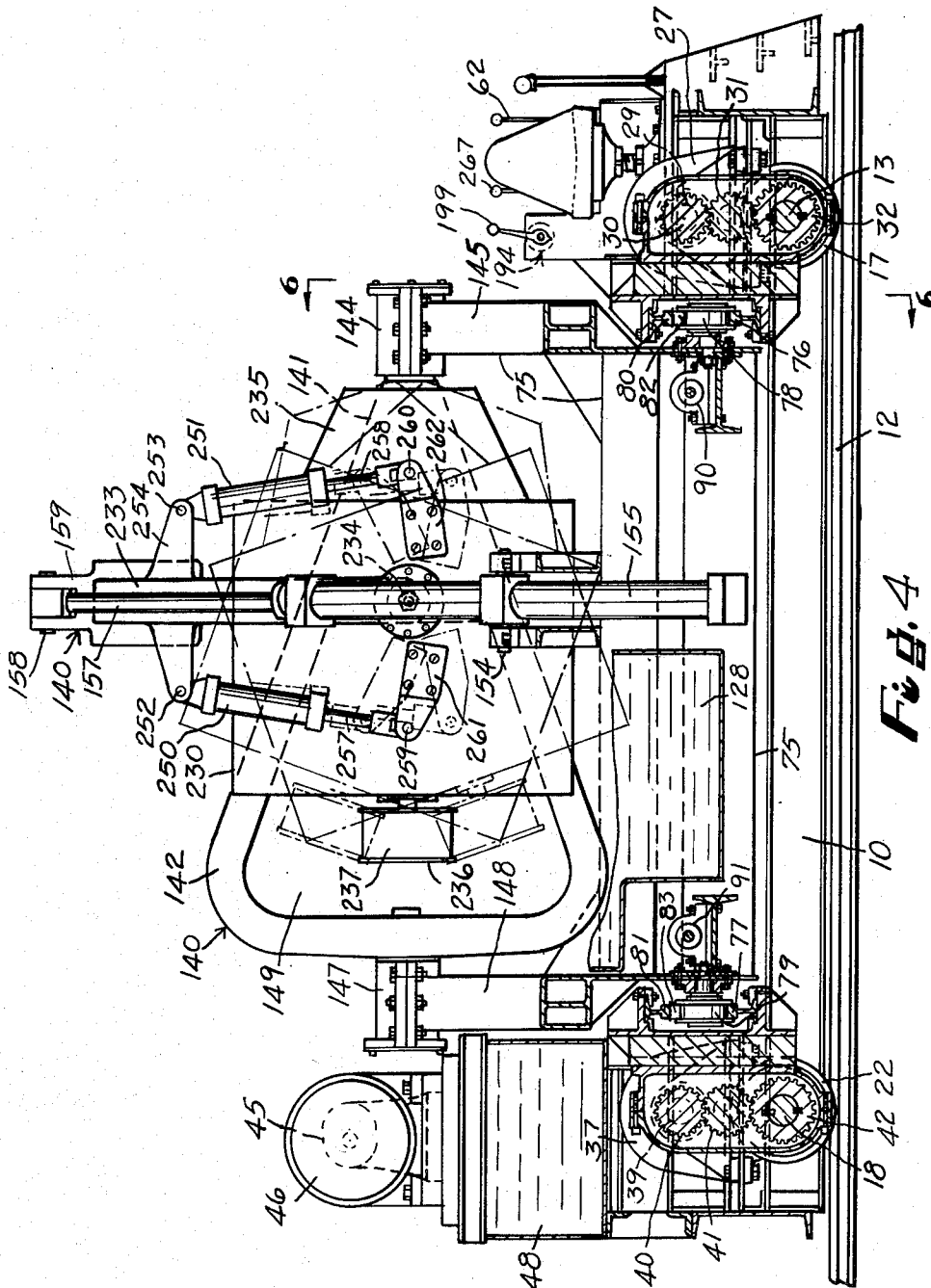
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6 Sheets-Sheet 4



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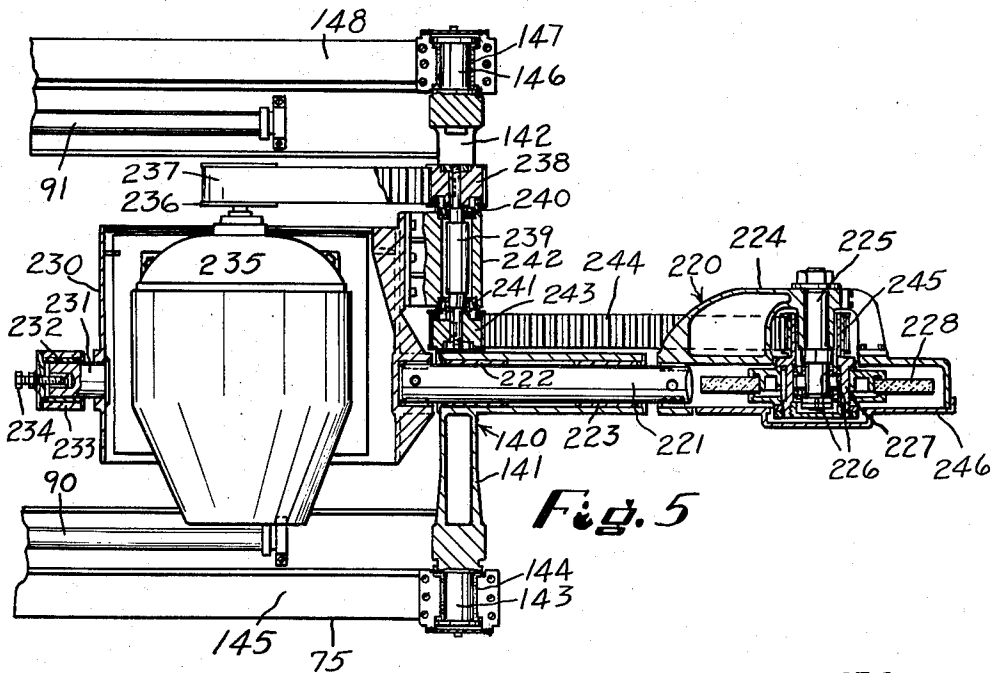


