July 4, 1967 W. R. SCHEIB 3,328,973

TUBE STRETCH REDUCING MILL

Filed May 15, 1964

6 Sheets-Sheet 1

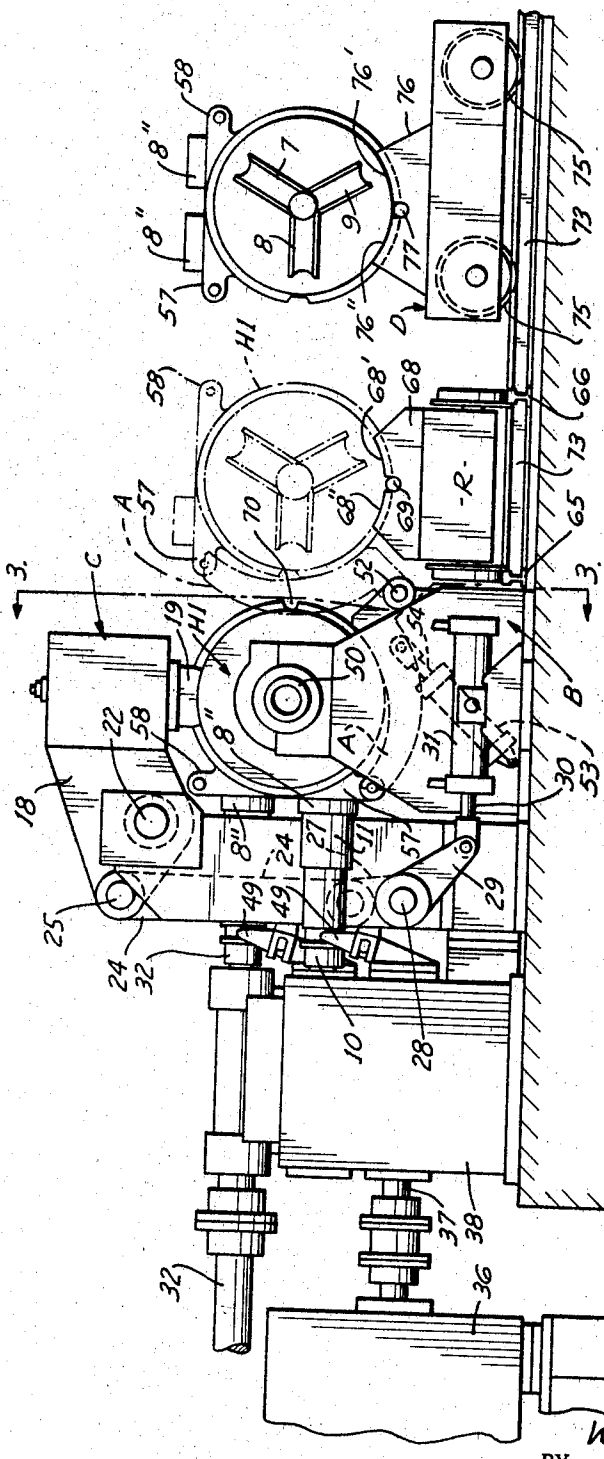


Fig. 1.

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Fig. 1A.

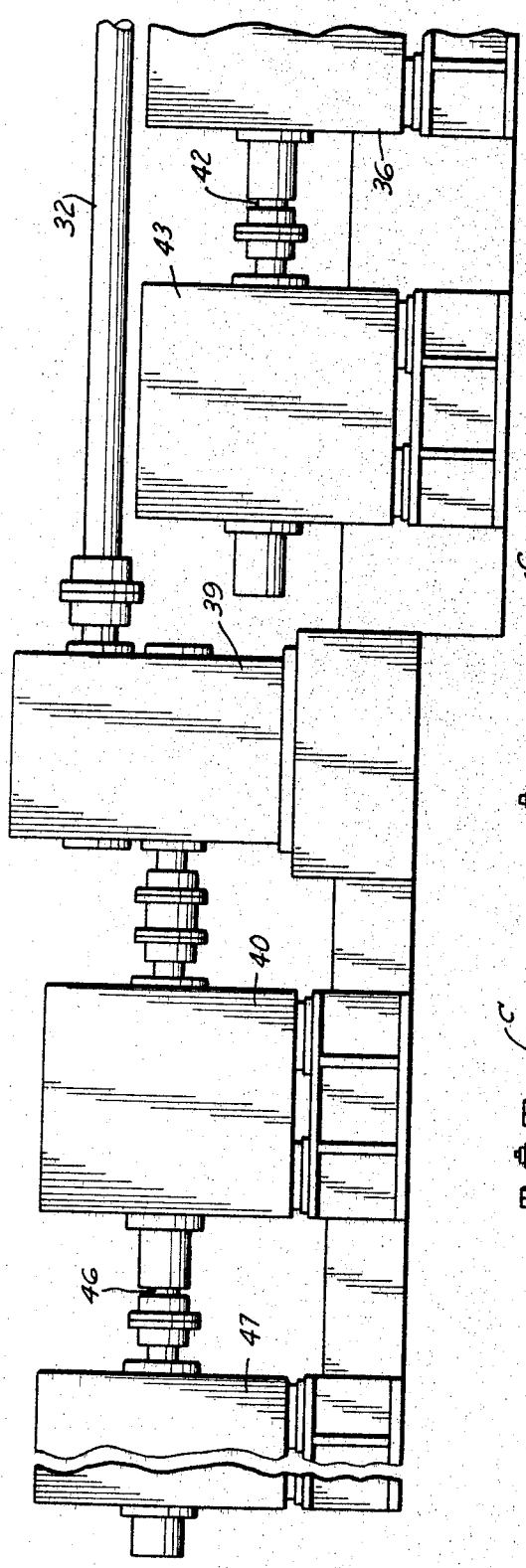
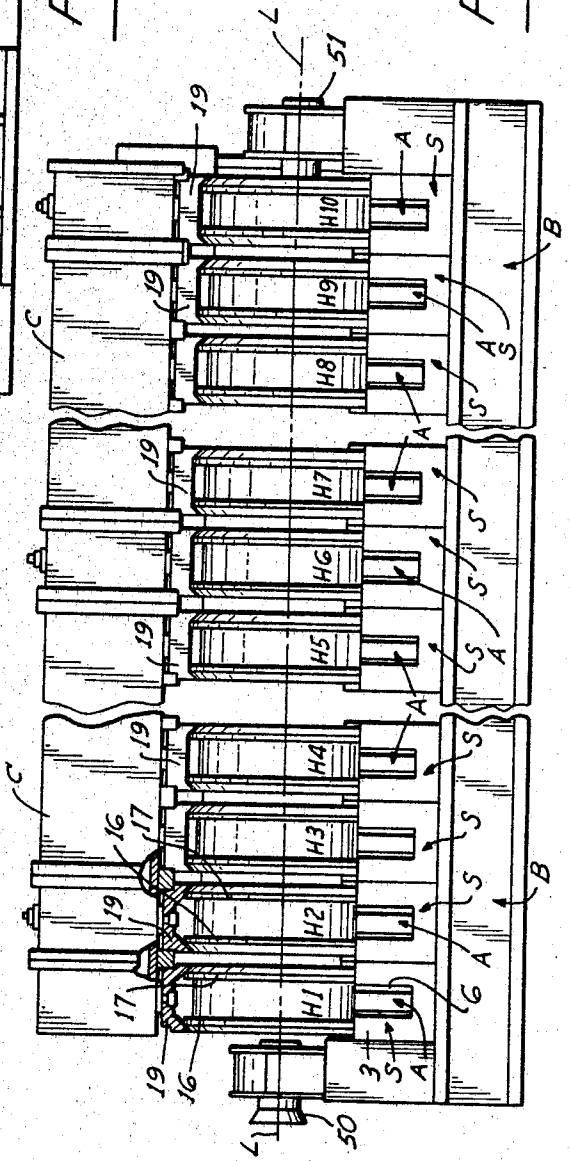



