April 23, 1968 A. KIRSCHNER 3,379,044

CLEANING DEVICE FOR A ROLLING MILL

Filed Jan. 14, 1965 6 Sheets-Sheet 1

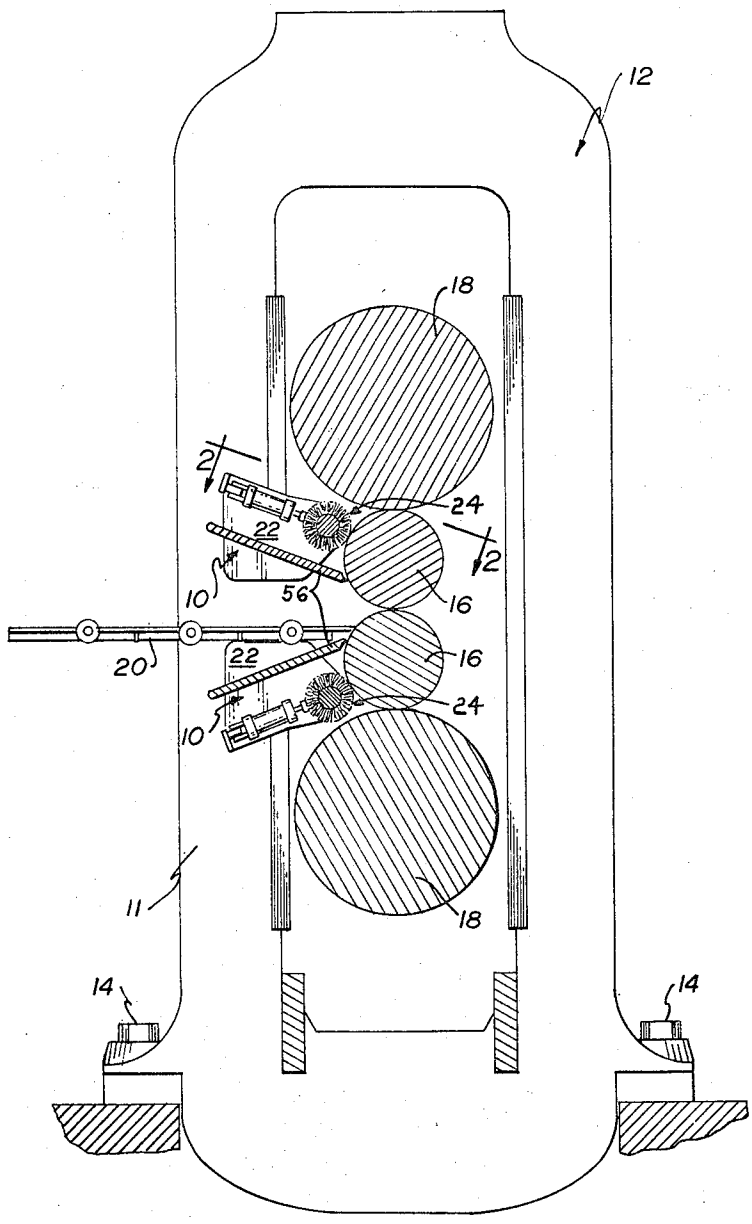

FIG. 1

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CLEANING DEVICE FOR A ROLLING MILL

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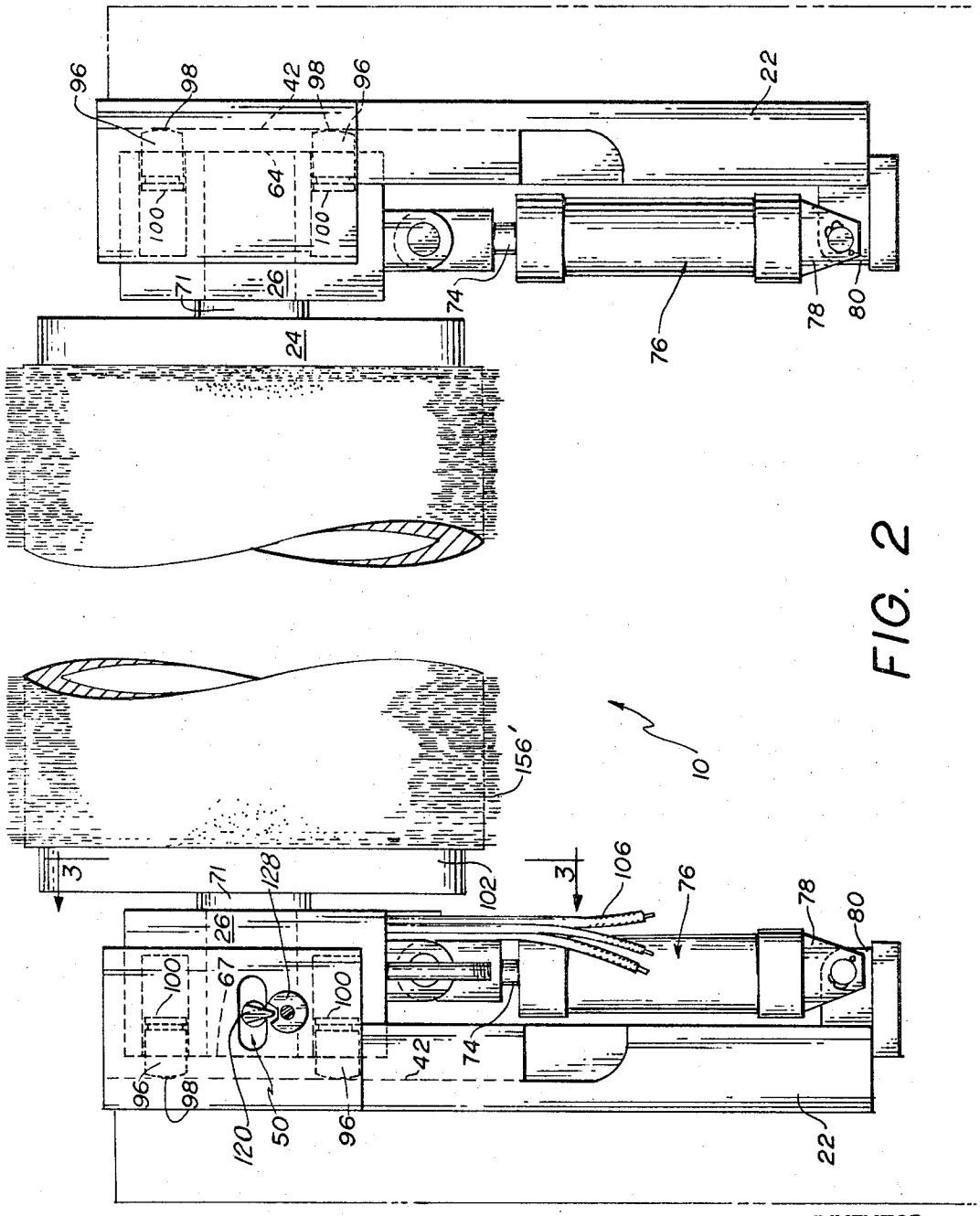

FIG. 2

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CLEANING DEVICE FOR A ROLLING MILL

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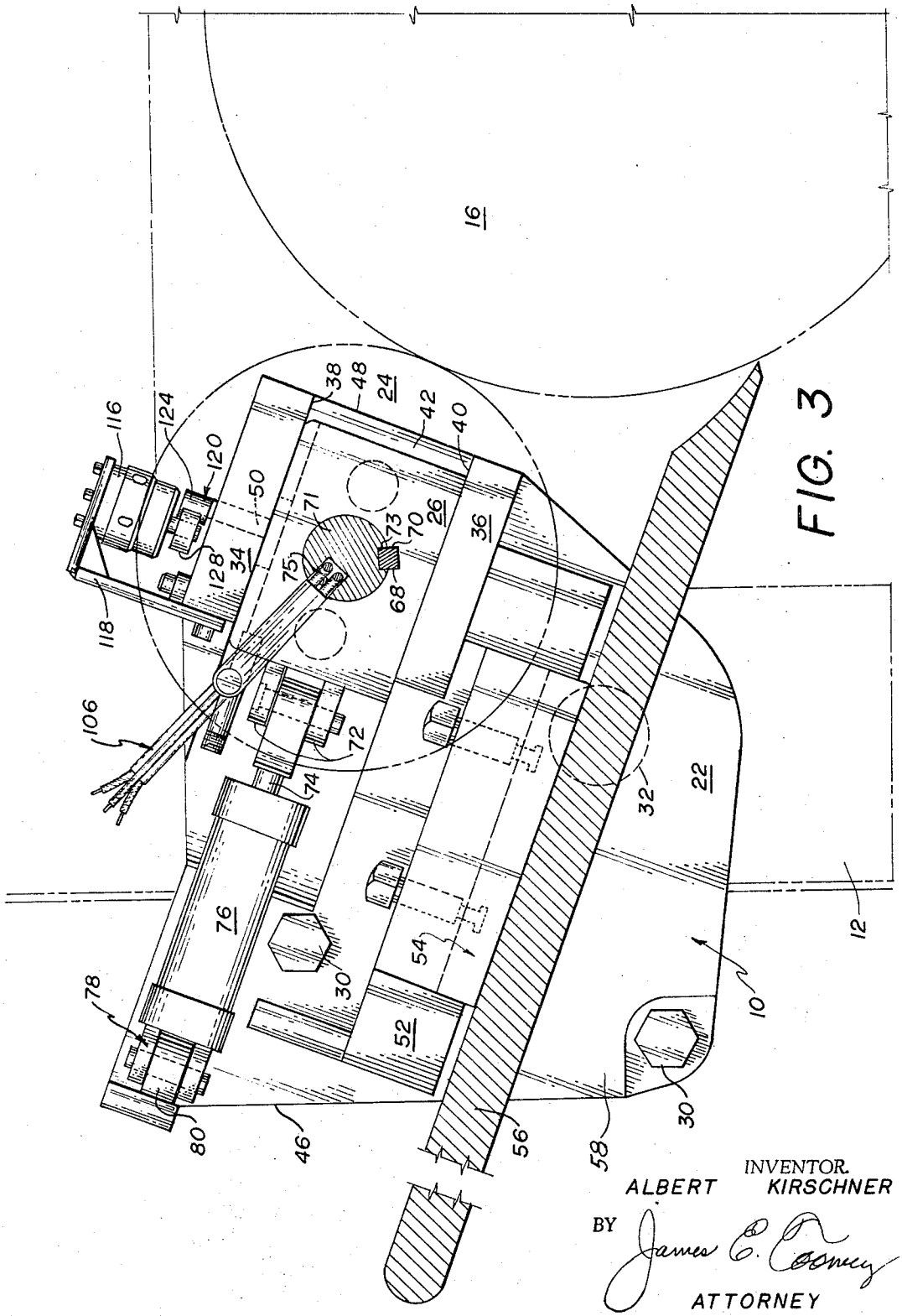

FIG. 3

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CLEANING DEVICE FOR A ROLLING MILL

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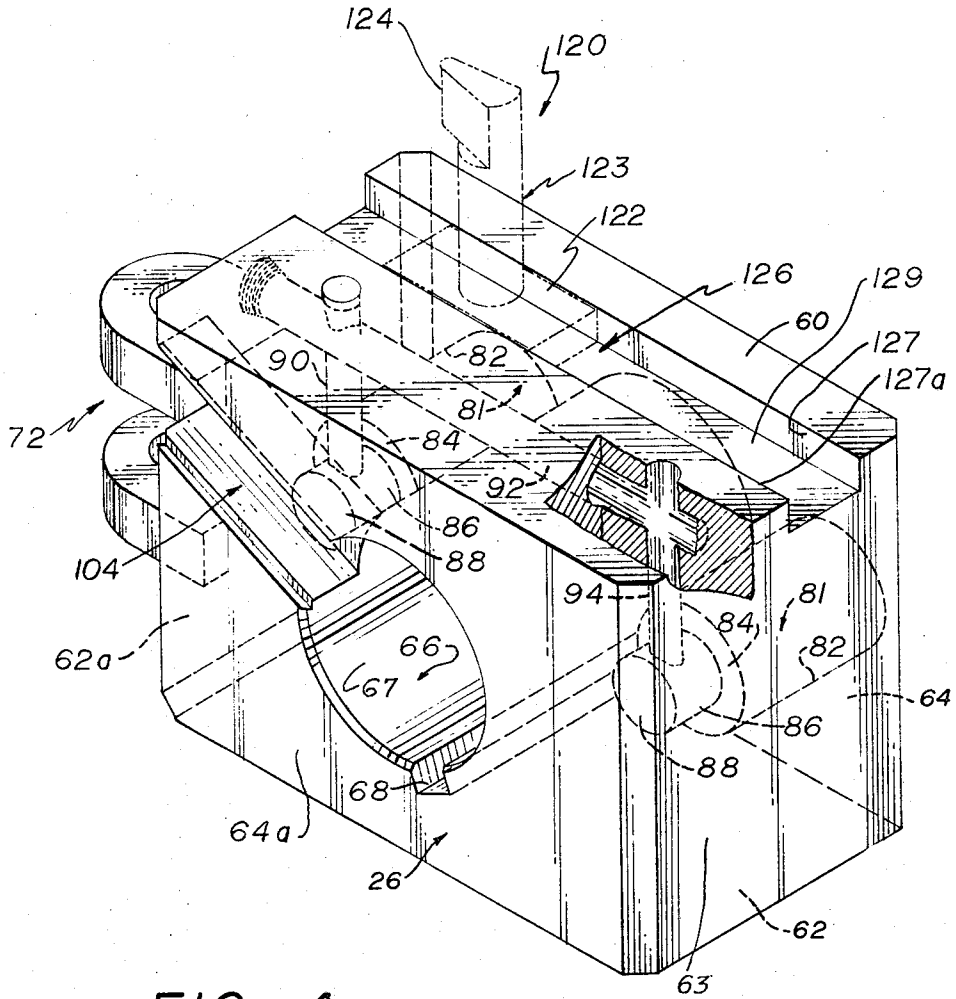

FIG. 4

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CLEANING DEVICE FOR A ROLLING MILL

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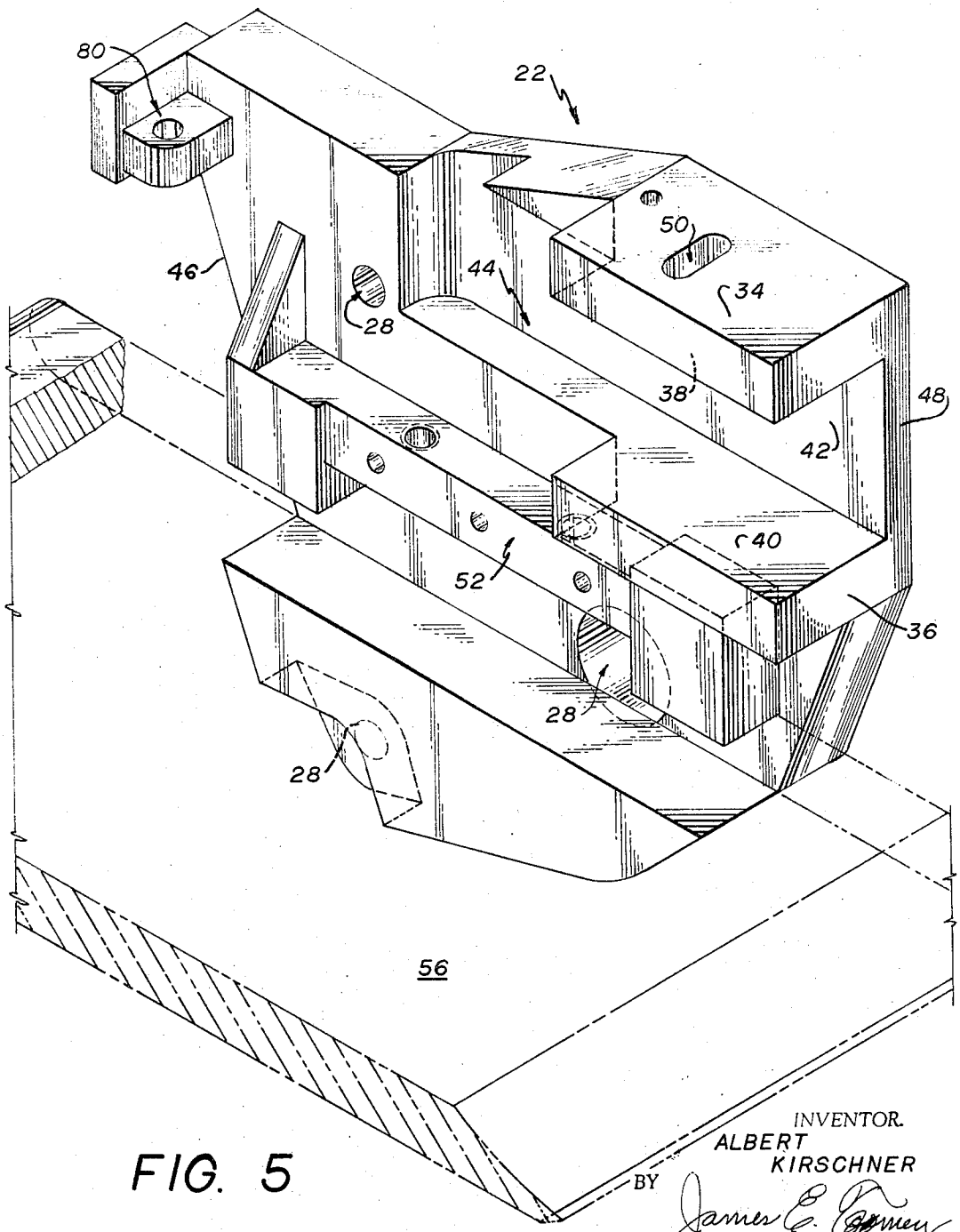

FIG. 5

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April 23, 1968 A. KIRSCHNER 3,379,044

CLEANING DEVICE FOR A ROLLING MILL

Filed Jan. 14, 1965 6 Sheets-Sheet 6

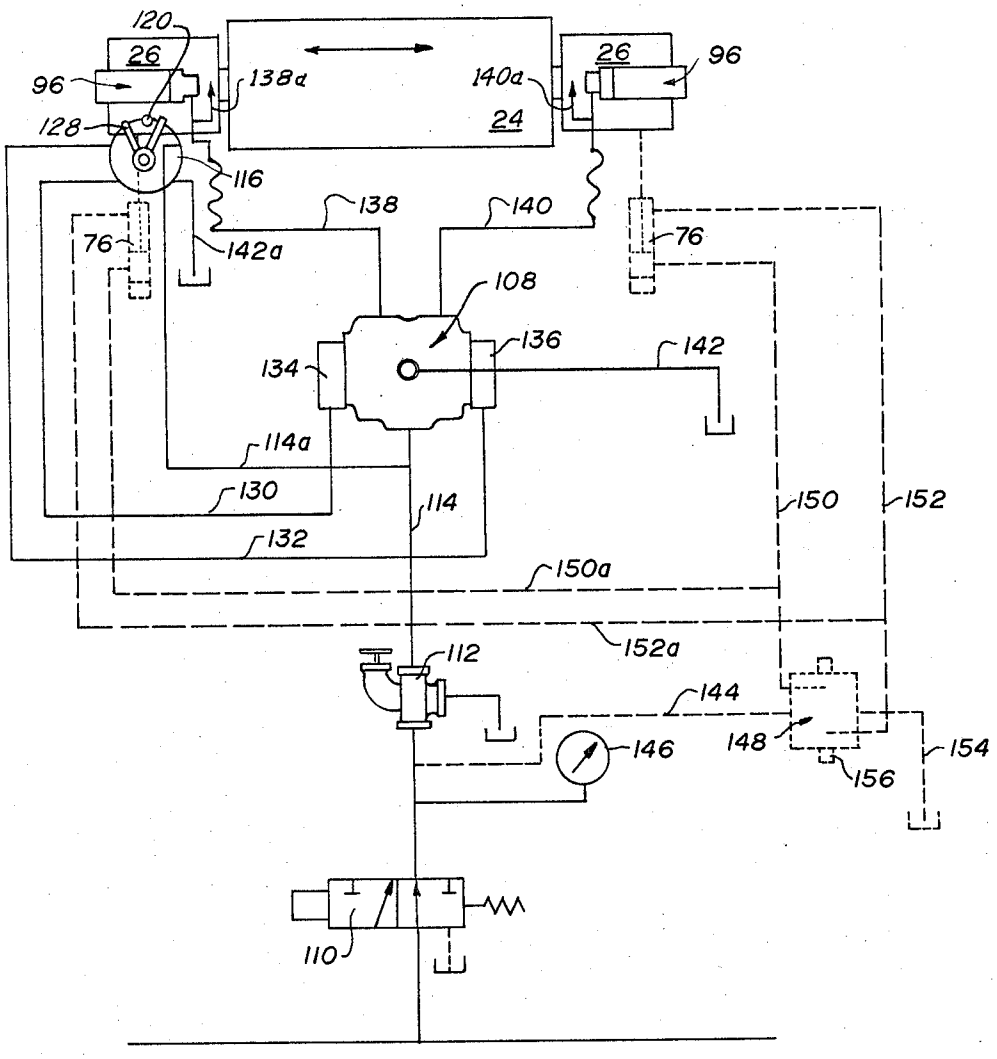

FIG. 6

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United States Patent Office 3,379,044 Patented Apr. 23, 1968

3,379,044

CLEANING DEVICE FOR A ROLLING MILL

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3 Claims. (Cl. 72—236)

ABSTRACT OF THE DISCLOSURE

A brush cleaning device attached to a rolling mill or the like for use in engaging the surface of a work roll in order to remove picked-up debris from the surface thereof during treatment of a workpiece between the work rolls and being controllably adjustable transversely and longitudinally of the work roll.

This invention relates to rolling mills used to produce metal plates, sheets and the like and to improved means for cleaning the roll surfaces thereof. More particularly, this invention relates to an improved means for not only controlling the force exerted by the cleaning means on the roll surfaces, but also for effecting a more efficient cleaning action by use of the said cleaning means.

Accordingly, it is the primary purpose of the instant invention to provide an improved apparatus for cleaning the surfaces of work rolls of a rolling mill used to produce metal plates and the like wherein novel means are provided for not only controlling the force exerted on the roll surfaces by the cleaning apparatus, but also for effecting a more efficient cleaning of the roll surfaces.

This and other purposes and advantages of the instant invention will become more apparent from a review of the following detailed description when taken in conjunction with the appended drawings, wherein:

FIGURE 1 is a side elevational view with parts thereof being shown in section of one stand of a rolling mill wherein an attachable rotating brush-type cleaning means incorporating the instant invention can be employed;

FIGURE 2 is an enlarged broken plan view taken generally along line 2—2 of FIGURE 1, with certain parts being removed, and illustrating further details of the apparatus of the instant invention;

FIGURE 3 is a sectional view taken generally along line 3—3 of FIGURE 2 with certain parts being added and other parts being shown in dotted lines;

FIGURE 4 is a perspective view on an enlarged scale of certain parts of the apparatus of the instant invention;

FIGURE 5 is another view in perspective on an enlarged scale of another part of the apparatus of the instant invention; and

FIGURE 6 is a schematic illustration of a suitable hydraulic circuit that can be used to control the operation of the apparatus of the instant invention.

With further reference to the drawings and in particular FIGURES 1–3, a preferred form of the improved apparatus that can be used in carrying out the teachings of the instant invention generally comprises a cleaning device 10 that can be affixed in a suitable fashion to a roll stand 12 of conventional construction as shown in FIGURE 1. Although two such devices 10 are shown, inasmuch as the structure and operation of each device 10 is the same, a description of one will suffice for both. The roll stand 12 is mounted in a suitable fashion to an appropriate base by the bolt means 14 and includes within its structure a pair of vertically aligned work rolls 16 which are disposed between a pair of back-up rolls 18 in a fashion conventional in the art. After metal plates or sheet material are passed from right to left as viewed in FIGURE 1 between the opposed cylindrical surfaces of

the work rolls 16, the formed plates or sheet are deposited onto the conveyor 20 partially shown. The roll cleaning apparatus or device 10 of the instant invention associated with each work roll 16 generally comprises a pair of guide members 22 affixed in a suitable fashion and in spaced relation to the main frame 11 of the roll stand 12. It is to be understood that the guide members 22 can be directly affixed to the frame 11 of the roll stand 12 or they can be separately affixed to mounting plate (not shown) which in turn are directly affixed in a suitable fashion to the frame 11 of the roll stand. The ends of a rotatable brush means 24 are journalled in a pair of brush supporting blocks or members 26 which in turn are interconnected in a novel manner to the associated guide member 22 for transverse and longitudinal reciprocal stroke movements with respect to the guide members 22 whereby the rotary brush means can effect more sufficient cleaning of rolls 16 during the removal of foreign material therefrom all as hereinafter described in further detail.

The guide members 22, unless otherwise specified, are of identical construction. As indicated more particularly in FIGS. 3 and 5 each guide member 22 includes a series of circular holes 28 that extend through opposed surfaces to facilitate mounting of the guide member 22 to the frame 11 of the roll stand 12 by means of cap screws 30 and dowel pin 32. A pair of parallel spaced flanges 34 and 36 are advantageously formed on the exposed surface of the guide member 22. These flanges generally extend from the side edge 48 and terminate intermediate the side edges of the guide members. Opposed parallel surfaces 38 and 40 of the flanges 34 and 36 interconnected by a planar surface 42 project inwardly into the body of the member 22. The interconnected surfaces 38, 40 and 42 define a recess 44 best shown in FIG. 5 that extends beyond the longitudinal extent of the flanges 34 and 36 but only partially between the opposed end edges 46 and 48 of the member 22. The flange 34 in one of the members 22 includes a closed-end opening or slot 50, best illustrated in FIGURES 2 and 5. The shape of this slot roughly approximates that of an ellipse. The purpose of the slot 50 will become more apparent hereinafter.

Although not heretofore mentioned the lower portion of the exposed surfaces of the guide members 22 below the flange 36 includes a substantially C-shaped flange 52 upon which a screw-type clamp 54 is mounted. Clamp 54 is affixed to a conventional deflector 56 used with the cleaning device 10. This deflector blade 56 assists the rotary brush means 24 in cleaning the associated roll 18 especially during the processing of material between the rolls of the mill stand.

Each brush supporting member 26, as indicated in FIG. 4, is of generally rectangular shape such that it includes surfaces 60 and 62, 62*a* and 63, and 64 and 64*a*. The surfaces 60, 62 and 64 of brush member 26 are adapted to slidably interengage the surfaces 38, 40 and 42 respectively that define the recess 44 of the associated guide member 22. The member 26 includes a longitudinal bore 66 therethrough defined by the interior cylindrical surface 67 extending between the surfaces 64 and 64*a*. The shaft ends 71 of the rotary brush means 24 are adapted to slidably fit into the bore 66 in the appropriate block 26. The surface 67 of the bore 66 is modified to include a conventional keyway slot 68 that is alignable with the corresponding keyway slot 73 on the shaft end 71 to enable the mounted shaft end 71 to be affixed to the supporting member 26 by the key 70 in a conventional fashion as illustrated in FIGURE 3.

The supporting members 26 and the affixed brush means 24 are then disposed to advantageously extend between the guide members 26 whereby each supporting member 22 is in interengagement with the recess 44 of the asso-

ciated guide member 22 in such a fashion that the brush means 24 is advantageously movable in both a longitudinal and transverse direction. To this end, the surface 62*a* includes parallel projections that define a U-shaped bracket 72 to which the free end of a piston rod 74 is connected in an appropriate manner. The piston rod 74 constitutes part of an extensible fluid actuator 76 provided at its cylinder end with a U-shaped bracket 78 that is pivotally connected to the projection 80 on the guide member 22 adjacent the end edge 46 thereof. From the above description it will be obvious that upon actuation of the fluid actuator 76 by control means to be subsequently described, the fluid actuator 76 can be extended or retracted to produce movement of the supporting members 22 and the rotary brush means 24 in a direction generally parallel to the longitudinal axis of the affixed guide members 22.

In addition, the surface 64 of each member 26 includes a pair of closed-end stepped bores 81 disposed radially outward in opposite directions from the longitudinal axis of the bore 66. Each of the bores 81 is defined by a large cylindrical surface 82 extending from the surface 64 to the annular shoulder 84 and a small cylindrical surface 86 that extends from shoulder 84 to the closed end bottom surface 88 of the bore 81. The two bores 81 are placed in open communication with each other by a series of fluid lines indicated at 90, 92 and 94 formed within the member 26. A cylindrical piston 96 of conventional design is disposed within each bore 81. This piston is adapted to slidably engage the cylindrical surface 82 while the exposed end surface 98 of the piston is adapted to abuttingly engage the recess surface 42 when the supporting members 26 are assembled to the guide members 22 in the manner indicated in FIGURE 2. The control means for pistons 96 to be subsequently described is connected in a conventional fashion to one of the lines 90, 92 and 94 in each member 26 whereby fluid pressure can be exerted from the closed ends of the radially disposed bores 81 upon the inner end surface 100 of the pistons 96.

It is to be understood that the longitudinal position of the rotary brush means 24 in FIGURE 2 corresponds to an intermediate position. If the control means directs a greater volume of pressure fluid to the radially outward disposed bores 81 in the left hand member 26 as viewed in FIG. 2 with a corresponding removal of pressure fluid from the bores 81 in the right hand member 26 as viewed in FIG. 2 the rotary brush means 24 would be moved in a longitudinal direction to the right by the action of the piston surfaces 98 disposed in abutting engagement with the recess surfaces 42 of the guide members 22. Similarly if fluid under pressure is directed by the control means to the radially disposed bores 81 to increase the volume of fluid pressure therein the right hand supporting member 26 is viewed in FIG. 2 and a corresponding removal of fluid is removed from the radially disposed bores in the left hand supporting member 26 there will be a consequent longitudinal movement of the rotary brush means to the left. Thus the control means advantageously provides the improved cleaning device 10 of the instant invention with relative reciprocal longitudinal and transverse stroke movements by virtue of the extensible fluid actuators 76 and the pistons 96.

Although the pistons 96 are preferably disposed within the bores 81 provided in the supporting members 26, the pistons 96 could beneficially be disposed in corresponding bores, not shown, within the guide members 22 whereby the piston surface 98 would then abuttingly engage surface 64 of the associated supporting member 22 to effect longitudinal reciprocal stroke movements of the brush means 24.

In view of the fact that the shaft ends 71 of the rotary brush means 24 are affixed to the block members 26 as aforedescribed, apropriate motor means can be provided within the rotary brush means 24 for effecting rotation of the same on the shaft or spindle ends 71. One appropriate motor means would be a suitable electric motor whereby the rotor would constitute an integral part of the outer cylindrical housing 102 upon which the brush is mounted while the stator would constitute an integral part of the intermediate portion of the shaft not shown which is affixed at its ends 71 to the supporting member 26 as aforedescribed. To provide electrical connections for driving the electrical motor, one of the supporting members 26 is modified to include a radial keyway slot 104 that extends radially outward from the bore surface 67 to the surface 62*a* and extends axially inward from the surface 64*a*. As shown in FIG. 3, one of the shaft ends 71 is also modified to include an axial recess 75 that is alignable with the slot 104. Thus, it is evident that the aligned slot 104 and recess 75 enable the passage therethrough of the electrical conductors 106 whereby electrical connection to the motor (not shown) within the brush means 24 is advantageously maintained even though the associated guide and supporting members 22 and 26 can move in reciprocal longitudinal and transverse directions.

Referring to FIG. 6 a suitable hydraulic control circuit is schematically illustrated that can be used to obtain the desired transverse and reciprocal movements of the rotary brush means 24 of the instant invention. The hydraulic control circuit includes a pilot operated main control valve 108 which is supplied with a source of fluid under pressure by a pump means (not shown) through the main supply conduit 114 containing a series connected solenoid operated shut-offff valve 110 and a pressure regulating valve 112. As indicated in FIGS. 3 and 6 a commercially available pilot control valve 116 is preferably mounted by means of an L-shaped bracket 118 in a suitable manner to the uppermost flange 34 of the guide member 22 associated with the supporting member 26 that provides the electrical connection. As indicated in FIGS. 2–4 and 6, a trip pin 120 comprised of a shaft portion 123 extending between a base portion 122 at one end and a laterally projecting enlarged portion 124 at the other end is desirably employed to engage a collar 128 affixed to the protruding shaft end of the pilot control valve 116. Referring particularly to FIGURES 2–4 the surface 60 of the supporting member 26 associated with the guide member 22 that has the pilot valve control element 116 affixed thereto has been modified to include a groove 126 which extends lengthwise across the surface 60. The groove 126 is defined by parallel surfaces 127, 127*a* extending inwardly from surface 60 to intersect the bottom surface 129 of the groove 126. The base portion 122 of the pin 120 is arranged to slidably engage the groove 126 while the intermediate shaft portion 123 of the pin 120 is adapted to freely extend through the aforedescribed slot 50 of the flange 34 of the guide member 22 upon insertion of the enlarged end portion 124 through the slot 50. It is to be observed here that the groove 126 in the supporting member 26 and the slot 50 of the guide member 22 are disposed with their longitudinal axes in transverse relation to each other. Thus, with the base portion 122 in slidable engagement with the groove 126 and the intermediate portion 123 freely extending through the slot 50, the trip pin 120 desirably functions to indicate to the control valve 116 the extent of the stroke movements made in either longitudinal direction by the brush means 24 while it permits transverse reciprocal movement of the brush means 24. In other words, the apex end of the enlarged end portion 124 of the trip pin 120 angularly rotates the collar 128 of the pilot valve 116 in either direction corresponding to the extent of the longitudinal stroke movement made in either direction by the brush means 24. Pilot control valve 116 is connected to the main supply conduit 114 by means of the branch line 114*a* while the conduits 130 and 132 interconnect the valve 116 with the pilot valves generally indicated at 134 and 136 associated with the main control valve 108 used to control the flow of fluid to the left or right pistons 96 by way of lines 138 and 140 all as indicated in FIG. 6. In the event any excess fluid is directed to the valves 108 and 116, this excess fluid is carried off

by bypass lines **142** and **142***a* and directed to the sump as shown. If the trip pin **120** indicates by its engagement with the collar **128** that the rotary brush means **24** has been extended fully to the right as indicated in FIG. 6 the control valve **116** is automatically actuated whereby it will operate to direct fluid from its supply line **114***a* to pilot valve line **132** to thereby direct fluid through lines **140** and **140***a* leading to the right hand piston (not shown so that fluid can act upon the right hand pistons **96** and at the same time release a corresponding amount of pressure fluid through the medium of lines **138** and **138***a* from the left hand pistons **96** as viewed in FIG. 6 to the sump through line **142**. Similarly, when the rotary brush means **24** is moved in a fully extended position to the left as viewed in FIG. 6 the trip pin **120** signals the control valve **116** to now direct pilot pressure fluid from line **132** to line **130** whereby fluid will be passed from line **140** to lines **138** and **138***a* the latter of which is connected to one of the left hand pistons **96** (not shown) and thereby increase the volume of pressure fluid acting against the left hand pistons **96** so as to shift the rotary brush means **24** in a similar fashion to the right. Thus, it is evident that the pilot control valve **116** in combination with the trip pin **120** advantageously enables the hydraulic circuit in FIG. 6 as aforedescribed to automatically effect longitudinal movement of the rotary brush means **24** in opposite directions relative to the work roll with which it is associated.

To effect actuation of the extensible fluid actuators **76** for adjustable transverse positioning of the rotary brush means **24** relative to the work rolls and to increase the pressure contact between the work roll **16** and a brush means **24** a second hydraulic circuit is advantageously connected by means of the secondary source line **144** shown in dotted lines to the main source line **114**. It is noted here that to indicate the pressure in the lines **114** and **144**, a conventional pressure indicating device **146** is interconnected as shown. The second hydraulic circuit includes a conventional manually operated control valve **148** that directs fluid under pressure and in equal amounts either to the free or to the rod end of the piston disposed within the actuators **76** by means of the interconnecting lines **150** and **150***a* or **152** and **152***a* as shown. Excess fluid from the source line **144**, which is not directed to either end of the fluid actuator **76** is carried off to the sump by the bypass sump line **154**. Thus, if an operator or other suitable actuating means moves the control plunger **156** within the valve **148** in FIG. 6 from its neutral position fluid can be directed either to the free end of the pistons within the actuators **76** or to the rod ends of the fluid actuators **76**. In other words, in order to extend the fluid actuators **76** the valve plunger **156** is actuated in a suitable fashion to direct the proper amount of fluid under pressure through lines **150** and **150***a* to the piston ends of the actuators **76** while a corresponding volume of fluid is exhausted from rod ends of the actuators **76** through lines **152** and **152***a* and control valve **148** to sump line **154**. To retract the fluid actuators **76** pressure fluid is directed through lines **152** and **152***a* and exhausted through lines **150** and **150***a* by further actuation of the plunger **156** in the control valve. Consequently, the aforediscussed hydraulic circuit in FIG. 6 enables the device **10** of the instant invention to automatically effect reciprocal longitudinal movements of the rotary brush means **24** relative to a work roll **16** by the pilot operated control valve **108** alone or in combination with selective transverse movements of the rotary brush means **24** relative to the same work roll **16** by means of the control valve **148**. The preferred embodiment of the invention however, contemplates that both hydraulic actuating circuits will be simultaneously actuated whereby during pressure contact between brush elements **156'** and a work roll **16** the elements **156'** will be moved longitudinally relative to the work roll axis.

It is to be understood that the outer periphery of the cylindrical portion **102** of the rotary brush means **24** has appropriate cleaning elements affixed thereto in a suitable fashion and generally indicated at **156'**. These cleaning elements can be made up of groups of radially extending bristles of a suitable material such as metal, plastic, fiber, etc., which act to remove any foreign material that may become adhered to the work contacting surface of the work rolls **16** as a result of roll pick-up.

One of the significant features of the apparatus **10** of the instant invention resides in the fact that the cleaning action of the brushing elements **156'** is significantly enhanced by virtue of the ability of the rotary brush means **24** to be moved in a longitudinal direction or in path of travel which parallels the longitudinal axis of a work roll. If the rotary brush means **24** is merely moved transversely of the longitudinal axis of the work rolls and into pressure contact with the work rolls by the fluid actuators **76** as aforedescribed it has been found that the effective brushing action diminishes in proportion to the time of exposure or pressure contact between the forming surface of the work rolls **16** and the brush elements **156'**. Further, to merely increase the forceful contact by adjustment of the fluid actuators **76** as the brushing action diminishes does not effectively improve the cleaning action. The ability of the brush elements **156'** to move longitudinally of a work roll not only significantly improves the cleaning action of the rotary brush means **24** whereby it is more uniform, but it provides for uniform wear of the rotary brush means **24** itself.

An advantageous embodiment of the invention has been shown and described. It will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the spirit and scope thereof as set forth in the appended claims, wherein:

What is claimed is:

1. In a mill stand provided with a work roll, a cleaning device for said work roll, said cleaning device comprising a pair of guide members affixed to the frame of the mill stand adjacent said work roll and in opposed spaced relation to each other, each of said guide members being provided with a pair of inwardly directed surfaces interconnected by an intermediate surface so as to define an open recess in one guide member disposed in opposed relation to a similar recess on the opposed guide member, a pair of supporting members each having an outer surface, cleaning means disposed between and affixed to said supporting members, said supporting members being individually sldably disposed in said recesses with the respective outer and intermediate surfaces of each adjacent pair of guide and supporting members being in confronting relation such that the combined length of said supporting members and said cleaning means is less than the distance between the intermediate surfaces of the recesses of said guide members, piston-cylinder means disposed in the supporting members of each adjacent pair of supporting and guide members such that the outer ends of the pistons of said piston-cylinder means are in abutting engagement with the adjacent surfaces of the guide members of said adjacent pairs of members, said piston-cylinder means being operable to effect movement of said cleaning means and said supporting members between said guide members in a direction generally parallel to the longitudinal axis of the work roll, and further means interconnecting the associated guide and supporting members in order to effect movement of said cleaning means in a direction towards and away from the work roll while the outer ends of the piston of said piston-cylinder means remaining in abutting engagement with said adjacent surfaces of said guide members.

2. In a mill stand as set forth in claim **1** including a fluid operable control means connected to said piston-cylinder means for operating same, said control means being provided with a control valve having a trip pin associated therewith, said trip pin being disposed in oper-

ative relation to one of the associated guide and supporting members for effecting automatic reversal in the stroke movement of said cleaning means in a direction generally parallel to the longitudinal axis of the work roll.

3. In a mill stand as set forth in claim 1 in which said piston-cylinder means and said further means are connected to a fluid operable control means whereby said piston-cylinder means and said further means can be simultaneously actuated by said fluid operable control means.

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