This invention relates to roll changing apparatus and particularly to apparatus for changing rolls of a rolling mill. Our apparatus enables the changing of rolls with unprecedented speed and efficiency yet by the use of relatively simple and inexpensive roll changing means.

Our roll changing apparatus may be adapted for the changing of any rolls of a rolling mill. However, the rolls which require most frequent changing are the work rolls as distinguished from the back-up rolls in mills of the type having back-up rolls. For purposes of explanation and illustration the invention will be described as embodied in roll changing apparatus for changing the work rolls of a 4-high rolling mill. Our roll changing apparatus in the form shown in the drawings is adapted for changing at the same time both of the work rolls of a 4-high mill. Our apparatus may easily be adapted for the simultaneous changing of the three work rolls of a 3-high rolling mill.

We provide roll changing apparatus for rolling mills comprising a carrier, means on the carrier for grasping an end of a rolling mill roll and means for moving the carrier to deliver the roll while supported from said end in cantilever fashion between a roll stand and a roll support separate from the roll stand.

The carrier preferably includes a plurality of means for grasping the ends of the rolls, which are arranged so that the carrier may remove a roll while carrying the replacement roll.

Preferably the carrier has a socket for receiving and supporting an end of a rolling mill roll. In one embodiment the socket may be disposed in a tilttable portion of the carrier so that upon tilting of the tilttable portion with the end of a roll in the socket the carrier can support the roll from said end in cantilever fashion. The tilttable portion of the carrier is preferably tilted to an extent sufficient to compensate for the droop of the roll so that the roll is supported from its end in cantilever fashion with its axis substantially horizontal.

In the preferred embodiment a wedge device may be disposed in the socket for receiving the end of a rolling mill roll. The carrier may support the roll in cantilever fashion and compensate for roll droop when the end of a roll is received by the wedge device.

The carrier of our roll changing apparatus may have means for grasping superposed ends of a pair of rolling mill rolls and the carrier is adapted to be moved to deliver the rolls together while supported from said ends in cantilever fashion. We may provide a pair of sockets in the carrier for receiving and supporting superposed ends of a pair of rolls. One socket may be movable with respect to the second socket of the pair.

In another aspect our roll changing apparatus may comprise a carrier, means for moving the carrier to and from a roll stand, the carrier having a portion turntable generally horizontally, said portion having roll grasping means for grasping at least one roll. At least a portion of the carrier which has the roll grasping means is preferably movable to different elevations for alignment with the rolls to be changed.

We further provide roll changing apparatus for rolling mills comprising a carrier, means for moving the carrier to and from a roll stand, a roll supporting element carried by the carrier for turning movement about a generally vertical axis, means for turning said element and means for raising and lowering said element, said element having a head with roll grasping means. We preferably employ screw means for raising and lowering the roll supporting element together with means for turning the screw means. The head preferably has a plurality of roll grasping means.

In one embodiment of our invention we provide means for stowing the carrier below the level of the rolling mill floor when the roll changing apparatus is not in use. The roll changing apparatus preferably includes a guideway for guiding the carrier in movement to and from a roll stand and the means for stowing the carrier below the level of the rolling mill floor when the roll changing apparatus is not in use, which means may include a portion of the guideway which when the roll changing apparatus is in use is disposed in horizontal alignment with the remainder of the guideway and which when the roll changing apparatus is not in use is lowered with the carrier.

Means may be provided for stowing the carrier and replacement rolls held by the carrier below the level of the rolling mill floor.

Other details, objects and advantages of the invention will become apparent as the following description of certain present preferred embodiments thereof proceeds.

