United States Patent

[11] 3,585,831

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[21] Appl. No. **813,059**
[22] Filed **Apr. 3, 1969**
[45] Patented **June 22, 1971**
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[54] **ROLLING MILL STRUCTURE AND ROLL CHANGING MEANS THEREFOR**
10 Claims, 14 Drawing Figs.

[52] U.S. Cl. 72/239
[51] Int. Cl. B21b 31/08
[50] Field of Search 72/237, 238, 239, 240, 245, 248, 224, 225, 250, 235

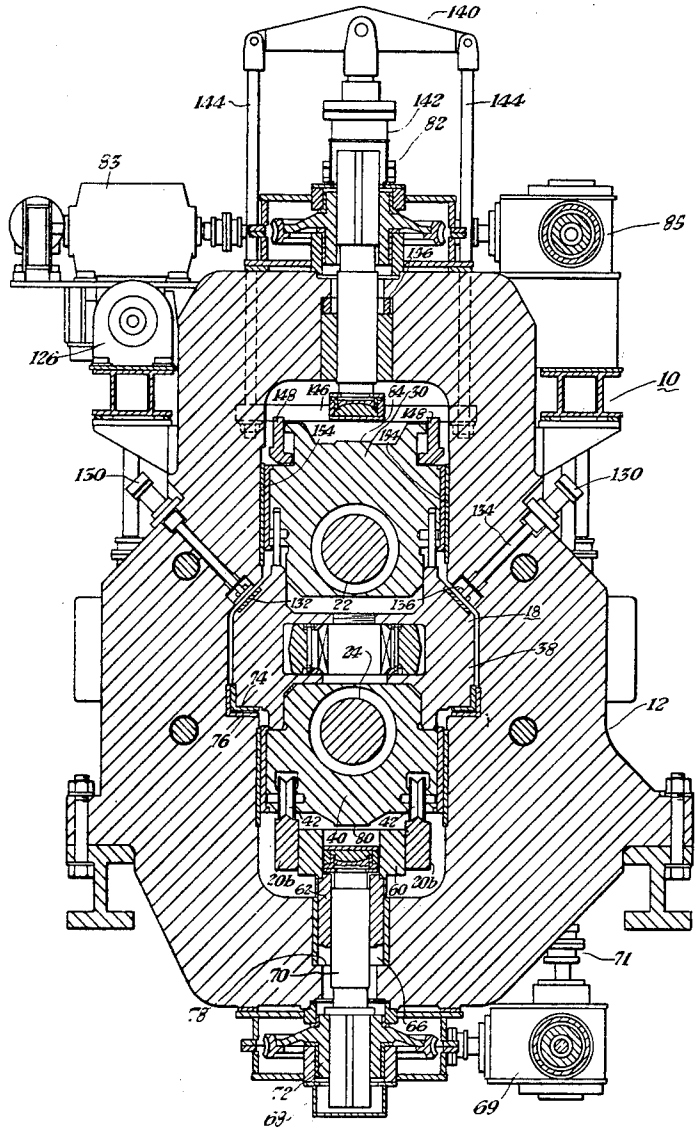
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Primary Examiner—Richard J. Herbst
Assistant Examiner—Gene P. Crosby
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ABSTRACT: A rolling mill structure comprising a roll assembly insertable through a mill housing window. A roll housing carrying a roll is movable toward and away from another roll forming part of the roll assembly. A plunger is longitudinally movable along an inclined passageway intersecting the path of movement of the roll housing, and is inserted into a complementary recess in the housing to establish a predetermined roll gap. The plunger can be withdrawn from the housing and out of the path of the assembly without removal of the plunger from the mill housing.



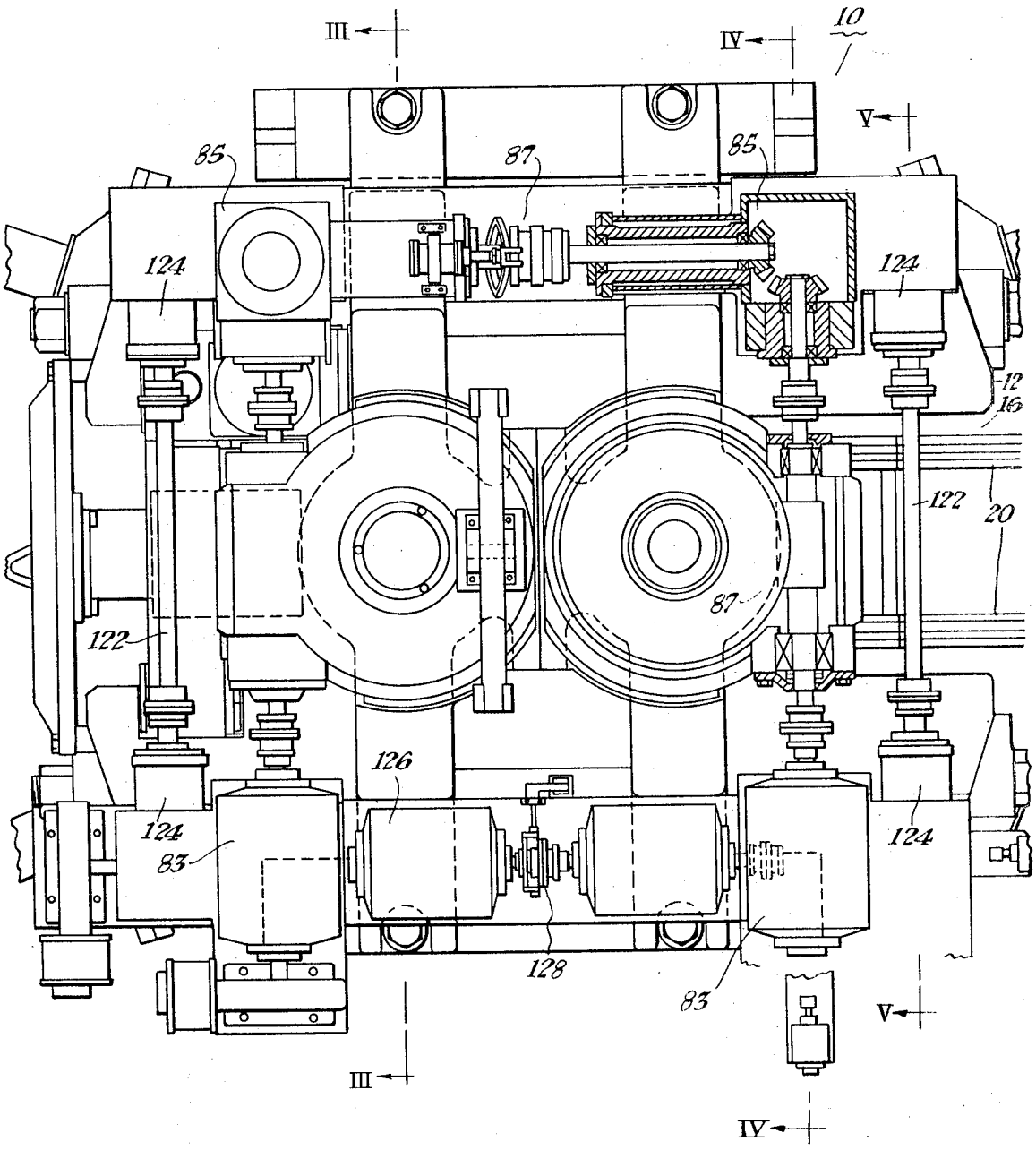


Fig. 1A.

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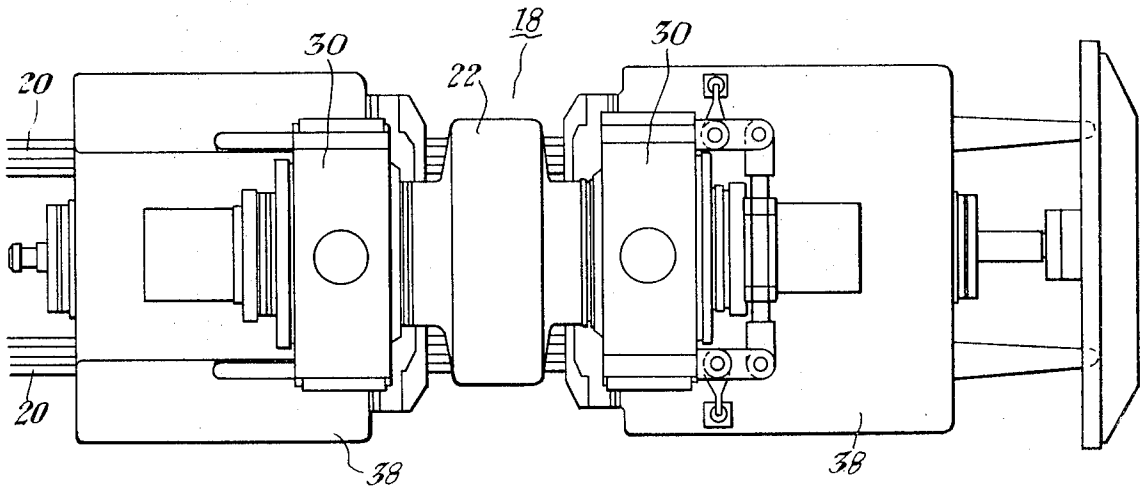


Fig. 1B.

