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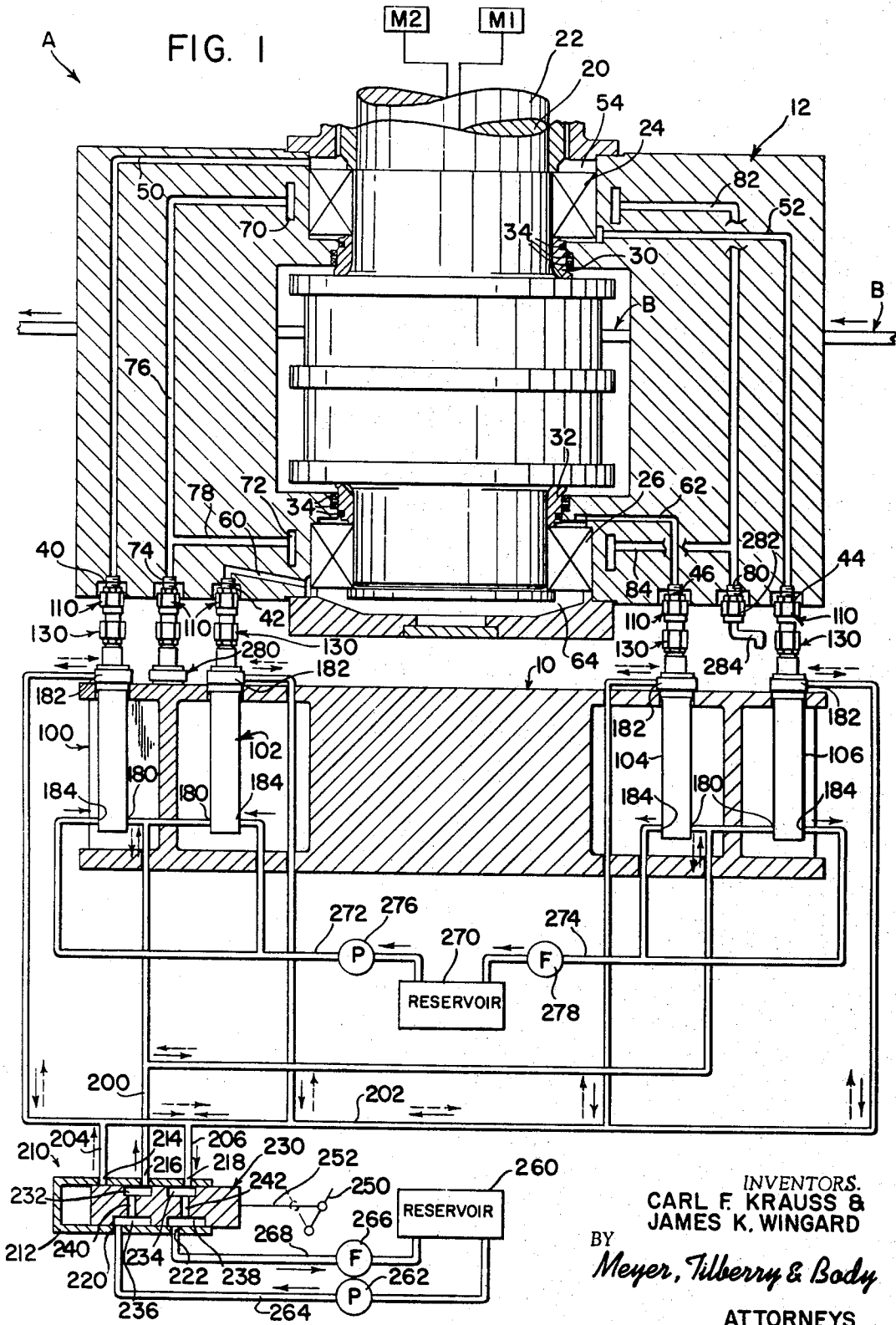
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3,406,552