Fig. 5

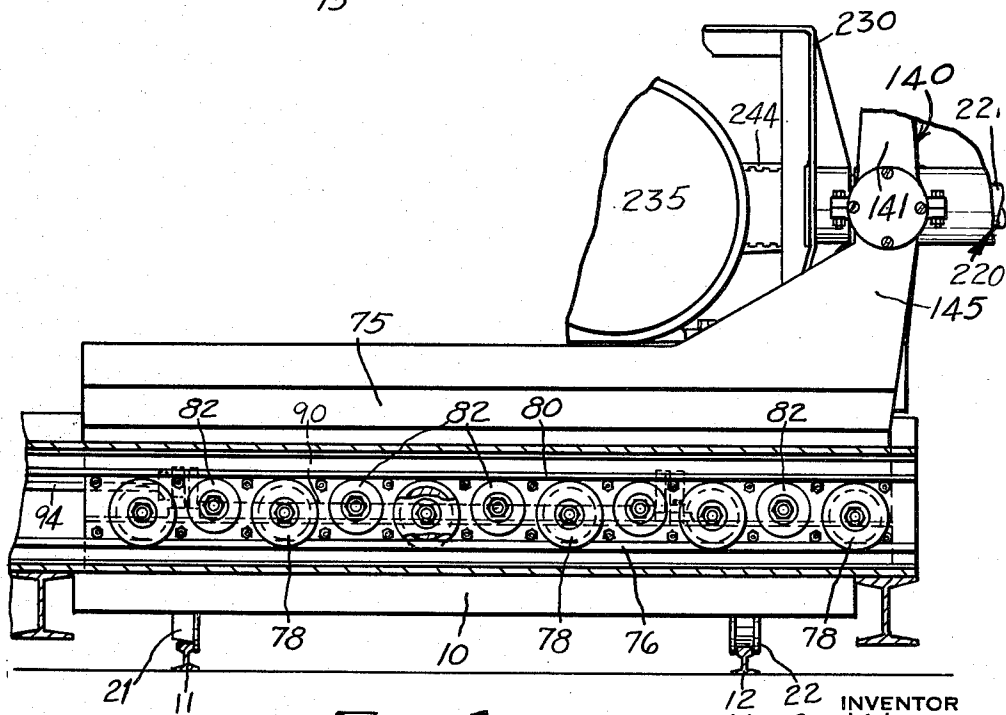


Fig. 6

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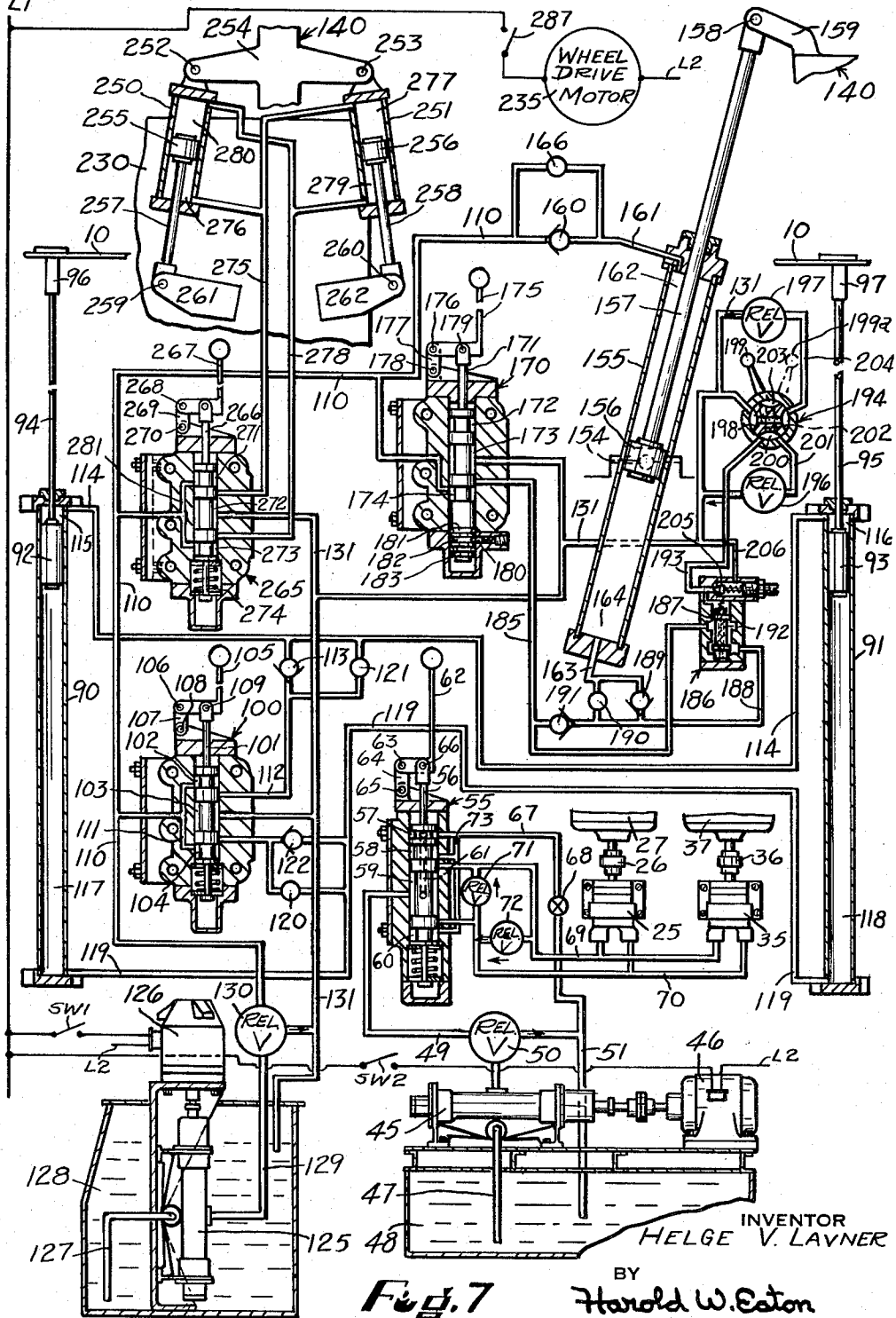
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6 Sheets-Sheet 6



