# United States Patent [19]

**Shumaker**

[11] **3,747,387**

[45] **July 24, 1973**


[54] **ROLL CHANGING ARRANGEMENT FOR A ROLLING MILL**


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[73] Assignee: **Wean United, Inc.**, Pittsburgh, Pa.



[22] Filed: **Mar. 27, 1972**

[21] Appl. No.: **238,308**

[52] **U.S. Cl.** ..... **72/239**
[51] **Int. Cl.** ..... **B21b 31/08**
[58] **Field of Search** ..... 72/238, 239



[56] **References Cited**

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*Primary Examiner*—Milton S. Mehr
*Attorney*—Henry C. Westin

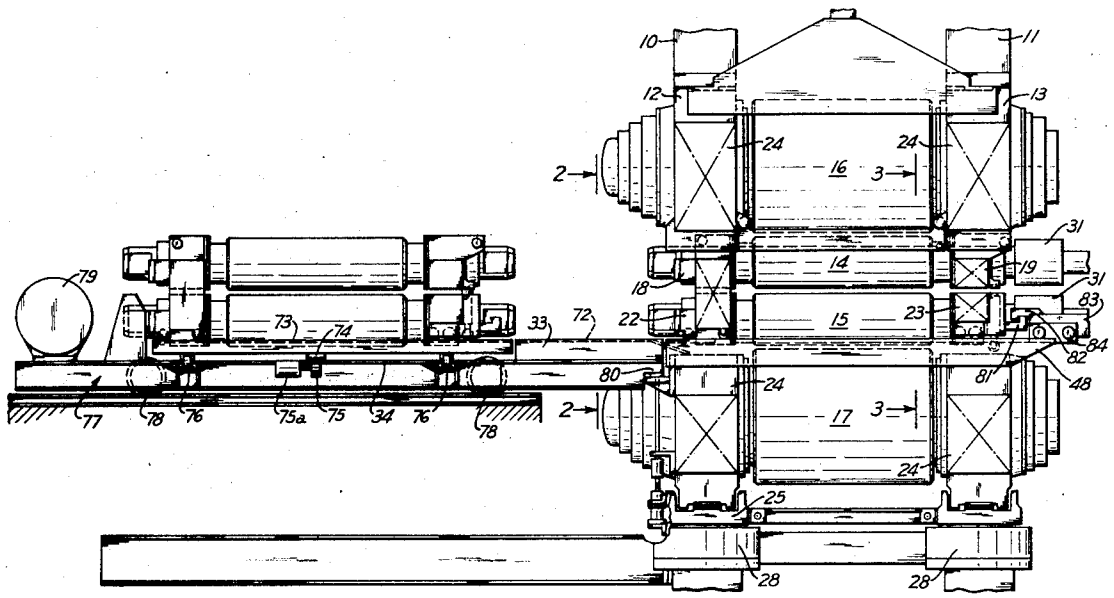


[57] **ABSTRACT**

The disclosure of this invention relates to a rolling mill wherein the chocks of the work roll on the drive side of the mill are split to enable the work rolls to be removed and replaced while strip is still being passed between the rolls. The chocks of the work rolls on the operating side are nested. The work roll chocks are provided with wheels which, during the roll changing operation, are carried by a pair of upper tracks secured to the housings and chocks of the upper backup roll and by a pair of lower tracks carried only by the housings. A lower track runs past the front of the mill to a side shifting unit having tracks which serve as continuations of the lower tracks and which receive the wheels of the chocks of the operating side work roll and the wheels of the chock of the lower drive side work roll as the rolls are brought to and from the mill to transfer them from and to the side shifter. The wheels of the chock of the upper drive side work roll are held apart after the drive side chocks leave the mill by a plunger displaced by a cam and cam track.

In an attempt to improve the productivity of rolling mills, and particularly high-speed tandem cold mills, much effort in recent years has been given to developing a system that would allow the work rolls of one or more stands to be changed while a strip is still passing through these stands and is being rolled by the other stands of the mill.


**10 Claims, 5 Drawing Figures**



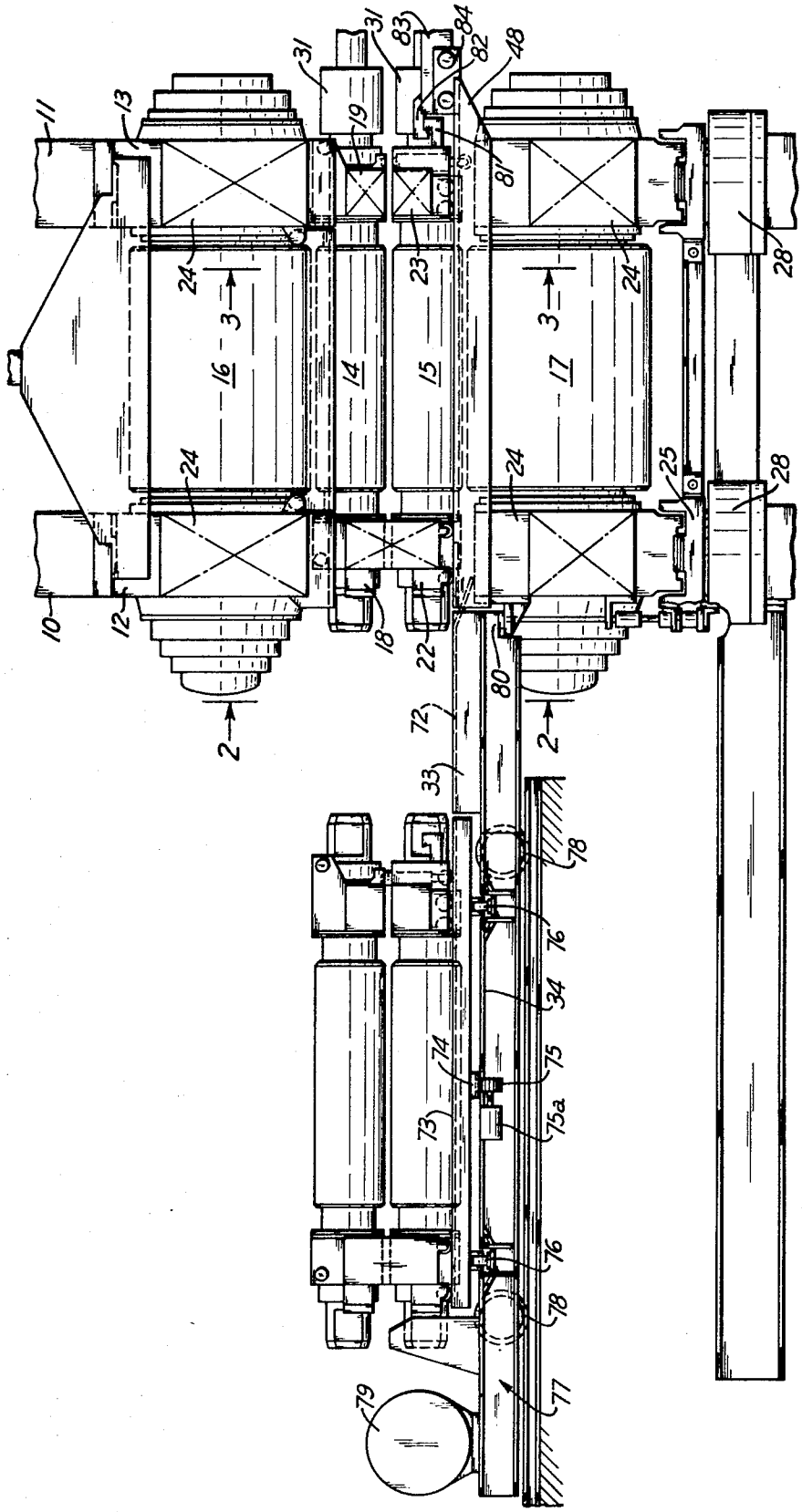

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Fig. 1

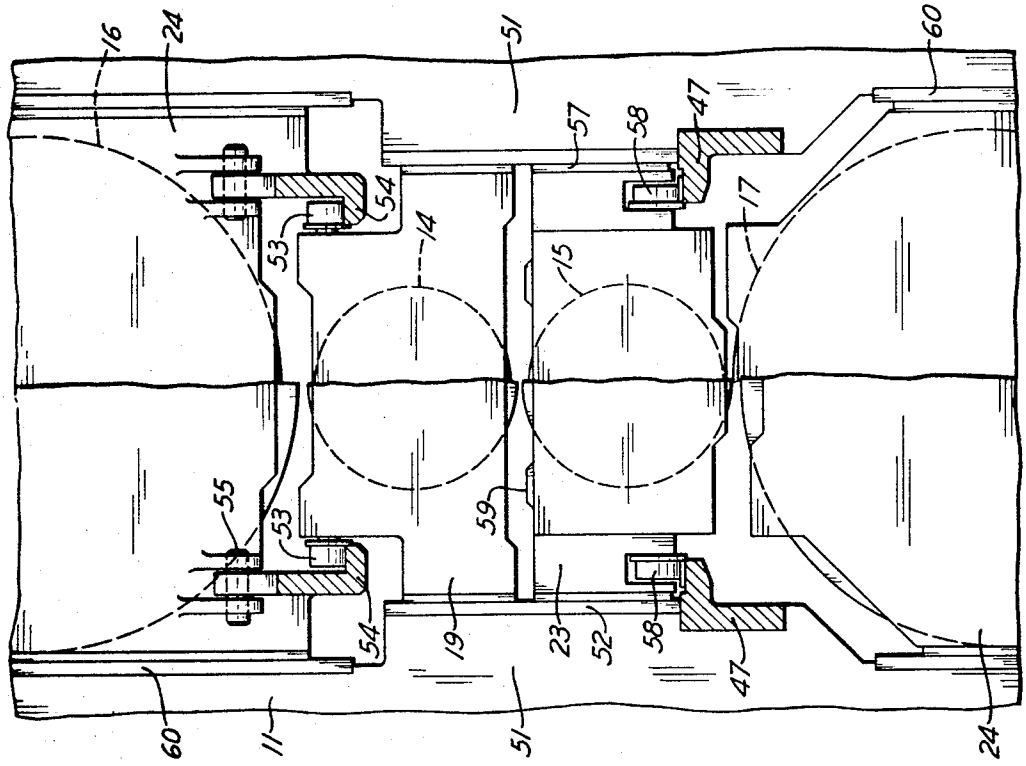
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Fig. 3