REMOTELY OPERATED FLUID COUPLING MECHANISM FOR A ROLLING MILL OR A SIMILAR DEVICE

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2 Sheets-Sheet 1



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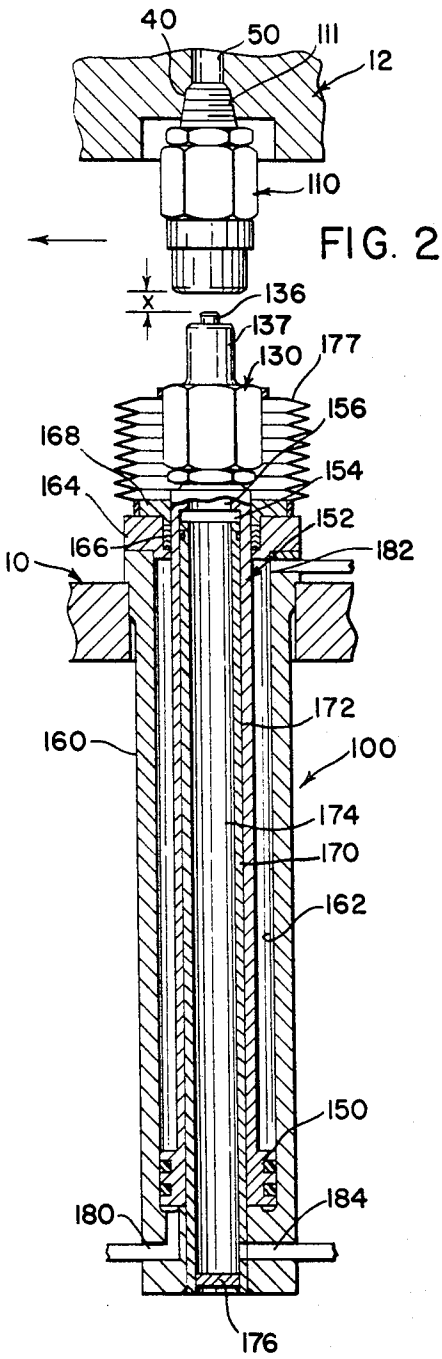


FIG. 2

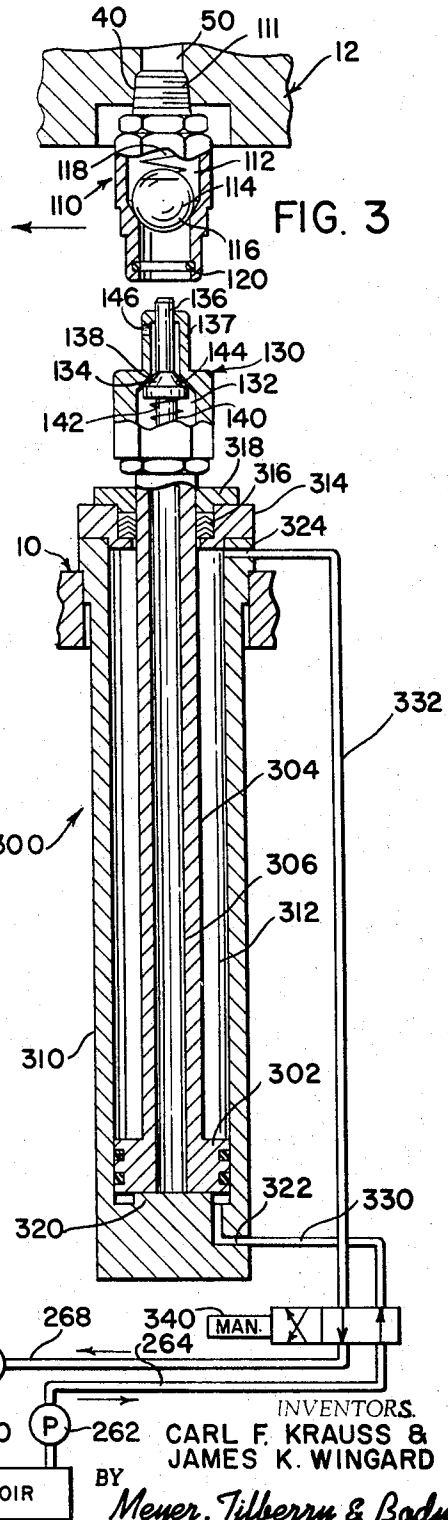


FIG. 3

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REMOTELY OPERATED FLUID COUPLING MECHANISM FOR A ROLLING MILL OR A SIMILAR DEVICE

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ABSTRACT OF THE DISCLOSURE

There is provided a device for coupling and uncoupling the coolant and lubricant lines between the removable work roll supporting housing and the fixed frame of an edging mill. This device includes a first set of nipples on the housing and a matching second set of nipples on the frame. These nipples are the type which seal themselves when the nipples are separated. A fluid system on the fixed frame shifts the second set of nipples between a first position with the nipples joined and a second position with the nipples separated. When the nipples are separated, the housing may be removed from the frame without interference from the nipples on the frame.