In the accompanying drawings we have shown certain present preferred embodiments of the invention in which:

FIGURE 1 is a more or less diagrammatic elevational view of roll changing apparatus, the rolls, roll stand and roll support being shown in dotted lines, certain positions of the carrier being indicated in chain lines;

FIGURE 2 is an enlarged side elevational view of the carrier and a portion of the means for lowering and raising the carrier between operative and stowed positions, with parts in vertical cross-section;

FIGURE 3 is a horizontal cross-sectional view taken on the line III—III of FIGURE 2;

FIGURE 4 is a view partly in end elevation and partly in vertical cross section of the apparatus shown in FIGURE 2;

FIGURE 5 is a fragmentary detail cross-sectional view taken on the line V—V of FIGURE 3;

FIGURE 6 is a fragmentary side elevational view of a carrier head with wedge devices;

FIGURE 7 is an end elevational view of the structure shown in FIGURE 6; and

FIGURE 8 is a fragmentary cross-sectional view to enlarged scale taken on the line VIII—VIII of FIGURE 6.

Referring now more particularly to the drawings, FIGURE 1 indicates in dotted lines a roll stand 2 for a 4-high rolling mill having work rolls 3 and back-up rolls 4. The mill may be conventional in all respects as well known to those skilled in the art.

The floor level of the mill is indicated at 5. The roll changing apparatus when in operative position is disposed partly below and partly above the floor level and provision is made for stowing it entirely below the floor level when not in use.

Below the mill floor level 5 is a relatively shallow elongated pit extending toward the roll stand 2 from a roll support separate from the roll stand and shown in the drawings as comprising a roll supporting car 6 mounted on a track 7. The relatively shallow elongated pit is designated 8. Adjacent the roll stand 2 the relatively shallow elongated pit 8 communicates with a relatively deep pit 9. In the pit 8 is a fixed guideway 10 comprising opposed outwardly open channels and in alignment with the guideway 10 in the pit 9 when the roll changing apparatus is in operative position is a guideway 11 mounted on a platform 12 guided for vertical up and down movement in the pit 9 and thus movable by a piston in a cylinder 13 which is connected with the platform 12 by a rod 14. When the roll changing apparatus is in operative position the guide-
way 11 is in horizontal alignment with the guideway 10 as mentioned above and as shown in FIGURE 1. When the roll changing apparatus is not in use, the platform 12 is moved down into the pit 9 and the guideway 11, being mounted on the platform 12, is correspondingly lowered.

Supported on the guideway 11 for movement therealong is a carrier 15 having wheels 16 disposed in the guideway 11 as shown in FIGURE 4 so that the carrier 15 is guided by the guideway as it moves therealong. When the roll changing apparatus is not in use the carrier 15 is moved to the position indicated by chain lines in FIGURE 1 and designated A whereupon the platform 12 carrying the guideway 11 and the carrier 15 is moved downwardly in the pit 9 to a position in which the carrier is disposed entirely below the floor level 5 as indicated at B in FIGURE 1.

Mounted atop the guideway 11 at opposite sides of the center line of the guideway are racks 17 with which mesh pinions 18 driven through suitable connections by an electric motor and gear reducer 19. Fixedly mounted in the pit 8 are racks 20 which when the platform 12 is in the position shown in FIGURE 1 are in alignment with the racks 17. Thus upon operation of the motor the carrier 19 is moved longitudinally of the guideway 11, and when the guideway 10 is in alignment with the guideway 11 as shown in FIGURE 1 the carrier 15 may move to any position along the combined guideways 10 and 11, the pinions 18 meshing with the racks 20 when the carrier is disposed on the guideway 10.

Carried by the carrier 15 and disposed with its axis substantially vertical is an element 21 which is splined within a ring gear 22 for up and down axial movement relatively to the ring gear. The element 21 is adapted to be turned about its vertical axis by an electric motor and gear reducer 23 acting through suitable connections as shown to turn the gear 22. Thus the element 21 may be turned about its vertical axis while occupying various vertical positions within the ring gear 22 or indeed while turning with the ring gear 22.

