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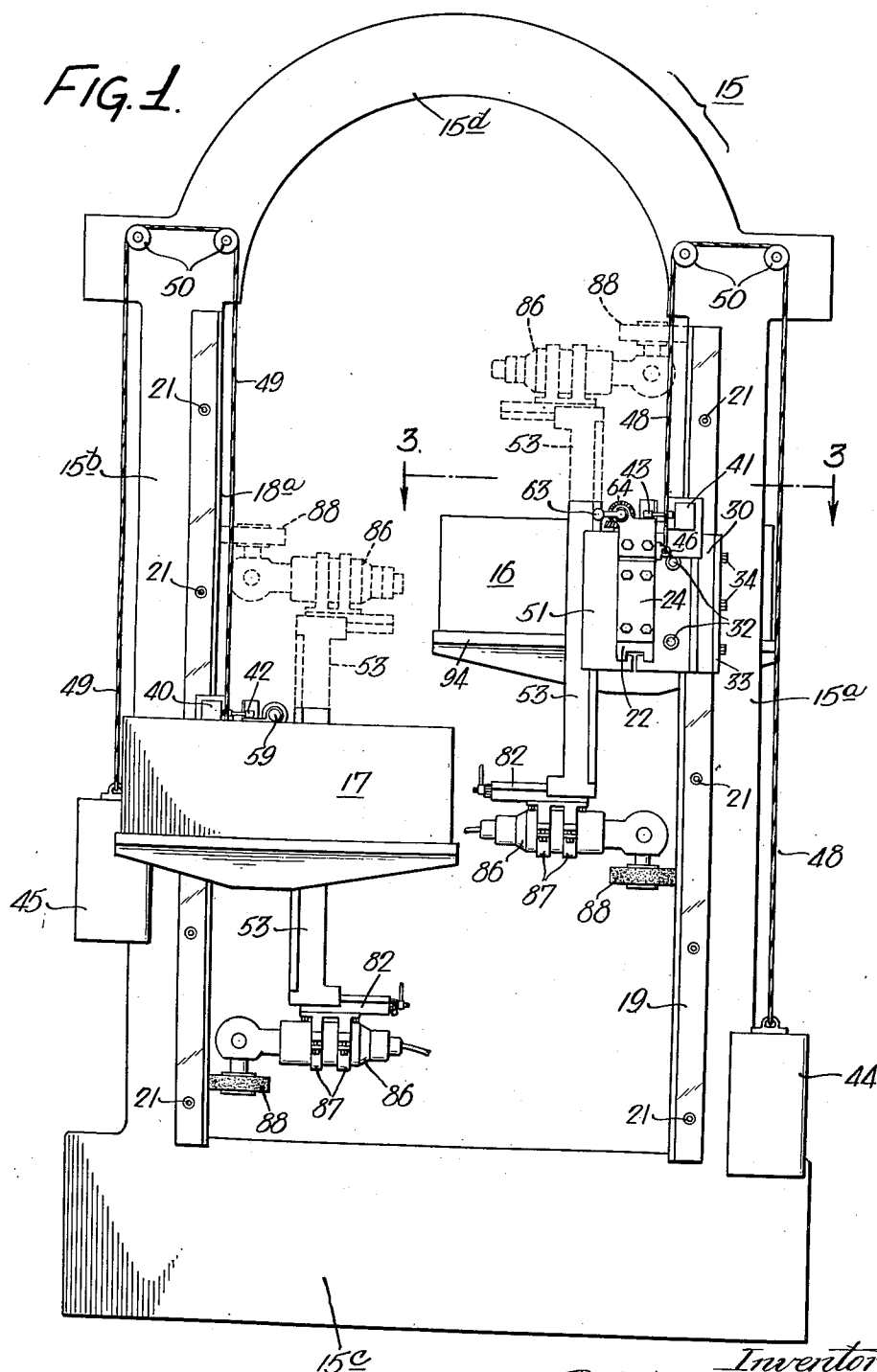
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2,581,244

SURFACE GRINDER FOR MILL HOUSINGS AND THE LIKE

Filed Sept. 16, 1949

5 Sheets-Sheet 1



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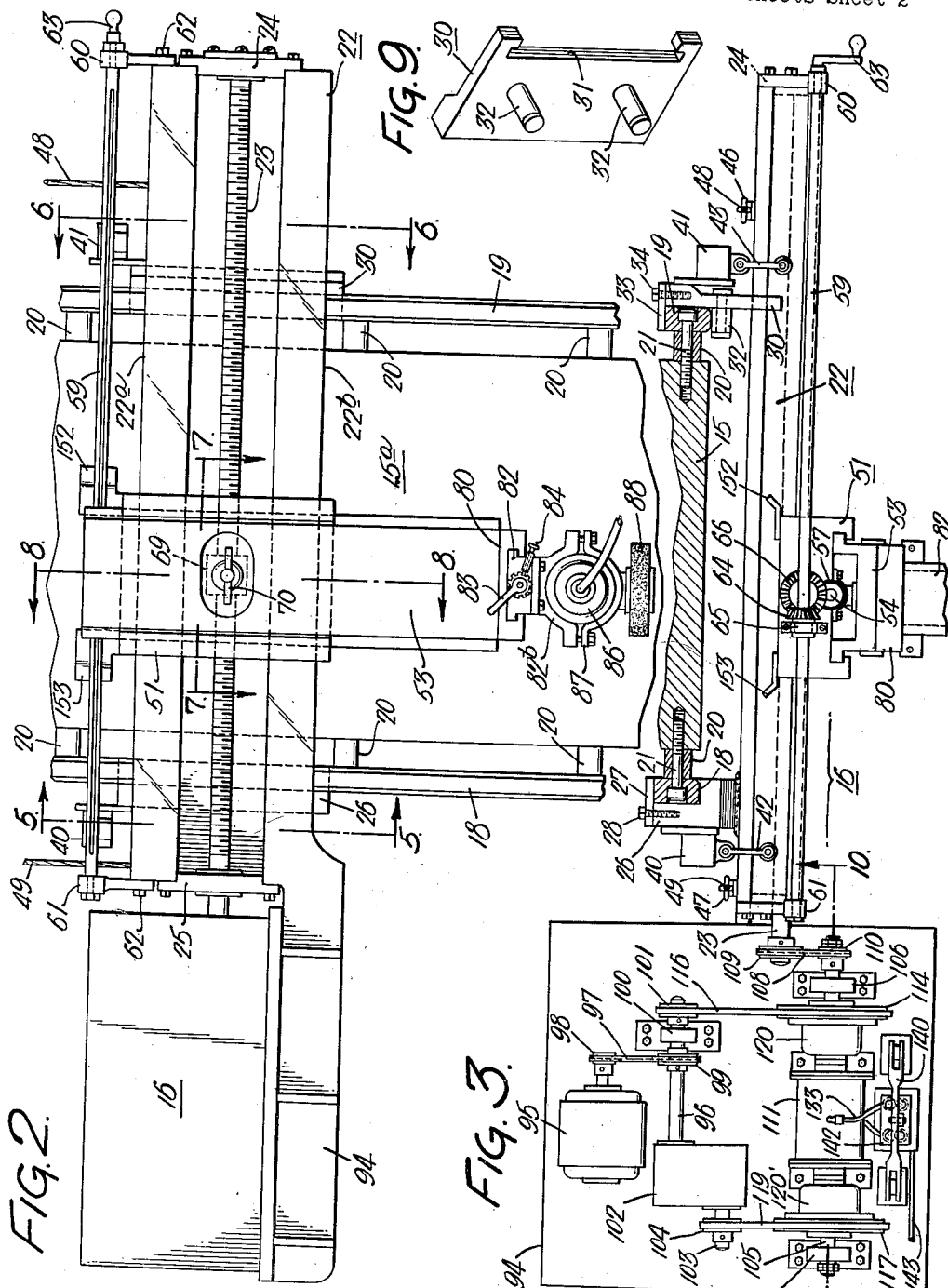
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SURFACE GRINDER FOR MILL HOUSINGS AND THE LIKE

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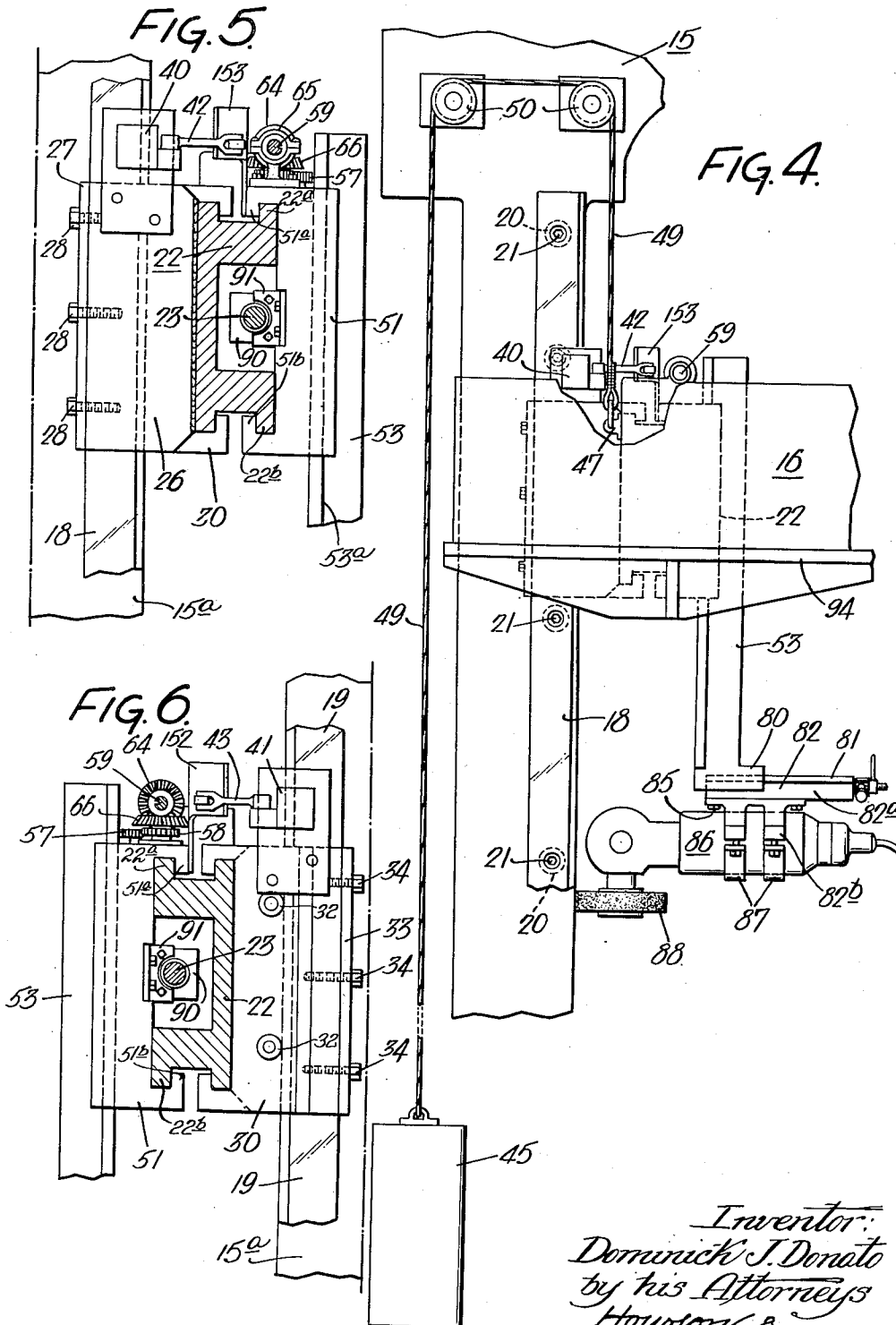
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FIG. 7.

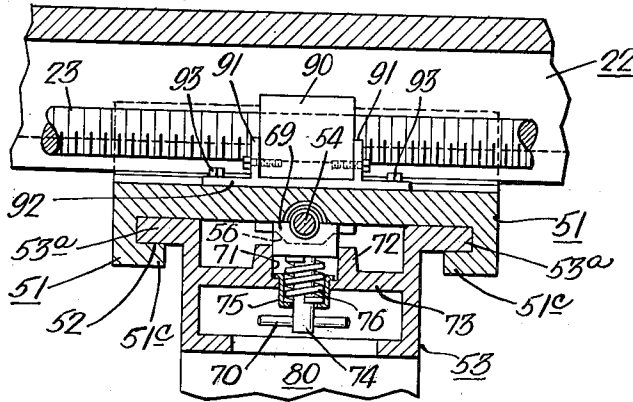
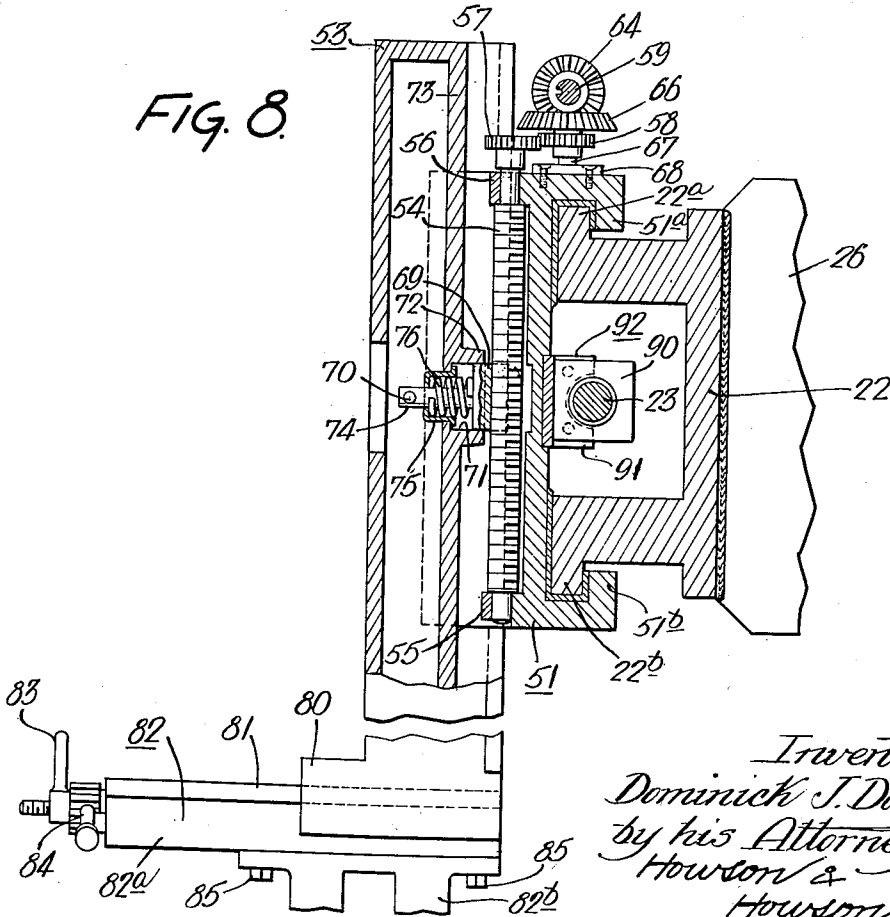


FIG. 8.



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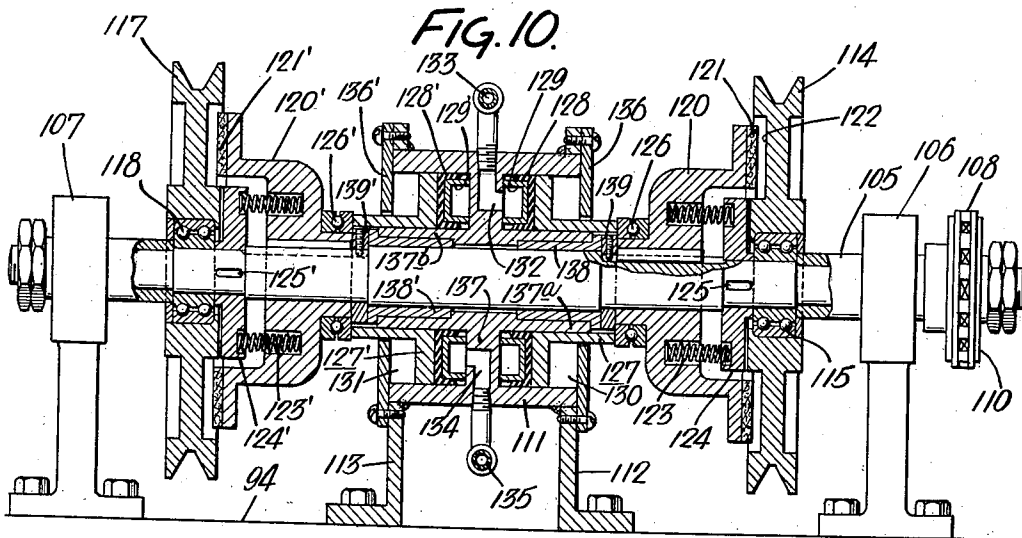
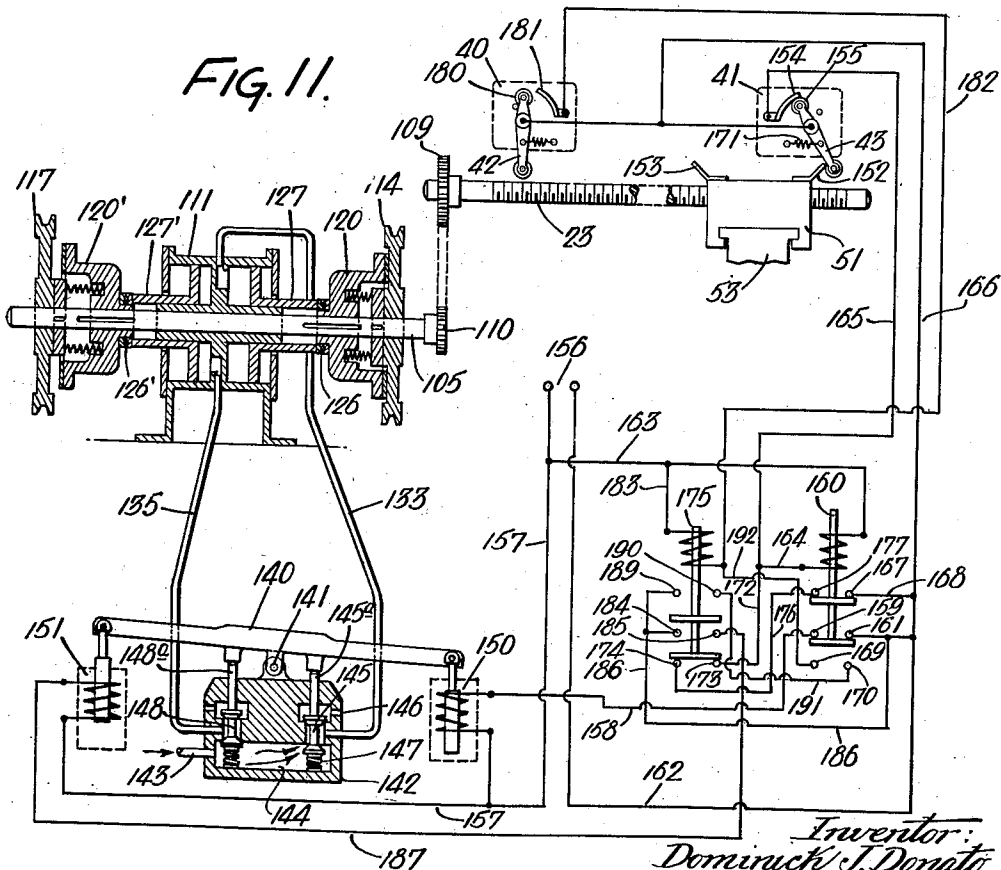
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SURFACE GRINDER FOR MILL HOUSINGS AND THE LIKE

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5 Sheets-Sheet 5



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## UNITED STATES PATENT OFFICE

2,581,244

SURFACE GRINDER FOR MILL HOUSINGS  
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Application September 16, 1949, Serial No. 116,195

4 Claims. (Cl. 51-241)

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This invention relates to surface grinders and more particularly to a grinder adapted to be used on large vertical surfaces such as rolling mill housings.

The housing of a rolling mill used in sheet steel and steel plate mills is subject to considerable wear due to the tremendous stresses and impacts exerted during the rolling of a steel billet into steel sheet or plate. When the wear in the mill housing exceeds predetermined tolerances, it is necessary to take down the mill and to replace or to refinish the worn surfaces of the housing. The size of the housings has been such that heretofore no adequate means even in large rolling mills could be employed to repair these housings in situ, and it was necessary to ship them to a location where special equipment was available for this purpose. This necessitated lengthy shutdowns and involved considerable expense. In order to overcome this difficulty, I have devised an apparatus whereby the mill housing may be refinished and put back into operation within a matter of hours.

A primary object of the invention therefore, is to provide a grinder which may be quickly attached to a mill housing and which will automatically and accurately finish the surface of said housing.

A further object of the invention is to provide an improved mounting and supporting structure for heavyweight grinding attachments.

A further object of the invention is to provide improved automatic control mechanisms for a heavy surface grinder.

A still further object of the invention is to provide an automatic reversing mechanism for surface grinders and the like, by which reversal of direction is instantaneous.

Further objects will be apparent from the specification and drawings in which:

Fig. 1 is a side elevation showing a mill housing having a pair of surface grinders attached thereto;

Fig. 2 is a fragmentary end elevation of one of the grinders shown in Fig. 1;

Fig. 3 is a fragmentary sectional view on an enlarged scale, as seen at 3-3 of Fig. 1;

Fig. 4 is an enlarged fragmentary elevation showing the opposite side of one of the grinders seen in Fig. 1;

Fig. 5 is a transverse sectional view on an enlarged scale, as seen at 5-5 of Fig. 2;

Fig. 6 is a transverse sectional view on an enlarged scale, as seen at 6-6 of Fig. 2;

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Fig. 7 is a longitudinal sectional view on an enlarged scale, as seen at 7-7 of Fig. 2;

Fig. 8 is an enlarged sectional detail, as seen at 8-8 of Fig. 2;

Fig. 9 is a perspective showing one of the gib plates for guiding the grinder on the ways;

Fig. 10 is an enlarged sectional detail, as seen at 10-10 of Fig. 3; and

Fig. 11 is a diagrammatic view of the reversing mechanism of Fig. 10 and the wiring diagram therefor.

The invention comprises essentially the provision of a pair of removable ways for the vertical side edges of a mill housing or other large structure on which it is desired to mount a surface grinder. In the present instance, the ways are intended to be quickly attached just prior to the grinding operation and they may then be quickly detached in order to put the mill housing back into service. The grinder itself comprises a framework adapted to slide vertically on the mill housing ways on gibs. The framework at one end has a platform on which the reversing mechanism for a transverse horizontal feed screw is mounted. This horizontal feed screw serves to reciprocate a carriage back and forth over the framework and suitable limit stops adapted to be contacted by the carriage actuate the reversing mechanism for the horizontal feed screw. The carriage is provided with a cross head which can be adjusted in a vertical direction by means of a vertical feed screw on the cross head. In the preferred form, the amount of vertical travel for the cross head is on the order of one foot, so that after the maximum travel for the cross head has been reached in one position, the entire grinder assembly may be raised to a successive position on the ways, whereupon the grinding operation is resumed. Suitable counterweights are provided for readily raising and lowering the entire assembly. The cross head carries a bracket in which the grinder is mounted and the amount of cut is controlled by means of a second horizontal feed screw located at right angles to the main reversible feed screw on the frame.

In addition to the reversing mechanism which enables the direction of travel of the carriage to be reversed so quickly that it is possible to reverse carriage travel in the middle of a traverse without waiting for the grinder to become disengaged with the workpiece, the carriage may also be mounted at 180° positions so that the grinder may be either above or below the main frame.

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Referring now more particularly to the drawings, a mill housing 15 comprises a pair of upright pillar sections 15a, 15b, a base 15c, and a connecting arch 15d. The inner oppositely opposed faces of pillars 15a and 15b are finished and must be held to close working tolerances. In refacing the bearing surfaces of pillars 15a and 15b, I propose to build up these faces with stainless steel to a point well beyond the finished dimension. Grinder assemblies 16 and 17 are then mounted on vertical ways 18, 18a, and 19, which are detachably secured to the housing by means of spacing collars 20, 20 and cap screws 21, 21. It will be understood that Fig. 1 illustrates the use of grinder assemblies 16 and 17 which are identical in every respect. In the interest of clarity therefore, it is considered necessary to describe only one grinder assembly although it will be understood that in servicing a mill housing, it may be desirable to operate two simultaneously.

The grinder assembly proper comprises cross frame 22 which supports the main horizontal feed screw 23 by means of end plates 24, 25 in which the feed screw is suitably journaled. The frame member 22 is welded at one end to gib 26 (Fig. 5) which extends backwardly to engage the outside face of way 18 and also to abut the front face of way 19 as shown in Fig. 3. A retaining plate 27 is secured to the rear edge of gib 26 by means of cap screws 28, 28. The other end of frame member 22 is slidably guided on way 19 by means of a gib plate 30 (Fig. 9) having a T-slot 31 adapted to fit over member 22, as shown in Figs. 3 and 6. Gib plate 30 is provided with a pair of rollers 32, 32 which engage the front face of way 19. Retaining plate 33 slidably contacts the rear edge of way 19 and is attached to plate 30 by means of cap screws 34, 34. Gib 26 carries a limit switch assembly 40, whereas gib 30 likewise carries a limit switch 41 and these switches are provided with contact arms 42 and 43 respectively. The function of the switches will be more fully described hereinafter.

Vertical movement of the grinder assembly is guided and controlled by means of ways 18 and 19 and the cooperating structure described above, which is secured to the frame member 22. Raising and lowering of the grinder is facilitated by means of counterweights 44 and 45 which are attached to frame 22 at rings 46, 47 by means of cables 48 and 49 suspended from pulleys 50, 50.

As shown in Figs. 3, 5 and 6, frame member 22 is provided on its front face with upper and lower flanges 22a and 22b on which the carriage 51 reciprocates back and forth horizontally. The carriage 51 has cooperating legs and flanges 51a and 51b forming a horizontal guide which overlaps the flanges 22a and 22b of the frame member 22. The front face of carriage 51 is provided with a vertical T-slot 52 which permits vertical movement of cross slide 53 by means of the overlapped interengagement between flanges 53a, 53a on cross slides 53, and flanges 51c, 51c on carriage 51.

The cross slide 53 is actuated vertically by means of screw 54 journaled in brackets 55 and 56 on carriage 51 (Fig. 8) and this screw extends upwardly through bracket 56 where it is provided with a gear 57 which meshes with gear 58. The actuating mechanism for screw 54 comprises a slotted or splined shaft 59 which extends substantially the entire length of frame 22 and is mounted in brackets 60 and 61 bolted to the ends of frame 22 by means of screws 62, 62. A hand

crank 63 is secured to one end of shaft 59 which extends through bracket 60 for convenient manual adjustment of the cross slide. The central portion of shaft 59 is slidably engaged with bevel gear 64 which is journaled in bracket 65, mounted on the top of carriage 51. Bevel gear 64 meshes with bevel gear 66 which is in turn secured to gear 58 by means of vertical shaft 67 pivotally supported in plate 68. It will thus be apparent that rotation of crank 63 serves to turn screw 54 and thus raise and lower cross slide 53 through a half nut 69 which is selectively engageable with screw 54 by means of a handle 70 (Fig. 7). Half nut 69 is horizontally slidable in a socket 71 formed by walls 72, 72 formed on web 73 of the cross slide 53. The half nut 69 is provided with a shank 74 extending through a cup washer 75 seated in socket 71 and retaining a helical spring 76 which serves to urge the nut against the threads of screw 54. When the handle 70 is retracted, spring 76 is compressed and nut 69 withdrawn from engagement with the threads of screw 54 to a distance sufficient to permit the nut to pass over both brackets 55 and 56. In this way, the cross slide may be completely removed from carriage 51 in order that its position may be reversed on the carriage.

The bottom of the cross slide 53 carries an elongated guideway 80 having a horizontal T-slot which is engaged by the flanges 81, 81 of grinder bracket 82. Adjustment of the grinder bracket 82 is achieved by means of a threaded wing nut 83 which may be locked in any desired position by means of a spring-loaded dog 84. The grinder bracket 82 may be made in two parts, as shown in Fig. 8, in which the upper part 82a is in slidable engagement with the guideway 80 of cross slide 53, and in which the lower part 82b is secured to the upper part 82a by means of cap screws 85, 85. A conventional electric or pneumatic grinder 86 is clamped in bracket 82 by means of caps 87, 87 and is provided with a grinding wheel 88 adapted to contact the work surface to be ground.

Reciprocating action of carriage 51 and its associated elements is achieved through feed screw 23 which is threadedly engaged with a follower nut 90. Nut 90 is secured between the arcuate flanges 91, 91 of bracket 92 which is in turn secured to the carriage by means of screws 93, 93. It will thus be understood that clockwise rotation of screw 23 causes carriage 51 to travel horizontally in one direction across frame member 22, and counterclockwise rotation of screw 23 causes carriage 51 to travel in the opposite direction. Frequently it becomes necessary to reverse the direction of carriage travel short of a full stroke in order to grind off an especially high spot on the mill housing. In this event, unless the carriage is reversed in a minimum of time, an undesired depression or groove may be ground in the face of the housing. In order to eliminate this disadvantage therefore, I have devised an especially efficient and quick-operating reversing mechanism for the feed screw 23.

Referring now to Figs. 2 and 3, frame member 22 at one end is provided with an extension which forms a platform 94 on which is mounted an electric motor 95 drivingly connected to jackshaft 96 by means of chain 97 and sprockets 98, 99. Jackshaft 96 is journaled in pillow block 100 at one end and is provided with a pulley 101 rigidly secured thereto. At the other end, jackshaft 96 is journaled in and drives a reverse gear box 102

which causes shaft 103 and pulley 104 to turn in a direction opposite to that of shaft 96.

Referring now to Fig. 10, the specific structure of the reversing device comprises a jack shaft 105 journaled in pillow blocks 106 and 107 mounted on platform 94. Shaft 105 is drivingly connected with feed screw 23 by means of chain 108 and sprockets 109, 110. Shaft 105 extends longitudinally through a pressure-tight cylinder housing 111 supported by legs 112 and 113 on platform 94. A pulley 114 is rotatably mounted at one end of shaft 105 by means of annular bearing 115 so that the pulley 114 is normally free to turn on shaft 105. Pulley 114 is driven from jackshaft 96 through belt 116 and pulley 101. The opposite end of shaft 105 likewise carries a pulley 117 rotatably journaled on shaft 105 by means of bearing 112. Pulley 117 is drivingly connected to shaft 103 and pulley 104 by means of belt 119. Since pulley 117 is connected to shaft 103, whereas pulley 114 is connected to shaft 96, it will be appreciated that pulleys 114 and 117 rotate at all times when motor 95 is running and in opposite directions to each other.

A clutch carrier 120 is slidably keyed to shaft 105 in such a way that the friction face 121 on the clutch carrier is adapted to engage the annular face 122 of pulley 114. Clutch carrier 120 is spring-loaded by means of a plurality of helical compression springs 123, 123 which abut a backing plate 124 rigidly keyed to shaft 105 by means of key 125. Thrust imparted to backing plate 124 may be transmitted to the inner race of bearing 115, whereas ample clearance is provided between the backing plate 124 and pulley 114. Thrust of springs 123 in the opposite direction is transmitted through clutch carrier 120 to annular thrust bearing 126 mounted on shaft 105 between clutch carrier 120 and flanged collar 127 which functions as a piston in one end of housing 111.

A suitable fluid seal or packing 128 and backing ring 129 are provided for piston 127 so that the piston is free to slide axially within housing 111 and independently of shaft 105. The construction and actuation of the opposite clutch carrier 120' and its associated parts is identical to that just described in connection with clutch carrier 120. Corresponding parts for each clutch assembly have therefore been given primed numbers.

The interior of cylinder housing 111 is divided into two separate cylinders 130 and 131, piston 127 being contained in the former and piston 127' being contained in the latter. Fluid connection to cylinder 130 is by means of passage 132 and conduit 133, whereas fluid communication with cylinder 131 is by means of fluid passage 134 and conduit 135. When no fluid pressure exists in either cylinder, the clutch carriers 120 and 120' assume the disengaged position as shown in Fig. 10. When however, pressure is supplied to conduit 133 and piston 127, clutch carrier 120 is slidably moved on shaft 105 until the friction surface 121 thereof drivingly engages the side face of pulley 114, thus causing shaft 105 to be rotated in the same direction as the pulley.

The cylinder housing 111 is provided with a pair of cylinder heads 136, 136' at either end thereof, which are secured to the cylinder proper in any suitable manner, such as by screws. The opposite or internal head for the cylinder is comprised of an annular wall 137 in which passages 132 and 134 are located. Shaft 105 is journaled in the cylinder housing 111 by means of a pair

of sleeve bearings 138, 138' which are retained in the housing by means of collars 139, 139'. Inner wall 137 extends axially at 137a and 137b to provide suitable seats for bearings 138, 138'.

When fluid pressure is introduced into cylinder 131 through conduit 135, clutch carrier 120' will then be urged axially outward until the facing 121' engages pulley 117. This connects shaft 105 with pulley 117 and causes it to rotate in the opposite direction since pulleys 114 and 117 are counter-rotating.

Referring now to Fig. 11, the means for actuating the pistons 127 and 127' comprises a walking beam 140 which is pivoted at 141 on valve housing 142 which is in turn mounted on platform 94. Fluid pressure is introduced into housing 142 through passage 143 which communicates with a chamber 144. When valve 145 is moved to its downward position, as shown in Fig. 11, by means of valve rod 145a, fluid is permitted to flow from chamber 144 into conduit 133 to actuate piston 127. In this position the relief port 146 is closed by valve 145. When the walking beam 140 is pivoted to its opposite position, valve 145 is actuated to close conduit 133 to chamber 144 by means of spring 147 and to open the relief port 146 thereby opening conduit 133, permitting springs 123, 123 to return clutch carrier 120 and piston 127 to the disengaged position shown in Fig. 10. However, since movement of walking beam 140 also moves valve 148 downwardly by means of valve rod 148a, fluid pressure from chamber 144 passes through conduit 135 to chamber 130 to cause engagement of clutch carrier 120' with pulley 117, thereby instantaneously reversing the direction of rotation of shaft 105 and the horizontal direction of travel of carriage 51. I have found in practice that the time required to effect the reversal of the carriage is practically instantaneous and that the reversing mechanism is relatively simple and highly effective.

The position of walking beam 140 is controlled by means of a pair of solenoids 150 and 151 which are in turn selectively energized by closing of limit switches 40 and 41. When carriage 51 has reached the limit of horizontal travel, either bracket 152 or bracket 153 engages contact arm 42 or 43 to close their associated limit switches 40 and 41, as the case may be. Fig. 11 illustrates the position of the mechanism when carriage 51 has reached the limit of travel in a right-hand direction and bracket 152 has urged arm 43 to close the circuit between contacts 154 and 155 of limit switch 41. As soon as contacts 154 and 155 have been closed, current from a source of power 156 flows through line 157 to solenoid 150. The return line 158 from solenoid 150 is connected to contact 159 of relay 160. The corresponding contact 161 of relay 160 is connected to the source of power 156 through line 162 to complete the circuit to solenoid 150 when relay 160 is energized to close contacts 159 and 161. The energizing circuit for relay 160 is through line 163 from the power source to the relay, thence through lines 164 and 165 to contact 154 of limit switch 41. The return line 166 from contact 155 of switch 41 is connected to the contact 167 of relay 160 through line 168 and also to the power source 156 through line 162, thus completing the circuit to energize relay 160 when contacts 154 and 155 are closed. Therefore it will be seen that as soon as carriage 51 closes switch 41, actuation of relay 160 deenergizes solenoid 151 by breaking the circuit through contacts 169 and 170 of relay

160, and then solenoid 150 is energized by closing the circuit through contacts 159 and 161 of relay 160.

As the carriage immediately begins to travel in the opposite direction on frame 22, switch 41 automatically opens due to the action of spring 171 which tends to move arm 43 to a normally open position. When this occurs, the holding circuit for relay 160 and consequently for solenoid 150 is through lines 163, 164, 172, contacts 173, 174 of relay 175, line 176, contacts 177, 167 of relay 160, and back to line 162 through lead 168. Thus it will be seen that solenoid 150 remains energized even after switch 41 is open during the return traverse of carriage 51.

When carriage 51 reaches the limit of travel in a left-hand direction as seen in Fig. 11, bracket 153 engages arm 42 of limit switch 40 to close contacts 180 and 181. This action closes the circuit through relay 175 by means of lines 162, 166, 182, 183, and 163. This actuation of relay 175 immediately deenergizes solenoid 150 by opening contacts 173 and 174, thus breaking the holding circuit for relay 160 and at the same time energizes solenoid 151 by closing contacts 184 and 185 of relay 175 to complete the circuit to solenoid 151 through lines 162, 186, 187, and 157. This action instantly pivots walking beam 140 to reverse the carriage travel.

The holding circuit for relay 175 which is effective to continue the travel of carriage 51 after contacts 180 and 181 have opened, is through lines 162, 186, to contact 189 of relay 175, thence to contact 190, line 191, contacts 169 and 170 (which are closed due to the deenergization of relay 160), line 192, relay 175, line 183 and line 163. In this manner, the carriage may be caused to reciprocate transversely in the frame until the desired grinding operation has been completed.

In the preferred form of surface grinder, I have provided for approximately twelve inches of vertical operating travel of cross slide 53 on screw 54. After this grinding has been completed, the entire assembly is raised on ways 18 and 19 and cross slide 53 repositioned so that the next cut may be made. When the grinding has proceeded substantially halfway, the cross slide 53 may be reversed as shown in broken lines in Fig. 1, so that the other half of the mill housing may be ground. It will be understood that the operation may be conducted with one or two grinders. Fig. 1 illustrates how grinders having the platforms on opposite ends of the frame members may be used simultaneously in the same mill housing.

As soon as the grinding operation has been completed, the grinder assembly may be readily removed from the ways merely by detaching plates 27 and 33 whereupon the ways themselves may be removed and the mill housing returned to service.

The present grinder assembly greatly expedites the servicing of mill housings and has permitted the continued operation of the mill without any interruption in normal schedules. For example, the entire refinishing operation may be conducted at night or over a weekend, whereas heretofore it has been a matter of several days which in turn has necessitated the shutdown of the mill and the interruption of production schedules.

Having thus described my invention, I claim:

1. A surface grinder for mill housings and the like, comprising a frame, reciprocating carriage mounted on said frame, a grinding wheel journaled on the carriage and positioned to contact

the vertical face of said mill housing, means for turning said grinding wheel, a feed screw journaled in said frame, a nut on the carriage in threaded engagement with said feed screw whereby the carriage is reciprocated on the frame, a platform on the frame, unidirectional driving means mounted on said platform for said feed screw, reversing means operably connected to the driving means and to the feed screw for instantaneously reversing the direction of rotation of said feed screw, a pair of limit switches on the frame for actuating said reversing means, a pair of ways detachably secured to a workpiece and on which the frame is movable, and a pair of gibs on the frame positioned to slidably cooperate with the ways on the workpiece.

2. A surface grinder for mill housings and the like, comprising a frame, a reciprocating carriage mounted on said frame, a grinding wheel journaled on the carriage and positioned to contact the vertical face of said mill housing, means for turning said grinding wheel, a feed screw journaled in said frame, a nut on the carriage in threaded engagement with said feed screw whereby the carriage is reciprocated on the frame, a platform on the frame, unidirectional driving means mounted on said platform for said feed screw, reversing means operably connected to the driving means and to the feed screw for instantaneously reversing the direction of rotation of said feed screw, a pair of limit switches on the frame for actuating said reversing means, a pair of ways detachably secured to a workpiece and on which the frame is movable, mounting means for detachably securing said ways to a workpiece, a first gib on the frame for cooperating with one of said ways, said gib being integrally secured to the frame, a retaining plate detachably secured to said gib, a second gib slidably mounted on the frame to slidably engage the second way, and a removable retaining plate detachably secured to said second gib.

3. A surface grinder for mill housings and the like, comprising a frame, a reciprocating carriage mounted on said frame, a grinding wheel journaled on the carriage and positioned to contact the vertical face of said mill housing, means for turning said grinding wheel, a feed screw journaled in said frame, a nut on the carriage in threaded engagement with said screw whereby the carriage is reciprocated on the frame, a platform on the frame, unidirectional driving means mounted on said platform for driving said feed screw, reversing means operably connected to the driving means and to the feed screw for instantaneously reversing the direction of rotation of said feed screw, a pair of limit switches on the frame for actuating said reversing means, a pair of ways detachably secured to a workpiece and on which the frame is movable, a first gib adapted to cooperate with one of said ways, said gib being integrally secured to the frame, a retaining plate detachably secured to said gib, a second gib adapted to slidably engage both the other of said ways and the frame, a removable retaining plate detachably secured to said second gib, and a roller on said second gib, said roller and retaining plate cooperating with the other of said ways to position the second gib on said last named way.

4. A surface grinder for mill housings and the like, comprising a frame, a reciprocating carriage mounted on said frame, means including a feed screw mounted on the frame for controlling the horizontal reciprocation of the frame with re-

spect to the housing, means on the carriage engageable with said control means whereby the carriage is reciprocated on the frame, a platform on the frame, unidirectional driving means mounted on said platform for said feed screw, reversing means operably connected to the driving means and to the feed screw for instantaneously reversing the direction of rotation of said feed screw, a pair of limit switches on the frame for actuating said reversing means, a pair of ways detachably secured to a workpiece and on which the frame is movable, and a pair of gibs on the frame positioned to slidably cooperate with the ways on the workpiece.

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