Disclosure

The present invention pertains to the general art of rolling mills used for forming continuously moving metal workpieces, such as metal strip, and more particularly to a remotely operated fluid coupling mechanism for a rolling mill, or a similar device.

This invention is particularly applicable for use on a rolling mill used in sizing metal strip and including a pair of parallel working rolls secured within a housing or housings releasably mounted onto a fixed frame structure, and it will be described with particular reference to this specific application; however, it will be appreciated that the invention has much broader uses and may be used with other devices which require a remotely operated fluid connection between a first fixed structural member and a second structural member releasably secured thereto.

The production of thin gauged metal strip generally requires a rolling mill having at least one pair of parallel working rolls between which the strip passes. These working rolls may either reduce the thickness of the strip, or size the width of the strip according to the disposition of the working rolls with respect to the strip. The latter-mentioned operation employs a mill known as an "edging mill." The present invention is particularly applicable to an edging mill because the working rolls are each secured within a housing member that must be removed from the mill when work is to be done on the working roll. The frequent removal of the roll supporting housing presents certain difficulties. For instance, the roll housing is provided with a network of fluid conduits for directing lubricants to the working roll bearings and for circulating cooling water through the housing to reduce the temperature of the bearings and the rolls in general. Fluid, such as lubricant and coolant, must be directed into the working roll housing from the fixed frame onto which the housing is secured. Coupling and uncoupling the fluid conduits in the housing with appropriate fittings on the fixed frame has heretofore required a considerable amount of time because the couplings between the housing and the frame must be located in somewhat inaccessible places. Also, the previously used fluid coupling arrangements presented protruding elements which somewhat hindered the actual removal of the housing from the mill frame.

All of these disadvantages of the prior fluid coupling

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mechanisms between the working roll housing and the fixed frame of an edging mill are completely overcome by the present invention which is directed toward an improved fluid coupling mechanism which is remotely operated and presents no interference to the actual removal of the housing from the mill when disconnected or uncoupled.

In accordance with the broadest aspect of the present invention, there is provided a fluid coupling mechanism between a supply of pressurized fluid supported onto a first structural member and a fluid conduit on a second structural member releasably secured to the first member. This coupling mechanism comprises a first nipple on the second member and communicated with the conduit and a second nipple, with each nipple having an internal passageway and a valve element normally closing the passageway. There is also provided means on at least one of the nipples for opening the valve elements when the nipples are forced together. The second nipple is supported onto a piston having a central passageway communicating the passageway of the second nipple with the supply of pressurized fluid. The piston is reciprocally received within a cylinder fixedly secured onto the first structural member and axially aligned with the first nipple, and means are provided for selectively directing fluid into the cylinder to move the piston between a first position with the nipples separated and a second position with the nipples forced together whereby fluid may be directed from the pressurized supply, through the passageways and into the fluid conduit when the nipples are in the second position.

When this fluid coupling mechanism is used for all of the fluid connections between the working roll housing and fixed frame of an edging roll, the second nipples may be moved in unison away from the working roll housing by a remote actuator, such as a valve. With all of the second nipples drawn or forced away from the working roll housings, the housings may be easily removed from the edging roll without interference from protruding elements on the coupling mechanism. When the working roll housing is replaced, the remote actuator forces all second nipples into the first nipples on the working roll housings so that the bearings may be lubricated and coolant may be circulated through the housing. After the bearings are adequately lubricated, the coupling mechanisms used for the lubricant may be detached, while the coupling mechanisms for the coolant system are maintained in their operative position for continuous use. This arrangement provides a substantial improvement in the fluid coupling arrangement between the removable working roll housing and fixed frame of the standard edging mill.