2,955,388

SNAGGING GRINDER

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4 Claims. (Cl. 51—35)

The invention relates to grinding machines and more particularly to a heavy-duty floor-type snagging grinder for surfacing steel billets and the like.

One object of the invention is to make a simple and thoroughly practical heavy-duty floor-type snagging grinder. Another object of the invention is to provide a snagging grinder in which a longitudinally moveable carriage serves as a support for a transversely moveable carriage for imparting a transverse movement to the grinding wheel in a horizontal plane.

Another object of the invention is to provide a dual driving mechanism synchronously to rotate the carriage supporting axles which are controlled by a single control valve. Another object of the invention is to provide a fluid pressure operated mechanism for imparting a swinging movement to the grinding wheel to provide a predetermined high or low grinding pressure between the grinding wheel and the work being ground while being traversed either longitudinally or transversely. Other objects will be in part obvious or in part pointed out hereinafter.

In the accompanying drawings in which is shown one of various possible embodiments of the mechanical features of this invention:

Fig. 1 is a side elevation of the snagging grinder;

Fig. 2 is a front elevation of the grinder;

Fig. 3 is a plan view of the grinder;

Fig. 4 is a rear elevation, partly in section, taken approximately on the line 4—4 of Fig. 1;

Fig. 5 is a fragmentary horizontal sectional view, on an enlarged scale, taken approximately on the line 5—5 of Fig. 1;

Fig. 6 is a fragmentary vertical sectional view, on an enlarged scale, taken approximately on the lines 6—6 of Fig. 4, showing the roller support for the transversely moveable slide; and

Fig. 7 is a combined hydraulic and electric diagram of the actuating mechanisms and the controls therefor.

A heavy-duty floor-type snagging grinder has been illustrated in the drawings comprising a longitudinally movable carriage 10 which is arranged to travel longitudinally on a pair of spaced parallel rails 11 and 12. The carriage 10 is provided with a transversely extending axle 13 which is rotatably journaled in spaced bearings 14 and 15 (Fig. 3). The axle 13 is provided with a wheel 16 which rides on the rail 11. The axle 13 is also provided with a flanged wheel 17 which is arranged to ride upon the rail 12 so as to guide the longitudinally movable carriage 10 during its longitudinal movement.

The carriage 10 is also provided with a rotatable axle 18 rotatably journaled in spaced bearings 19 and 20 which are supported on the longitudinally movable carriage 10.

The axle 18 is provided with a wheel 21 which rides upon the rail 11 and is also provided with a flanged wheel 22 which rides upon the rail 12. It will be readily apparent from the foregoing disclosure that the flanged

wheels 17 and 22 serve to guide the carriage 10 as it is traversed longitudinally.

A suitable driving mechanism is provided for traversing the carriage 10 longitudinally comprising a fluid motor 25 (Fig. 1 and 3) which is connected by a coupling 26 with a speed reducer unit 27. The speed reducer 27 may be any of the well known commercial speed reducer units. The driven shaft of the speed reducer unit 27 is connected by the coupling 28 with a shaft 29. The shaft 29 is provided with a fixedly mounted gear 30 (Fig. 4) which meshes with an intermediate gear 31. The gear 31 in turn meshes with a gear 32 which is fixedly mounted on the axle 13. It will be readily apparent from the foregoing disclosure that rotary motion transmitted from the fluid motor 25 will be imported to give a longitudinal movement of the carriage 10.

A similar driving mechanism is provided for driving the axle 18 comprising a fluid motor 35 which is connected by a coupling 36 with a speed reducer unit 37. The driven shaft of the speed reducer unit 37 is connected to a rotatable shaft 39 having a gear 40 fixedly mounted thereon. The gear 40 meshes with an intermediate gear 41 (Fig. 4) which, in turn, meshes with a gear 42 fixedly mounted on the axle 18. The fluid motors 25 and 35 are controlled by a single control valve mechanism to be hereinafter described to control the longitudinal movement of the carriage 10.

A fluid pressure system is provided for supplying fluid under pressure to the various mechanisms of the machine. This system comprises a fluid pump 45 which is driven by an electric motor 46 (Fig. 7). The pump 45 draws fluid through a pipe 47 from a reservoir 48 and forces fluid under pressure through a pressure pipe 49 to the fluid motors 25 and 35. A balanced pressure relief valve 50 is connected in the pipe line 49 to facilitate passing excess fluid under pressure directly through a pipe 51 into the reservoir 48 to facilitate maintaining a substantially constant fluid pressure throughout the system.

A piston type control valve 55 is provided for controlling the admission to and exhaust of fluid from the fluid motors 25 and 35. The valve 55 comprises a valve stem 56 having a plurality of spaced valve pistons formed integrally therewith to form a plurality of spaced valve chambers 57, 58, 59, and 60. The valve is provided with a central passage 61 which interconnects the valve chamber 57 with the valve chamber 59. A compression spring serves normally to hold the valve stem 56 in the position illustrated in Fig. 7.