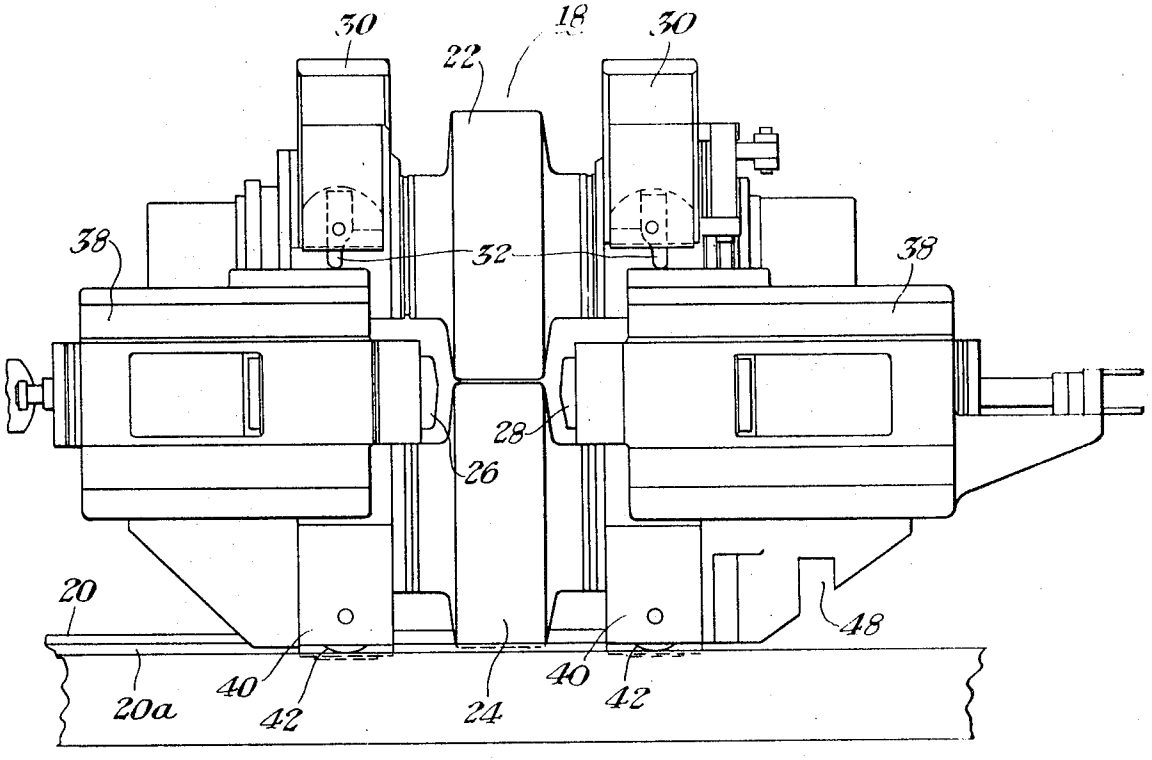


Fig. 2B.

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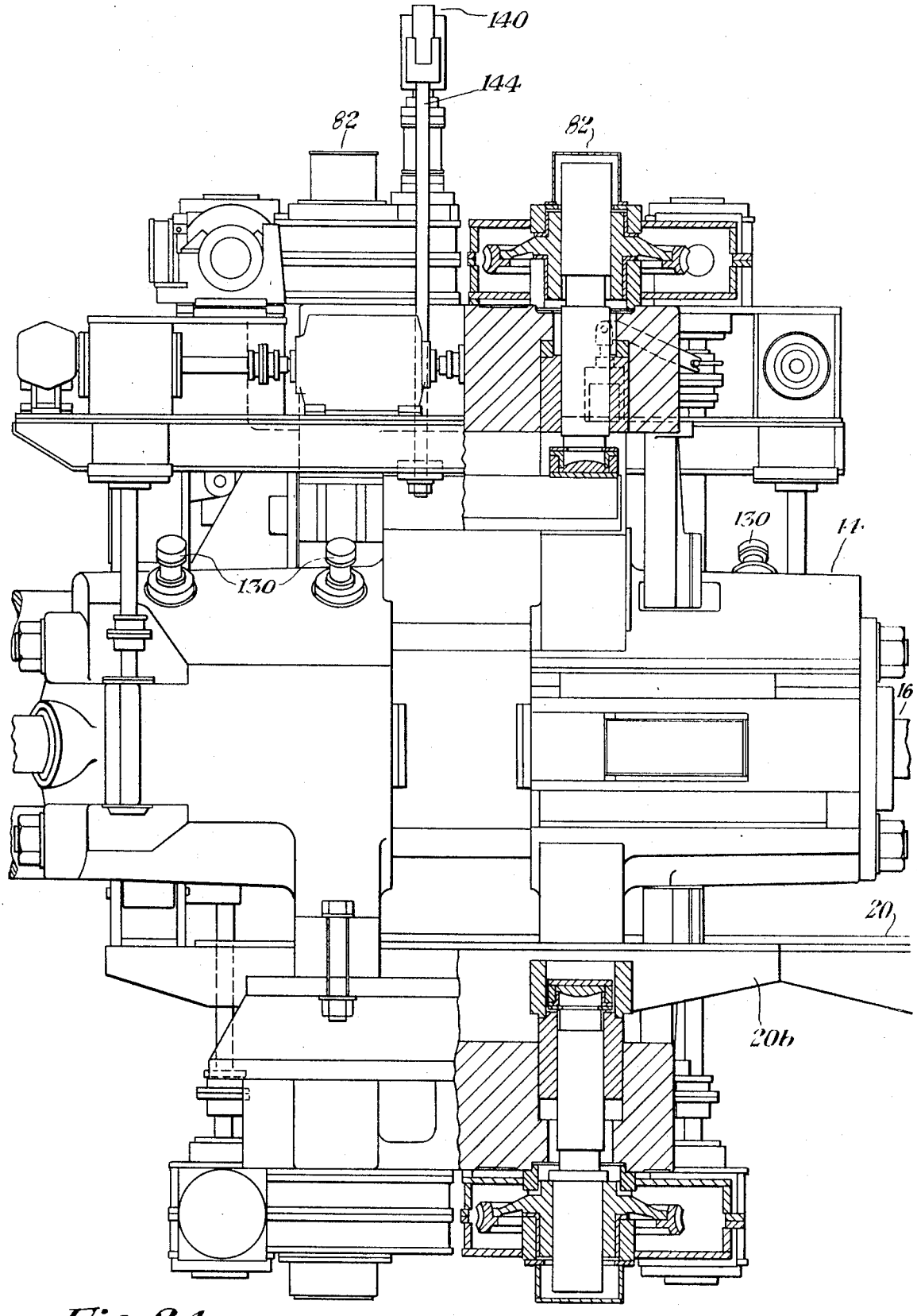


Fig. 2A.