Other objects and advantages will become apparent from the following description used to illustrate the preferred embodiments of the invention as read in connection with the accompanying drawings in which:

FIGURE 1 is a schematic view showing, in cross-section, the general application of the present invention;

FIGURE 2 is an enlarged cross-sectional view illustrating the preferred embodiment of the present invention; and

FIGURE 3 is an enlarged cross-sectional view, similar to FIGURE 2 and showing a modification of the preferred embodiment of the invention.

Referring now to the drawings wherein the showings are for the purpose of illustrating preferred embodiments of the invention only and not for the purpose of limiting same, FIGURE 1 shows an edging mill A for sizing the transverse edges of a moving strip B. The edging mill is schematically illustrated as including a lower fixed frame 10 and a housing 12 releasably secured onto the frame with known structures, not shown. Housing 12 supports a working roll 20, and a similar housing is provided for

mounting a parallel working roll 22. The rolls 20, 22 are driven by motors M1, M2, respectively, which are shown only schematically to better represent the environment to which the present invention is particularly adapted. Each housing 12 is identical; therefore, only one housing is shown and will be discussed. The housing supports bearings 24, 26 which engage the axially spaced necks of the working roll 20 to hold the roll in an operative position. Sealing rings 30, 32 coact with a plurality of annular seals 34 to isolate the bearings 24, 26 from the operative portion of the roll.

Housing 12 includes a bearing lubricant system having inlets 40, 42 and outlets 44, 46. Referring now to the portion of the lubricant systems for bearing 24, an inlet conduit 50 is connected to inlet 40, and outlet conduit 52 is connected to outlet 44. A chamber 54 surrounds bearing 24 and communicates the inlet conduit 50 with the outlet conduit 52. The portion of the lubricant system for lubricating bearing 26 is somewhat similar to the portion of the lubricant system for lubricating bearing 24. This former-mentioned portion includes inlet conduit 60 connected to inlet 42, and outlet conduit 62 connected to outlet 46. A chamber 64 surrounds bearing 26 and provides communication between the inlet and outlet conduits. The lubricant system not only supplies lubricant to the bearings, but also circulates lubricant through the bearing chambers so that rejuvenated lubricant is periodically supplied to the bearing chambers 54, 64.

To remove heat from the housing 12, especially adjacent bearings 24, 26, the housing is provided with a coolant system including annular passages 70, 72. An inlet 74 is communicated with inlet conduits 76, 78 connected with passages 70, 72, respectively. A coolant outlet 80 is communicated with outlet conduits 82, 84, which direct coolant from the annular passages 70, 72. Consequently, the coolant system provides a continuous flow of coolant through the critical areas of housing 12.

It is appreciated that the edging mill A, as so far described, is somewhat conventional, and it is only schematically represented to illustrate the environment to which the invention to be described in detail, is particularly adapted. The particular cooling and lubricating systems may be changed without departing from the invention.

When the rolls 20, 22 are to be reground or otherwise repaired, one or both of the housings 12 must be removed and taken to a maintenance area. This presents certain practical problems. The lubricant system and coolant system for the housings must be disconnected from the fixed frame 10 even though the location of the various inlets and outlets is somewhat inaccessible. For this reason, it has heretofore been a time consuming task to efficiently remove one of the roll housings from the fixed frame. The present invention is directed toward a coupling mechanism for the inlets and outlets which mechanism substantially decreases the effort, and time, required to disconnect the housings and remove the same from the edging mill proper.

In accordance with the invention, there is provided novel coupling mechanisms 100, 102 for inlets 40, 42 and novel coupling mechanisms 104, 106 for outlets 46, 44. Each of the coupling mechanisms is substantially identical; therefore, only coupling mechanism 100 will be described in detail, and this description will apply equally to the other coupling mechanisms. Referring now to FIGURE 2, coupling mechanism 100 includes a first nipple 110 having an upwardly extending threaded shank 111 secured onto inlet 40. The first nipple is best shown in FIGURE 3 and includes an internal passageway 112 communicated with conduit 50 and a ball valve element 114 adapted to engage selectively valve seat 116 under the influence of biasing spring 118. An O-ring seal 120 is provided in a lowermost portion of passageway 112.

A second nipple 130, best shown in FIGURE 3, includes passageway 132 and a reciprocal poppet valve 134 having a nose 136 extending outwardly from shank 137, a

valve seat element 138, and a spring support stem 140. Coil spring 142 is received around stem 140 and biases the valve element 138 into the closed position. The outer housing of second nipple 130 includes a seat 144 coacting with element 138 to seal passageway 132, and an aperture 146 in shank 137.