A manually operable control lever 62 is provided for actuating the control valve 55. The lever 62 is pivotally supported by a stud 63 carried by the upper end of a link 64. The lower end of the link 64 is supported by a stud 65 carried by the control valve 55. A stud 66 connects the valve stem 56 with the control lever 62. The pipe 49 is arranged to convey fluid under pressure from the pump 45 to the valve chamber 59 of the control valve 55. A pipe 67 is connected between the control valve 55 and a throttle valve 68 which serves to control the rate of exhaust of fluid from the control valve 55 into the reservoir 48. A pipe 69 is connected between the control valve 55 and one side of each of the fluid motors 25 and 35. A pipe 70 is connected between the control valve and the other side of each of the fluid motors 25 and 35. The control valve 55 is arranged to simultaneously control the admission to and exhaust of fluid from the fluid motors 25 and 35. A balance pressure relief valve 71 is connected between the pipe 70 and the pipe 69. A balance pressure relief valve 72 is similarly connected between the pipe 69 and the pipe 70. The balance pressure relief valves 71 and 72 are provided so that when

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fluid under pressure to the motors 25 and 35 is reversed fluid may readily pass between the pipes 69 and 70 respectively thereby preventing an excessive build up of pressure in the pipe lines and motors at the time of reversal.

When it is desired to impart a longitudinally traversing movement of the carriage 10 the control lever 62 may be moved in a clockwise or counter-clockwise direction (Fig. 7). When the control lever 62 is moved in a clockwise direction (Fig. 7) the valve stem 65 is moved downwardly against the compression spring. In this position of the parts fluid under pressure from the pipe 49 entering the valve chamber 59 passes through the pipe 70 to start both the fluid motors to impart a longitudinal traversing movement to the carriage 10. During this movement fluid may simultaneously exhaust from the other side of the fluid motors 25 and 35 through the pipe 69 into the valve chamber 58 and pass through a passage 73, through the pipe 67, through the throttle valve 68 and through the exhaust pipe 51 into the reservoir 48. The rate of movement of the carriage 10 may be readily controlled by manipulation of the throttle valve 68.

When it is desired to stop the carriage 10 the control lever 62 may be released by the operation at which time the released compression of the spring causes an upward movement of the valve stem 56 to position the valve 55 in a central or neutral position, as shown in Fig. 7. When the control valve 55 is in a central or neutral position, fluid under pressure from the pressure pipe 49 entering the valve chamber 59 may pass through the central passage 60 into the valve chamber 57 and through the pipe 67 through the throttle valve 68 and exhausts through the pipe 51 into the reservoir 48.

When it is desired to traverse the carriage 10 longitudinally in the opposite direction, the control lever 62 may be moved in a counter-clockwise direction so as to cause an upward movement of the valve stem 56 so that fluid under pressure entering the valve chamber 59 may pass through the pipe 69 to the other side of both of the fluid motors 25 and 35 thereby causing the motors to rotate in opposite directions and to traverse the carriage 10 in an opposite direction. It will be apparent from the foregoing disclosure that by manipulation of the control lever 62 the carriage 10 may be traversed in either direction. The movement of the carriage in either direction may be stopped at any time by releasing the control lever 62 to allow the released compression of the spring to return the valve 55 to a central position or the carriage may be reversed in its direction of travel by manually shifting the lever 62 in the opposite direction.

The longitudinally movable carriage 10 serves as a support for a transversely movable carriage 75 (Figs. 2 and 4). The longitudinally movable carriage 10 is provided with a pair of spaced parallel rails 76 and 77. The transversely movable carriage 75 is provided with a plurality of flanged wheels or rollers 78 and 79 which ride upon the rails 76 and 77 respectively. The carriage 10 is also provided with a pair of spaced parallel depending rails 80 and 81 (Figs. 2 and 4) which serve to hold the transversely movable carriage 75 against a lifting movement. The transversely movable carriage is provided with a plurality of spaced wheels or rollers 82 (Fig. 6) which ride upon the lower surface of the rail 80. Either the set of rollers 78 or the set of rollers 82 may be provided with adjustments so that lost motion may be taken up between the rails 76 and 80. A similar set of rollers 83 are carried by the carriage 75 and rolled upon the lower surface of the depending rail 81.

A hydraulically operated mechanism is provided for imparting a traverse movement to the carriage 75 comprising a pair of spaced parallel cylinders 90 and 91 (Figs. 3 and 7) which are fixedly mounted on the carriage 75. The cylinders 90 and 91 contain the pistons 92 and 93 respectively which are connected to one end of a pair of piston rods 94 and 95 respectively. The other ends of

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the piston rods 94 and 95 are connected by brackets 96 and 97 respectively with a rearwardly extending portion of the longitudinally movable carriage 10. The cylinders 90 and 91 are arranged on opposite sides of the transversely movable carriage 75 to facilitate the transverse traversing moving of the carriage 75.

The control valve 100 is provided for simultaneously controlling the admission to and exhaust of fluid from the cylinders 90 and 91 respectively. The control valve 100 is a piston type valve comprising a valve stem 101 having a plurality of spaced valve pistons formed integrally therewith to form a plurality of spaced valve chambers 102, 103 and 104. A compression spring is provided normally to hold the valve stem 101 in a central or neutral position as illustrated in Fig. 7.

A manually operable control lever 105 is pivotally supported by a stud 106 carried by an upper end of the link 107. The lower end of the link 107 is supported by a stud 108 carried by the valve 100. A stud 109 connects the valve stem 101 with the control lever 105. A fluid pressure pipe 110 is provided for conveying fluid under pressure to the valve chambers 102 and 104. A pipe 112 is connected to a ball check valve 113 which is connected by a pipe 114 with the upper ends of the cylinders 90 and 91 respectively. Fluid passing through the pipe 114 simultaneously enters a cylinder chamber 115 and a cylinder chamber 116 formed in the upper ends of the cylinders 90 and 91, respectively. A pair of cylinder chambers 117 and 118 formed in the lower end of the cylinders 90 and 91, respectively, are connected by a pipe 119 with a throttle valve 120 which is in turn connected with the valve 100. A throttle valve 121 is connected between the pipes 112 and 114. A ball check valve 122 is connected between the pipes 119 and the valve 100.