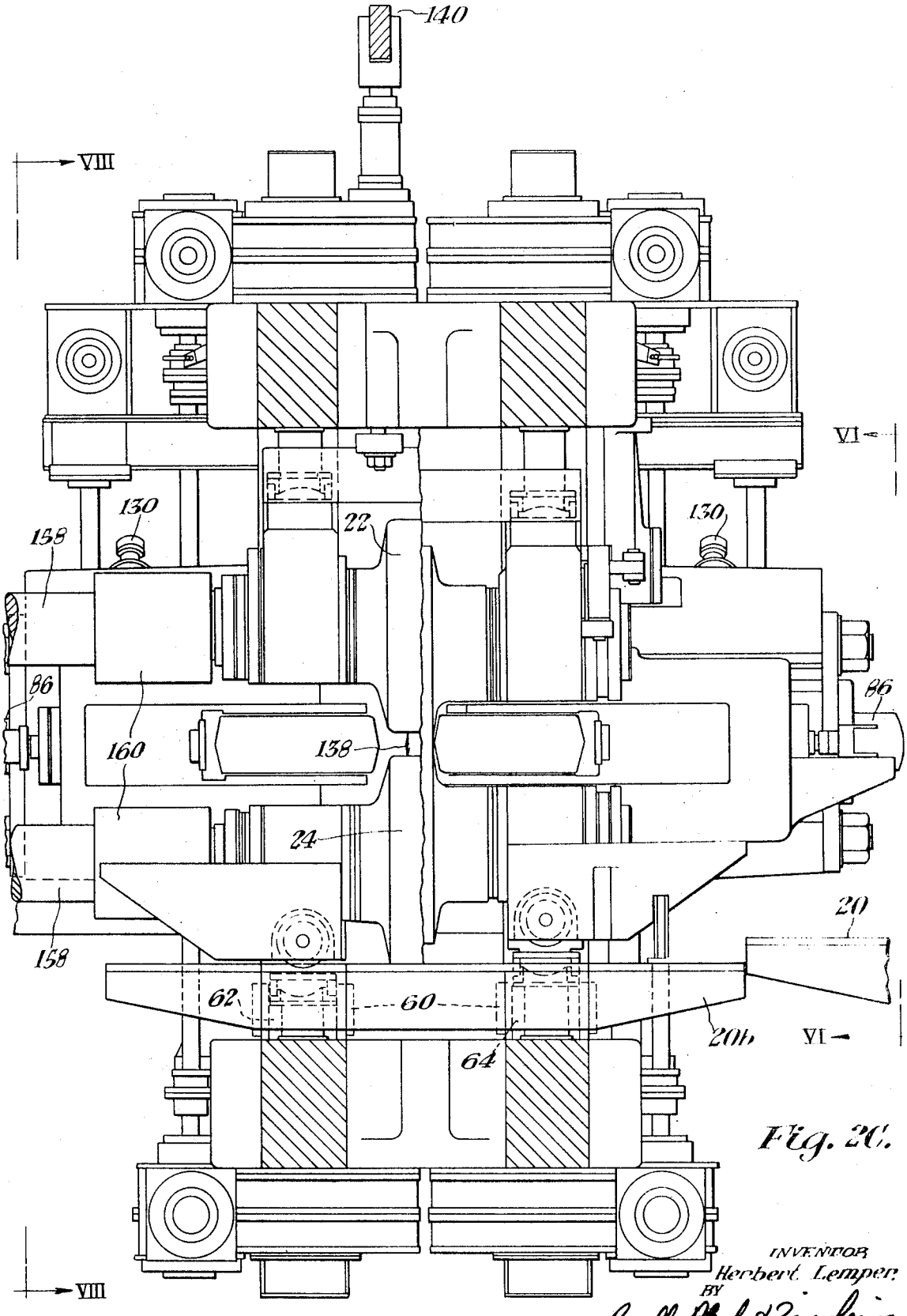


Fig. 2C.

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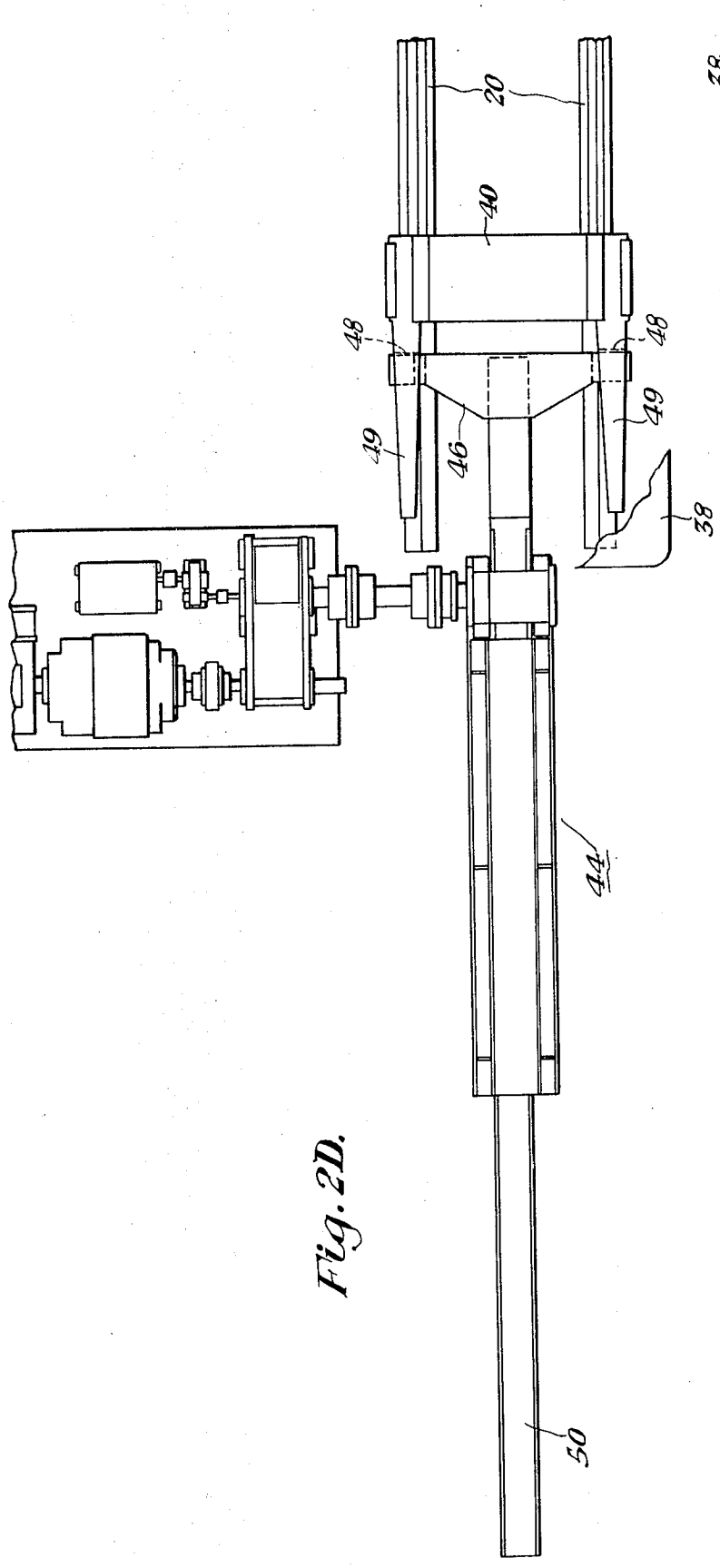


Fig. 2D.

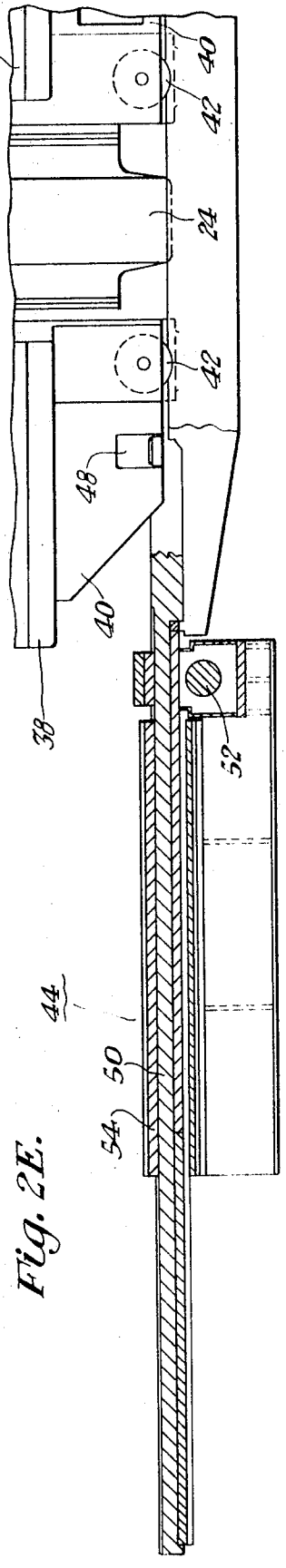


Fig. 2E.