In operative of the two nipples, when the nipples are in a first, or "down" position, they are separated and the valve elements 114, 138 are closed. Consequently, there is no flow path through the respective nipples. The nipples are separated by a distance x which allows the housing 12 to be moved transversely as shown by the arrows in FIGURES 2 and 3 without interference from upwardly projecting structural elements. This substantially enhances the ability to remove housings 12 from the edging mill for repair purposes. When nipple 130 is forced upwardly into a second position, the shank 137 moves into passageway 112 and shifts the ball valve element 114 from its seat. O-ring 120 engages shank 137 below orifice 146 to provide a closed connection between the two nipples. Also, the orifice 146 is then directly communicated with passageway 112 of nipple 110. Ball valve element 114, when the nipples are in the second position, abuts nose 136 and forces poppet valve 134 downwardly. This lifts valve element 138 from its seat 144 and provides a direct communication between the passageway 132 of the second nipple and passageway 112 of the first nipple. In this second position, the coupling mechanism 100 is ready to direct lubricant into conduit 50.

Referring again to FIGURE 2, the structure utilized by mechanism 100 for shifting the position of nipple 130 with respect to nipple 110 includes an annular piston 150 having a hollow rod 152 onto which nipple 130 is fixed. Passageway 132 of nipple 130 is communicated with central passage 154 of the rod by an aperture 156. A cylinder 160 is fixedly secured onto frame 10 so that nipple 130 is vertically aligned with nipple 110. The cylinder includes an annular piston receiving passageway 162 which is closed by an upper end cap 164. A rod seal 166 is held in position by a ring 168 to prevent fluid flow outward around the rod from passageway 162. An upwardly extending support sleeve 170 in cylinder 160 has an outer surface 172 telescopically receiving the reciprocal hollow rod 152. Sleeve 170 is provided with a passageway 174 communicated directly to central passage 154 and a lower cap 176 to close the lower end of the sleeve. A dust shield or bellows 177 is provided between ring 168 and the upper portion of nipple 130.

A lower passage 180 is communicated with cylinder passageway 162 on the side of piston 150 opposite from second nipple 130. In a similar manner, an upper passage 182 is communicated with passageway 162 on the side of piston 150 facing the second nipple 130. Opposite passage 180 there is a fluid passage 184 which acts as either an inlet or as an outlet, according to the function desired for the coupling mechanisms.

In operation, fluid is introduced into lower passage 180 while upper passage 182 is exhausted or vented. This forces nipple 130 into nipple 110 and opens the internal valve elements of these nipples. Thereafter, fluid may flow through the nipples and passage 184. By connecting passage 180 with a vent and connecting passage 182 with a supply of pressurized fluid, the nipples are separated, as shown in FIGURE 2. This closes the internal valve elements of the nipples and prevents fluid flow there-through. Of course, the pressure of the fluid introduced into passage 182 must be sufficiently high to force piston 50 downwardly against any force upwardly by fluids within passages 154, 174. The particular construction of mechanism 100 includes a plurality of concentric elements; therefore, the ease of manufacturing this mechanism is readily apparent.

Referring again to FIGURE 1, the system secured with respect to the fixed frame 10 for supplying lubricant to the housing 12 and actuating the coupling mechanisms

100, 102, 104 and 106 is schematically illustrated. A hydraulic line 200 is connected with the lower passages 180 of the mentioned coupling mechanisms. In a like manner, a hydraulic line 202 having branches 204, 206 is connected with the upper passages 182. A valve 210 controls fluid flow to lines 200, 202 for raising and lowering the second nipples 130. This valve includes a housing 212 having openings 214, 216, 218, 220 and 222. Reciprocally mounted within the housing is a shuttle 230 having recesses 232, 234, 236 and 238. A port 240 joins recesses 232, 236, and a port 242 joins recesses 234, 238.

The shuttle 230 is reciprocated selectively by an appropriate actuator, schematically represented as a lever 250 and a connecting link 252. When the lever 250 is positioned as shown in FIGURE 1, line 202 is hydraulically communicated with opening 222, and line 200 is communicated with opening 220. When the shuttle 230 is shifted by moving lever 250 to the dashed line position, line 202 is connected with opening 220 and line 200 is connected with opening 222. Consequently, movement of lever 250 reverses the openings which are communicated with the control lines for the four coupling mechanisms.

Hydraulic fluid is maintained within a reservoir 260 from which it may be forced by a pump 262 through line 264 to opening 220. A filter 266 is provided within a return line 268 connecting the reservoir with opening 222. Lubricant is maintained within a second reservoir 270 connected by line 272 with passages 184 of mechanisms 100, 102. A return line 274 communicates the passages 184 of mechanisms 104, 106 with the lubricant reservoir 270. The lubricant is pressurized by a pump 276 in line 272 and is cleaned by a filter 278 in line 274.

In operation, when the housings 12 are in place, lever 250 is moved into the position shown in FIGURE 1. Pressurized fluid is forced through opening 220 into line 200 and the pistons 150 are moved upwardly. This forces the second nipples 130 of mechanisms 100, 102, 104 and 106 into the respective first nipples 110. Branch 206 of line 202 is communicated with opening 222 so that hydraulic fluid is returned to reservoir 260 through filter 266. In this position, pump 276 forces lubricant through the mechanisms 100, 102 into the bearing chambers 54, 64. The lubricant then flows through the mechanisms 104, 106 and filter 278 back into the reservoir 270. After the bearings are properly lubricated with clean lubricant, lever 250 is moved to the left. This communicates line 202 with opening 220 and line 200 with opening 222. In this manner, pressurized hydraulic fluid is forced through passages 182 of the coupling mechanisms, and passages 180 are vented to the return line 268. This uncouples the various coupling mechanisms until further lubricant is required. While uncoupled, the mechanisms present no interference to the removal of housings 12.

Referring now to the water system within the housings 12, there is provided a coupling mechanism 280, partially shown in FIGURE 1. This mechanism is moved upwardly and downwardly by a separate system similar to the system disclosed in connection with the coupling mechanisms for lubricating bearings 24, 26. The outlet 80 for the cooling system is provided with an outlet nipple 282 and an outlet line 284. Coupling mechanism 280 is maintained in the coupled position during continued use of the edging mill. Water is continuously circulated through the mechanism 280 and out the line 284. When it is desired to remove one of the housings 12, mechanism 280 is shifted into the uncoupled or separated position so that the coupling mechanism presents very little interference to the actual removal of the housing from the edging mill. All of the coupling mechanisms are remotely controlled so that an operator does not have to work in an inaccessible location to uncouple the various fluid connections of a housing 12 preparatory to its removal from the mill.

Referring now to FIGURE 3, a modification of the present invention is illustrated. Remotely controlled cou-

pling mechanism 300 includes a piston 302 having a rod 304 which supports the nipple 130. A central passage 306 extends through the rod to the under side of the piston 302 and thus, provides communication between the side of the piston opposite nipple 130 and the nipple passageway 132. A cylinder 310 supported on fixed frame 10 reciprocally receives piston 302 within a chamber 312. The end of the chamber is closed by a cap 314, a seal 316 and a holding ring 318. The lower portion of chamber 312 includes a bottom abutment 320, which maintains the piston 302 away from the bottom of the chamber.

Passages 322, 324 are connected onto fluid lines 330, 332, respectively. A remotely operated valve 340, somewhat similar to valve 210, connects lines 330, 332 selectively with the pressure line 264 and the exhaust 268 of reservoir 260. In this embodiment of the invention, the second nipple 130 is moved by the lubricant itself and not by separate hydraulic systems.

In operation, lubricant is maintained within reservoir 260 and pump 262 forces the lubricant through line 330 into chamber 312 on the side of piston 302 opposite from nipple 130. In this manner, the piston 302 is moved upwardly, and the nipples 110, 130 are forced together. This opens the nipple passageways and allows lubricant to flow through central passage 306 into the lubricant system of the housing 12. Since the bottom area of piston 302 is substantially larger than the area of passage 306, the piston is held in the up position even through the nipples are open. To disconnect the nipples, valve 340 is shifted to reverse the connections of lines 330, 332. This forces pressurized lubricant into chamber 312 on the side of the piston facing the nipple 130. At the same time, the opposite side of the piston is exhausted through line 268. This causes the nipples to separate and close. This same type of mechanism could be used for coupling the water system of housing 12 if the reservoir 260 includes water; however, the coupling mechanism 300 is primarily used for the lubricant system.

The embodiments of the invention shown in FIGURES 2 and 3 provide a mechanism for remotely operating the various fluid connections between the working roll housing of an edging mill and the fixed frame of the mill. The benefits of this type of arrangement in an edging mill have been previously discussed.

The present invention has been described in connection with certain structural embodiments; however, it should be appreciated that various changes may be made in these embodiments without departing from the intended spirit and scope of the present invention.

Having thus described our invention, we claim:

1. In a rolling mill including two parallel working rolls, each roll having axially spaced necks, a housing releasably secured onto a stationary mill frame, journal means in said housing and surrounding said necks for supporting said working rolls, means for rotating said working rolls to process a workpiece passing between said rolls, a conduit in said housing and communicated with said journal means for lubricating said journal means, said conduits having at least one inlet on said housing, and means for forcing lubricant through said inlet and into said conduit, the improvement comprising: said lubricant forcing means comprising a first nipple on said housing at said inlet, a second nipple, said nipples each having an internal passageway and a valve element normally closing said passageway, means on at least one of said nipples for opening said valve elements when said nipples are forced together, said second nipple being supported on a piston having a central passageway communicating said passageway of said second nipple with a pressurized supply of lubricant fixed with respect to said stationary mill frame, a cylinder fixedly secured onto said stationary mill frame and axially aligned with said first nipple when said housing is secured onto said frame, said piston being reciprocally received in said cylinder, and means for

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selectively directing fluid into said cylinder to move said piston between a first position with said nipples separated and a second position with said nipples forced together whereby lubricant is directed from said supply to said housing conduit.

2. The improvement as defined in claim 1 wherein said central passageway extends through said piston to the side of said piston opposite said second nipple, a first supply conduit communicating said lubricant supply with said cylinder on the side of said piston opposite said second nipple, and said fluid directing means comprising first control valve means for selectively opening and closing said supply conduit whereby when said conduit is opened said lubricant forces said piston to said second position and when said lubricant is closed said piston can move to said first position.

3. The improvement as defined in claim 2 wherein said fluid directing means also includes a second supply conduit communicated with said cylinder on the side of said piston facing said second nipple, and second control valve means for connecting said second supply conduit with a supply of pressurized fluid when said first control valve means is closed whereby said piston is forced into said first position.

4. The improvement as defined in claim 3 wherein said supply of pressurized fluid is said pressurized supply of lubricant.

5. The improvement as defined in claim 1 wherein said cylinder includes an internal sleeve communicated with said pressurized supply of lubricant, said piston is annular and includes a hollow rod telescopically received over said sleeve, said control passageway being communicated with the interior of said sleeve and rod, and said fluid directing means being a supply of pressurized fluid and control valve means for selectively communicating said supply of pressurized fluid to either the side of said annular piston opposite said second nipple to move said piston into said second position or the side of said annular piston facing said second nipple to move said piston into said first position.

6. The improvement as defined in claim 5 including means venting the side of said annular piston opposite to

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the side communicated with said supply of pressurized fluid by said control valve means.

7. The improvement as defined in claim 1 including a second housing conduit communicated with said journal means, said second conduit terminating in an outlet and means for opening said outlet when said piston is in said second position.

8. A fluid coupling mechanism between a supply of pressurized fluid supported onto a first structural member and a fluid conduit on a second structural member releasably secured onto said first structural member, said coupling mechanism comprising a first nipple on said second member and communicated with said conduit, a second nipple, said nipples each having an internal passageway and a valve element normally closing said passageway, means on at least one of said nipples for opening said valve elements when said nipples are forced together, said second nipple being supported on a piston having a central passageway communicating said passageway of said second nipple with said supply of pressurized fluid, a cylinder fixedly secured onto said first structural member and axially aligned with said first nipple when said second member is secured onto said first member, said piston being reciprocally received in said cylinder, and means for selectively directing fluid into said cylinder to move said piston between a first position with said nipples separated and a second position with said nipples forced together whereby fluid is directed from said supply, through said passageways and into said fluid conduit.

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