When it is desired to traverse the transversely movable carriage 75, the control lever 105 may be rocked in either a clockwise or counter-clockwise direction (Fig. 7) depending upon the direction of movement of carriage 75 desired. When it is desired to move the carriage 75 rearwardly, that is, in an upward direction (Fig. 3) the control lever 105 is rocked in a clockwise direction to move the valve stem 101 downwardly so that fluid under pressure within the valve chamber 102 may pass through the pipe 112, through the ball check valve 113 and the throttle valve 121 into the pipe 114 to simultaneously convey fluid under pressure into the cylinder chamber 115 and 116 respectively. Fluid under pressure entering the cylinder chambers 115 and 116 causes an upward movement of the cylinders so as to cause a rearward movement of the carriage 75. During this movement fluid within the cylinder chambers 117 and 118 simultaneously exhausts through the pipe 119, through the throttle valve 120 into the valve chamber 103 into an exhaust pipe 131. By manipulation of the throttle valve 120, the rate of exhaust of fluid from the cylinder chambers 117 and 118 may be readily controlled to control the speed of the rearward movement of the carriage 75.

Similarly if it is desired to cause a forward movement to the carriage 75, the control lever 105 is rocked in a counter-clockwise direction (Fig. 7) thereby causing an upward movement of the valve stem 101 so that fluid under pressure entering the valve chamber 104 passes through the ball check valve 122, through the pipe 119 simultaneously into the cylinder chambers 117 and 118 respectively thereby moving the cylinders 90 and 91 respectively together with the transversely movable carriage 75 in a forward direction. During this movement fluid within the cylinder chambers 115 and 116 simultaneously exhausts through the pipe 114, through the throttle valve 121, through the pipe 112 through the valve chamber 103 in the valve 100 and exhausts through the pipe 131. The rate of the forward movement of the carriage 75 may be readily controlled by manipulation of the throttle valve 131.

An independent fluid pressure system is provided for supplying fluid under pressure to the mechanism above described and also to other mechanisms to be hereinafter described. This system comprises a fluid pump 125 (Fig. 7) which is driven by an electric motor 126. The pump 125 draws fluid through a pipe 127 from a reservoir 128 and forces fluid under pressure through a pipe 129, through a balanced pressure relief valve 130 into the pressure pipe 110. The exhaust pipe 131 is connected to the relief valve 130 to return excess fluid under pressure directly to the reservoir 128. The relief valve 130 is preferably adjusted to open at 300 lbs. per square inch so as to maintain an operating pressure in the fluid system of 300 lbs. per square inch.

The transversely movable slide or carriage 75 serves as a support for a pivotally mounted frame 140 which is provided with horizontally extending portions 141 and 142. The portion 141 is provided with a trunnion 143 which is supported in a bearing 144 mounted in an upwardly extending bracket 145 on the carriage 75. The horizontally extending portion 142 of the frame 140 is provided with a trunnion 146 which is journaled in a bearing 147 supported by an upwardly extending bracket 148 fixedly mounted on the carriage 75. The frame 140 is provided with an opening 149 to facilitate passing a driving mechanism for a grinding wheel to be hereinafter described.

The frame 140 is provided with a horizontally extending arm 150 (Figs. 1 and 3). A hydraulically operated mechanism is provided to facilitate rocking the frame 140 about the axis of the trunnion 143—146 as a pivot. This mechanism comprises a cylinder 155 which is pivotally supported by a bearing 154 mounted on the transversely movable carriage 75 (Fig. 1). The cylinder 155 contains a slidably mounted piston 156 which is connected to the lower end of a piston rod 157. The upper end of the piston rod 157 is connected by the stud 158 carried by a bracket 159 formed integral with the arm 150 of the frame 140. It will be readily apparent from the foregoing disclosure that movement of the piston 156 within the cylinder 155 will impart a rocking motion to the arm 150 and the frame 140 to control the feeding movement of a grinding wheel to be hereinafter described.

In order to provide a controlled movement of the piston 156, it is desirable to rely upon the differential effective area of the piston 156. The effective area of the upper surface of the piston is less than the effective area of the lower surface thereof due to the piston rod 157. Fluid under pressure from the pipe 110 is continuously passed through the check valve 160 and a throttle valve 166, through a pipe 161 into a cylinder chamber 162 to exert a downward thrust on the piston 156 tending to rock the frame 140 in a counter-clockwise direction (Fig. 1). The throttle valve 166 controls the rate of exhaust of fluid from the cylinder chamber 162 against the pressure in the pipe 110 when fluid under pressure is passed into the cylinder chamber 164. Due to the greater area of the under side of the piston 156, a controlled swinging movement is imparted to the frame 140 to produce the desired grinding pressure.

A control valve 170 is provided for controlling the admission to and exhaust of fluid from the cylinder chamber 164. The valve 170 is a piston type valve having a valve stem 171 formed with a plurality of spaced pistons to form a plurality of spaced valve chambers 172, 173 and 174. A manually operable control lever 175 is pivotally supported by a stud 176 to the upper end of a link 177. The lower end of the link 177 is connected by a stud 178 with the valve 170. A stud 179 connects the control lever 175 with the valve stem 171. A spring pressed detent 180 is arranged to engage one of a plurality of spaced grooves 181, 182, and 183 to maintain the valve stem 171 in a predetermined position. A pipe 185 is connected between the valve 170 and a pressure reducing valve 186 which contains a vertically

arranged slidable valve member 187. The valve 186 is connected by a pipe 188 with a ball check valve 189 and a throttle valve 190 with the pipe 163 leading to the cylinder chamber 164. A ball check valve 191 (Fig. 7) is connected between the pipe 188 and the pipe 185.