Fig. 3.




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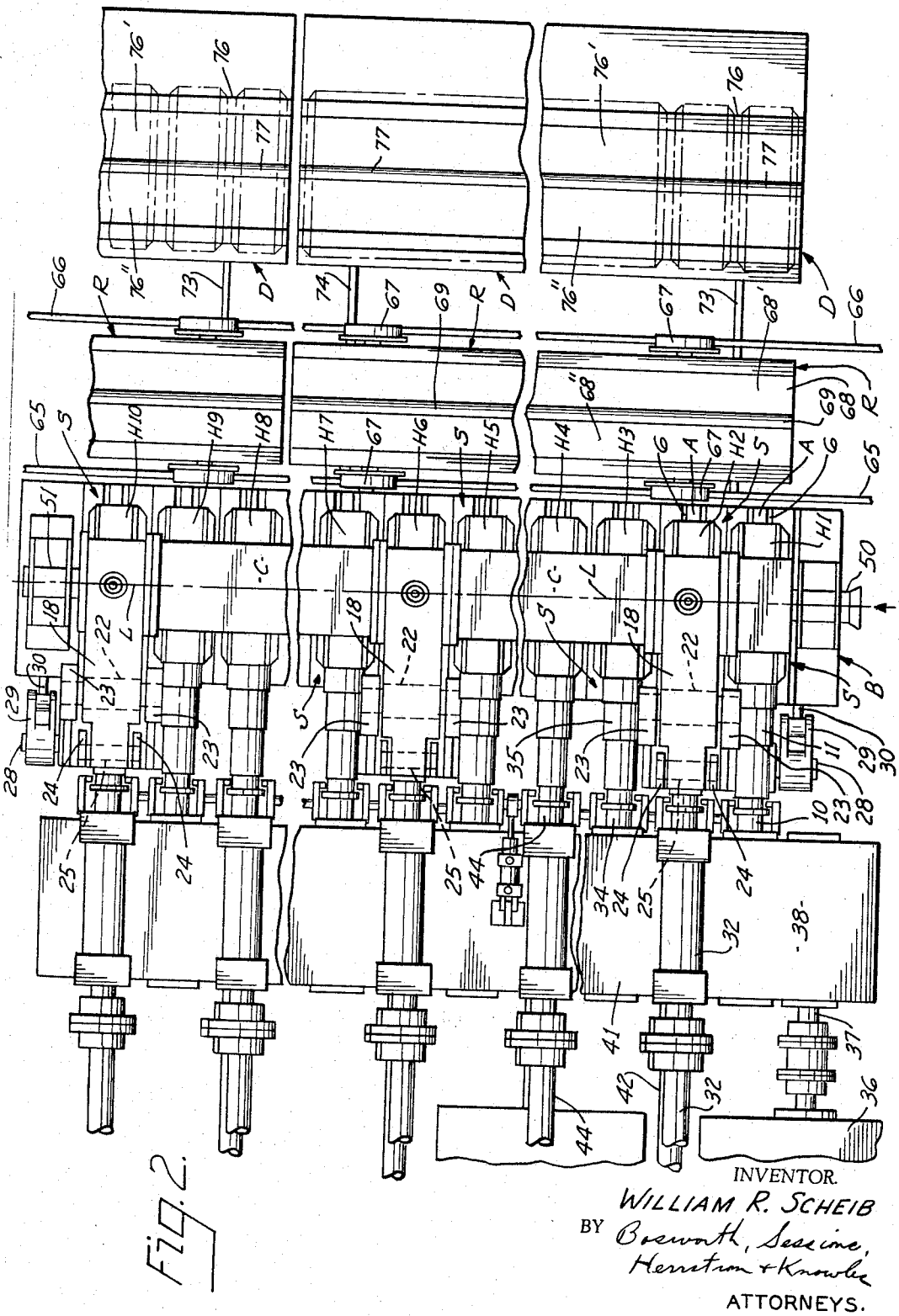


FIG. 2.