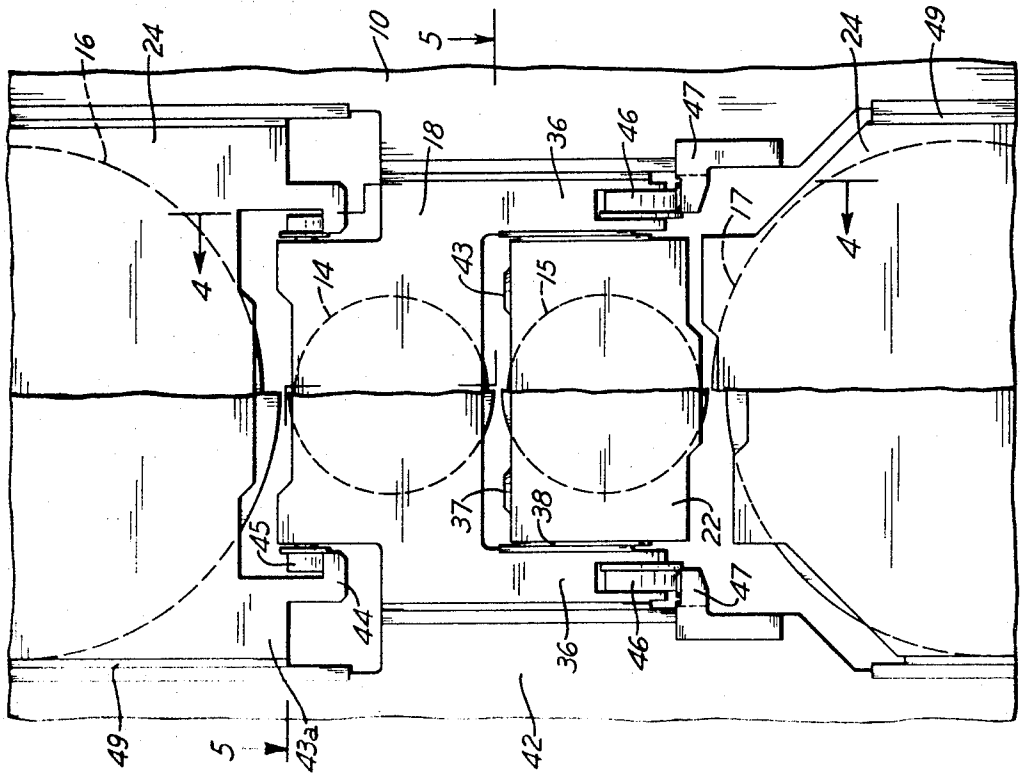
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Fig. 2

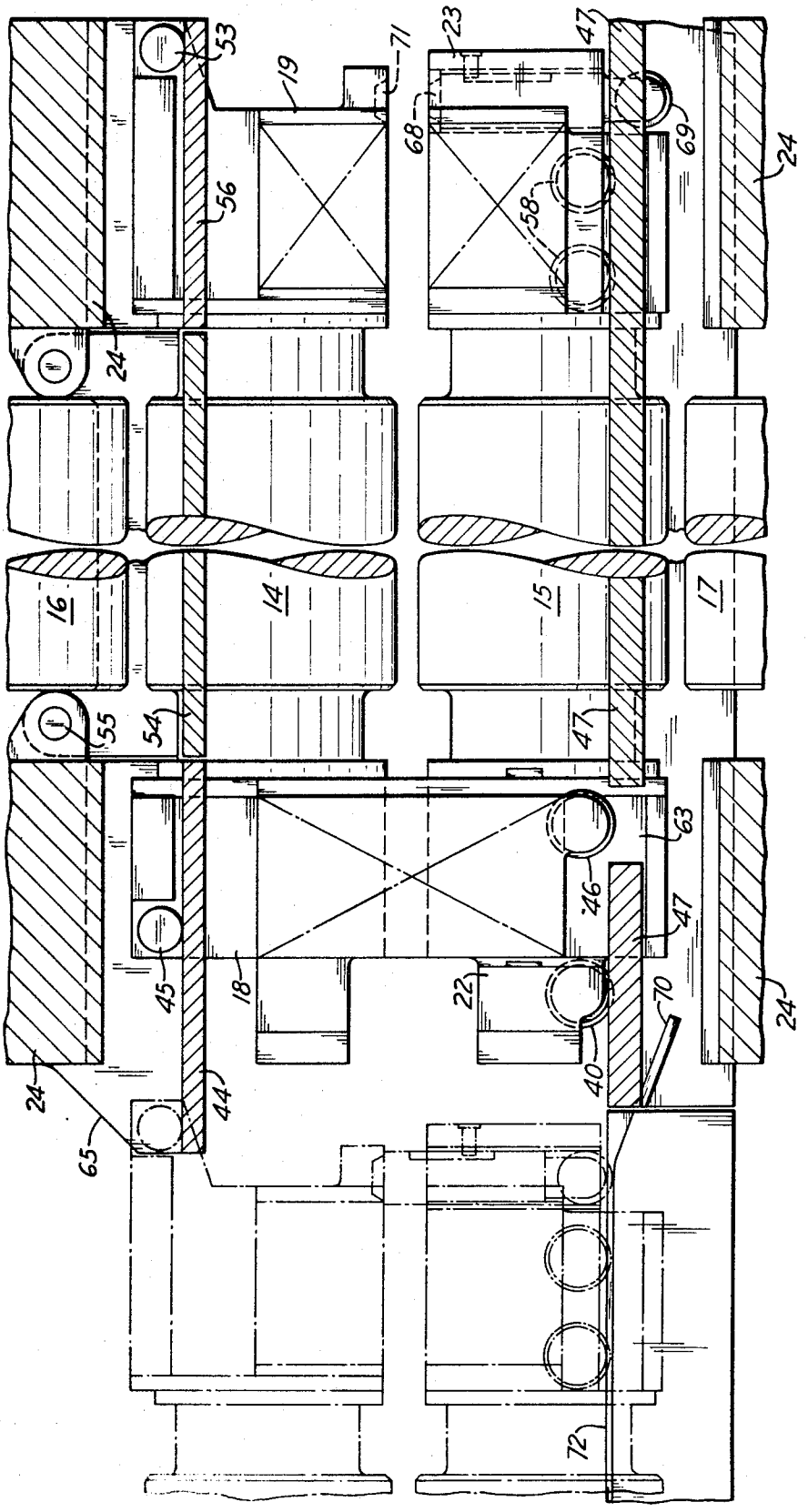
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Fig. 4

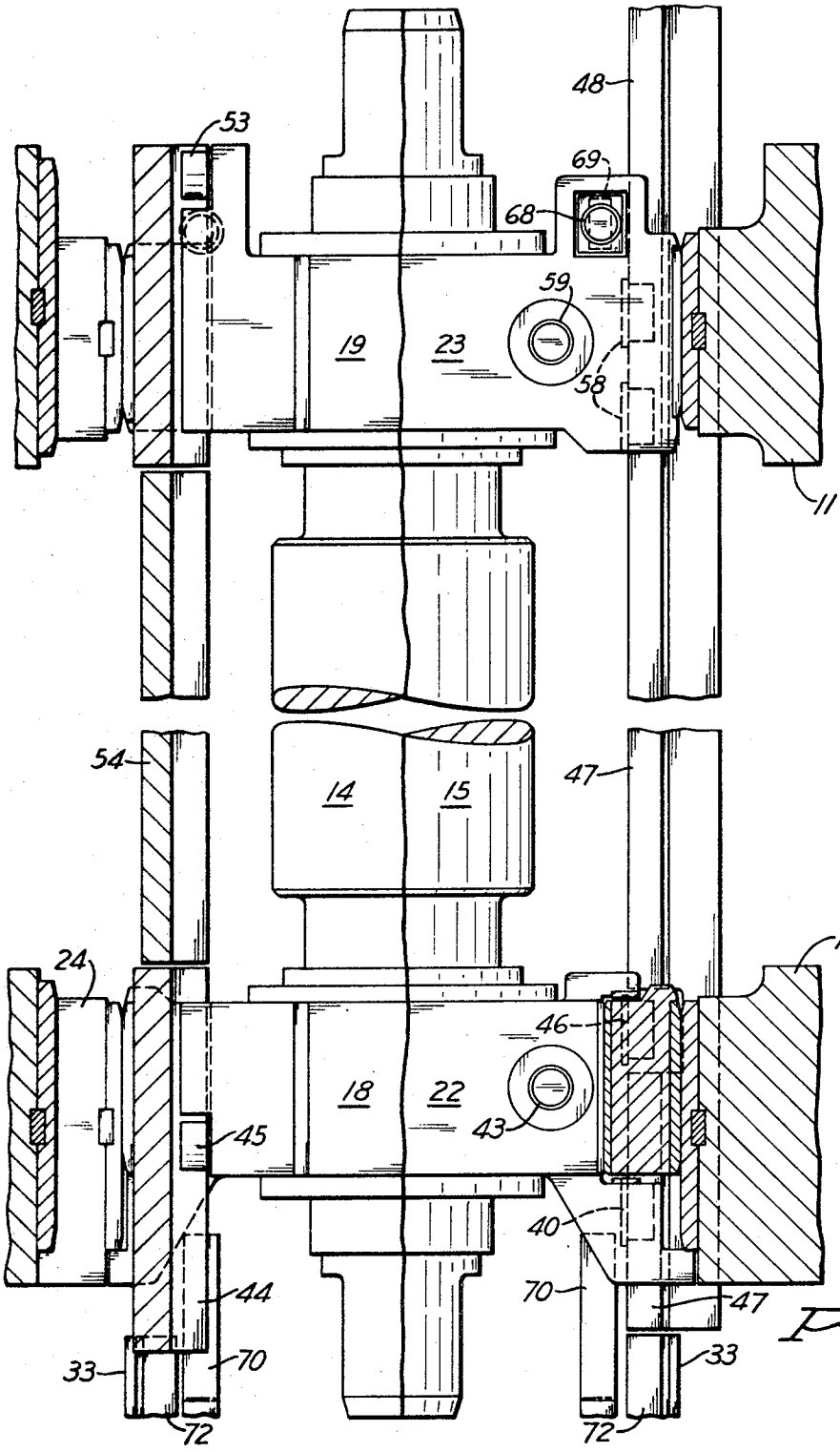
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Fig. 5

# ROLL CHANGING ARRANGEMENT FOR A ROLLING MILL

The present invention provides an improved mill arrangement for economically and efficiently carrying out the aforesaid object.

It provides a work roll chock and supporting arrangement that allows the work rolls to be held and transferred into and out of the mill without interfering with the passing strip.

More particularly, the present invention provides for the drive side chocks of the work rolls to be split and the upper chock to be carried by a first track and the lower chock by a second track, whereas the operating side chocks of the work roll are nested in which the low chock thereof is received in the upper chock, and the operating side lower chock is carried by the second track, whereas the operating side upper chock is carried by both the first and second tracks and in which the upper drive side chock, when this chock passes beyond the tracks, is supported by the lower drive side chock.

It is a further feature of the present invention to provide for the lower tracks to extend beyond the front of the mill to a side shifter having tracks serving as extensions of the lower tracks of the mill and which tracks support the chocks of the operating side and the lower drive side chock when the rolls are being changed, displaceable means on said lower drive side chock for engaging and supporting the upper drive side chock when it is not being supported by said upper track.

These objects, as well as other novel features and advantages of the present invention, will be more fully appreciated when the following description is read along with the accompanying drawings, of which:

FIG. 1 is an elevational view of one of the stands of a tandem mill incorporating the features of the present invention,

FIG. 2 is an elevational view at the operator's side of the window of the mill shown in FIG. 1,

FIG. 3 is a sectional view taken on line 3—3 of FIG. 1 illustrating the drive side windows of the mill shown in FIG. 1,

FIG. 4 is a sectional view taken on line 4—4 of FIG. 2, and

FIG. 5 is a sectional view taken on line 5—5 of FIG. 2.

In referring first to FIG. 1, there is Illustrated a rolling mill comprising two upright spaced-apart housings 10 and 11, each of which, according to customary designs, is provided with windows 12 and 13 into which are received the bearing chock assemblies of the rolls of the mill. The rolls comprise work rolls 14 and 15, each of which is backed up by backup rolls 16 and 17, respectively. The work roll 14 has bearing chock assemblies 18 and 19, whereas the lower work roll 15 has bearing chock assemblies 22 and 23. Likewise, the backup rolls have bearing chock assemblies 24.

The chocks of the lower backup roll 17 are carried in a roll changing sled 25, the lower surface of which is received in the windows 12 and 13. The chocks 24 of the upper backup roll 16 are adapted to be engaged by screws, not shown, arranged in each housing 10 and 11, FIG. 1 actually showing the chocks 24 of the upper backup roll 16 separated from the screws since this drawing is meant to depict the roll changing position of the work rolls. The sled 25 at the bottom of the mill



rests on pistons of piston cylinder assemblies 28 arranged in the lower portion of each housing 10 and 11. The work rolls 14 and 15 are adapted to be driven and for which purpose there are provided driving spindles 31 connected to a power source, not shown.

At the operator's side of the mill there is provided a platform 33 and a side shifter 34, the functions and descriptions of which will be given later.

Reference will now be made to FIGS. 2 and 3 in order to more fully describe the characteristics of the chocks of the rolls 14, 15, 16 and 17. FIG. 2 depicts the characteristics of the front or operating side chocks of the work rolls 14 and 15 and associated mill elements. In this connection, it will be noted that the chock 18 of the upper work roll 14 has downwardly extending leg portions 36 that provide an opening 37 for receiving the vertical sides of the lower front work roll chock 22. The adjacent vertical surfaces of these chocks are provided in the usual manner with liners 38. Similar liners are provided between the housing 10 and the outside vertical surfaces of the chock of the upper work roll 14, in which connection it will be noted that the housing is indented by portions 42. Wheels 40 are provided at the lower portions of the chock 22, and, while not seen in FIG. 2, they do appear in FIGS. 1, 4 and 5. The work roll chocks 18 and 22 are equipped with balance cylinder assemblies 43 arranged in the lower chock 22, which are retracted in view of the fact that the drawing depicts the roll changing position of the components.

In still referring to FIG. 2 and with reference to the chock 24 of the upper backup roll 16, it also is provided with downwardly projecting portions 43*a* which terminate into tracks 44. These tracks have guiding surfaces adapted to guide and support wheels 45 provided at the top of the front chock 18 of the upper work roll 14. Somewhat larger wheels 46 are provided in the legs 36 of the chock 18 which engage tracks 47 mounted in the housings 10 and 11. These tracks, as illustrated in FIGS. 1, 4 and 5, run from the front of the mill through the space between the housings and terminate at the back of the housing 11, actually having an extended portion 48 beyond the housing 11, the purpose of which will be described later. The vertical surface of operating side chocks 24 of the backup rolls 16 and 17 are provided with the usual liners 49 that allow them to slide vertically relative to the housing 10.

Referring now to FIG. 3, which depicts the back or drive side of the rolling mill, it will be noted that the chocks 19 and 23 of the work rolls 14 and 15 are split in counter-distinction to the nested relationship of the work roll chocks 18 and 22 at the operating side of the mill. This split construction allows the chocks 19 and 23 to be axially moved in and out of the mill without interfering with a strip passing between the rolls 14 and 15. The chock 19 of the upper roll 14 has lined vertical surfaces that engage projecting portions 51 of the housing 11, which portions are protected by liners 52. At the top of the chocks 19, horizontal extending wheels 53 are provided which engage tracks 54 extending downwardly from the chock 24 of the backup roll 16. The tracks 54, as shown in FIG. 3, are actually hinged to the drive side chock 24 by pins 55 and serve as extensions for both the tracks 44, as well as tracks 56 formed on the chock 24 similar to the tracks 44 of the front backup chock 24. It will be noted, and which is confirmed by looking at FIG. 1, that the hinge construction just described is also employed with respect

to the chock 24 at the front of the mill so that the tracks 54 extend between and are secured by the upper backup chocks 24.

The chock 23 of the lower work roll 15 is also provided with liners 57 that engage the portions 51 of the housing 11 and have two pairs of spaced-apart wheels 58 arranged at their outer lower portions that engage the upper surfaces of the tracks 47, already identified with respect to FIG. 2. As in the case of the chock 22, the chock 23 is provided with balance cylinder assemblies 59, shown retracted in view of the roll changing position of the mill components. The drive side backup chocks 24 for the backup rolls 16 and 17 are provided with vertical liners 60 that allow for vertical movement of the backup chocks.

More specifically referring now to the various tracks earlier identified and the wheels of the chocks that engage them, reference will be made to FIGS. 1, 4 and 5, in which regard it will be noted that the two pairs of wheels 40 and 46 of the front work roll chocks 18 and 22 generally fall in the same longitudinal plane. As one views FIG. 4, the foremost wheels 40 mounted on the work roll chock 22 of the lower roll 15 fall immediately ahead of the wheels 46, which are secured to the leg portions 36 of the chock 18 of the upper work roll 14. Since the upper work roll 14 must move towards the lower roll 15 to set the pass opening of the mill during rolling, the tracks 47 are provided with slots 63 immediately below the operating position of the wheels 46 of the upper work roll chock 18. In order to support the upper chock until the wheels 46 pass over the slots 63, a pair of wheels 45 at the top of the chock 18 are spaced to the left of the wheels 46, as one views FIG. 4, and during roll changing are in engagement with the tracks 44. During the period while roll changing that the wheels 46 are in the slot areas, the chock 18 is only supported by the wheels 45, whereas, during the remainder of the time, the chock will be supported by both the wheels 45 and the wheels 46.

Referring now to the drive side chock 23 of the lower work roll 15, the two pairs of wheels 58 are spaced apart with reference to the length of the slots 63 in the rails 47 so that, in removing the rolls from the mill, the chock 23 will be supported by the back wheels 58 while the front wheels 58 are passing over the slot 63. The reverse will take place when the rolls are moved into the mill. In referring now to the chock 19 at the drive side of the work roll 14, its pair of wheels 53, as noted in FIG. 4, is arranged at the very back of the chock assembly so that the chock 19 can be supported by the track network 44, 54 and 56 during the entire period that the work rolls are moved from the mill. In order to allow for the convenient transfer of the wheels 53 of the chock 19 from the tracks 44 to the platform 33, and vice versa, the front chock 24 of the backup roll 16 is provided with an extending portion 65 on which the tracks 44 are formed and which cooperation with the platform is shown in phantom at the left-hand side of FIG. 4.

It will be noted that the tracks 44, 54 and 56 only support the drive side upper chock 19 when the roll assemblies are in the mill during roll changing. The chocks 19 and 23 are maintained apart when they are out of the mill at the same spaced distance they assume when in the mill by plungers 68 mounted at the back of the chock 23 for vertical movement on displacement of rollers 69. As shown in FIG. 5, the plungers and rollers are arranged inward of the tracks 47 so that the rollers do not contact the tracks on axial movement of the rolls 14 and 15. The rollers are designed to contact cam tracks 70 arranged in the vicinity of the platform 33 just ahead of the outermost portion of the extension 65 of the front backup chock 24. The chock 19 has recesses 71 to receive and be supported by the adjacent ends of the plungers 68 when the rollers 69 are caused to rise on contact with the cam tracks 70.

In referring now to FIG. 1 and with reference to the platfrom unit 33, it will be notd that it is provided with a pair of tracks 72 which form continuations of the tracks 47 that service the lower work roll chocks 22 and 23. The platform extends between the mill and the side shifter 34 which is provided with two pairs of side-by-side tracks 73 for supporting a new pair of work roll assemblies to be inserted into the mill and a pair of used work roll assemblies that are retracted from the mill. The tracks of each of these pairs, depending on which pair is positioned in front of the mill, will serve as extensions of the tracks 72 of the platform 33. The positioning of the tracks is brought about by a rack 74 and pinion 75 which, through a motor 75*a*, drives the side shifter 34 over tracks 76 in a direction parallel to the steel line of the mill. The side shifter itself is carried by a carriage 77 supported by wheels and tracks 78 and driven to and from the mill by a motor 79. The carriage 77 also carries the platform 33 in which, when the carriage is positioned in front of the mill, the far end of the platform rests on a pad 80 carried by the housing 10.

There remains one additional element to be described that has reference to the replacement of the work rolls 14 and 15, which is shown only in FIG. 1. As noted, the lower drive side work roll chock 23 is provided with a hook 81 that is adapted to be engaged by a cooperative hook element 82 connected to a ram 83. The ram is adapted to be driven through the mill by a power means, not shown. The front end of the ram 83 is supported by two pairs of wheels 84 arranged to engage the extension 48 of the tracks 47.

A brief description of the withdrawal of the work roll assemblies will now be given. As noted before, the drawings depict the roll changing position of the various mill components, in which connection the lower backup roll 17 has been lowered on operation of the piston cylinder assemblies 28 to allow the lower work roll 15 to be lowered and its wheels 40 and 58 to engage the tracks 47. In a like manner, the upper backup roll 16 has been raised to cause the tracks 44 and 56 to engage the wheels 45 and 53, respectively.

The lowering and raising of the backup rolls 17 and 16, respectively, provide an opening between the work rolls and brings them out of engagement with the strip passing through the mill. The raising of the chocks 24 of the backup roll 16 is accomplished by lifting the mill screws and operating the roll balance for the backup roll 16. The actual amount or distance that the upper backup roll 16 is raised is controlled by the consideration that the wheels 46 of the front upper work roll chock 18 must be brought into alignment with the tracks 47 and the stroke of the plungers 68. The registry of the tracks can be accomplished in any number of ways, for example, by a pin operated by a piston cylinder assembly that will position the upper chocks 24 relative to the housings 10 and 11. As noted previously, the balance cylinders, for example, the work roll balance cylinders 43 and 59, are retracted so as to avoid

their interfering with or contacting the strip as the rolls are moved axially.

Prior to the separation of the work rolls preparatory to roll changing, the carriage **77**, which, as noted before, includes the platform **33**, is brought to a position in front of the mill and arranged so that an empty pair of tracks **73** is provided in front of the mill to receive the roll assemblies **14** and **15** to be removed from the mill. The rolls are removed by simply operating the ram **83** to cause the pair of rolls **14** and **15** with their chock assemblies to move over their associated tracks onto the platform **33** and eventually onto the side shifter **34**. As previously described, the relationship of the several wheels to the tracks and slots **63** provide that the rolls throughout the entire transport will be supported in a manner that they are held out of contact with the strip passing between them. ParticularlY with respect to the chocks **19** and **23** at the drive side of the work rolls **14** and **15**, they are individually supported in a spaced-apart relationship and their split construction allows them to be passed over and under the strip passing through the mill. In bringing the new roll assemblies into the mill, the procedure is essentially reversed as above described, in which the side shifter **34** will position the new set of rolls in front of the mill to be engaged by the ram **83**, the drive side chocks being held apart by plungers similar to the plungers **68** until they pass the cam tracks **70**.

In accordance with the provisions of the patent statutes, I have explained the principle and operation of my invention and have illustrated and described what I consider to represent the best embodiment thereof.

I claim:

**1.** In a rolling mill comprising:

a housing,

a pair of working rolls arranged on the opposite sides of the passline of said mill and each having a drive side bearing chock and an operating side bearing chock received in said housing,

said bearing chocks at the respective ends of said working rolls being arranged to form cooperative pairs of bearing chocks,

said cooperative pairs of bearing chocks at the drive side being split in a manner that the adjacent surfaces thereof can be spaced from said mill passline during roll changing,

said cooperative pair of bearing chocks at the operating side being nested in a manner that one of the bearing chocks thereof is received and carried by the other bearing chock, and

means for supporting said drive side bearing chocks to maintain them spaced from said mill passline when moved through said mill during roll changing,

other means including a member movable in the direction of one of said drive side bearing chocks contained by said other drive side bearing chock for continuing said spaced supporting thereof when said drive side bearing chocks are out of said mill during roll changing.

**2.** A rolling mill comprising:

a housing,

a pair of working rolls arranged on the opposite sides of the passline of said mill and each having a drive side bearing chock and an operating side bearing chock received in the housing,

the bearing chocks at the respective ends of the working rolls being arranged to form cooperative pairs of bearing chocks,

means for supporting the drive side bearing chocks so as to maintain them spaced from said mill passline when moved through said mill during roll changing, and

other means including a member movable in the direction of one of said drive side bearing chocks contained by the other drive side bearing chock for continuing the spaced supporting thereof when the drive side bearing chocks are out of the mill during roll changing.

**3.** In a rolling mill according to claim **2** wherein said movable member is carried by one of said drive side bearing chocks movable towards and away from said other drive side bearing chocks and arranged to engage said other drive side bearing chock, and

means arranged to engage said member when said pair of drive side bearing chocks are out of said mill during roll changing.

**4.** In a rolling mill according to claim **3** wherein said member comprises a plunger arranged in the lower of said pair of drive side bearing chocks displaceable vertically towards and away from the upper of said pair of drive side bparing chocks and adapted to engage said upper drive side bearing chock when displaced upwardly, and

means arranged on one side and outside said mill for engaging said plunger when said drive side bearing chocks are outside said mill during roll changing.

**5.** In a rolling mill according to claim **4** wherein said means for engaging said plunger comprises a track, and

a roller carried by said plunger arranged to engage said track.

**6.** In a rolling mill according to claim **5** wherein the end of said track adjacent said mill is sloped away from said plunger and said plunger is of a length sufficient to engage the slope portion of said track, and wherein

said slope is sufficient to cause said plunger to rise a distance sufficient to continue said spaced supporting of said drive side bearing chocks.

**7.** A rolling mill according to claim **3** in which the first means includes a first pair of tracks arranged to suport the bearing chocks of the upper working roll and, in addition, includes a second pair of tracks arranged to support the drive side bearing chock of the upper roll,

said second pair of tracks having sloped portions,

said member comprising a pair of plungers to engage a different one of the sloped portions,

a third pair of tracks arranged to support the bearing chocks of the lower roll,

separate means carried by the upper and lower drive side bearing chocks for engaging in a supporting relationship said first and third pairs of tracks, respectively, for supporting the drive side bearing chocks in the spaced-apart condition when passing through said mill during roll changing,

said third pair of tracks being arranged to overlap the slope portions in a manner that said uppermost drive side bearing chock is supportable by one or the other of the first and second pairs of tracks by means of said plungers and separate means.

**8.** In a rolling mill according to claim **7** wherein said slope portions and said plungers are transversely spaced from said third pair of tracks.

9. A rolling mill according to claim 2 in which the first means include a first pair of tracks having supporting surfaces, a second pair of tracks having supporting surfaces arranged on the same elevation as the supporting surfaces of the first pair of tracks and including sloped portions which are arranged to overlap portions of said first pair of tracks, and to assume a supporting relationship with said other means when the uppermost drive side bearing chock is not being supported by the first means.

10. A rolling mill according to claim 2 in which the first means include first track means, and means in the mill for supporting the first track means,

the first track means being of a length sufficient to maintain the drive side bearing chocks spaced from the mill passline while the chocks are moved through the mill,

second track means arranged to overlap a portion of the first track means and to be engaged by said other means in a manner to continue said spaced support for the uppermost drive side bearing chock when passing to and from the mill during roll changing.

* * * * *

# UNITED STATES PATENT OFFICE
# CERTIFICATE OF CORRECTION

Patent No. 3,747,387 Dated July 24, 1973

Inventor(s) Charles Storer Shumaker

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

On the cover sheet insert item [30] --Foreign Application Priority Data April 15, 1971 Great Britian 9529/71 --.

Column 4, line 11 "notd" should read -- noted --.

Column 5, line 18, "ParticularlY" should read -- Particularly --.

Column 6, line 26, claim 4, "bparing" should read -- bearing --.

Signed and sealed this 19th day of March 1974.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

FORM PO-1050 (10-69)

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