The slidably mounted valve member 187 of the pressure reducing valve 186 is provided with a central passage 192 which is arranged so that when the slidable valve member 187 moves upwardly fluid may pass through the central passage 192 and through a vent pipe 193 to a rotary control valve 194. The control valve 194 is operatively connected in a manner to be hereinafter described to pass fluid from the venting pipe 193 either to an adjustable relief valve 196 or to an adjustable relief valve 197 which are adjusted to operate at different pressures so as to facilitate controlling the pressure conveyed to the cylinder chamber 164.

The valve 194 contains a valve rotor 198 which is actuated by a manually operable control lever 199. In the position of the valve 194 (Fig. 7) fluid passing through the venting pipe 193 enters a valve chamber 200 in the valve 194 and passes through a pipe 201 to the relief valve 196 which allows excess fluid under pressure to pass through the exhaust pipe 131 into the reservoir 128 thereby reducing the fluid pressure passed to the cylinder chamber 194.

If desired the control lever 199 may be swung into position 199a to turn the valve rotor 198 so that fluid under pressure entering the valve chamber 200 may pass through a passage 202 in the valve rotor 198 into a valve chamber 203 and through a pipe 204 to the relief valve 197 so that excess fluid may be passed through the relief valve 197 into the exhaust pipe 131 which exhausts into the reservoir 128.

The pressure reducing valve 186 is provided with a pilot control piston 205. The pilot control piston 205 is spring pressed and adjustable so that fluid passing through the central passage 192 into the pipe 193 may move the piston 205 toward the right (Fig. 7) to allow a variable amount of fluid to pass through a drain pipe 206 into the exhaust pipe 131. The pilot control piston 205 is preferably adjusted to open at pressure in excess of the setting of relief valve 130 to allow excess fluid to exhaust through pipe 131 into the reservoir 128.

When it is desired to impart a clockwise feeding movement to the frame 140, the control lever 175 is rocked in a counter-clockwise direction until the spring pressed detent 180 engages the groove 183. In this position of the valve 170 fluid from the pipe 110 passes through the valve chamber 174, through the pipe 185, through the pressure reducing valve 186, through the pipe 188, through the ball check valve 189 and the throttle valve 190, through the pipe 163 into the valve chamber 164 to cause an upward movement of the piston 156 at a predetermined controlled rate. During this feeding movement excess fluid under pressure within the pipe 188 causes an upward movement of the valve member 187 (Fig. 7) which serves to allow fluid under pressure to pass through the pipe 193 to the rotary control valve 194 and through either the relief valve 196 or the relief valve 197 into the exhaust pipe 131.

The relief valves 196 and 197 are adjustable to facilitate varying the grinding pressure of the grinding wheel 228 and the work piece 285. The valve 196 may be set to open at 75 lbs. per square inch and the valve 197 may be set to open at 200 lbs. per square inch to facilitate obtaining either a low or a high grinding pressure. At the same time the pilot control piston 205 may be moved toward the right to allow a portion of the excess fluid to pass through the venting pipe 206 into the exhaust pipe 131. It will be readily apparent from the foregoing disclosure that by applying a predetermined pressure toward the upper face of the piston 156 and applying a controlled pressure to the lower surface of the piston 156 having a greater piston area will cause a controlled

upward movement of the piston 156 (Fig. 7) thereby imparting a controlled feeding movement to the frame 140 in a clockwise direction (Fig. 1).

When it is desired to rock the frame 140 in a counter-clockwise direction (Fig. 1), the control lever 175 may be moved in a clockwise direction until the detent 180 engages the groove 181. In this position of the valve fluid under pressure from the pipe 110 is cut off from the valve 170 and fluid from the cylinder chamber 164 may exhaust through the pipe 163 through the throttle valve 190, through the ball check valve 191, through the pipe 185, through the valve chamber 173 into the exhaust pipe 131 which exhausts into the reservoir 128. By manipulation of the pressure reducing valve 186 and the relief valves 196 and 197 a precise control of fluid under pressure entering the cylinder chamber 164 may be obtained.

The frame 140 serves as a support for a grinding unit 220. The grinding unit 220 comprises a cylindrically shaped support 221 which is journaled in spaced bearings 222 and 223 which are fixedly mounted within an aperture formed in the frame 140. The grinding unit further comprises a frame 224 which serves as a combined support for a grinding wheel and as a wheel guard. The frame 224 (Fig. 5) supports a fixedly mounted non-rotatable spindle 225. The spindle 225 supports a pair of spaced roller bearings 226 which in turn support a rotatable wheel sleeve 227 upon which a grinding wheel 228 is mounted. The grinding unit 220 is arranged to rock about the axis of the cylindrical member 221. In order to perform a heavy duty snagging operation, the longitudinally movable carriage 10, the transversely movable carriage 75, the pivotally mounted frame 140 together with associated parts are massive in structure so that a large diameter grinding wheel, such as, a 36" diameter grinding wheel 228 driven by a 75 H.P. driving motor may be employed to facilitate rapid stock removal from the billet or work piece being ground.

A driving mechanism is provided for the grinding wheel 228 comprising an open-ended box-like frame 230 which is fixedly keyed onto the left hand end of the cylindrical member 221 (Fig. 5). The opposite side of the box-like frame 230 is provided with a fixedly mounted trunnion 231 which is supported in a bearing 232 carried by a downwardly projecting bracket 233 which is fastened to the left hand end of the arm 150 of the frame 140. An adjusting screw 234 is provided to facilitate taking up the end thrust of the grinder unit 220 in a direction toward the left (Fig. 5).

The box-like frame 230 supports a wheel driving motor 235 having a cog pulley 236 which is connected by a cog driving belt 237 with a cog pulley 238 which is keyed onto the upper end of a rotatable shaft 239. The shaft 239 is journaled in a pair of spaced bearings 240 and 241 which are supported in a bracket 242 fixedly mounted on the box-like frame 230. The axis of the shaft 239 is preferably in axial alignment with the trunnions 143 and 146 of the frame 140 in order to facilitate the swinging movement of the frame 140 about the axis of the trunnions.

A cog pulley 243 is keyed onto the lower end of the shaft 239 (Fig. 5). The pulley 243 is connected by a cog driving belt 244 with a cog pulley 245 which is carried by the wheel sleeve 227. A wheel guide cover 246 encloses the open side of the frame 224. It will be readily apparent from the foregoing disclosure that the motor 235 will transmit power to rotate the grinding wheel 228 during a swinging or feeding movement of the frame 140.

It is desirable to rock the grinding wheel in a vertical plane passing through its axis. This rocking movement is obtained by a hydraulically operated mechanism comprising a pair of cylinders 250 and 251, the upper ends of which are connected by studs 252 and 253, respectively, with a bracket 254 which is fixedly mounted relative to the frame 140. The cylinders 250 and 251 con-

tain slidably mounted pistons 255 and 256 respectively. The pistons 255 and 256 are connected to the upper ends of a pair of piston rods 257 and 258 respectively. The lower ends of the piston rods 257 and 258 are connected by a pair of studs 259 and 260 respectively with a pair of brackets 261 and 262 which are fixedly mounted on the rear surface of the box like frame 230.

A control valve 265 is provided for controlling the admission to and exhaust of fluid from the cylinders 250 and 251 respectively to obtain the desired rocking movement of the wheel supporting frame 224. The control valve 265 is a piston type valve having a valve stem 266 which is actuated by a control lever 267. The control lever is pivotally supported by a stud 268 on the upper end of a link 269. The lower end of the link 269 is connected by a stud 270 carried by the valve 265.

The valve stem 266 is provided with a plurality of spaced valve pistons forming a plurality of spaced valve chambers 271, 272, and 273. A compression spring 274 serves normally to maintain the valve 265 in a central or neutral position, as indicated in Fig. 7. A pipe 275 connects the valve 265 with a lower cylinder chamber 276 in the cylinder 250 and an upper cylinder chamber 277 in the cylinder 251. A pipe 278 connects the valve 265 with a lower cylinder chamber 279 in the cylinder 251 and an upper cylinder chamber 280 in the cylinder 250.

The valve 265 is provided with a passage 281 which receives fluid under pressure from the pressure pipe 110. With the valve 265 in a central or neutral position, fluid under pressure is conveyed by the passage 281 into the valve chambers 271 and 273. When it is desired to impart a clockwise rocking motion to the frame 140 (Fig. 7), the control lever 267 is rocked in a clockwise direction to cause a downward movement of the valve stem 266 so that fluid under pressure entering the valve chamber 271 passes through the pipe 275 simultaneously into the cylinder chambers 276 and 277. During this rocking movement of the frame 140 fluid within the cylinder chambers 279 and 280 exhausts through the pipe 278, through the valve chamber 272 into the exhaust pipe 131 which exhausts into the reservoir 128.

Similarly when a rocking motion in a counter-clockwise direction of the frame 140 is desired, the control lever 267 is rocked in a counter-clockwise direction thereby causing an upward movement of the valve stem 266 so that fluid under pressure from the valve chamber 273 passes through the pipe 278 into the cylinder chambers 279 and 280 to impart a counter-clockwise swinging of the box-like frame 230 and the frame 140. During this movement fluid may exhaust from the cylinder chambers 276 and 277, through the pipe 275 into the valve chamber 272 and pass through the exhaust pipe 231 into the reservoir 128.

A work piece 285, such as a billet or slab of steel to be snagged may be placed on a work supporting base 286. The grinding wheel 228 may then be fed downwardly by a swinging movement of the frame 140 into operative engagement with the surface to be ground. The carriage 10 may be traversed longitudinally by imparting a longitudinal traversing movement to the carriage 10. The grinding wheel 228 may be moved transversely to present the wheel to a different portion of the work piece being snagged by imparting a traverse movement to the carriage 75. Due to the opposed roller support for the transversely movable carriage 75, any desired grinding pressure may be imparted to the grinding wheel 228. If desired the grinding unit 220 may be rocked about a horizontal axis so as to tilt the grinding wheel in either direction as shown in Fig. 2.

In Fig. 1, the arm 150 of the frame 140 has been illustrated in broken line position 150a when the frame 140 is swung in a clockwise direction to swing the grinding wheel 228 into its extreme lower position 228a. Arm 150 has also been shown in broken line position 150b when the frame 140 is swung in a counter-clockwise direction to swing the grinding wheel 228 into its extreme

upper position 228b. The arm 150 has also been shown in broken line position 150c when the slide 75 is moved toward the left (Fig. 1) to position the grinding wheel 228 in broken line position 228c.

In Fig. 2, the broken positions 228d and 228e of the grinding wheel 228 illustrate extreme positions of the grinding wheel 228 when the grinding wheel unit 220 is swung within the bearings 221—222 (Fig. 5).

An operator's seat 290 (Figs. 1 and 2) is provided at a control station 291 on the transversely movable slide 75. The control levers 62, 105, 175, 199 and 267 for actuating the control valves 55, 100, 170, 194 and 265, respectively, are positioned within easy reach of the operator.

The operation of the improved snagging grinder will be readily apparent from the foregoing disclosure. After a work piece 285 has been positioned on the work support 286, the wheel driving motor 235 is started by closing a switch 287. The pump driving motor 46 is started by closing the switch SW2. The pump driving motor 126 is started by closing the switch SW1.

By manipulation of the control lever 175, the valve 170 may be actuated to swing the frame 140 in a clockwise direction (Fig. 1) to feed the grinding wheel 228 into grinding engagement with the work piece 285 at a desired and predetermined pressure. The grinding pressure may be varied by manipulation of the valve 194 and by adjustment of the relief valves 196 and 197. The carriage 10 may then be traversed longitudinally by actuation of the control lever 62 which in turn actuates the control valve 55 to start the fluid motors 25 and 35 in either direction. The direction of movement of the carriage 10 being determined by the direction of movement of the control lever 62. At the end of a longitudinal stroke of the grinding wheel 228, the carriage 75 may be traversed transversely by actuation of the control lever 105 to present a new portion of the work surface to be ground during the next longitudinal traverse of the carriage 10. If desired the surface of the work piece being snagged or ground may be ground by successive longitudinal movement of the carriage 10 combined with a transverse movement of the carriage 75 at the ends of the longitudinal stroke of the carriage 10.

If desired, a transverse movement of the carriage 75 controlled by the control lever 105 may be utilized to traverse the grinding wheel 228 transversely across the work piece 285. After the grinding wheel has ground the surface to the desired extent, the longitudinally movable grinding wheel carriage may be moved longitudinally to present the grinding wheel to an adjacent portion of the surface. This sequence may be continued until the entire surface has been ground to the desired and predetermined extent. After a predetermined area has been ground at one end of the work piece in a manner above described, the carriage 10 may be traversed longitudinally to present the grinding wheel to the other end portion of the work piece to be ground. A similar portion of the face of the work piece may be ground to the desired extent by a transverse movement of the carriage 75. After an area at each end of the work piece has been ground to the desired extent by a transverse movement of the carriage 75, the longitudinally movable carriage 10 may be traversed longitudinally to grind the area between the two end portions. Between longitudinal strokes by the carriage 10 the carriage 75 may be advanced transversely so as to present the grinding wheel to a new portion of the work piece on each successive longitudinal stroke.

In both methods of operation, that is, by grinding with a longitudinal stroke or grinding by a transverse stroke of the wheel, the wheel axis may be mounted parallel to the plane of the work surface or may be tilted into either the position 228c or 228d when desired. If it is desired to change the pressure of the grinding wheel against the

work piece, the control valve 194 may be actuated to render the relief valve 196 or the relief valve 197 operative.

It will therefore be seen that there has been provided by this invention apparatus in which the various objects hereinafter set forth together with many thoroughly practical advantages are successfully achieved. As many possible embodiments may be made of the above invention and as many changes might be made in the embodiments above set forth, it is to be understood that all matter hereinbefore set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

I claim:

1. A snagging grinder comprising a traversable longitudinal carriage, a fluid motor to traverse said carriage, a transversely movable slide on said carriage, a fluid motor interposed between the carriage and the slide to move said slide transversely of the carriage, a pivotally mounted swing frame supported on said slide, spaced axially aligned horizontally arranged trunnions on said frame, spaced bearings on said slide for said trunnions having their common axis arranged parallel to the direction of movement of the longitudinal carriage, a fluid motor to swing said frame relative to said slide, an elongated grinding unit on said frame including a support for said unit projecting through and rotatably mounted on said frame, the axis of said support being rotatable about the axis of said trunnions in a vertical plane parallel to the path of movement of said slide, a grinding wheel rotatably mounted on one end of said unit, a box-like frame fixedly mounted on the other end of said unit, an electric motor adjustably supported on said box-like frame, a trunnion fixedly mounted on said box-like frame in axial alignment with the said rotatable support, a bearing on said swing frame to support said trunnion, a rotatable shaft, spaced bearings supported on said grinding unit for supporting said shaft in a common plane with the spaced trunnions on said swing frame, belt driving connections between said motor and said shaft, and belt driving connections between said shaft and said grinding wheel to facilitate driving the grinding wheel in any position of the swing frame or grinding unit without disturbing the belt driving connections between the motor and the grinding wheel.

2. A snagging grinder comprising a traversable longitudinal carriage, a fluid motor to traverse said carriage, a transversely movable slide on said carriage, a fluid motor interposed between the carriage and the slide to move said slide transversely of the carriage, a pivotally mounted swing frame supported on said slide, spaced axially aligned horizontally arranged trunnions on said frame, spaced bearings on said slide for said trunnions having their common axis arranged parallel to the direction of movement of the longitudinal carriage, a fluid motor to swing said frame relative to said slide, an elongated support for a grinding wheel projecting through and mounted rotatably on said frame, the axis of rotation of said support being rotatable about the axis of said trunnions in a vertical plane parallel to the path of movement of said slide, a grinding wheel rotatably journaled in bearings mounted on one end of said support, a box-like frame fixedly mounted on the other end of said support, an electric motor supported within said box-like frame, a trunnion fixedly mounted on said box-like frame in axial alignment with said rotatable support, a bearing on said swing frame to support said trunnion, a rotatable driven shaft, spaced bearings supported on said box-like frame for supporting said shaft for angular displacement about the axis of said support in a plane intersecting the spaced trunnions on said swing frame, belt driving connections between said motor and said shaft, and belt driving connections between said shaft and said grinding wheel to facilitate driving the grinding wheel in any position of the swing frame or

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grinding unit without imparting a twist to said driving belts.

3. In a snagging grinder, as claimed in claim 1, in combination with the parts and features therein specified in which the fluid motor for swinging the grinder frame relative to the transverse slide comprises a piston and cylinder, operative connections between the frame and transverse slide, said piston having differential piston areas, means for applying pressure direct from a source to the upper end of said cylinder to exert a downward pressure on the smaller piston area, and means including a manually operable control valve operatively connected to apply a lower pressure to the greater piston area on the under side of said piston so as to impart a controlled swinging movement to the frame and grinder unit to obtain the desired grinding pressure.

4. In a snagging grinder as claimed in claim 3, in com-

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bination with the parts and features therein specified of means including a pressure regulating valve to pass fluid under pressure to the lower end of said cylinder, means including a pair of independent adjustable relief valves one of which is set for a low grinding pressure and the other set for a high grinding pressure, said relief valves being arranged to exhaust excess fluid under pressure from the pressure regulating valve, and means including a manually operable valve to render either of said relief valves operative to facilitate obtaining either a controlled high or low pressure between the grinding wheel and the work piece being ground.

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