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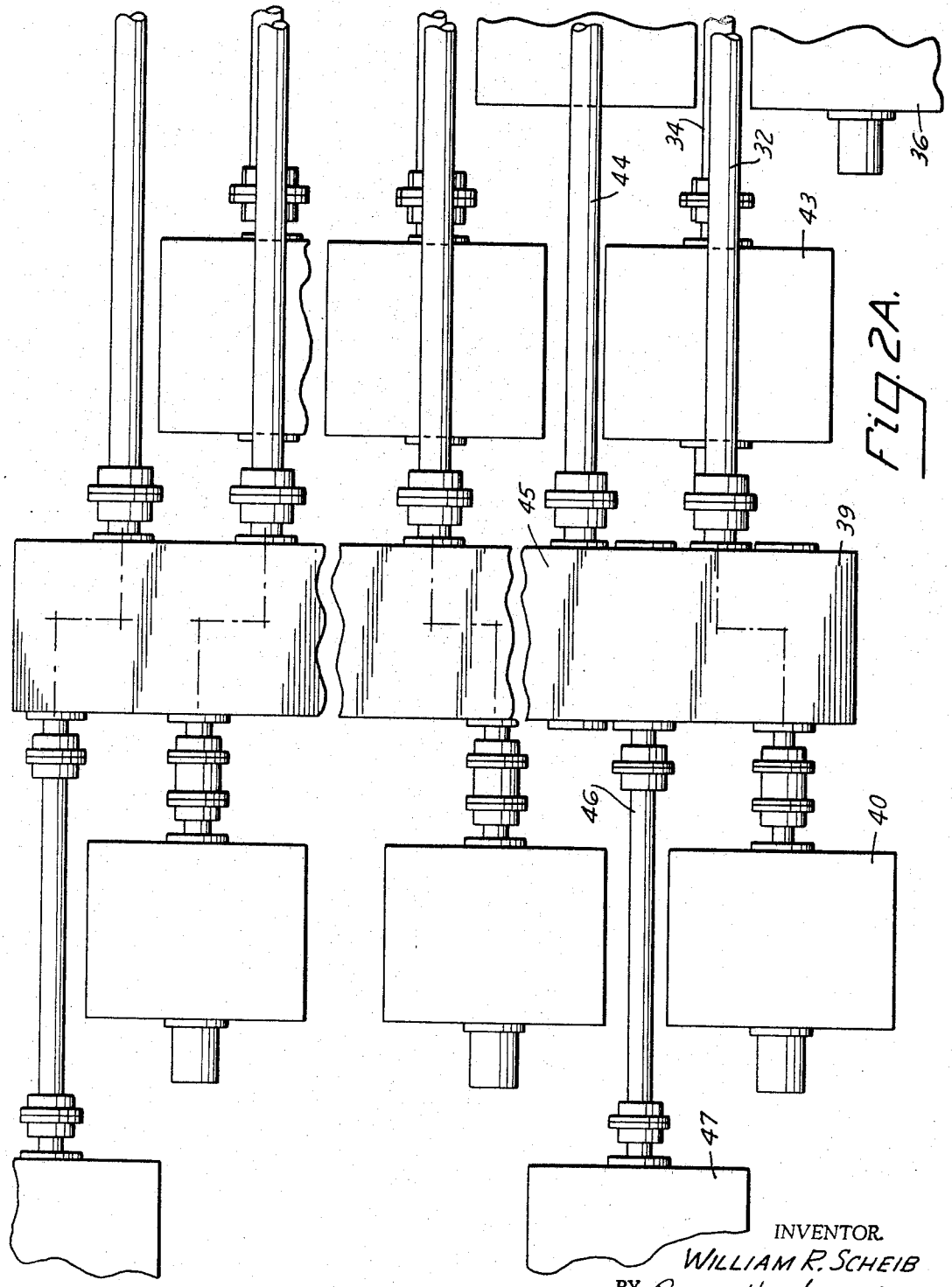



Fig. 2A.

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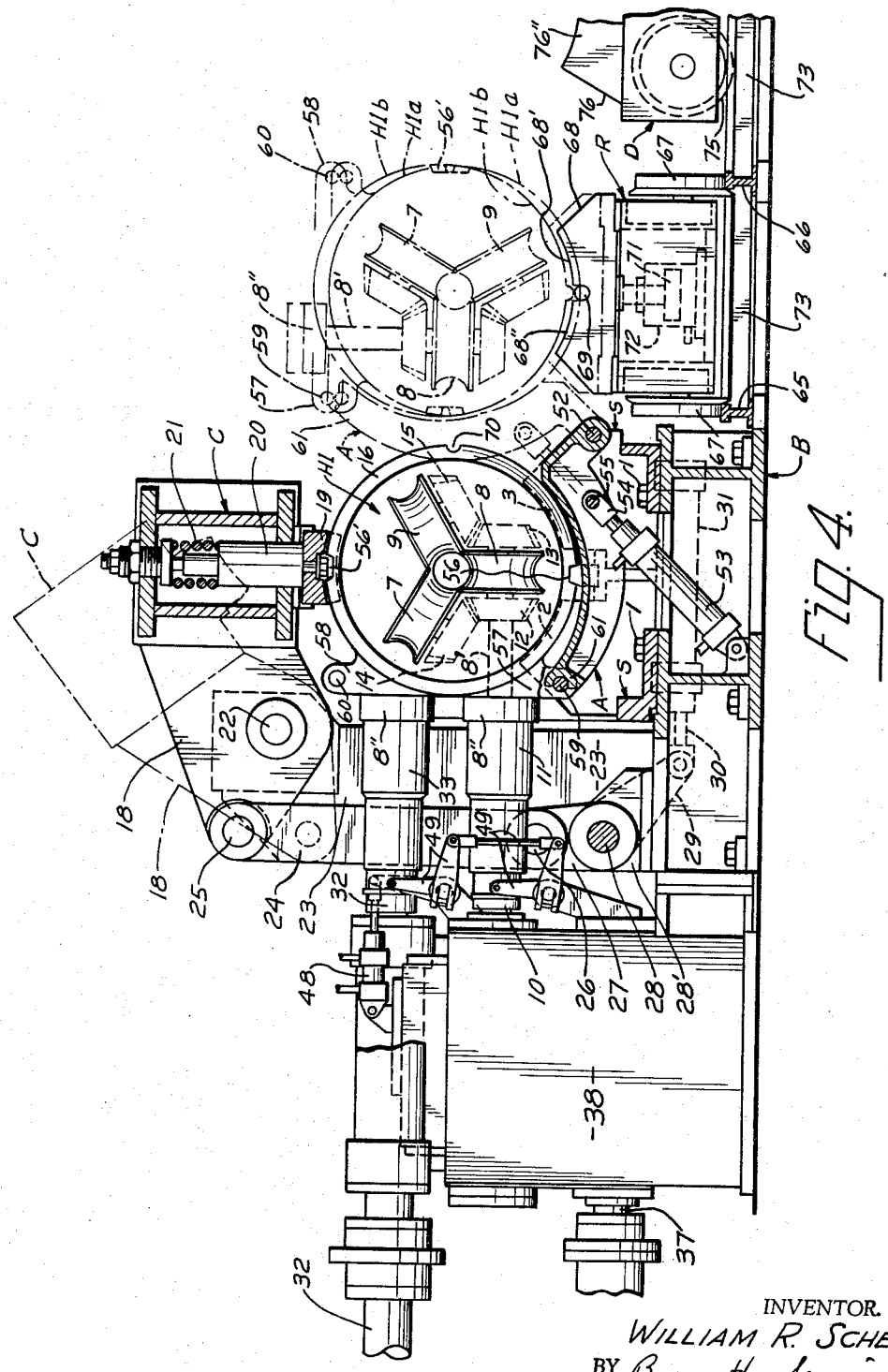