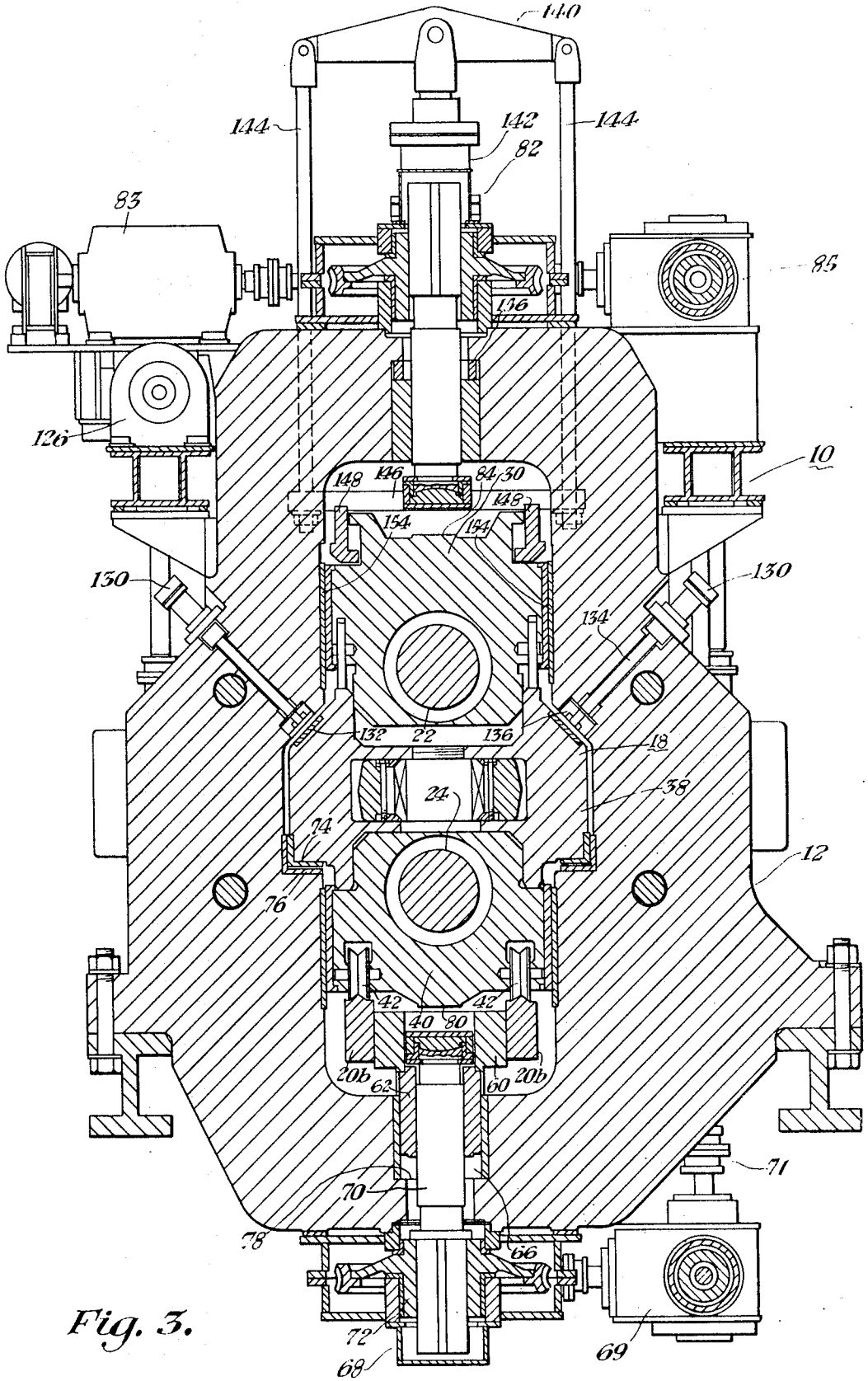

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Fig. 3.

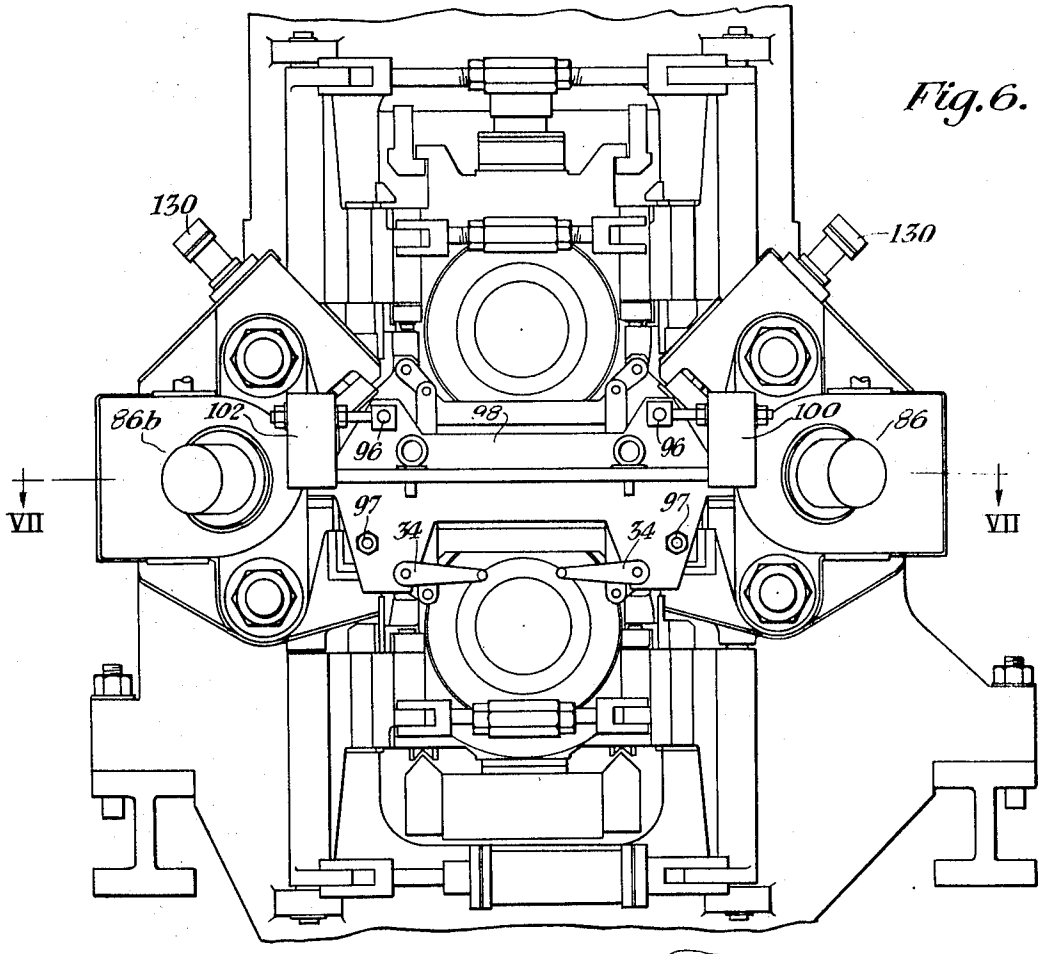

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Fig. 6.

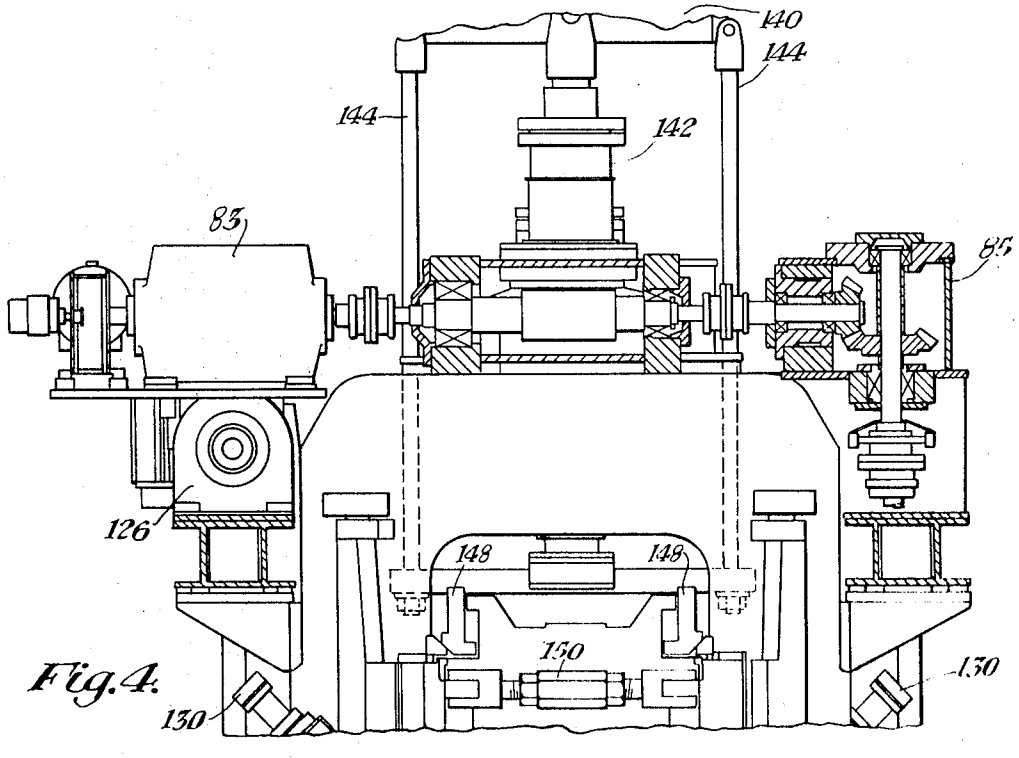

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Fig. 4.

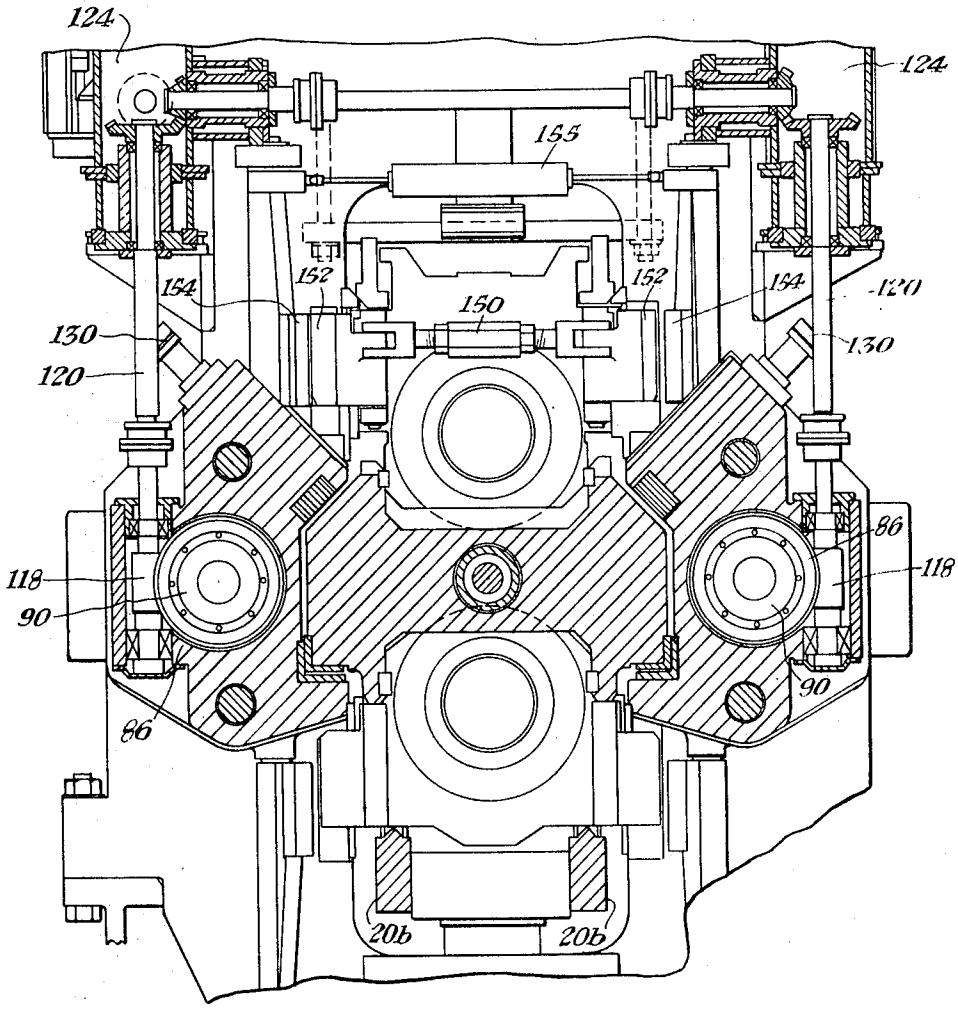


Fig. 5.

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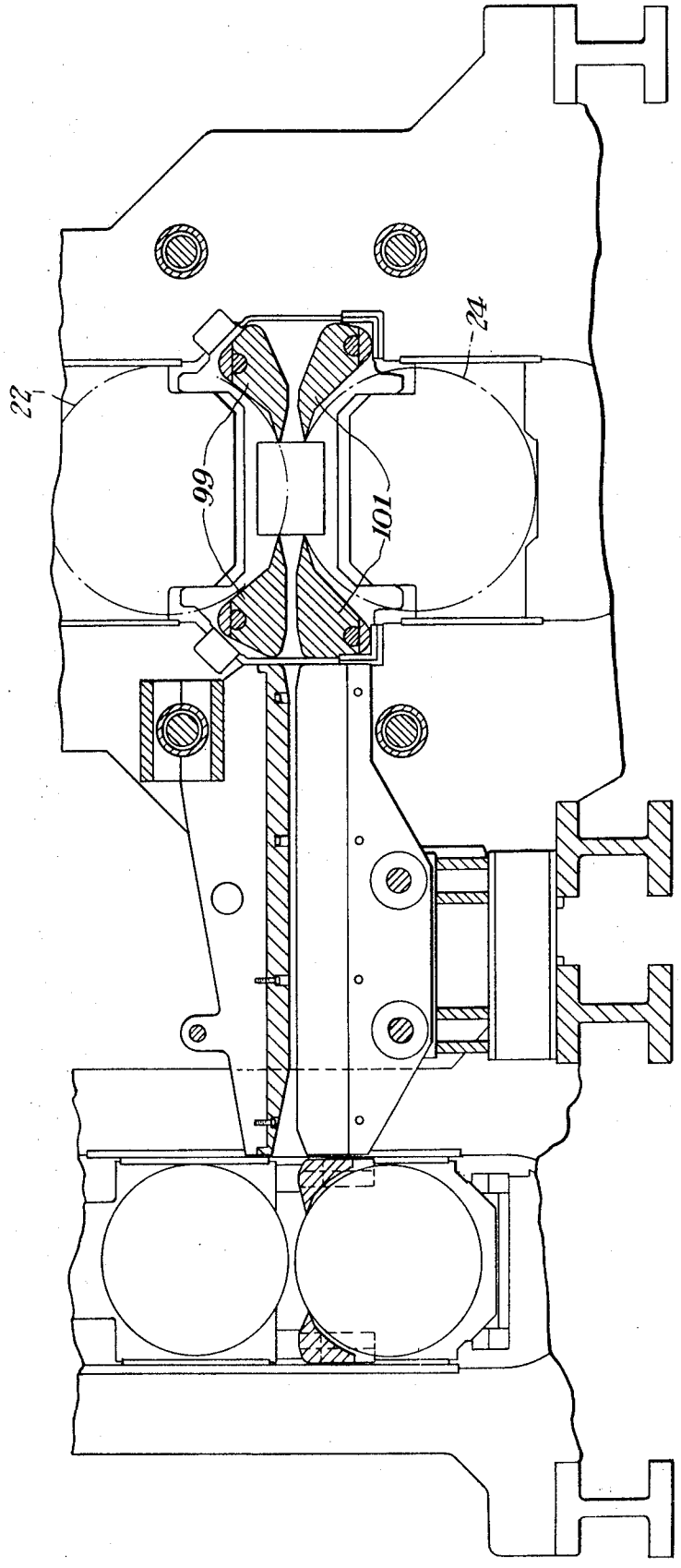


Fig. 7A.

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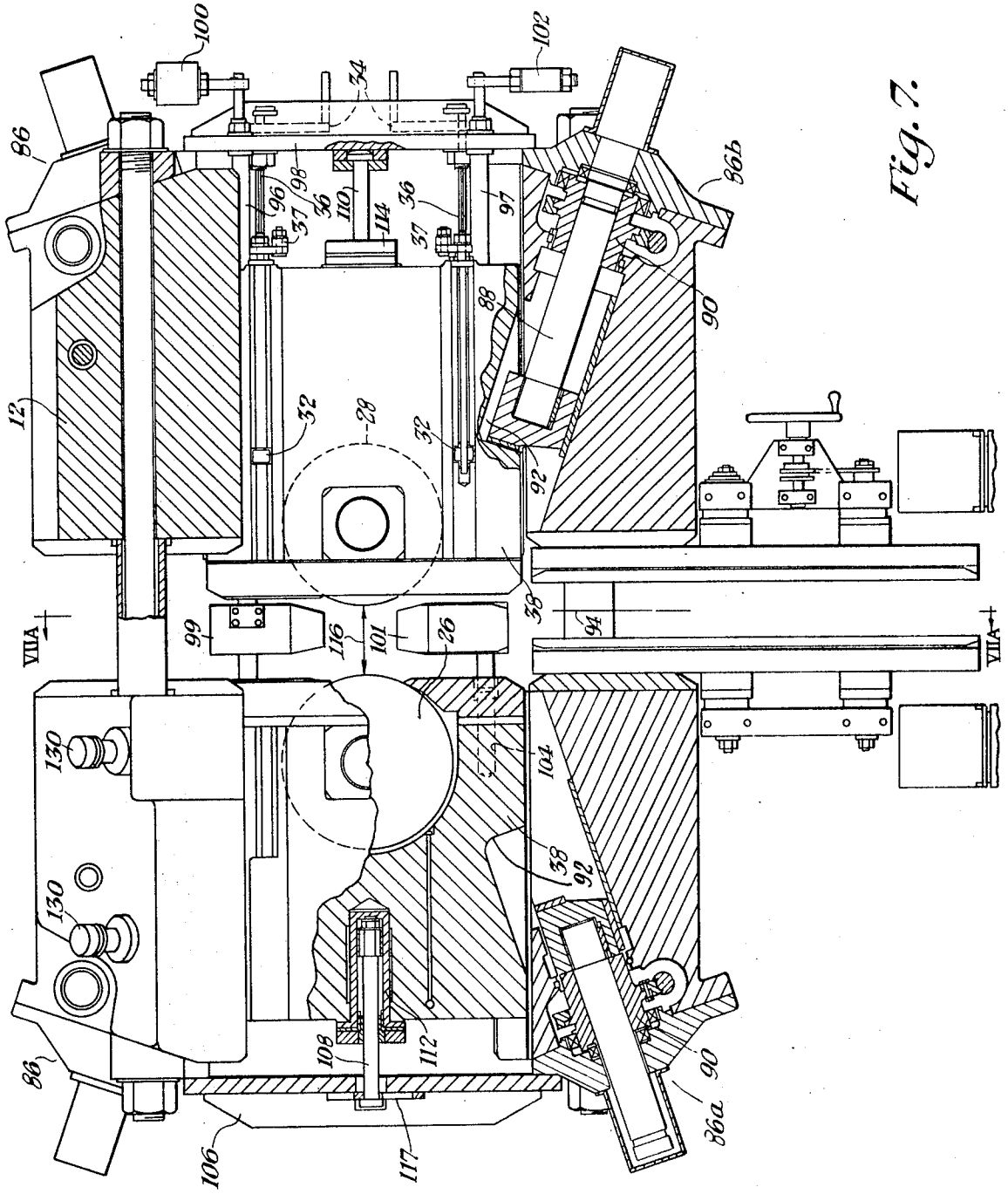


Fig. 7.

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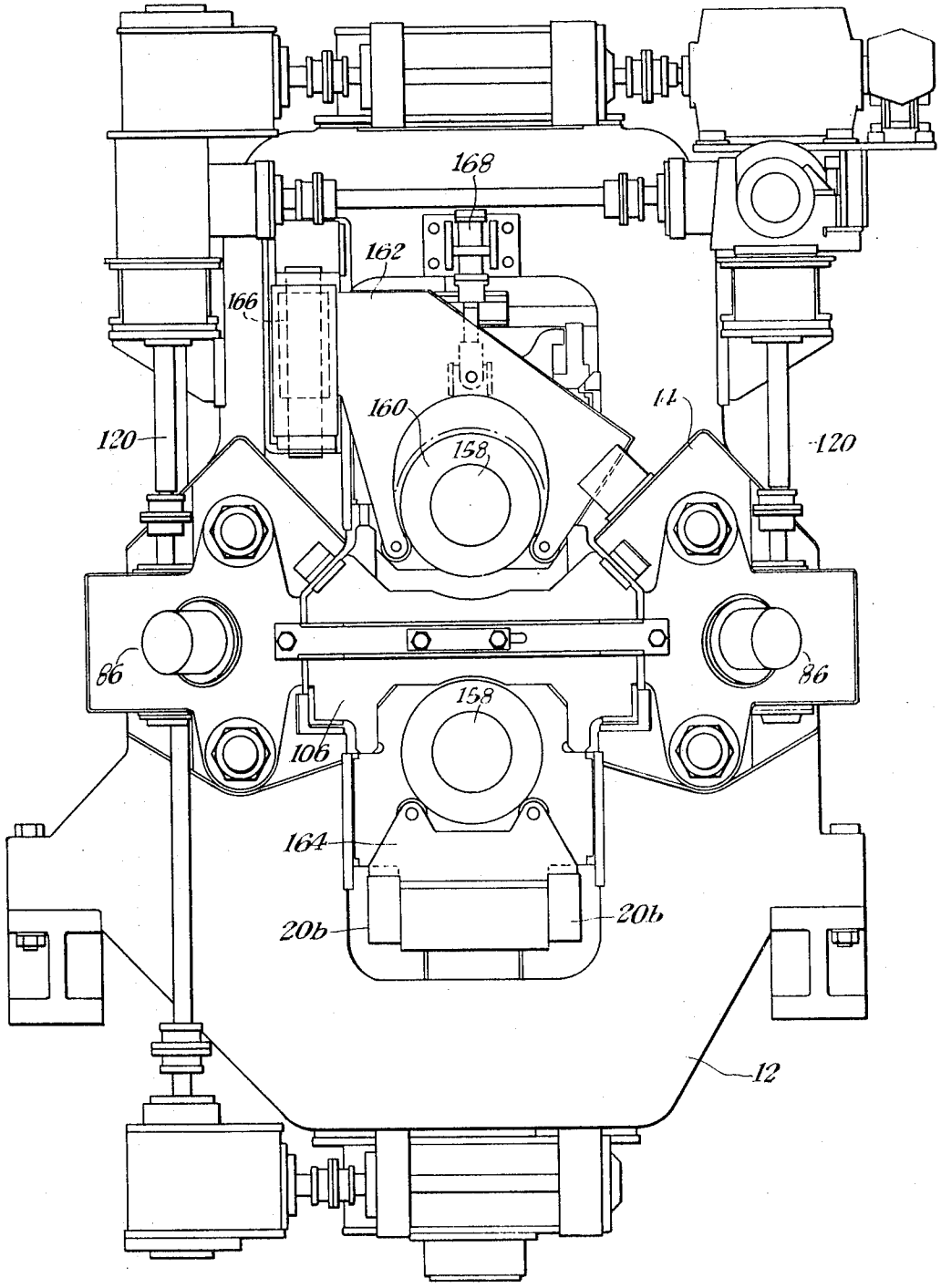


Fig. 8.

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ROLLING MILL STRUCTURE AND ROLL CHANGING MEANS THEREFOR

The present invention relates to wide flange beam mills and more particularly to mills of the character described having novel means for adjusting and removing the vertical and horizontal roll assemblies for rapid adaptation to changes in productional dimensions and for facilitating roll changing operations.

Known wide flange beam mills require removal of vertical roll housing guides, vertical roll housings, the various screw adjustments associated with the rolls and other components of the mill to permit replacement of the work rolls for maintenance purposes or for changes in productional scheduling. Many present mills employ a massive yoke-type arrangement which communicates with the screwdown drive and the vertical rolls and which must be lifted and transported en masse before the vertical rolls can be removed. This operation naturally is cumbersome and time-consuming. Changing of the work rolls therefore, is an involved operation resulting in considerable lost time and production.

Some form of adjustment means is desirable for varying the several roll gaps among the work rolls to meet operational variations in the mill structure and to accommodate minor productional changes. Previous means for this nature have been nonrepetitive, inaccurate, and difficult to manipulate.

In addition to removing and replacing the several rolling mill components mentioned above to furnish access to the work rolls, the actual withdrawal and replacement of conventionally supported work rolls alone entail considerable loss in production and expenditure of time and effort.

The disadvantaged condition of the prior art therefore comprises at least three related problem areas:

1. The difficulty of normal productional adjustment of the vertical and horizontal rolls;
2. The time-consuming removal and replacement of various rolling mill components for access to the work rolls; and
3. Difficulties attended upon the actual withdrawal and placement of the work rolls.

A partial solution to one of these problems is shown in the U.S. patents to Sieger, No. 3,212,314 and O'Brien, No. 3,180,125. In the patented structures, separate means are employed for supporting differing lengths of horizontal rolls which then can be removed through the window of the mill housing. However, changing of the vertical rolls is not facilitated, as their yokes and other related components must be removed prior to changing the rolls.

I overcome these disadvantages of the prior art by the provision of novel mill structures whereby rapid roll changing is made possible. This is accomplished by arranging the components of the mill so that both the vertical rolls and the horizontal rolls may be removed as a unit therefrom. With my arrangement, a roll change can be made in a matter of minutes whereas in the past, rolling mills of this type required as much as 8 hours to withdraw and reinsert the work rolls.

I also employ motor-driven screw adjustment mechanisms for the vertical rolls which are disposed for displacement from the path of movement of the vertical roll housings so as not to impede removal of the vertical rolls through the mill housing window. To facilitate accurate productional adjustments, means are employed on the vertical roll chocks to ensure seating of the chocks against the adjustment screws and to prevent backlash in the adjustment screws associated components. Such means are so arranged that the vertical roll housings, upon backing off all adjustment screws can be removed together with the horizontal rolls on horizontal slides or rails through the mill housing window. Means are also provided by my invention for operating the adjustment screws either independently or in concert.

My invention further contemplates the use of novel clamp and mounting means for vertical roll housings, together with a novel guide arrangement to obviate the previous requirement for disassembly of the vertical rolls prior to roll changing. A unique arrangement is provided for elevating the mill housing rails to facilitate and expedite the actual withdrawal and replacement of work rolls during the roll changing operation.

Once the vertical roll housings are clear of the screw-in devices, the vertical rolls are engaged with the horizontal rolls, and the entire roll assembly then is supported by the elevatable rails of the mill stand for transport therefrom. The roll changing procedure and associated components provided by my new design can be used either on a reversible roughing stand of typical wide flange beam mills.

To accomplish these desirable ends, I provide a rolling mill structure comprising a mill stand, a mill housing forming part of said stand and having a window sized for closely receiving a roll assembly; a roll assembly insertable through said mill housing window; said assembly including at least one slidably mounted roll housing having a roll rotatably mounted thereon; said roll housing with said roll being movable toward and away from another roll forming part of said roll assembly to establish a variable roll gap between said rolls; and means for so moving said roll housing, said means including a plunger longitudinally movable through a passageway in said mill housing and inclined to the path of movement of said roll housing, said passageway including a complementary recess in said roll housing for engagement of said roll housing with said plunger, and means for moving said plunger into engagement with said roll housing to establish a predetermined roll gap and for withdrawing said plunger into said mill housing passageway and entirely out of said path to permit removal of said roll assembly without removal of said plunger from said mill housing.

I also desirably provide a similar rolling mill structure wherein said plunger is disposed to move said roll housing toward said other roll, and said roll housing is provided with retraction means coupled thereto and to a stationary portion of said structure for moving said roll housing in a direction generally opposite to that induced by said plunger.

I also desirably provide a similar rolling mill structure wherein stripper means for another roll of said assembly are rotatably and slidably mounted upon said roll housing.

I also desirably provide a similar rolling mill structure wherein said mill stand is provided with elevatable internal rail means mounted generally below said roll assembly, said roll assembly is provided with wheel means for engaging said rail means, means are provided for elevating said internal rail means to engage said wheel means and to align said internal rail means with external rail means to permit withdrawal and insertion of said roll assembly relative to said mill housing window.

I also desirably provide a rolling mill structure comprising a mill stand, a mill housing forming part of said mill stand and having a window for closely receiving a roll assembly, a roll assembly insertable through said mill housing window, elevatable rail means movably mounted in a lower portion of said mill housing and generally beneath said roll assembly when so inserted, external rail means juxtaposed to said internal rail means, said roll assembly having wheel means for engaging said internal and said external rail means, and means for elevating said internal rail means for engagement with said roll assembly and for alignment with said external rail means, said elevating means including a screwdown mechanism mounted in the lower end portion of said mill stand and engageable with said roll assembly for operational support of said assembly, said mechanism in addition being coupled to said rail means but extending therethrough so that upon engagement between said rail means and said mill stand and further actuation of said screw mechanism at a lowered position of said rail means said screw mechanism supportingly engages said roll assembly.

During the foregoing discussion, various objects, features and advantages of the invention have been set forth. These and other objects, features and advantages of the invention together with structural details thereof will be elaborated upon during the forthcoming description of presently preferred embodiments of the invention and presently preferred methods of practicing the same.

In the accompanying drawings I have shown certain presently preferred modifications of my invention and methods of practicing the same, wherein:

FIGS. 1A and 1B constitute a composite top plan view partially in section, of a wide flange beam mill arranged in accordance with my invention and showing the horizontal and vertical rolls thereof in their withdrawn position;

FIGS. 2A and 2B constitute a composite front elevational view, partly in section, of the mill structure of FIGS. 1A and 1B;

FIG. 2C is a similar and vertically sectioned view showing the horizontal and vertical rolls in their operating positions;

FIG. 2D is a partial top plan view of roll changing mechanism for use with the apparatus of FIGS. 2A—2B and 2C;

FIG. 2E is an elevational view, partly sectioned, of the mechanism of FIG. 2D with a roll assembly attached;

FIG. 3 is a vertically sectioned view of the mill structure generally as shown in FIGS. 1A and 1B with the rolls in their inserted position however, and taken generally along reference line III–III of FIGS. 1A and 1B;

FIG. 4 is a partial, similar view of the mill structure of FIGS. 1A and 1B and taken along reference line IV–IV thereof;

FIG. 5 is a partial, similar view of the mill structure of FIGS. 1A and 1B and taken along reference line V–V thereof;

FIG. 6 is a partial right side elevation of the mill structure as shown in FIG. 2C and taken generally along reference line VI–VI thereof;

FIG. 7 is a horizontal section of the mill structure as shown in FIG. 6 and taken generally along reference line VII–VII thereof;

FIG. 7A is a partial, vertically sectioned view of the mill structure as shown in FIG. 7 and taken generally along reference line VIIA–VIIA thereof; and

FIG. 8 is a left side elevational view of the mill structure as shown in FIG. 2C and taken generally along reference line VIII–VIII thereof. FIG. 8 illustrates a spindle carrier arrangement utilized in the roll changing operation.

Referring now to FIGS. 1—5 of the drawings, the mill structure or stand 10 of my invention includes a pair of mill housing sections 12 having delivery and entry sides as indicated on the drawings. The mill housing 12 includes a closely fitting roll assembly window 16 through which a vertical and horizontal roll assembly 18 (FIGS. 1A—1B and 2A—2B) can be inserted and withdrawn on rails 20.

The roll assembly 18 includes a pair of horizontal rolls 22, 24 and a pair of vertical rolls 26, 28. The upper horizontal roll 22 is mounted on a pair of bearing chocks 30 each of which is furnished with recessible spacer blocks 32 which can be manipulated as described and claimed in the copending and coassigned application of Andrew J. Petros, Jr., filed July 18, 1967, Ser. No. 654,268, now U.S. Pat. No. 3,475,940.

In their extended positions as shown in FIG. 2B the spacer blocks 32 engage the adjacent surfaces of vertical roll housings 38 to space the roll center of the horizontal rolls 22, 24 sufficiently to provide a constant center distance for subsequent spindle engagement. The vertical roll housings 38 in turn rest respectively on a pair of lower horizontal roll chocks 40, each of which is provided with a pair of railway wheels 42 for engaging the rails 20. The vertical roll housings 38 are keyed to the horizontal roll chocks 30, 40 by means of suitable chock locks which are manipulated by handles 34 and shafts 36 (FIGS. 6 and 7).

The roll assembly 18, therefore, can be inserted and withdrawn as a unit through window 16 of the mill structure 10.

To facilitate the roll changing operation a pusher device (FIGS. 2A, 2D, 2E) is mounted adjacent the internal elevatable rail section 20*b* and is provided at its forward end with a latch 46 engageable with notches 48 in chock extensions 49 of one of the lower horizontal roll chocks 40. The pusher 44 includes a push rack 50 which is operated by a drive pinion 52 and suitable drive means therefor (FIGS. 2D, 2E). The push rack 50 desirably is stabilized by a liner 54 through which the push rack 50 moves longitudinally of the external rail section 20*a*.

Cooperating with the external rail sections 20*a* are a pair of internal rail sections 20*b* which are movably supported within the mill stand 10. The internal rail section 20*b* are longitudinally aligned with the external sections 20*a* but can be raised to and lowered from the elevation of the external rail sections 20*a* to facilitate the roll changing operation. The extent of movement of the internal rail sections 20*b* can be ascertained from a comparison of FIGS. 2A and 2C.

As more apparent from an inspection of FIGS. 3 and 5, the internal rail sections 20*b* are mounted upon a pair of crossbars 60 which in turn rest upon a pair of heavily constructed threaded nuts 62, 64, which are mounted respectively for vertical sliding movement in recesses 66 of the mill stand 12. The nuts 62, 64 which are keyed against rotation are raised and lowered and with them the internal rail sections 20*b* by rotation of a lower pair of housing screw downs 68. The screw downs each include a jack screw 70 slidably and keyingly mounted on worm gear 72. In their position shown in FIG. 3, the lower screw downs 68 have been rotated to elevate the internal rail sections 20*b* sufficiently so that the roll assembly 18 including its vertical roll housings 38 is raised to provide withdrawal clearances between bearing plates 74, 76 located on the vertical roll housings 38 and and the mill stand housing 12 respectively. On the other hand, rotation of the jack screws 70 in the opposite direction lowers the nuts 62, 64 and the rail sections 20*b* until the lower ends of nuts 62, 64 engage shoulders 78 in the housing recesses 66.

At this time further rotation of the jack screws 70 elevates the jack screws by their threaded engagement with the now stationary nuts 62, 64 to bear against the undersurfaces 80 of the lower horizontal roll chocks 40. This rotation of the jack screws 70 is continued until the lower horizontal roll 24 is restored to its operating position. In a similar manner the upper horizontal roll 22 is backed up by conventional upper screwdown mechanism 82 bearing against the upper surfaces 84 of the upper horizontal roll checks 30. The upper housing screw downs 82 are actuated by a pair of drive motors 83 which are coupled through gear units 85 and shafting denoted communially by the reference characters 87. The lower housing screw downs 68 are actuated through gear units 69, shafting 71 and drive motors 83.

When the roll assembly 18 has been fully inserted into the mill stand 10, the operating gap 116 (FIG. 7) between the vertical rolls 26, 28 can be adjusted by motor driven screw adjustment mechanisms 86 with two such mechanisms being provided for each vertical roll housing 38. In the illustrated arrangement each of the screw adjustments 86 includes a plunger such as a jack screw 88 which is threaded through worm gear 90. The mechanism 86*a* in this example represents the full retracted position of the jack screw while the mechanism 86*b* shows the fully extended position of the jack screw.

Desirably, the screw adjustments 6 are mounted in the mill housings 12 and are inclined to bear against a similarly inclined recessed portion or notch 92 of the vertical roll housings 38. As mentioned previously, at the fully retracted position of the screw adjustments, such as represented by screw adjustment 86*a*, the adjustment mechanism is withdrawn completely from the path of movement of the vertical roll housings 38. Thus, the roll assembly 18 can be removed without removal of the screw adjustments 86, and an exceptionally time-consuming operation is obviated.

In FIG. 5 of the drawings for purposes of clarity, the screw mechanisms 86 are shown as having been revolved approximately 15° forward to illustrate the drive mechanisms provided therefor. The worm gears 90 of the mechanisms 86 are driven by worms 118, shafts 120, 122, gear reducers 124 and a pair of drive motors 126 normally connected through cutout coupling 128 (FIG. 1).

