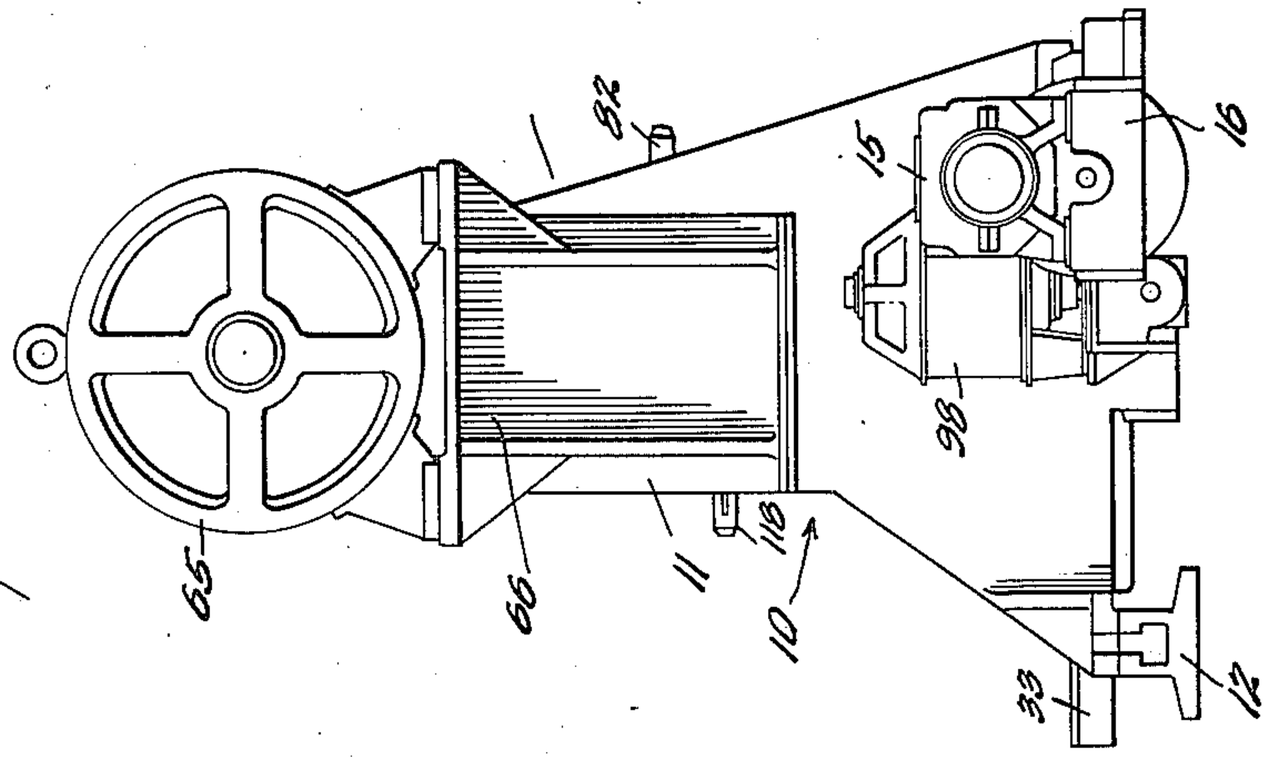
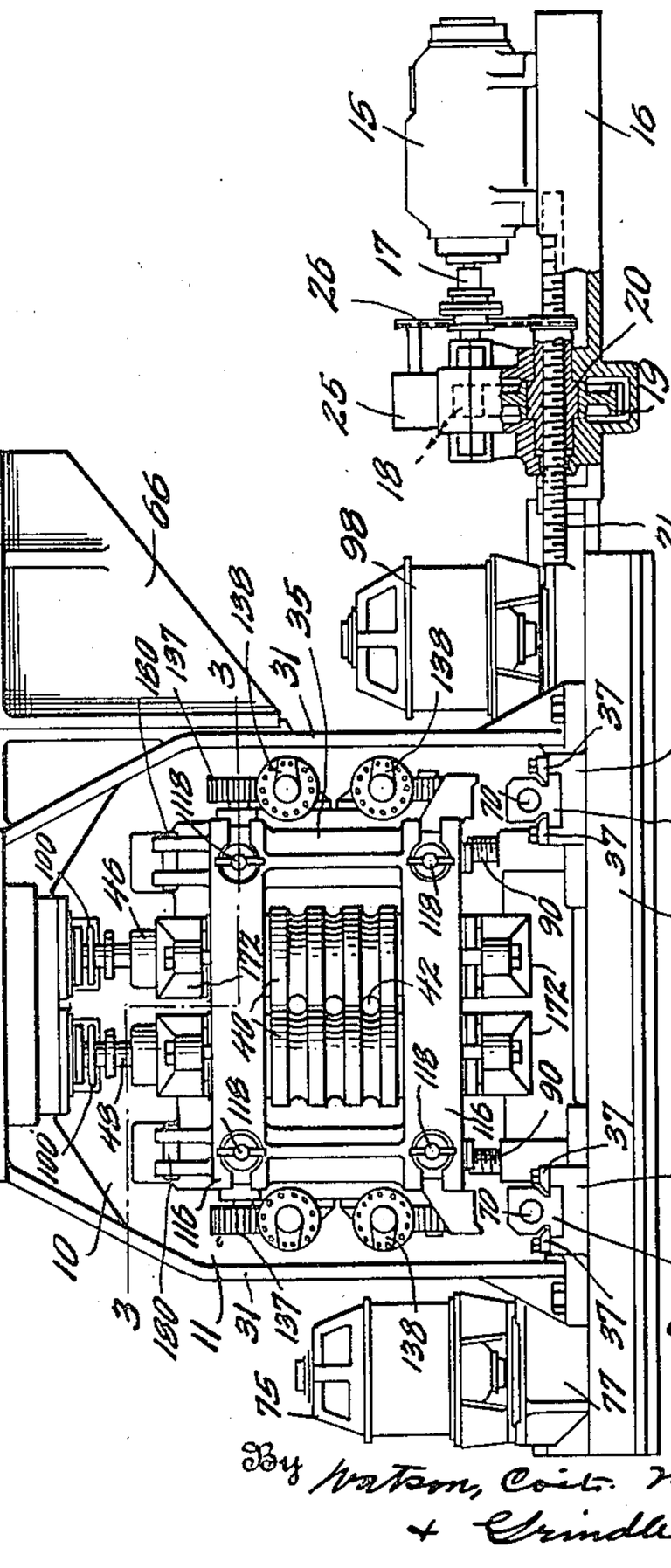
Aug. 20, 1935. E. W. MIKAELSON ET AL 2,011,686

ROLLING MILL

Filed May 9, 1933 5 Sheets-Sheet 1

FIG. 2.