At the bottom of the element 21 is a thrust bearing 24 against which bears the upper end of a screw jack 25 threaded through an internally threaded sleeve 26 fixedly mounted in the frame of the carrier 15. A gear 26a is fixed to the screw jack 25 at its bottom and meshes with a wide-faced gear 26b which is adapted to be turned through a suitably small angle to turn the gear 26a and consequently the screw jack 25. When the screw jack 25 is threaded through the fixedly mounted internally threaded sleeve 26, turning of the gear 26a accompanies by upward or downward movement of the screw jack and hence of the element 21 depending upon the direction in which the gear 26a is turned. During upward or downward movement the gear 26a moves upwardly or downwardly as the case may be relatively to the wide-faced gear 26b which drives it. Thus the screw jack 25 determines the elevation of the element 21 and the ring gear 22 independently determines the angular position of the element 21, neither being affected by the other.

Referring to the embodiment of the invention shown in FIGURES 6, 7 and 8 mounted upon the element 21 by a horizontally pivoted connection 28 is a head 29 having laterally facing roll grasping means shown in the drawings as a pair of superposed sockets 30. The element 21 carries a cylinder 31 in which operates a piston 32 connected through a piston rod 33 and a link 34 to an arm 35 which is integral with the head 29. Operation of the piston 32 and the cylinder 31 tilts the head 29 so that when the ends of rolls are in the sockets 30 the head may be tilted by turning it in the counterclockwise direction about the axis of the pivotal connection 28 viewing FIGURE 2 until the rolls are picked up, being supported by the sockets 30 in cantilever fashion, the tilting of the head 29 compensating for the droop of the rolls so that the rolls may be supported with their axes substantially horizontal.

FIGURES 6, 7 and 8 show a different form of the invention in which the element 21 supports head 36 having therein four pairs of sockets 30 in pairs facing in opposite directions so that a pair of new rolls may be held in one pair of sockets while a pair of rolls to be replaced are removed by the other pair of sockets, whereafter the element 21 may be rotated 180° to present the new rolls for insertion and mounting in the sockets. The head 36 may have a plurality of sockets with axes in any direction to facilitate removal and replacement of the rolls. Wedges 37 are disposed in sockets 30 for gripping the ends of work rolls. As shown in FIGURE 8 each of the wedges 37 is adapted to be slidably supported in its socket 30 by a dovetail interlocking bracket and slot, the wedges being disposed at right angles to each other. Springs 38 urge wedges 37 toward out position. Shoulder 39 of a roll engages the wedges 37 associated with the socket 30 into which the end of the roll is being inserted and moves the wedges inwardly so that they grip the end of the roll, inhibiting droop of the roll. The element 21 as shown in FIGURES 6, 7 and 8 can remove and replace work rolls by rotating 180° through its vertical axis as above indicated. The roll is released by any outward movement.

When the work rolls 3 of the 4-high mill shown in FIGURE 1 are to be changed the top back-up roll 4 is raised to free the work rolls 3 and the means mounting the work rolls in the housings are removed or freed so that the work rolls may be moved generally horizontally toward the left viewing FIGURES 1 and 2 of the housing.

When the work rolls are to be changed the platform 12 is raised to position the carrier 15 in position A of FIGURE 1. The sockets 30 which are to receive the rolls to be removed are disposed toward those rolls and the elevation of the element 21 is adjusted as required to dispose the axes of the socket 30 in line with axes of the rolls to be removed. Then the carrier 15 is moved toward the right viewing FIGURE 1 to the position indicated by the letter C whereupon the ends of the work rolls 3 are disposed in the sockets 30. Thereupon either clamping means such as the wedges 37 associated with the sockets shown in FIGURES 6, 7 and 8 are rendered operative or the head 29 is tilted in the counterclockwise direction viewing FIGURE 2 and/or raised to cause the roll ends to be grasped by the sockets, the tilting of the head 29 compensating for the droop of the rolls. In either case the roll ends are grasped and the rolls supported independently of the housings with the axes of the rolls substantially horizontal. If desired the element 21 may be raised slightly before withdrawing the rolls from the housings although 260° of the work rolls are raised slightly upon tilting of the head 29.