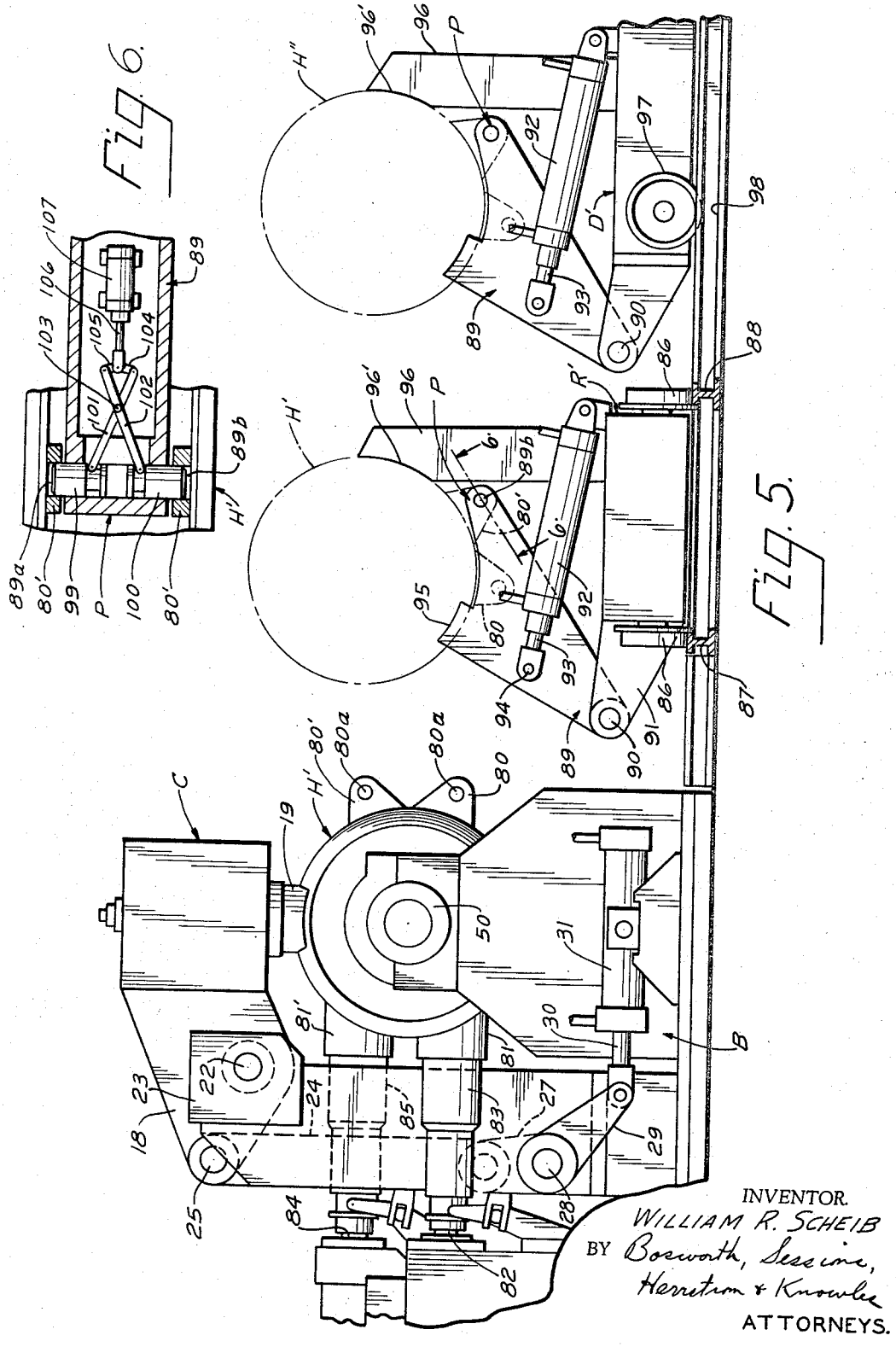
Fig. 4.

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TUBE STRETCH REDUCING MILL

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United States Patent Office 3,328,973 Patented July 4, 1967



3,328,973

# TUBE STRETCH REDUCING MILL

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20 Claims. (Cl. 72—239)

This invention relates to rolling mills and more particularly to rolling mills of the type which have a relatively large number of changeable rolling housings or stands.

In tube stretch reducing mills, which are employed in the manufacture of steel tubing or the like, a plurality of roll housings are mounted on a rolling mill base and the rolls of each housing act successively on the tube as is passes therethrough to effect the desired reduction thereof.

In the operation of mills of this type, when it is desired to change to a different size tubing or to carry out a different reducing operation upon the tube, its is necessary to change the rolling housings so that the mill will be made up of successive sets or passes of rolls which will effect the desired reduction on the particular tube being handled. Due to the large number of roll housings involved, and because of the necessity for extremely accurate alignment of the successive roll passes relative to the pass line of the mill, changeover from one reducing operation to another has in the past been a difficult and time consuming operation.

Accordingly, it is an object of my invention to provide a multiple pass rolling mill having interchangeable roll housings whereby any one or more of the roll housings may be rapidly removed and replaced and whereby each roll housing will be automatically aligned and centered relative to the pass line of the mill. Further objects of my invention are the provision of a multiple pass rolling mill having a plurality of readily interchangeable roll housings in which there is no sliding movement between the housings and the supporting base structure during roll changing thus eliminating wear and resulting inaccuracy of alignment, and the provision of rugged, long lived multiple pass rolling mill which requires minimum maintenance and which greatly facilitates changeover of the mill set up from one rolling operation to another.

The above and other objects of my invention will appear from the accompanying drawings in which:

FIGURE 1 is an end elevational view of my improved rolling mill with the parts in operating position, with the roll housing receiving car disposed to receive roll housings, and with the roll housing supply car in its withdrawn or retracted position.

FIGURE 1A is an extension of FIGURE 1 on the left hand end thereof showing the mill drive means including the drive motors, gear boxes, drive shafts, etc.

FIGURE 2 is a plan view of the mill shown in FIGURE 1, sections of the mill being omitted in order that the illustrated and typical portions will be on a larger scale.

FIGURE 2A is an extension of FIGURE 2 on the left hand end thereof showing the roll drive shafts, motors, gear boxes, etc.

FIGURE 3 is an elevational view taken substantially on line 3—3 of FIGURE 1, sections of the mill being omitted as in FIGURE 1.

FIGURE 4 is an enlarged end view generally similar to FIGURE 1 but partly in vertical cross-section and on an enlarged scale more clearly to illustrate the arrangement of the parts of my improved roll housing supporting and changing mechanism.



FIGURE 5 is an end elevational view generally similar to FIGURE 1 but illustrating a modified form of my invention in which the swingable roll housing transfer arms are mounted on the roll housing receiving and supply cars.

FIGURE 6 is a fragmentary enlarged cross sectional view, taken substantially on line 6—6 of FIGURE 5, illustrating one form of latch pin advancing and retracting mechanism adapted for use with the apparatus of FIGURE 5.

The tube stretch reducing mill illustrated in the drawings includes a mill base structure generally indicated at B, having a plurality of roll housing supporting and locating saddles S supported thereon along the mill pass line L (FIGURES 2 and 3), and secured in position by bolts 1 (FIGURE 4). Each saddle S includes a pair of spaced arcuate roll supports 2 and 3 the upper surfaces of which are formed to receive and accurately locate the roll housings as will be later described. These roll supports 2 and 3 have transversely extending slots 6 extending vertically therethrough to accommodate the swingable roll housing transfer arms A.

As is clearly seen in FIGURES 1, 2 and 3, a plurality of roll housings H1, H2, H3, H4, etc., generally cylindrical in form, are supported on their respective saddles S thus providing a series of closely spaced roll passes along the pass line of the mill (the line of travel of the tube indicated at L in FIGURE 3). Referring particularly to FIGURE 4, each of the roll housings H1, H2, etc. supports three rolls 7, 8 and 9. These rolls are supported on shafts which are mounted in the housing and inclined at 120° to each other. The shaft 8′ of roll 8 extends outwardly through a bearing sleeve 8″ on the housing H1 and at its outer end is formed to be quickly attached to and released from the drive shaft 10 by a suitable coupling means indicated at 11. Bevel gears 12 and 13 are secured to the shaft 8′ on the opposite sides of roll 8 and mesh with similar gears 14 and 15 on the roll shafts of rolls 7 and 9 respectively and thus when shaft 8′ is rotated all of the rolls 7, 8 and 9 will rotate. Each of the rolls 7, 8 and 9 is arcuately grooved on its outer surface and they are supported so as to be substantially in contact with each other to define a circular roll pass. As each of the housings H1, H2, etc. contains a set of rolls 7, 8 and 9 and, as these rolls are so designed that each succeeding roll housing provides a roll pass of a successively different size, when a length of tubing is passed through the mill it will be subjected to a progressive series of rolling operations. As will be later more fully explained, each housing H1, H2, etc. is connected to a separate drive shaft which in turn is connected to a separate source of power such as an electrical motor. In any particular roll housing, when the drive shaft 8′ thereof is driven it in turn will directly rotate the roll 8 and the rolls 7 and 9 will be simultaneously rotated in the same direction and at the same velocity by the bevel gears 12, 13, 14 and 15.

Each of the roll housings H1, H2, etc. is provided with annular flanges 16 and 17 (FIGURE 3) which are formed to accurately fit the correspondingly contoured arcuate portions 2 and 3 of the saddles S. Preferably the outer faces of the flanges 16 and 17 and the corresponding faces of the portions 2 and 3 of saddles S are oppositely inclined or beveled so that, when a roll housing is placed in position on a saddle it will be firmly supported and accurately positioned thereon.

In order firmly to secure the housings H1, H2, etc. on their saddles S a swingable cross beam C extends longitudinally of the mill and is supported on a plurality of spaced pivotally mounted arms 18 for lifting and lowering movement betweent housing clamping and housing released positions. The cross beam C supports a series of

spring backed hold down clamps **19** (FIGURE 4), each of which is carried by a plunger **20** mounted in the beam C for vertical sliding movement relative thereto and is backed by a compression spring **21**. As will appear more fully later, when the cross beam C is in operating position (as seen in FIGURE 4) each of the housings H1, H2, etc., is engaged at its upper surface by a hold down clamp **19**, which is grooved to receive the flanges **16** and **17** on the roll housings, and, as the heavy springs **21** have been compressed when the cross beam C is swung down into operating position, the series of roll housings H1, H2, etc. will be held firmly in place on saddles S on the mill base B and in accurate alignment with each other.

Each of the pivotally mounted arms **18** of cross beam C is supported on a shaft **22** which in turn is mounted at the upper end of column members **23**. Pairs of operating links **24** are pivotally secured at their upper ends to shafts **25** carried by the arms **18**. The lower ends of links **24** are also pivotally secured, as seen at **26** (FIGURE 4), to the upper arm **27** of a bell crank lever which is in turn carried by and rotatable with a shaft **28**. The lower arm **29** of the bell crank lever is also rotatable with shaft **28** and is pivotally connected at its outer end to a piston rod **30** which extends into the operating cylinder **31**. Shaft **28** is rotatably supported in brackets **28'** on the mill base B.

Suitable fluid connections (not shown) lead to the cylinder **31** and reciprocation of the piston rod **30** in the piston **31** will, through the bell crank arm **29**, effect rotary movement of shaft **28**. Suitable control valve means, not shown but of any known type, are provided for controlling the application of fluid under pressure to the cylinder **31** and thus controlling the operation of the cross beam C and hold down clamps **19** carried thereby. Each of the arms **18** is provided with an operating linkage and cylinder such as that just described and these are arranged to be simultaneously actuated whereby the cross beam C may be moved from its lowered operating or roll housing clamping position (see in full lines in FIGURE 4) into its retracted or roll housing released position (indicated in phantom lines in FIGURE 4). Thus, when the piston rods **30** are moved to the left from the position seen in FIGURE 4 the bell cranks **27**, **29** will move in clockwise direction and the links **24** will be moved downwardly, thus swinging the arms **18** and cross beam C in counterclockwise clamping direction around supporting shafts **22**.

During the final movement of the cross beam C into its roll housing clamping position as seen in FIGURE 4 the hold down clamps **19** engage the upper surfaces of the several roll housings H1, H2, etc. and the heavy springs **21** are compressed so that each of the series of roll housings is firmly held in a three point grip by the arcuate portions **2** and **3** of its saddle S and its clamp member **19**.

In order to minimize the spacing between adjacent roll housings along the pass line L of the mill, the roll housings H1, H2, etc. are mounted on their respective saddles disposed at 180° to the adjacent housing. Thus, referring to FIGURE 4, it is seen that the drift shaft **8'** and bearing sleeve **8''** of the housing H1 are disposed to extend horizontally at the lower portion of the housing to connect with the drive shaft **10** through coupling **11**. The adjacent housing H2 is turned 180° before it is placed in the mill so that its drive shaft **8'** and bearing sleeve **8''** extend horizontally in the upper portion of the housing and is coupled to a drive shaft **32** through a coupling **33**. The next housing H3 is mounted in the mill in the same manner as housing H1 with its drive shaft **8'** in its lower position and it is connected to a drive shaft **34** through a coupling **35** (FIGURE 2). Successive housings are correspondingly arranged. The couplings **11** and **33**, and the corresponding couplings for all of the roll housings, are actuated by fluid pressure cylinders **48** acting through linkage and levers **49**.



It is desirable to drive the rolls of each individual roll housing or stand by a separate motor and, because of the close spacing of the housings along the pass line L, it is necessary to stagger the motors and gear boxes for the several roll housings. This arrangement is illustrated in FIGURES 1A and 2A. Thus the motor **36** drives shaft **37** which in turn drives the shaft **10** (connected to housing H1) through a gear box **38**. The drive for roll housing H2 is through shaft **32** which extends at an elevated level to a gear box **39** through which it is driven by the motor **40**. In like manner, the rolls of housing H3 are driven by shaft **34**, gear box **41**, offset shaft **42**, and motor **43**. The rolls in housing H4 are driven through shaft **44** gear box **45**, shaft **46** and motor **47**. The succeeding roll housings of the series are connected to their individual drive motors through similarly arranged shafts and gear boxes, and by controlling the speeds of the several drive motors the speeds of each individual roll passes may be regulated to produce the desired action on the tube as it passes through the mill. A bell mouth tube entering guide **50** is mounted on the base B at the entering end of the mill and a tube exit guide, indicated at **51**, is suitably supported on the base B at the exit end of the mill.

As has been previously pointed out, in multiple pass mills of this type when it is desired to change from one rolling operation to another, for example from one size tube to a different size, it is ordinarily necessary to change all of the roll housings. Furthermore, for some rolling operations more sets of rolls are required than for others and therefore, in order to reduce the down-time of the mill during roll changes it is important that it be possible to remove and replace the roll housings in a rapid and efficient manner.

This result is accomplished in my apparatus by the provision of a plurality of roll housing transfer arms A each of which has a pivotal support at one end on a shaft **52** (FIGURE 4) carried by the adjacent saddle S. The arms A, when in their idle positions seen in FIGURE 4, extend across and below the mill pass line L in the slots **6** in the saddles S. Each arm A has its individual actuating cylinder **53** and piston rod **54** the upper end of which is pivotally connected to the arm at **55**. Each saddle S, as previously noted, is provided with spaced arcuate roll housing supporting portions **2** and **3** forming a depressed roll housing seat, and is provided with a pair of stationary upwardly projecting locating lugs **56** which are disposed on either side of slots **6** at the bottom of the depressed seat formed by arcuate portions **2** and **3** and which are adapted to extend into corresponding notches **56'** in the periphery of the roll housings H1, H2, etc. Each roll housing has a pair of these notches **56'** spaced 180° apart on its outer periphery (the upper notch **56'** on housing H1 being clearly seen in FIGURE 4) to permit 180° turning of adjacent housings as previously explained.

As is also best seen in FIGURE 4, each housing H1, H2, etc. is formed with a pair of transfer lugs **57** and **58**. Transfer pins **59** and **60** are carried by the lugs **57** and **58** respectively and it will be understood that these pins are provided in duplicate so that any particular roll housing may be positioned on a saddle S with its drive shaft **8'** either in its upper or its lower position and one of the transfer pins **59** and **60** will always be in a position to be engaged by the notched end **61** of the transfer arm A. This notched end **61** of arm A and pin **59** or **60** (as the case may be) provide co-acting engaging means on the transfer arms and roll housings whereby swinging movement of the arms about their pivotal supports **52** will move the roll housings from, or lower them to, the saddles S in arcuate paths without relative sliding movement. This substantially eliminates wear and resulting mill mis-alignment.

As seen in full lines in FIGURE 4 the roll housing H1 is in operating position on the support portions **2** and **3** of its saddle S and is firmly held in place by the hold

down clamp **19**. The transfer arm A is in its lowered or idle position slightly below the outer periphery of the roll housing **H1** and with its notched end **61** in position to engage the transfer pin **59**. When it is desired to remove the housing **H1** from the mill the cylinders **31** are first operated to lift the cross beam C into its elevated or released position and the cylinder **53** is then actuated so that the piston rod **54** moves outwardly, swinging the arm A transversely of the mill pass line L and clockwise about its pivotal support **52**. By virtue of the securing engagement of the notched end **61** of arm A with the pin **59** this movement of arm A will lift the housing **H1** upwardly off of the support pads or portions **2** and **3** of the depressed seat in the saddle S in an arcuate path over the elevated outer edge of pad **3** and, after the arm A has been swung through approximately 90°, the housing **H1** will have been lowered into the lower phantom line position indicated at **H1*a*** of FIGURE 4. Suitable control means (not shown) of any appropriate type are provided whereby the cylinders **53**, and thus the arms A, may all be operated together or they may be operated one at a time or in preselected groups.

A pair of tracks **65** and **66** are mounted on the mill floor and extend parallel to the pass line L of the mill. These tracks support one or more longitudinally movable roll housing transfer or receiving cars R supported on wheels **67**. Each of the cars R carries a roll housing receiving and supporting saddle member **68** the upper face of which is formed to provide arcuate roll housing supporting pads or portions **68'** and **68''**. These portions **68'** and **68''** are separated by a longitudinally extending guide rod **69** which engages and co-acts with the half round notches **70** in the housings **H1**, **H2**, etc. to index these housings on the cars R and retain them in proper aligned angular positions thereon to be engaged by arms A.

The saddle member **68** is supported for limited vertical movement on one or more piston members **71** carried by fluid pressure cylinders **72**, and suitable control mechanism (not shown but which may be of any well-known type) is provided so that the saddle member **68** may be lifted and lowered between the lower full line roll housing receiving position seen at **H1*a*** (FIGURE 4) and the elevated phantom line roll housing arm retracting position seen at **H1*b***.

Pairs of transversely extending tracks **73** and **74** are adapted to support second roll housing supply cars D (FIGURE 1) for movement in a direction normal to the mill pass line. These second cars are supported on wheels **75** and each car carries elongated roll receiving saddle members **76** having spaced arcuate roll housing supporting pads or portions **76'** and **76''**. A longitudinally extending guide rod **77** is supported between the arcuate portions **76'** and **76''** in the same manner and for the same purposes as guide rods **69** on cars R. As the tracks **73** and **74** cross the tracks **65** and **66** the cars D may be moved up immediately adjacent to the mill base B when the cars R have been moved away. Suitable track crossings are of course, provided where the tracks intersect and the roll receiving saddles **76** of cars D are also provided with lifting and lowering means, not shown but like pistons **71** and cylinders **72** shown in FIGURE 4 for lifting and lowering the roll receiving saddle members **68** on cars R. It will be understood that enough pairs of tracks **73** and **74** and cars D are provided so that the entire length of the mill may be serviced by one or the other of the cars D. The reason for this arrangement will appear from the following description of the operation of the above described mill.

It is assumed that the mill has been set up with a series of roll housings **H1–H10** to carry out a particular rolling operation, and that it is desired to change over the mill to a different rolling operation. It may also be assumed that to effect this change-over it will be necessary to remove all of the roll housings **H1–H10** and to replace them with a different set of roll housings.



The roll housing transfer or receiving cars R are first moved into roll housing receiving or transferring position on the tracks **65**, **66** with the roll receiving and support saddle members **68** of cars R in alignment with the roll housing saddles S on the mill base B. The hydraulic cylinders **31** are operated to pull the operating links **24** downwardly with accompanying counterclockwise rotation of the arms **18** about their pivots **25**. This movement will lift the swingable cross beam C and the hold down clamps **19** carried thereby upwardly away from the roll housings **H1**, **H2**, etc. into the position seen in phantom lines in FIGURE 4. The shaft coupling **11**, **33** etc. of each roll housing are disconnected by operating the cylinders **48**. Now the cylinders **53** are actuated to swing the several roll housing transfer arms A from their idle or housing receiving positions below the roll housings **H1**. **H2**, etc. (seen in full lines in FIGURE 4) in clockwise direction through approximately 90° to their housing removed positions seen in phantom lines in FIGURE 4. During this movement of the arms A each of the arms will lift and transfer its roll housing **H1**, **H2**, etc. from its seat on its saddle S over to the saddle member **68** of the adjacent roll housing receiving car R.

During this transfer of the roll housings from the mill to the receiving car the saddle **68** is in its lower position as seen in full lines in FIGURE 4. In order to permit the notched upper ends **61** of the arms A to disengage the transfer pins **59** or **60** (as the case may be) and the arms A to be swung back toward the saddles S, the saddle **68** is elevated by a piston and cylinder mechanism **71**, **72**, to lift the saddle **68** and the roll housings thereon into the upper phantom line position of FIGURE 4. This provides clearance between the pin **59** or **60** and the upper ends **61** of arms A and permits the arms to be retracted by the cylinder and piston mechanisms **53**, **54** so that the cars R with the removed roll housings thereon may be moved out of the way.

The mill is now ready to receive a new set of roll housings equipped with suitable rolls for performing the new operation. The cars R are moved away from the mill on the tracks **65** and **66** to clear the way for moving the roll housing supply car or cars D into housing transfer position on the tracks **73** and **74**. A new set of roll housings has been previously positioned on the saddles **76** of cars D with the rolls of each housing accurately adjusted relative to the center line of the generally cylindrical housing. Next the cars D are moved on tracks **73**, **74** from their withdrawn position seen in FIGURE 2 up closely adjacent to the base B of the mill. At this time the saddles **76** of the cars D are elevated by their lifting mechanism so that the lugs **57** of the housings may be moved into position directly overlying the notches in the upper ends **61** of arms A which have been returned to the vertical phantom line positions of FIGURE 4.

When the cars D are so positioned the elevator or lifting means for the saddles **76** is operated to lower the saddles so that the pins **59** or **60** of the roll housings will lie in the notches in the upper ends **61** of the arms A. The hydraulic cylinder means **53** of the arms A are now actuated to retract the piston rods **54** and swing the arms A in counterclockwise direction carrying therewith the new set of roll housing. When the arms A have been moved through approximately 90° the cylindrical roll housings will be set down upon the supporting pads portions **2** and **3** of the saddles S with their axes lying on the mill pass line L and will accurately angularly indexed thereon by engagement of the co-acting notches **56'** and lugs **56**.

When all of the new set of housings have been positioned on the saddles S the cylinders **31** are actuated to swing the cross beam C downwardly and the spring backed hold down clamps **19** will engage the top of the several roll housings, firmly clamping them against their supports on the pads **2** and **3**.

As these supporting pads **2** and **3** of the saddles S are accurately aligned and as the individual rolls in each housing have been previously accurately positioned relative to the center line of their housing (which center line when the housings are in place coincide with the pass line of the mill), after the new set of housings has been positioned and clamped in place and the couplings reconnected the mill is immediately ready for operation without further adjustment. An entirely new set up of rolls may be positioned on the cars D while the mill is operating; therefore, the change-over of the mill to perform a new operation may be effected in a most rapid and economical manner.

In FIGURES 5 and 6 a modified form of my invention is illustrated in which the swinging roll housing transfer arms are mounted on the roll housing receiving and supply cars R' and D' together with actuating means therefor. In this design the base mill B carries a plurality of roll housing supporting saddles for the series of roll housings, the end of one of which is seen at H' in FIGURE 5. These housings are generally cylindrical and similar to the roll housings H1, H2, etc., except that the transfer lugs **57** and **58** are omitted and two pairs of transfer tabs **80** and **80'** are substituted therefor. These pairs of tabs extend to the right when the housings are in rolling position in the mill.

The drive shaft for the rolls of housing H' extends from the lower portion of the housing through the bearing sleeve **81** and is connected to the drive shaft **82** through a coupling **83**. As in the previously described apparatus, the adjacent roll housings are mounted in the mill at 180° to each other so that the roll housing immediately behind the housing H' of FIGURE 5 will have its bearing shaft sleeve **81'** extending from the upper portion thereof for connection to a drive shaft **84** by a coupling **85**. Also the roll housing immediately behind housing H' will have its pair of tabs **80** on top as distinguished from housing H' which has its pair of tabs **80'** on top.

The roll housing receiving cars R' are mounted on wheels **86** which in turn run on tracks **87** and **88** extending longitudinally of the mill. Each car carries a plurality of housing transfer arms **89** pivotally secured at **90** on brackets **91** which extend outwardly from the cars R'. Actuating cylinders **92** have piston rods **93** which are pivotally secured to the arms **89** at **94**. The outer end of each arm **89** has a housing supporting pad portion **95** and also carries an attaching pin mechanism generally indicated at P and seen in detail in FIGURE 6. To assist in locating and supporting the roll housings on the cars R' vertical members **96**, having arcuate housing engaging portions **96'**, are carried by the cars R'.

In similar manner the roll housing supply cars D' are supported on wheels **97** running on transverse tracks **98** and are equipped with a plurality of transfer arms **89** and operating mechanisms therefor. As these arms **89** and the operating means therefor are similar to those previously described in connection with cars R' further explanation is not necessary here.

As seen in FIGURE 6, each of the arms **89** supports at its outer end a pair of oppositely movable attaching or locking pins **99** and **100** which form a part of the previously referred to mechanism P. These pins are slidably supported in holes **89***a* and **89***b* the end of the arm **89** and the pins **99** and **100** are adapted to be moved simultaneously in opposite directions outwardly into their extended or locking positions seen in FIGURE 6 or back inwardly into their retracted positions by means of levers **101** and **102** pivotally mounted within the arm **89** at **103**. The left hand ends of these levers engage slots in the pins **99** and **100** and their right hand ends are connected by links **104** and **105** to a piston rod **106**. This piston rod **106** is actuated by the hydraulic cylinder **107** and it will be observed that when the piston rod **106** is moved to the right from the position seen in FIGURE 6 the left hand ends of the levers **101** and **102** will be moved toward each other and the pins **99** and **100** will be withdrawn out of the holes **89***a* and **89***b* in the tab **80'** into the arm **89**.



When it is desired to remove the roll housings from the mill of FIGURE 5 the cars R' are moved into position with their arms **89** in alignment with the tabs **80, 80'** of the housings. Cylinders **92** are now actuated to move the piston rods **93** and swing the arms **89** in counterclockwise direction until the outer end portions thereof, carrying the attaching pin mechanisms P, are disposed in the upper one of the pairs of tabs **80** or **80'** of each housing, depending on which of these pairs of tabs is on top, this in turn depending on the angular position of the particular roll housing in the mill. During this movement of the arms **89** the pins **99** and **100** are retracted but when the ends of the pins **99** and **100** are aligned with the holes **89***a* and **89***b* in the tabs the cylinders **107** are actuated to move the pins **99** and **100** outwardly so that their outer ends enter the holes **89***a* and **89***b* in tabs and firmly lock the arms **89** to the roll housings.

When the arms **89** are retracted by their cylinders and pistons **92, 93** the several roll housings will be lifted from their seats on the mill base and transferred into the position seen in phantom lines in FIGURE 5 where they are firmly supported by the arms **89** and the vertical members **96**. The overall operation of the mill of FIGURE 5 is the same as that previously described in that, when it is desired to change over the mill for a new operation, the old set of roll housings is removed to the cars R' which are then taken away and a new set of rolls is moved up on the cars D' and transferred into position on the mill base.

It will be understood that, with either embodiment of my invention, one or several selected roll housings may readily be changed without changing the entire set if such a partial replacement becomes necessary or desirable for any reason such as wear or breakage. Furthermore, although I have described my invention as incorporated in rolling mills having the several rolls in each housing geared together and driven by a single drive shaft, my novel roll housing handling means may also readily be adapted for use in mills in which each roll of each housing is individually driven through a separate shaft.

Accordingly, as these and other variations and modifications may be made in the specific form and arrangement of the apparatus in which my invention is incorporated without departing from the spirit thereof, I do not wish to be limited to the exact mechanisms and structures herein illustrated and described but claim as my invention all embodiments thereof coming within the scope of the appended claims.

I claim:

**1.** A rolling mill including a base structure, a roll housing supporting and locating saddle on said base structure adjacent the mill pass line, said saddle having a depressed seat and elevated side portions, a roll housing removably supported in said seat on said saddle, a roll housing transfer car, means for supporting said transfer car for movement into and away from a roll housing transferring position adjacent said saddle on said base structure, a pivotally supported roll housing transfer arm, means for swinging said transfer arm about its pivotal support transversely of said pass line of the mill, and means for detachably securing said housing to said arm whereby said swinging movement of said arm will move said roll housing in an arcuate path between said saddle on said base structure and said transfer car, said arcuate path being of a radius to lower said roll housing down into said depressed seat over said elevated side portion of said saddle and to lift said roll housing up out of said seat and over said elevated side portion of said saddle.

**2.** A rolling mill including a base structure, a plurality of roll housing supporting and locating saddles on said base structure adjacent to and disposed along the mill pass line, said saddles having depressed seat and elevated side portions, a plurality of roll housing removably supported in said seats on said saddles, a roll housing trans-

fer car, means for supporting said transfer car for movement to and from a roll housing transferring position adjacent said base structure, roll housing supporting means on said car, a plurality of roll housing transfer arms, pivotal supports for said transfer arms, independent means for moving each of said transfer arms about its said pivotal support in a direction transversely of said pass line of the mill, and means for detachably securing said housings to said arms whereby movement of said arms about said pivotal supports will move said roll housings in arcuate paths between said saddles on said base structure and said transfer car, said arcuate paths being of a radius to lower said roll housings down into said depressed seat over said elevated side portions of said saddles and to lift said roll housings up out of said seats and over said elevated side portions of said saddles.

3. A rolling mill according to claim 2 including releaseable hold down clamping means carried by said base structure and adapted to engage the upper portions of said roll housings and retain same in position on said saddles.

4. A rolling mill according to claim 3 in which said hold down clamping means includes a longitudinally extending swingable cross beam, individual resilient hold down clamp members carried by said cross beam and positioned to engage and clamp said roll housings, and means for lifting and lowering said cross beam and hold down clamp members out of and into clamping position.

5. A rolling mill according to claim 4 in which said saddles each have two spaced roll housing supporting portions which together with said hold down clamp members provide three point supports for said roll housings on said mill base.

6. A rolling mill according to claim 2 in which said roll housing transfer car supporting means includes tracks extending parallel to said pass line of the mill whereby said car may be moved parallel to said mill pass line into and out of roll housing transferring position adjacent said roll housing supporting saddles.

7. A rolling mill according to claim 2 in which said roll housing car supporting means includes tracks extending transversely of said mill pass line whereby said car may be moved toward or away from said mill pass line into and out of roll housing transferring position adjacent said roll housing supporting saddles.

8. A rolling mill according to claim 2 in which said roll housing transfer arms have fixed pivotal supports adjacent said saddles on said base and are adapted to swing from housing receiving positions below the roll housings on said saddles transversely across said pass line, and said tranfer car carries roll housing supporting means adapted to receive roll housings transferred thereto from said saddles by said transfer arms.

9. A rolling mill according to claim 8 including means on said transfer car for releasing roll housings supported thereon from said transfer arms.

10. A rolling mill according to claim 8 in which the roll housing transfer car supporting means includes tracks extending parallel said mill pass line whereby said car may be moved into and out of roll housing transferring position adjacent said roll housing support saddles.

11. A rolling mill according to claim 8 in which the roll housing transfer car supporting means includes tracks extending transversely of said mill pass line whereby said car may be moved toward or away from said mill pass line into and out of roll housing transferring position adjacent said roll housing support saddles.

12. A rolling mill according to claim 2 in which said roll housings are generaly cylindrical in form and said saddles on said base structure are adapted to support said cylindrical roll housings with their axes disposed substantially on said mill pass line.



13. A rolling mill according to claim 12 including co-acting indexing means on said roll housings and said saddles and co-acting indexing means on said roll housings and said transfer car for angularly indexing and aligning said housings thereon in position to be engaged by said transfer arms when said car is brought into roll housing transferring position adjacent said roll housing support saddles.

14. A rolling mill according to claim 2 in which said roll housing transfer arms have their pivotal supports on said roll housing transfer car and said means for moving said transfer arms are mounted on said car.

15. A rolling mill according to claim 14 in which the roll housing transfer car supporting means includes tracks extending parallel to said mill pass line whereby said car may be moved into and out of roll housing transferring position adjacent said saddles.

16. A rolling mill according to claim 15 including a second roll housing transfer car, tracks therefor extending transversely of said mill pass line, a plurality of roll housing transfer arms pivotally supported on said second car for swinging movement in a direction transversely of said mill pass line, and independent means on said second car for moving the transfer arms supported thereon about their pivotal supports.

17. A rolling mill according to claim 16 in which said roll housings are generally cylindrical in form and said saddles on said base structure are adapted to support said cylindrical roll housings with their axes disposed substantially on said mill pass line.

18. A rolling mill according to claim 17 including means for angularly indexing and aligning said roll housings on said saddles.

19. A rolling mill according to claim 14 in which retractable attaching pins and means for operating same are supported at the outer ends of said transfer arms and said roll housings are apertured to receive said pins.

20. A rolling mill including a base structure, a plurality of roll housing supporting and locating saddles supported on said base structure along the mill pass line, a plurality of roll housings removably supported on said saddles, a plurality of roll housing transfer arms pivotally supported for movement transversely of said mill pass line, roll housing engaging means adjacent the outer ends of said transfer arms, engageable means on said roll housings adapted to be releasably engaged by said engaging means of said transfer arms, means for swinging each of said transfer arms between a housing receiving position and a housing removed position whereby said housings may be moved transversely of said mill pass line, a roll housing transfer car supported for movement to and from a roll housing receiving position adjacent said base structure, and roll housing aligning and supporting means on said car.


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