Inventor

E. W. Mikaelson,

& A. K. Hamilton

By Watson, Coit, Morse + Grindle

Attorney

Aug. 20, 1935. E. W. MIKAELSON ET AL 2,011,686

ROLLING MILL

Filed May 9, 1933 5 Sheets-Sheet 2

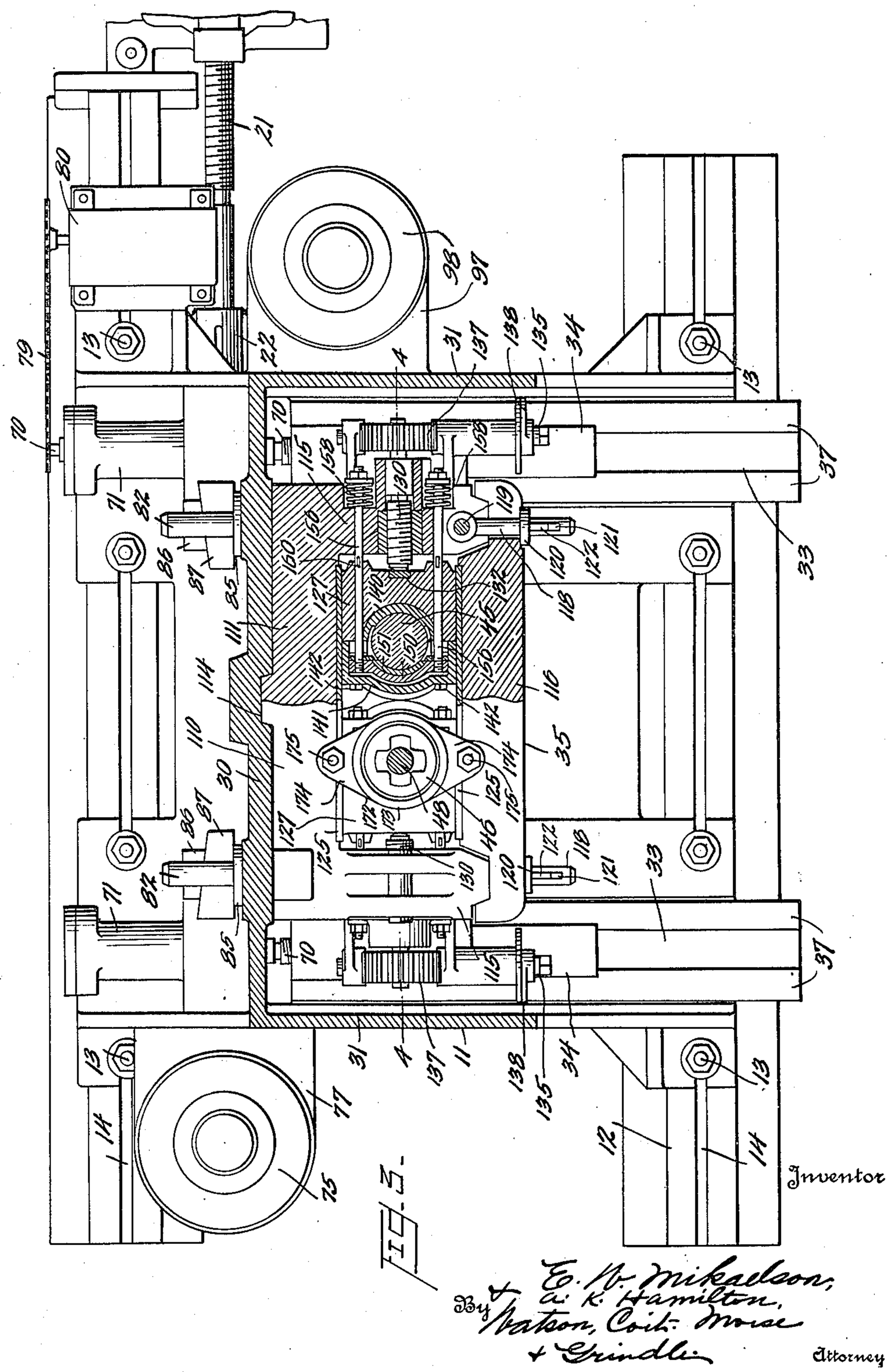


FIG. 3.

Inventor

By E. W. Mikaelson,
A. K. Hamilton,
Watson, Coit, Morse
& Grindle

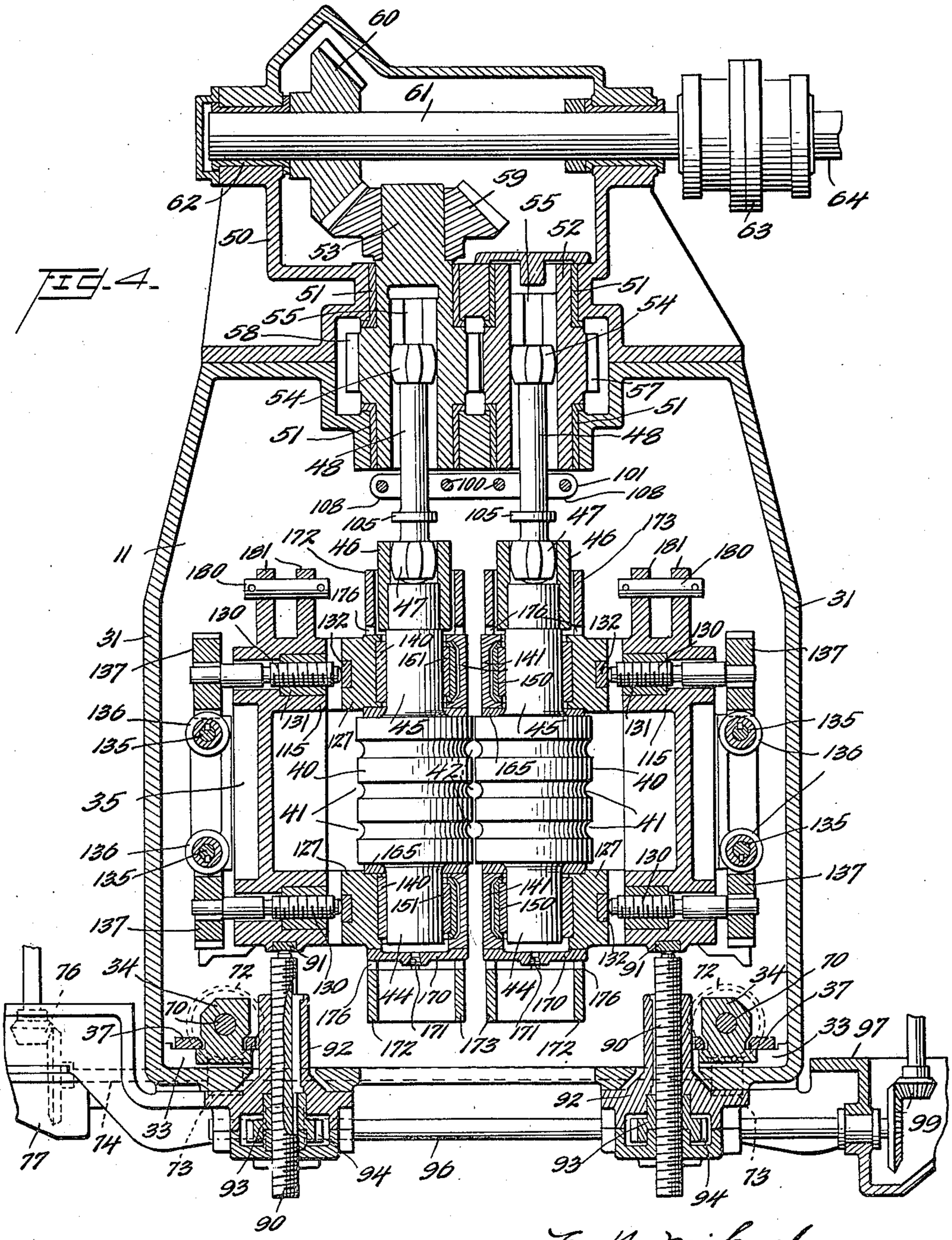
Attorney

Aug. 20, 1935. E. W. MIKAELSON ET AL 2,011,686

ROLLING MILL

Filed May 9, 1933 5 Sheets-Sheet 3

FIG. 4.