With the rolls thus supported by the head 29 in cantilever fashion the carrier 15 is moved toward the left viewing FIGURE 1. After the rolls 3 have cleared the mill housings the element 21 is tilted through an angle of 180° about its vertical axis. The element 21 is indicated as having been turned through 90° at the position indicated by the letter D in FIGURE 1. The turning of the element 21 may occur simultaneously with the movement of the carrier 15 toward the left viewing FIGURE 1. When the element 21 has been turned 210° from its initial position the carrier may be moved to the position indicated by the letter E in FIGURE 1 when the rolls are disposed above the car 6. Thereupon the head 29 may be tilted downwardly or lowered to deposit the rolls on the car. The car may be provided with means laterally embracing the rolls when they are thus deposited so that they will remain in substantially superposed position.

After the rolls have been deposited on the car 6 the carrier 15 may be moved away from the back-up rolls as shown in FIGURE 1 until the head 29 clears the roll ends. Thereupon the car 6 may be moved along the track 7 to dispose a new pair of rolls in alignment with the sockets 30 of the head 29. The carrier 15 may
be moved toward the left back to position E whereupon the ends of the new rolls are disposed in the sockets 30. The head 29 may then be tilted and/or raised to pick up the new rolls which are supported in the sockets 30 in cantilever fashion as were the original rolls. The carrier 15 may then be moved toward the right viewing FIGURE 1 through positions D and A to position C during which movement the element 21 may be rotated about its vertical axis through an angle of 180°. The new rolls are disposed in the housings in the position originally occupied by the rolls which were removed whereupon the head 29 may be tilted to release the new rolls and the carrier 15 may be moved from position C to position A and thence to position B. The mill floor is of course provided with a slot through which the element 21 extends while the rolls are being changed. If desired that slot may be covered when rolls are not being changed.

If the structure shown in FIGURES 6, 7 and 8 is employed and if new rolls are carried by one pair of sockets in the head 36 while the old rolls are being removed by another pair of sockets the new rolls may be inserted and mounted in the housings before the carrier 15 moves to the car 6. Alternatively, the old rolls may be removed before the new rolls are picked up and the carrier may be moved from the mill to the car 6 carrying the old rolls which have just been removed, the new rolls may be picked up before the element 21 is turned through 180° and thereafter the element 21 may be turned through 180° and the new rolls presented to the mill. Car 6 may therefore be replaced by a fixed stand.

The chores for the rolls are removed with the rolls and the new rolls are preferably provided with their own chocks. When referring to the rolls in the specification and claims it is to be understood that the chocks may be assembled to the rolls so that the chocks and rolls are removed together and the new rolls are inserted with their chocks.

Thus we provide for changing rolling mill rolls quickly and efficiently with comparatively simple and inexpensive apparatus.

While we have shown and described certain present preferred embodiments of the invention it is to be distinctly understood that the invention is not limited thereto but may be otherwise variously embodied within the scope of the following claims.

We claim:
1. Roll changing apparatus for rolling mills comprising a supporting structure, a carrier mounted on the supporting structure for guided movement relatively thereto, a socket in the carrier for receiving and supporting an end of a rolling mill roll and means for moving the carrier to deliver the roll while supported from said end in cantilever fashion between a roll stand and a roll support separate from the roll stand.

2. Roll changing apparatus for rolling mills comprising a supporting structure, a carrier mounted on the supporting structure for guided movement relatively thereto, a socket in the carrier for receiving and supporting an end of a rolling mill roll and means for moving the carrier to deliver the roll while supported from said end in cantilever fashion between a roll stand and a roll support separate from the roll stand.

3. Roll changing apparatus for rolling mills comprising a carrier having a tiltable portion having a socket for receiving an end of a rolling mill roll so that upon tilting of the tiltable portion with the end of a roll in the socket the carrier can support the roll from said end in cantilever fashion and means for moving the carrier to deliver the roll while so supported between a roll stand and a roll support separate from the roll stand.

4. Roll changing apparatus for rolling mills comprising a carrier having a tiltable portion having socket means for receiving ends of a plurality of rolling mill rolls so that upon tilting of the tiltable portions with the ends of a plurality of rolls in the socket means the carrier can support the rolls from said ends in cantilever fashion and means for moving the carrier to deliver the rolls while so supported between a roll stand and a roll support separate from the roll stand.