From FIGS. 6 and 7, it will be observed that each of the vertical roll housings 38 is mounted for movement in the horizon-

tal direction and transversely of pass line 94 for adjustment purposes by means of guide and bearing plates 74, 76. At least one of the vertical roll housings 38 has slidably mounted supporting rods 96 and 97 which are displaced below and above the notches 92 so as not to interfere with movements of the screw adjustments 86. At their outer ends the rods are rotatably secured to end plate 98 or other relatively stationary member of the roll assembly 18. At their opposite ends the supporting rods 96, 97 are variably inserted into recesses 104 (depending on gap width) of the other of the vertical roll housings 38. The incorporation of the supporting rods 96, 97 within the removable roll assembly 18 obviates the time-consuming removal of the vertical housing rods which heretofore has aggravated the difficulties in removing and replacing conventional roll assemblies.

Mounted on the supporting rods 96, 97 are a like number of strippers 99, 101 for the horizontal rolls 22, 24 respectively. The upper strippers 99 are urged against the upper horizontal roll 22 by counterweights 100, 102. A similar relation between the lower stripper 101 and the lower horizontal roll 24 is maintained by gravity.

A similar end plate 106 is secured to the mill housing 12 on the opposite side of the mill stand 12. Each end of the plates 98, 106 is connected to a headed end of a piston rod 108 or 110 of a pullback cylinder 112 or 114 mounted on the adjacent end of the associated vertical roll housing 38. With the aid of the pullback cylinders 112, 114 and the aforedescribed screw adjustments 86, the gap 116 between the vertical rolls 26, 28 can be adjusted while maintaining a sufficient loading on the screw adjustments to obviate backlash and loss of accuracy. This is accomplished by actuating cylinders 112 or 114 (through suitable and known electrohydraulic circuitry, not shown) to urge the associated vertical roll housing 38 against its screw adjustment 86*a* or 86*b* as the latter is withdrawn. The screw adjustment drives can be operated individually or in concert through suitable and known control circuitry (not shown). When removing the roll assembly 18, the distal end of the pullback piston rod 108 is disconnected from the stationary end plate 106, by displacing retaining plate 117.

In operation the roll assembly 18 is inserted through access window 16 in the mill housing 12 at which time the vertical screw adjustments mechanisms 86 are fully withdrawing as noted above. Likewise the bottom screw downs have been rotated in a direction to elevate the internal rail section 20*b* so that the roll assembly 18 can be conveniently and readily received and positioned within the mill stand 10. Thereafter, the rails 20*b* are lowered in the manner described above, and the upper and lower horizontal roll chocks 30, 40 are positioned between the upper and lower screw downs 82, 68 in the manner described. After such positioning the vertical roll housings 38 are moved to adjust the gap 116 therebetween by operation of the vertical roll screw adjustments 86 and pullback cylinders 112, 114.

After the various adjustments among the vertical and horizontal rolls have been made the horizontal roll housings 30, 40 are positioned as aforesaid and the vertical roll housings 38 are clamped in position between the housing liner plates 76 and a number of clamping cylinders 130, with eight such cylinders 130 being employed in this arrangement of the invention. The clamping cylinders 130 are secured to the mill housing 12 (FIGS. 3 and 5) in inclined positions which are normal to the juxtaposed linear plates 132 of the vertical roll housings 38. In furtherance of this purpose the distal ends of the piston rods 134 are provided with clamp blocks 136 for engagement with the liner plates 132. The mill housing 12 is provided with suitable recesses and passages to accommodate the clamping blocks 136 and piston rods 134.

In order to open the gap 138 (FIG. 2A) between the horizontal rolls 22, 24 a retractive mechanism 140 is mounted on the upper end of the mill housing 12 (FIGS. 3 and 4). The mechanism 140 includes an actuating cylinder 142, draw rods 144, a common support 146 connected thereto, and a pair of lifting brackets 148 engageable through a lost-motion connection with the upper horizontal roll housing 30. Prior to insertion of the roll assembly 18 into the mill housing window 16 the upper and lower horizontal roll chock 30 and 40 are positioned by means of turnbuckle 150 (FIGS. 5 and 6) which actuates pivoted liner segments (FIG. 1B) to bear against stationary liner plates on the mill housing, pivotally mounted clamps 154 are actuated by cylinders 155 to retain roll assembly 18 in mill housing.

With the vertical rolls idling, the horizontal rolls 22, 24 are driven in the conventional manner by spindles 158 and spindle couplings 160. As better shown in FIG. 8, the spindle couplings 160 are readily aligned with the roll assembly 18, when the latter is inserted into the mill housing 12, through use of the spindle carriers 162, 164. The lower spindle carrier 164 is mounted on internal rail sections 20*b* and thus is raised and lowered with the rail sections to carry with it the associated spindle coupling 160 in a position of alignment with the associated horizontal roll journal when the roll assembly 18 is inserted. The upper spindle carrier 162 likewise can be elevated to align the associated upper spindle coupling 160 with the roll assembly 18 by virtue of its slidable mounting on pin 166 and elevation by cylinder 168.

From the foregoing it will be apparent that novel and efficient forms of rolling mill structures have been described herein. While I have shown and described certain presently preferred embodiments of the invention and have illustrated certain presently preferred methods of practicing the same, it is to be distinctly understood that the invention is not limited thereto but may be variously embodied and practiced within the scope of the following claims.

I claim:

1. A rolling mill structure comprising a mill stand, a mill housing forming part of said stand and having a window sized mill closely receiving a roll assembly; a roll assembly insertable through said mill housing window; said assembly including at least one slidably mounted roll housing having a roll rotatably mounted therein; said roll housing with said roll being movable toward and away from another roll forming part of said roll assembly to establish a variable roll gap between said rolls; and means mounted on said mill housing for so moving said roll housing, said means including a plunger longitudinally movable through a passageway in said mill housing and inclined to the path of movement of said roll housing, said passageway including a complementary inclined recess in said roll housing for engagement of said housing with said plunger, and means for moving said plunger along said passageway and recess into engagement with said roll housing to establish a predetermined roll gap and for withdrawing said plunger into said mill housing entirely out of said path to permit removal of said roll assembly without removal of said plunger from said mill housing.

2. The combination according to claim 1 wherein said plunger is disposed to move said roll housing toward said other roll, and said roll housing is provided with retraction means coupled thereto and to a stationary portion of said structure for moving said roll housing in a direction generally opposite to that induced by said plunger.

3. The combination according to claim 1 wherein stripper means for said another roll are rotatably and slidably mounted upon said roll housing.

4. The combination according to claim 1 wherein said mill stand is provided with elevatable internal rail means mounted generally below said roll assembly, said roll assembly is provided with wheel means for engaging said rail means, means are provided for elevating said internal rail means to engage said wheel means and to align said internal rail means with external rail means to permit withdrawal and insertion of said roll assembly relative to said mill housing window upon withdrawal of said plunger.

5. The combination according to claim 4 wherein said elevating means include a screwdown mechanism mounted in the lower end portion of said mill stand and engageable with said roll assembly for operational support thereof, said

mechanism in addition being coupled to said rail means but extending therethrough so that upon engagement between said rail means and said mill housing at a lowered position of said rail means and further actuation of said screw mechanism said screw mechanism supportingly engages said roll assembly.

6. The combination according to claim 4 wherein traction means are mounted adjacent said internal rail means for withdrawing and inserting said roll assembly through said mill housing window, said traction means including a latch member movable by said traction means and disposable thereby for engagement with said roll assembly upon upward movement of said internal rail means.

7. A rolling mill structure comprising a mill stand, a mill housing forming part of said mill stand and having a window for closely receiving a roll assembly, a roll assembly insertable through said mill housing window, elevatable rail means movably mounted in a lower portion of said mill housing and generally beneath said roll assembly when so inserted, external rail means juxtaposed to said internal rail means, said roll assembly having wheel means for engaging said internal and said external rail means, and means for elevating said internal rail means for engagement with said roll assembly and for alignment with said external rail means, said elevating means including a screwdown mechanism mounted in the lower end portion of said mill stand and engageable with said roll assembly for operational support of said assembly, said mechanism in addition being coupled to said rail means but extending therethrough so that upon engagement between said rail means and said mill housing and further actuation of said screw mechanism at a lowered position of said rail means said screw mechanism supportingly engages said roll assembly.

8. The combination according to claim 7 wherein said mill housing is provided with stop surfaces for engaging said roll assembly when said internal rail means are lowered, and a plurality of clamp mechanisms are spacedly mounted on said mill housing, said clamp mechanisms including clamp members extending through passages therefor in said mill housing for engagement with said roll assembly to clamp said roll assembly within said mill housing and against said stop surfaces.

9. The combination according to claim 4 wherein spindle carrier means are mounted on said stand adjacent said mill housing window in alignment with journal means for said rolls for supporting at least one spindle coupling therefor prior to connection with said rolls, said spindle carrier means being at least partially mounted on said internal rail means for elevation and alignment movement therewith.

10. The combination according to claim 1 wherein said roll assembly includes a first pair of rolls and a second pair of rolls mounted substantially at right angles thereto, a housing for one of said first pair of rolls is so moved, and additional means are mounted on said mill housing for moving at least one of said second pair of rolls toward and away from the other second roll to adjust a roll gap between said second pair of rolls.