E. W. Mikaelson,
A. K. Hamilton
By Watson, Coit, Morse & Grindle
Attorney

Aug. 20, 1935. E. W. MIKAELSON ET AL 2,011,686

ROLLING MILL

Filed May 9, 1933 5 Sheets-Sheet 4

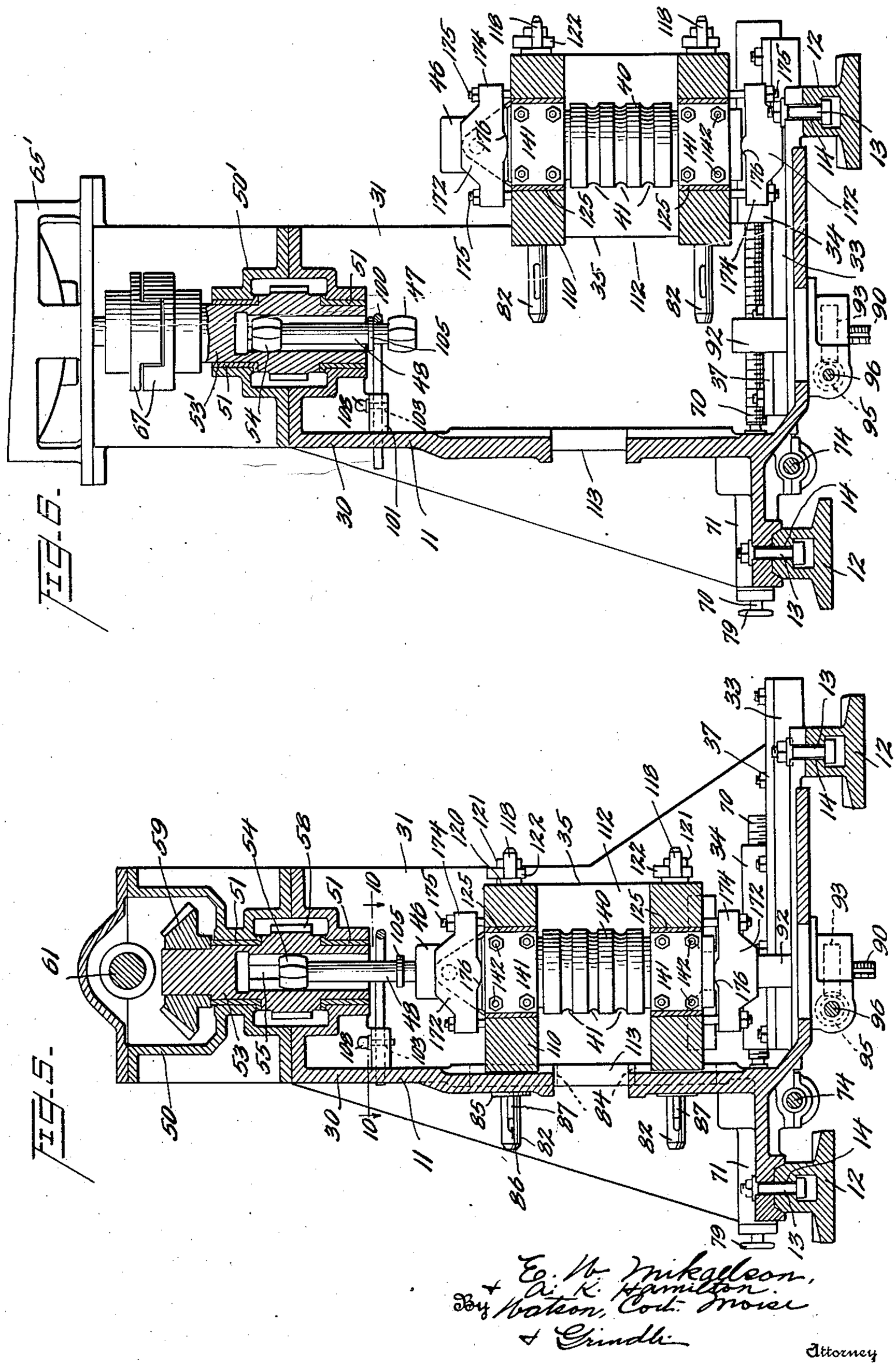


FIG. 5.

FIG. 6.

Ed. W. Mikaelson,
A. K. Hamilton.
By Watson, Cole, Grosier
& Grindle

Attorney

Aug. 20, 1935. E. W. MIKAELSON ET AL 2,011,686

ROLLING MILL

Filed May 9, 1933 5 Sheets-Sheet 5

FIG. 7.

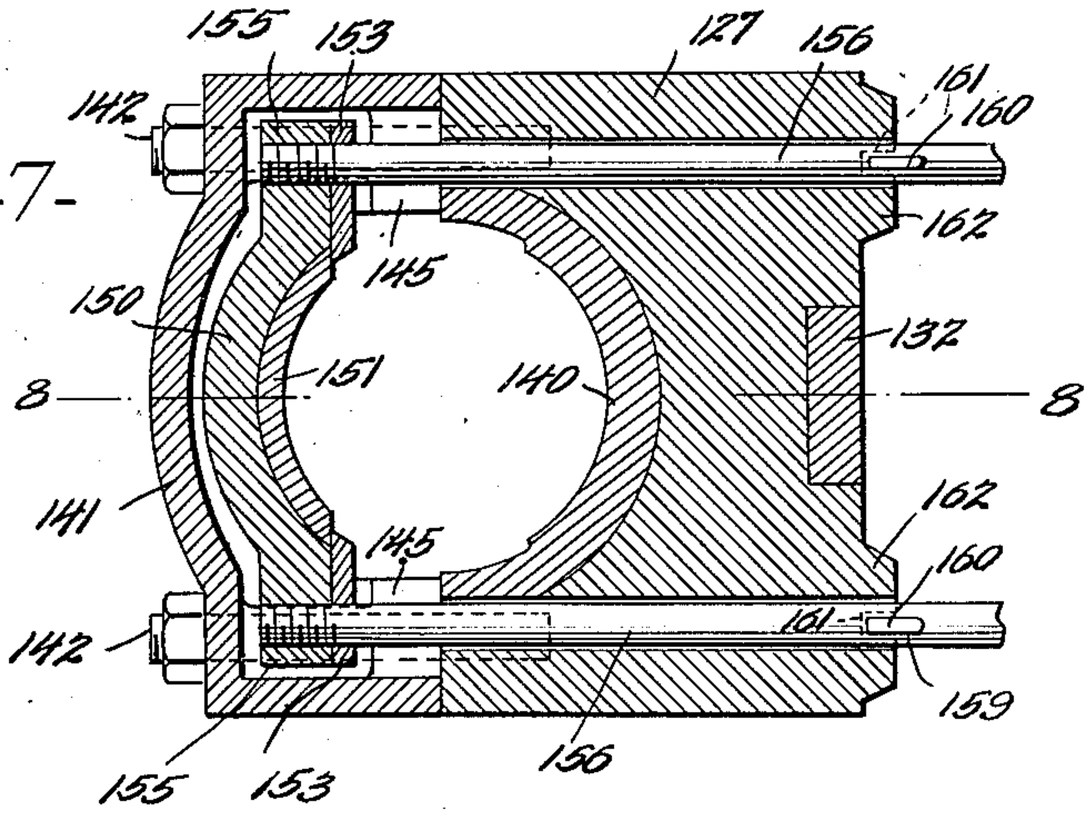


FIG. 8.

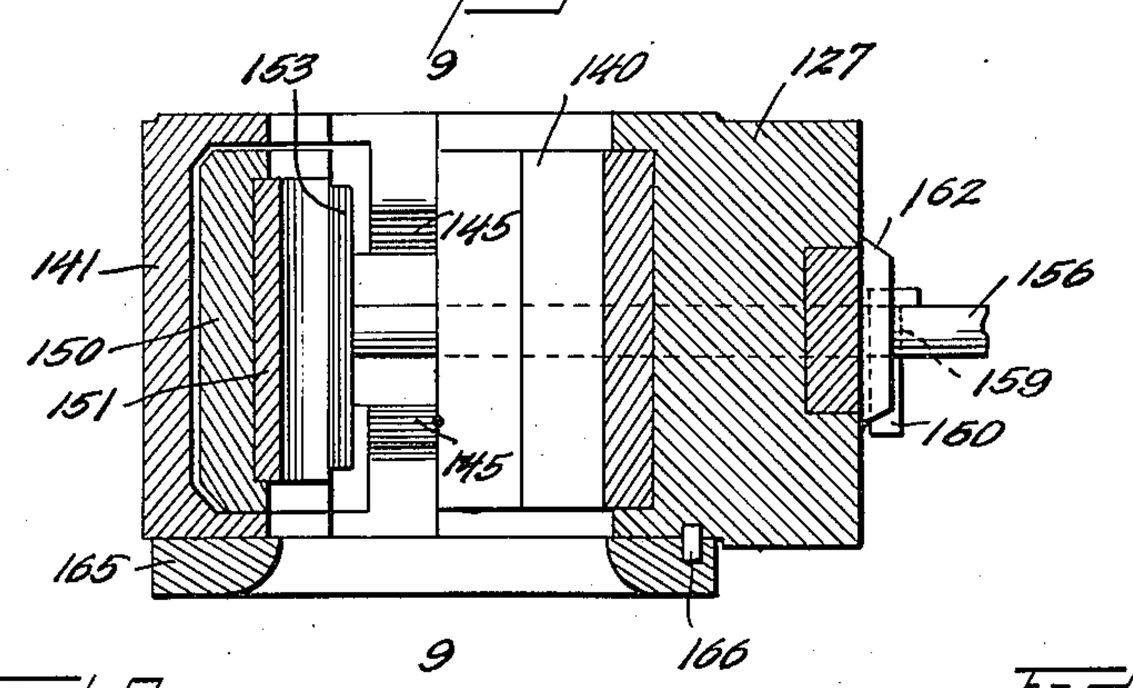


FIG. 9.

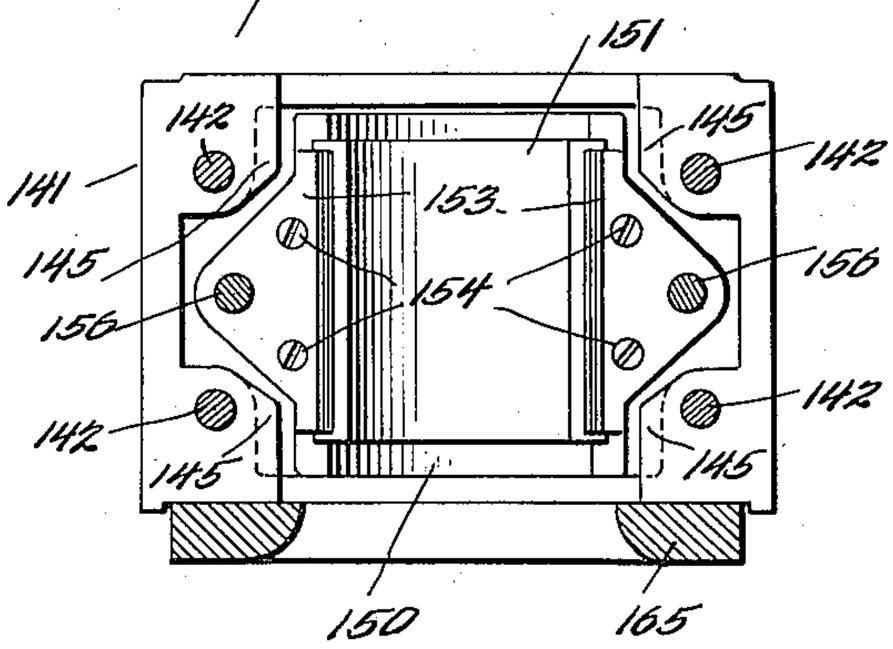
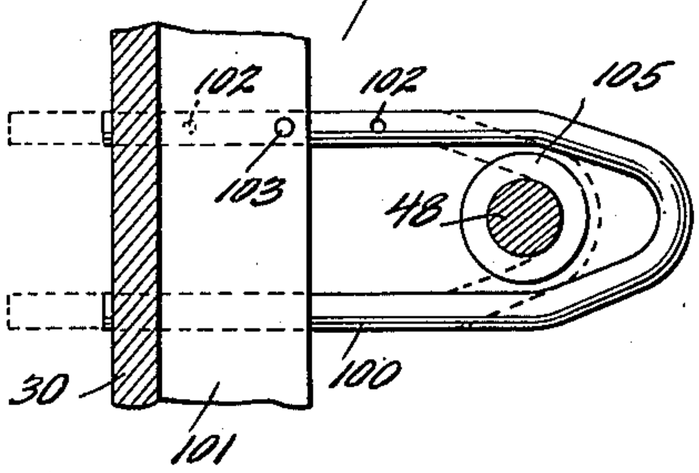


FIG. 10.



Inventor

E. W. Mikaelson,
& A. K. Hamilton
By Watson, Coit & Moser
& Grindle

Attorney

Patented Aug. 20, 1935

2,011,686

UNITED STATES PATENT OFFICE

2,011,686

ROLLING MILL

Erik W. Mikaelson, Easton, Pa., and Alexander K. Hamilton, Chicago, Ill., assignors to Treadwell Engineering Company, Easton, Pa., a corporation of Pennsylvania

Application May 9, 1933, Serial No. 670,156

31 Claims. (Cl. 80—31.1)

This invention relates to rolling mills and more particularly to mill stands employed therein in which the rolls are adjustable and from which they may be readily removed.

The general object of the invention is to provide a novel and improved rolling mill of this type.

In certain of its more specific phases the invention relates to rolling mill stands in which the rolls are vertically arranged. In a continuous mill,—that is, a mill comprising several roll stands through which the material to be attenuated or shaped is successively passed,—it is customary and desirable to provide in conjunction with the usual horizontal roll stands one or more roll stands with vertically disposed rolls. Very obviously, the grooves in these rolls are subject to considerable wear just as in the case of the ordinary horizontal rolls, and in order to maintain the uniform cross section of the roll passes, provision for rapid and convenient adjustment and removal of the rolls must be made.

In many installations, several sets of cooperating grooves of the same size and shape are provided in the rolls of each stand so that when one of these sets of grooves becomes worn excessively, a quick change to a new set may be accomplished by shifting the rolls endwise. One of the more specific objects of the present invention is the provision of improvements in the means for accomplishing this endwise shifting or adjustment.

When all of the grooves of a set of rolls have been worn down to a degree which unfits them for further use without renewal, new rolls must be substituted, and it is essential that the change from the old to the new rolls be made with the least possible delay. Consequently, the rolls with their bearings and associated supporting and adjusting mechanism are sometimes mounted in a carrier frame which may be removed from the roll stand or housing as a unit by means of a crane or like instrumentality, and another carrier frame with new rolls already mounted therein inserted in its place.

To facilitate the removal of the roll supporting frame or cage, the driving mechanism on certain existing mills is located beneath the rolls thus leaving the upper portion of the frame accessible to the crane. This type of installation has many practical objections and up to the present time, efforts to overcome them have not been entirely successful. For example, the driving gears and spindles must be protected from the water used to cool the rolls and from the scale that is loosened from the bars during their passage through the mill; access to the driving mechanism for purposes of inspection and repair is difficult; and the cost of excavating for and building the foundation for such mill stands is comparatively high.

One of the principal objects of the present invention therefore is to provide a vertical mill in which the driving mechanism is advantageously mounted at the upper end of the mill stand or housing but in which the rolls are so mounted that they may be conveniently removed and replaced.

Further objects include the provision of means for effecting the several necessary operative adjustments of the rolls; novel roll bearing assemblies; and means for effecting the removal of the rolls from the mill stand and from the roll carrying frame.

Other objects and features of novelty will be apparent from the following specification when read in connection with the accompanying drawings in which certain embodiments of our invention are illustrated by way of example.

In the drawings:

Figure 1 is a view in front elevation of a roll stand embodying the principles of our invention;

Figure 2 is a side view of the same;

Figure 3 is a horizontal cross sectional view on an enlarged scale taken on line 3—3 of Figure 1;

Figure 4 is a view in vertical transverse section of the major portion of the mill stand taken on line 4—4 of Figure 3;

Figure 5 is a vertical longitudinal cross sectional view of the roll stand on a scale intermediate those of Figures 2 and 4;

Figure 6 is a view similar to Figure 5 in which the roll cage is shown removed from the housing and in position to be lifted and transported by crane or the like; the driving means shown at the upper portion of the stand being of a slightly modified form;

Figure 7 is a horizontal cross sectional view through one of the roll bearing carrying frames on a greatly enlarged scale;

Figure 8 is a vertical sectional view through the same parts and taken on the line 8—8 of Figure 7;

Figure 9 is a vertical cross sectional view taken on line 9—9 of Figure 8; and

Figure 10 is a fragmentary horizontal sectional view taken on line 10—10 of Figure 5.

Referring to the drawings, the numeral 10 designates the roll stand assembly which comprises essentially the housing 11 which is disposed for adjustment transversely of the direction of movement of the material through the

mill upon the slotted tracks or guides 12. When in adjusted position the roll stand is adapted to be rigidly secured to the guides 12 by means of the bolts 13 which are adapted to pass through the slots 14 in the guides. Suitable mechanism is provided for shifting the roll stand laterally along the tracks or guides 12 and includes in the present disclosure the motor 15 which is mounted upon the stationary base 16. The motor 15 is adapted to drive the pinion 18 by means of the shaft 17 coupled thereto, and the pinion 18 meshes with the gear 19 which is carried by or forms a part of the nut 20 through the center of which is threaded the shaft 21. One end of the shaft 21 is secured to the housing 11 as at 22 and is adapted to reciprocate conveniently within the hollow base 16 of the motor installation. It will be readily understood that in aligning the roll stand pass with those of the other stands of the continuous mill, the roll stand is shifted laterally upon the shoes 12 by means of the motor and transmission 15—21 and when in the desired position is secured to the guides 12 by means of the bolts 13. In order to prevent excessive movement of this shifting means, a limit switch 25 is provided which may be conveniently mounted upon the housing of the gearing 18, 19 and which is connected with the rotatable nut 20 by means of the sprocket gearing 26.

The housing 11 which comprises the major portion of the roll stand is provided with the rear wall 30 and the side walls 31, the front of the housing being open as will be readily seen from Figures 3, 5 and 6. The floor of the housing 11 is provided with guides or trackways 33 which extend for a considerable distance beyond the open front of the housing proper and which are grooved for the reception of the sliding shoes 34 upon which the roll carrying frame or cage 35 is adapted to rest during its removal from the housing. The sliding shoes 34 are flanged at the bottom thereof and these shoes may be retained in the proper position with relation to the trackways 33 by means of the removable plates 37 which overlie the flanges and are bolted to the tracks 33. The mechanism for sliding the shoes 34 along the trackways will be described hereafter. In Figures 1, 4 and 5 the roll carrying frame or cage 35 is shown in one of the elevated positions which it may occupy during operation of the mill. It will be understood that the roll cage may be adjusted to various heights by suitable mechanism which will be described and which serves to register the various passes or grooves of the rolls with those of preceding and succeeding stands of the mill.

In the illustrated example, the vertical rolls which are carried by the cage 35 are indicated at 40, the rolls being provided with grooves 41 which may be of any desired shape depending upon the nature of the work to be done, and each of which cooperates with the corresponding grooves of the other roll to form the passes 42. Each roll is of course provided with a lower neck 44 and an upper neck 45, the latter being provided with the interiorly grooved members 46 which are adapted to receive the lower ends 47 of the spindles 48 which form a part of the extensible telescoping driving mechanism. The spindle ends 47 are of cruciform or some other irregular shape so as to interfit with the correspondingly grooved sockets in members 46. The end portions 47 are rounded longitudinally as shown in Figure 4 so that the spindles may incline to a certain degree whereby the driving relation of the spindle and rolls may be maintained when the rolls are individually shifted laterally.

The gearing for driving the rolls is mounted upon the top of the housing 11 and is enclosed within the casing 50. The lower portion of the casing 50 and the upper portion of the housing 11 are suitably formed and provided with bearings such as indicated at 51 for the reception of the hollow shafts 52 and 53 which are adapted to receive the upper ends 54 of the retractable and extensible spindles 48 and to thus form cooperating stationary portions of the telescoping driving arrangement. The hollow interior of the shafts 52 and 53 is slotted as at 55 for the reception of the spindle ends 54 which may be shaped in exactly the same manner as the lower ends 47. Intermeshing gear teeth 57 and 58 are provided on the shafts 52 and 53 and the shaft 53 is additionally provided at its upper end with the bevel gear 59. Another bevel gear 60 intermeshes with the gear 59 and is keyed to the horizontally disposed shaft 61 which rotates in the bearings 62 provided in the casing 50 and is coupled as at 63 with the shaft 64 of the main driving motor 65. A bracket 66 is secured to the housing 11 for supporting this motor. It will thus be seen that a very sturdy transmission arrangement is provided for the roll drive which will readily accommodate itself to not only the vertical adjustments of the rolls but also their individual lateral adjustments.

A modified form of drive which may be adopted is shown in the upper portion of Figure 6 of the drawings in which the driving motor, designated 65', is disposed in a vertical position on top of the gear housing 50' and is connected to the hollow shaft 53' by means of the coupling 67. Otherwise the arrangement is as described with reference to the other embodiment. In each case the driving mechanism is arranged in the most convenient and accessible position at the top of the roll stand, and the rolls are disposed within the lower portion of the stand represented by the housing 11.

As already stated, during removal of the roll carrying cage 35 from the roll stand, it is adapted to be lowered until it rests upon the sliding shoes 34 which are designed to carry it forwardly through the open front of the housing 11 until it is accessible to the crane or other means by which it may be completely removed from the roll stand and replaced by another cage containing a new set of rolls. The mechanism for actuating the sliding shoes 34 will now be described. Each of these shoes 34 is provided with a longitudinally threaded bore which is adapted to receive the threaded shaft 70. This shaft is mounted for rotation in a suitable casing 71 provided in the rear supporting bracket of the housing 11 and is provided with a worm wheel 72. Each of the worm wheels 72 is adapted to be driven by a worm 73 which is keyed to the cross shaft 74 driven by the motor 75 through the bevel gearing 76. The motor 75 and portions of the gearing are carried by the bracket 77 which may be conveniently cast integrally with the housing 11 or may be otherwise secured thereto. One of the screw shafts 70 is extended rearwardly through its casing 71 and is provided with a sprocket gearing connection 79 with a limit switch 80 which may be of any suitable type and which is designed to control the motor 75 so as to prevent excessive movement of the shoes 34 inwardly and outwardly of the housing 11. Figure 6 shows

clearly the extended position of the shoes 34 carrying the roll cage 35.

In order to rigidly retain the roll cage or frame 35 in its selected operative positions within the housing 11, the upper and lower pairs of studs 82 are carried by the cage and project rearwardly therefrom. Vertically extending slots are provided in the rear wall 30 of the housing 11 as indicated in dotted lines at 84 through which the studs 82 are adapted to extend when the roll cage 35 is brought to its rearward position within the housing and adjusted vertically so that the roll passes are in the desired alignment. Washers or collars 85 are applied to the studs 82 and the cage is rigidly secured to the rear wall of the housing by the gib 86 and the key 87 which are wedgingly secured within a slot provided in the stud 82.

The mechanism provided for raising and lowering the roll cage 35 will now be described. A pair of vertically disposed screw shafts 90 are splined for vertical reciprocation within the bearing members 92 which are suitably secured to the bottom wall of the housing 11. The upper ends of these shafts are adapted to abut the hardened contact plates 91 in the lower surface of the cage 35. Within the lower portion of each of the members 92 a nut 93 is disposed for rotation about a vertical axis. The nuts 93 are threaded upon the shafts 90 and are provided peripherally with the worm gear teeth 94 which are adapted to mesh with the worms 95 carried by the horizontal shaft 96. The shaft 96 is provided with suitable bearings in the members 92 and in a bracket 97, the latter element also being adapted to support a motor 98 which is designed to drive the shaft 96 through the bevel gears 99. It will be apparent from this description that when the motor 98 is energized the shaft 96 will be rotated and the vertical lifting jack shafts 90 will raise or lower the roll cage as desired.

Means are provided for retaining the spindles 48 of the telescoping driving connections in upwardly retracted positions when the cage 35 is lowered for removal from the mill stand, and comprise a pair of yokes 100, the arms of which are adapted to extend through openings in the rear wall 30 of the housing 11 and through the inwardly projecting reinforcing ledge 101 formed thereon. At least one of the arms of each yoke 100 is provided with a pair of openings 102 which are adapted to register with an opening 103 in the ledge 101 in the inner and outer positions of the yoke respectively. When the yoke is in its outer position as shown in Figure 5 or in solid lines in Figure 10 of the drawings, the spindle 48 may move freely in its vertical reciprocation within the yoke 100 since the annular enlargement 105 may pass freely therethrough. When the enlargement or shoulder 105 is raised above the level of the yoke 100, either manually or preferably through the raising of the cage 35, the yoke 100 may be retracted rearwardly until the outer opening 102 registers with the opening 103, whereupon a pin such as shown at 108 in Figures 5 and 6 may be dropped through the registering holes. In this retracted position shown in dotted lines in Figure 10 and also illustrated to advantage in Figure 6 of the drawings, the narrowed bight of the yoke 100 closely surrounds the spindle 48 and is disposed beneath the enlargement 105, thus effectively retaining the spindle 48 in its upper retracted position. The cage 35 may then be lowered and moved forwardly upon the shoes 34 without interference from the driving connections.

The novel construction of the roll cage 35 together with its various associated means for adjustably supporting the rolls 40 will now be described. The main body portion 110 of the cage 35 is substantially U-shaped in plan as may be determined from an inspection of Figure 3 of the drawings and consists of the rear transverse portion 111 which is adapted in operation to abut the rear wall 30 of the housing 11. The vertical movement of the cage is guided by the tongue and groove arrangement 114. This rear member 111 of course is provided with an opening 112 which substantially registers with the opening 113 provided in the rear housing wall 30 to permit the passage of the material to be handled by the mill. The body member 110 is also provided with the forwardly extending arms 115 to which is secured the substantially rectangular cap frame 116. This cap frame is, of course, also provided with an opening registering with the apertures 112 and 113 in the rear cage member 111 and the housing wall 30 respectively. The ends of the forwardly extending frame portions 115 are each provided with bifurcations within which are pivoted the lugs 118 as at 119. These lugs 118 are adapted to be received within bifurcations provided in the ends of the upper and lower horizontal cross members of the cap frame 116 as clearly shown in the cross sectional portions of Figure 3 and also in Figure 1. These lugs are provided with washers 120 and the usual gibs and keys 121 and 122 are employed to clamp the cap frame 116 rigidly in position upon the body member 110 of the cage 35.

Wear plates 125 are provided upon the inner surface of the horizontal upper and lower cross members of the body frame 110 and the cap frame 116. These wear plates provide ways upon which the roll bearing frames 127 may slide during lateral adjustment of the rolls. Each of the upper and lower roll necks 45 and 44 are carried in bearings mounted in these frames 127. The frames 127 are provided with individual lateral adjusting means comprising the screw shafts 130 which are threaded through the members 131, the ends of these shafts being adapted to abut the hardened inserts 132 provided in each of the bearing frames 127. The shafts 130 are designed to urge the frames 127 inwardly toward each other when they are rotated by the following adjusting means. Each of these individual adjusting means is provided with horizontally disposed shafts 135 which are provided with worms 136 which are adapted to mesh with the worm wheels 137 keyed to the ends of the shafts 130. An arm 138 is provided on the shaft 135 and is provided with perforations which register with corresponding perforations in a stationary plate or dial to retain the shaft 135 in adjusted position.

Each of the frames 127 is provided with half bearings 140 and is also provided with cap members 141 which are secured thereto by means of the bolts 142. These cap members are provided with lugs or flanges 145 which are adapted to abut the outwardly facing corners of the half bearing 140 in order to retain it within the member 127. A clamping carrier frame 150 is also provided for retaining the complementary bearing portion 151 which is adapted to embrace the inner sides of the roll necks. The bearing element 151 is retained within the clamping or carrier member by means of the clamp plates 153 which are secured to the inner faces of the members 150 by

means of the screws 154. Each of the carrier members 150 is provided with laterally extending ears 155 which are adapted to be received with adequate clearance between the corner flanges 145 of the cap member during assembly of the device, and which are provided with openings into which the ends of the shafts 156 are threaded. The shafts 156 pass freely through openings provided in the end arms 115 of the cage 35 and serve to resiliently urge the carrier 150 and consequently the roll necks 44 and 45 outwardly against the ends of the adjusting shafts 130. Coiled springs 158 are disposed on the shafts for this purpose and are received within depressions provided in the arms 115. In order to prevent rotation of the shafts or rods 156 with respect to the bearing frames 127, they are slotted as at 159 for the reception of the keys or cotters 160 which in turn are adapted to be received within vertical slots 161 provided in the annular bosses 162 formed on the members 127 and adapted to surround the openings through which the shafts 156 pass. This arrangement effectively prevents the rods 156 from rotating and thus becoming detached from the retaining members 150. Annular thrust bearing collars 165 are disposed around the roll necks between the enlarged body portions of the rolls and the bearing frames 127. Relative rotation between these bearings 165 and the frames 127 may be prevented by means of the dowels 166. A suitable lubricant retainer cap 170, provided with a plugged drain opening 171, may be employed to prevent the lubricant from escaping from the lower roll bearings.

Individual vertical adjustment of the rolls within the cage 35 may be effected by means of the upper and lower clamps 172. These clamps are provided with annular sleeve portions 173 which are coaxial with the rolls and are provided with laterally extending ears 174. These ears 174 are secured to the body and cap members 110 and 116 respectively of the cage 35 by means of the bolts 175, which pass through holes in the ears 174 with a slight clearance. The transverse central portions of the bottom edges of the clamps 172 are provided with the curved cam or rocker portions 176 which are adapted to bear upon the bearing carrying frames 127 and bearing caps 141 respectively. The proper downward pressure may be brought to bear upon the members 127 and 141 by tightening the nuts upon the bolts 175, and as will be readily perceived, regardless of whether or not the nuts are equally adjusted since the clamp members may rock to a certain extent upon the curved cam portions 176. Furthermore, the clamps 172 may also rock transversely about the bolts, thus exerting uniform pressure on the carrying frames 127 and the bearing caps 141. The lower clamps 172 are provided with similar cams 176 which are adapted to bear upwardly against the caps 170 which in turn are in contact with the lower bearing frames 127 and caps 141. It will be readily seen that by adjustment of the clamps 172 at the top and bottom of each of the rolls 40 the grooves 41 may be brought into proper cooperative alignment to provide the passes 42. Individual horizontal adjustments of each end of the rolls are obtained as has been described by means of the shafts 130, the forward motion of which is resisted by the resilient connections comprising the rods 156 and springs 158 connected to the carrier 150 applied to the necks of the rolls.

After the roll cage 35 is removed from the housing 11 by being lowered so as to rest upon the shoes 34 and carried forwardly out of the housing by means of these shoes a suitable crane or other hoisting means is attached to the cage by means of the horizontal pins 180 which pass between the upstanding ears 181 on the side arms 115 of the cage. After being transported to a suitable place the rolls 40 may be very conveniently removed from the cage 35 by the removal of the front cap frame 116 of the cage 35.

Various changes and modifications may be made in the embodiment illustrated and described without departing from the scope of our invention as defined by the following claims.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. A rolling mill of the class described comprising, in combination, a housing, a roll supporting cage normally disposed within said housing, means for removing said cage from said housing in a horizontal direction comprising a pair of separately formed shoes, slidable upon trackways formed in said housing, power and transmission means carried by said housing and operatively connected with said shoes for moving them upon said trackways, means for raising said cage from and lowering it upon said shoes comprising a pair of vertically threaded shafts adapted to contact with a portion of said cage, and means for reciprocating said shafts comprising power operated rotatable nuts thereon.

2. In a rolling mill of the class described, in combination, a housing, walls closing the two sides and rear of said housing leaving the front thereof open, a horizontally movable roll supporting cage within said housing and removable through said open front of the housing, retaining means for said cage comprising a stud carried by said cage and adapted to project through an opening in the rear wall of said housing, and gib and key means for locking said stud to said housing wall.

3. In a rolling mill of the class described, in combination, a housing, a horizontally removable roll supporting cage therein, means for removing said cage from said housing including a slidable shoe arranged for horizontal movement into and out of said housing, a trackway associated with said housing upon which said shoe is adapted to move, means for moving said shoe comprising a screw shaft threaded through said shoe and held against longitudinal movement, means for rotating said shaft comprising a power member, and operative means connecting said power member and said shaft, and a limit switch associated with said shaft for controlling said power member to prevent excessive movement of said shoe.

4. In a rolling mill of the class described, in combination, a housing, a horizontally removable roll supporting cage therein, means for removing said cage from said housing including a slidable shoe arranged for horizontal movement into and out of said housing, a trackway associated with said housing upon which said shoe is adapted to move, means for moving said shoe comprising a screw shaft threaded through said shoe and held against longitudinal movement, and means for rotating said shaft.

5. In a rolling mill of the class described, in combination, a housing, a horizontally removable roll supporting cage therein, means for removing said cage from said housing including a

slidable shoe arranged for horizontal movement into and out of said housing, a trackway within and projecting from said housing upon which said shoe is adapted to move, means for placing said cage upon said shoe for removal from said housing, and means for moving said shoe.

6. In a rolling mill of the class described, in combination, a housing, a removable and vertically adjustable roll carrying cage normally enclosed within said housing, power means carried by said housing for effecting the removal of said cage, and power means also carried by said housing for effecting the vetrical adjustment of said cage.

7. In a rolling mill of the class described, in combination, a housing, a horizontally removable roll carrying cage normally enclosed within said housing, a plurality of vertically disposed rolls within said cage, and means carried by said housing for effecting the removal of said cage.

8. In a rolling mill of the class described, in combination, a movable housing, a removable roll carrying cage normally enclosed within said housing, and means carried by said housing for effecting the removal of said cage from within said housing.

9. A rolling mill of the class described comprising, in combination, a stationary support or foundation, a housing arranged for limited travel in a horizontal direction relative to said support, a roll supporting cage containing a plurality of rolls removably disposed within said housing, and power means for effecting the removal of said cage from said housing also carried by the housing.

10. A rolling mill of the class described comprising, in combination, a housing having its lower portion closed on three sides but open upon the fourth, a roll supporting cage containing a plurality of vertically disposed rolls disposed within said housing and removable therefrom through the opening in said fourth side, and roll driving means disposed within the upper portion of said housing.

11. A rolling mill comprising, in combination, a housing, a bodily removable roll supporting cage in said housing, a plurality of vertically disposed rolls therein, means for moving said cage vertically, driving means for said rolls carried by said housing above said rolls, and means for removing said cage from said housing in a horizontal direction.

12. A rolling mill comprising, in combination, a housing, a bodily removable roll supporting cage in said housing, a plurality of vertically disposed rolls therein, driving means for said rolls carried by said housing above said rolls including vertically disposed extensible and retractable transmission means, and means for removing said cage from said housing in a horizontal direction as a unit.

13. A rolling mill comprising, in combination, a housing, a bodily removable roll supporting cage in said housing, a plurality of vertically disposed rolls therein, means for moving said cage vertically, driving means for said rolls carried by said housing above said rolls including vertically disposed extensible and retractable transmission means, said transmission means adapted to be retracted by the upward movement of said cage, and means on said housing for retaining said transmission means in retracted position during removal of said cage.

14. In a device of the class described, in combination, a frame, a driving element, a driven element, a longitudinally movable rotary drive shaft associated with said driving and driven elements which is continually constrained to move in one direction, means for restraining the longitudinal movement of said shaft comprising an annular enlargement thereupon, and a looped retaining element adjustably carried by said frame and adapted to abut said enlargement.

15. In a rolling mill of the class described, in combination, a housing, a plurality of vertically disposed rolls, a roll carrying cage disposed in the lower part of said housing, means for bodily removing said cage from said housing in a horizontal direction, means for moving said cage vertically, roll driving means associated with said housing, transmission means carried by the upper portion of said housing and including telescoping drive shafts for the rolls, the lower portions of said telescoping shafts having detachable connections with said rolls and being retractable by an upward movement of said cage, and means on said frame for retaining said lower portions in retracted positions whereby, upon again lowering said cage, it may be removed from said housing without interference by said transmission means.

16. In a rolling mill of the class described, a bearing frame associated with a neck of one of the rolls of the mill comprising a body member, a half bearing therein, a cap member rigidly secured to said body member, a complementary bearing element covered by said cap member and movable relative thereto, and means for urging said bearing element against said neck of the roll.

17. In a rolling mill of the class described, a hollow bearing frame associated with each roll neck, a bearing portion therein, fixed relatively thereto, and adapted to contact with one side of said neck, a complementary bearing portion adapted to contact another side of said neck and movable relatively to said frame, and means extending exteriorly of said frame and resiliently abuting a relatively stationary portion of the mill for urging said complementary bearing portion into operative contact with said neck.

18. In a rolling mill of the class described, in combination, a roll carrying cage having ways therein, a bearing supporting frame associated with each roll neck and arranged for adjustment within said cage along said ways, a bearing portion on said frame and adapted to contact one side of a neck of a roll, a complementary bearing portion movable with respect to said frame and adapted to contact another side of said neck, means serving to resiliently connect said relatively movable bearing portion with a portion of said cage, and means for adjusting said bearing frame along said ways in opposition to the resilient connection of said complementary bearing portion.

19. In a rolling mill of the class described, a roll bearing construction comprising, in combination, a bearing frame, a half bearing disposed in said frame, a cap rigidly secured to said frame and which together with said frame is adapted to surround a neck of a roll, means on said cap for retaining said half bearing in position, and a relatively movable complementary bearing portion enclosed by said cap.

20. In a rolling mill of the class described, a roll bearing construction comprising, in combination, a bearing frame, half a bearing disposed in said frame, a cap which together with said frame is adapted to surround a neck of a roll, means on

said cap for retaining said half bearing in position, a complementary bearing portion within said cap, a carrier for said complementary bearing portion within said cap, a carrier for said complementary bearing portion, clamps for securing said bearing portion to said carrier, and connecting means secured to said carrier passing through said frame and resiliently connected to a relatively stationary part of said rolling mill.

21. In a device of the class described, in combination, a frame, a driving element, a driven element, a vertically disposed rotary drive shaft connecting said elements and adapted to be raised in order to break the driving connection, means associated with said frame for retaining said shaft in raised position, said last named means comprising an annular sleeve like member on said shaft, and a looped element adjustably carried by said frame and adapted to surround said shaft beneath said member when adjusted to retaining position.

22. In a rolling mill of the class described, in combination, a housing, a plurality of vertically disposed rolls, a roll carrying cage disposed in the lower part of said housing, means for bodily removing said cage from said housing in a horizontal direction, roll driving means associated with said housing, transmission means carried by the upper portion of said housing and including telescoping drive shafts for the rolls, the lower portions of said telescoping shafts having detachable connections with said rolls and being retractable for removal of said cage, means for retaining said lower shaft portions in retracted position comprising an enlargement on each of said shaft portions, U-shaped rods horizontally adjustable with respect to a wall of said housing and adapted to receive said shaft portions within their bights at points beneath said enlargements.

23. In a rolling mill of the class described, in combination, a housing, a horizontally removable and vertically adjustable roll carrying cage adapted to be enclosed within said housing, a rest for said cage carried by said housing, means for projecting said rest from said housing, means also carried by said housing and adapted to be moved into contact with said cage to remove it from said rest and to support it in vertically adjusted positions.

24. In a rolling mill of the class described, in combination, a housing, a horizontally removable and vertically adjustable roll carrying cage adapted to be enclosed within said housing, a rest for said cage slidably carried by said housing, power means carried by said housing for projecting said rest horizontally from said housing, means also carried by said housing and adapted to be moved upwardly into contact with said cage to raise it from said rest and to support it in vertically adjusted positions.

25. In a rolling mill of the class described, in combination, a housing, a horizontally removable and vertically adjustable roll carrying cage adapted to be enclosed within said housing, a rest for said cage carried by said housing, means for projecting said rest from said housing, means also carried by said housing and adapted to be moved into contact with said cage to remove it from said rest and to support it in vertically adjusted positions, said means comprising a vertically arranged screw shaft, means for restraining rotation of said shaft, an actuating nut rotatable upon said shaft means for restraining axial movement of said nut, and power means and operative connections between said power means and said nut.

26. In a rolling mill of the class described, in combination, a plurality of rolls each provided at its ends with bearing necks or trunnions, a roll supporting frame comprising pairs of side members between which the respective ends of the rolls are disposed, a bearing block for each roll neck, said bearing blocks being adjustably mounted between said side members, a clamping yoke associated with each bearing block for securing it in adjusted position with respect to said frame, each of said yokes adapted to extend from one side member of said pairs to the other and having its ends secured respectively thereto, curved bosses formed on the intermediate portions of said yokes and adapted to contact with said bearing blocks.

27. In a rolling mill of the class described, in combination, a roll provided with a bearing neck or trunnion, a bearing block for receiving said neck, a roll supporting frame having parallel members between which said block is adjustably disposed, means for securing said block within said frame including a yoke, each of its ends adapted to be secured to one of said parallel members, whereby said yoke extends from one of said members to the other, said yoke being divided intermediate its length and provided with rocker portions adapted to bear upon said bearing block upon either side of said roll neck.

28. In a rolling mill of the class described, in combination, a roll carrying frame, a roll provided with a neck or trunnion portion, a bearing block provided with an opening through which said portion is adapted to extend, a cap member applied to said bearing block and adapted to cover said opening, and a clamping yoke for adjustably securing said block to said frame and also adapted to bear against said cap to retain it in its position with respect to said opening.

29. A rolling mill comprising, in combination, a housing, a bodily removable roll supporting cage normally enclosed within said housing, a plurality of vertically disposed rolls carried by said cage, and driving means for said rolls disposed upon said housing, means whereby said rolls may be positively disconnected from said driving means, and means for removing said cage as a unit from said housing in a horizontal direction.

30. A rolling mill comprising, in combination, a housing, a bodily removable roll supporting cage normally enclosed within said housing, a plurality of vertical disposed rolls carried by said cage, driving means for said rolls disposed upon said housing and including driving shafts substantially coaxial with said rolls and normally operatively connected therewith, means whereby said rolls may be positively disconnected from said driving shafts, and means for removing said cage as a unit from said housing in a direction transversely to the axes of said shafts and rolls.

31. In a rolling mill of the class described, a roll stand comprising, in combination, a housing, a bodily removable roll carrying frame normally enclosed within said housing, and means within said housing for projecting said frame from the interior of said housing.

ERIK W. MIKAELSON.
ALEXANDER K. HAMILTON.