5. Roll changing apparatus for rolling mills comprising a carrier, means for moving the carrier to and from a roll stand, the carrier having a portion turnable generally horizontally, said portion having roll grasping means for grasping at least one rolling mill roll, and means for positively so turning said portion of the carrier.

6. Roll changing apparatus for rolling mills comprising a carrier, means for moving the carrier to and from a roll stand, the carrier having a portion turnable generally horizontally and also movable to different elevations, said portion having roll grasping means for grasping at least one rolling mill roll, and means for positively so turning said portion of the carrier.

7. Roll changing apparatus for rolling mills comprising a carrier, means for moving the carrier to and from a roll stand, the carrier having a portion turnable generally horizontally and also movable to different elevations, said portion having roll grasping means for grasping at least one rolling mill roll, and means for positively so turning said portion of the carrier.

8. Roll changing apparatus for rolling mills comprising a carrier, means for moving the carrier to and from a roll stand, a roll supporting element carried by the carrier for turning movement about a generally vertical axis, means for turning said element and means for raising and lowering said element, said element having a head having laterally facing roll grasping means.

9. Roll changing apparatus for rolling mills comprising a carrier, means for moving the carrier to and from a roll stand, a roll supporting element carried by the carrier for turning movement about a generally vertical axis, means for raising and lowering said element, and means for turning the screw means, said element having a head having laterally facing roll grasping means.

10. Roll changing apparatus for rolling mills comprising a carrier, means for moving the carrier to and from a roll stand, a roll supporting element carried by the carrier for turning movement about a generally vertical axis, means for raising and lowering said element, said element having a head having laterally facing roll grasping means, said head being mounted for tilting movement generally in a vertical plane, and means for thus tilting said head.

11. Roll changing apparatus for rolling mills comprising a carrier, means for moving the carrier to and from a roll stand, the carrier having a portion turnable generally horizontally, said portion having roll grasping means for grasping at least one rolling mill roll, and means for stowing the carrier below the level of the rolling mill floor when the roll changing apparatus is not in use.

12. Roll changing apparatus for rolling mills comprising a carrier, a guideway for guiding the carrier in movement to and from a roll stand, the carrier having a portion turnable generally horizontally, said portion having roll grasping means for grasping at least one rolling mill roll, and means for stowing the carrier below the level of the rolling mill floor when the roll changing apparatus is not in use, said means including a portion of said guideway which when the roll changing apparatus is in use is disposed in horizontal alignment with the remainder of the guideway and which when the roll changing apparatus is not in use is lowered with the carrier.

13. Roll changing apparatus for rolling mills comprising a carrier, means for moving the carrier to and from a roll stand, the carrier having a portion turnable generally horizontally, said portion having a plurality of roll grasping means facing in different directions so that new rolls may be held in one of said means while old rolls are removed by another thereof whereby said portion of
the carrier may be turned to present the new rolls to the roll stand for mounting therein, and means for positively so turning said portion of the carrier.  

14. Roll changing apparatus for rolling mills comprising a carrier, means for moving the carrier to and from a roll stand, the carrier having a portion turnable generally horizontally, said portion having a socket for receiving a roll end and clamping means in said socket operable upon insertion of a roll end thereinto for clamping the roll end to support the roll in cantilever fashion from the socket.  

15. Roll changing apparatus for rolling mills comprising a carrier, means for moving the carrier to and from a roll stand, the carrier having a portion turnable generally horizontally, said portion having a socket for receiving a roll end and wedge means mounted in the socket in position to be engaged by a shoulder of the roll upon insertion of the roll end into the socket for moving the wedge means generally along the socket and into clamping relationship to the roll end to support the roll in cantilever fashion from the socket.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,323,345

June 6, 1967

David Lyle et al.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 1, line 24, for "many" read -- may --; line 61, for "moving" read -- moving --; line 68, for "apparatus" read -- apparatus --; column 4, line 35, for "socket" read -- sockets --; column 5, line 74, for "portion" read -- portions --.

Signed and sealed this 28th day of November 1967.

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents