
FEED AND TOE ANGLE INDICATOR FOR BILLET-PIERCING MILL

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ABSTRACT OF THE DISCLOSURE

An apparatus for indicating the feed and toe angles of work-rolls relative to the centerline of the pass in a piercing mill for rolling seamless steel tubes, in which the indication is effected mechanically by a single stationary pointer cooperatively arranged with respect to a pair of indicator disks, one of such disks being mounted on the part of the mill housing which is rotatable to adjust the feed angle of the work-roll supported for rotation thereon and the other being mounted on the part of the mill housing which is rotated to adjust the toe angle of such work-roll. The stationary pointer is carried by one arm of a linkage in the form of a pantograph that operates to hold it in a vertical position when a pivotal support for the work-roll is moved to adjust the clearance of such roll with respect to the piercing point.

This invention relates to mills for producing seamless steel tubes and is directed, as indicated, to an apparatus for indicating the feed and toe angles of the mill rolls with respect to a piercing point over which a steel billet is worked by the rolls.

Indicators previously used for indicating the feed and toe angles of work rolls in seamless tube mills have usually been in the form of dials mounted on the mill housing, and their operation has generally required electrical or mechanical motion transmitting mechanisms connected between the mill housing and the indicator dial. The mounting of the indicator dials on the mill housing or at other remote points resulted in the angle reading provided thereby not being readily available to operators working on the rolls and this made the task of adjusting the roll and toe angles more troublesome.

One of the principal objects of this invention accordingly is to provide a feed and toe angle indicator which eliminates the need for motion transmitting mechanisms of the character mentioned above. A further and related object is to provide an indicator which will provide feed and toe angle readings that are readily visible to an operator adjusting the angular positions of the rolls. These and related objects are effected by an indicator in the form of two dials mounted concentrically with respect to and for movement with supports for the rolls that are rotated to adjust the relative angular positions of the work-rolls, in conjunction with a stationary pointer that cooperates with the dials to indicate the feed and toe angles of the rolls.

Other objects and advantages of the invention will become apparent from the following description.

In the drawings there is shown a preferred embodiment of the invention. In this showing:

FIG. 1 shows the arrangement of the indicator of this invention with respect to one of the rolls of a seamless tube mill, the view being taken substantially along the line I—I of FIG. 3;

FIG. 2 is an end elevation looking in a direction from the right of FIG. 1;

FIG. 3 is a plan view of the mill and indicator shown in FIG. 1;

FIG. 4 is an enlarged fragmentary elevational view of a portion of the structure shown in FIG. 1, which shows in greater detail the angle indicator disks and their mounting on the supports for the mill work-rolls; and

FIG. 5 is a fragmentary plan view looking in the direction of the line V—V of FIG. 4, which shows the feed angle indicator dial and its mounting on one of the work-roll supports.

Mills for rolling seamless tubes usually comprise a pair of skewed work-rolls arranged in diametrically opposed positions about a piercing point over which a steel billet is worked by the rolls to form a seamless tube. Such mills may also be constructed with three work-rolls arranged in circumferentially equally-spaced positions about the piercing point, and the drawings show the indicator of this invention on a 3-roll mill of this type.

In this showing the rolls 1 operate to roll a billet over a piercing point 2. The rolls 1 are equipped with indicators of identical construction for indicating their respective feed and toe angles with respect to the center-line of the pass of the piercing mill.

The mill including the mounting for each of the rolls 1 as shown in the drawings is a known construction and forms no part per se of this invention. It comprises a pair of axially spaced end plates 3 and 4 in fixed vertical positions on which the rolls 1 are carried by supporting members 5. At one end, each member 5 has laterally spaced arms 6 (FIG. 3) which are supported on the end plate 3 by a pin 7 for pivotal movement of the member 5 to adjust the clearance 8 between the work-rolls and the piercing point 2. The opposite end 9 of the member 5 is supported on the other end plate 4 by a set-screw 10 which may be operated to adjust the pivotal position of the member 5 and thereby the clearance 8. Swivels 11 and 12 complete the mounting of the rolls 1 on the members 5 and provide for pivotal adjustment of their respective angular positions thereon to the desired feed and toe angles.

The swivel 11 as shown in FIG. 1 is a U-shaped housing having axial extended end plates 12 and a central bore 13 which extends axially through the outer ends of its arms 13 supporting a roll 1 for rotation thereon. A trunnion connection (not shown) at a point centrally of its base 14 provides for its connection to the swivel 12 and for its rotation about a feed angle axis 15 which is normal to the axis of rotation of the roll 1 and to the toe angle axis 16 (FIG. 3) about which the swivel 12 rotates in a manner to be described. Adjustment of the feed angle position of the swivel housing 11 about the axis 15 is effected by a pair of set screws 17 that are threaded on the arms 6 of the supporting member 5. The set screws 17 engage opposite sides of an adjusting plate 18 that extends upwardly from the swivel base 14.

The swivel 12 is pivotally supported on the member 5 by a shaft 19 that has its opposite ends rotatably supported in the arms 6 of the number 5. The center of the shaft 19 coincides with the defines the toe angle axis 16 as best shown in FIG. 3. Adjustment of the pivotal position of the swivel 12 about the axis 16 and thereby the toe angle of the roll 1 is effected by a set screw 20 which has an adjustable connection at one end with the supporting member 5 and a pivotal connection at its other end with an arm 21 which forms part of the swivel 12 and extends outwardly from the shaft 19. Operation of the set screw 20 is thus effective to rotate the swivel 12 and the roll 1 about the axis 16 to vary the toe angle of the roll 1.

The toe and feed angle indicator of this invention comprises a toe angle dial 22 and a feed angle dial 23 which cooperate with a stationary pointer 24 to indicate the toe and feed angles of a roll 1 in a manner to be described. As shown in FIG. 4, the dial 22 is fastened to
an end face 25 of the swivel 12 by screws 26 and has a circular edge 27 that is concentric about the swivel axis 16 of the shaft 19. Indicia including markers in the outer end face of the swivel 12 by screws 29 and has a circular face 30 (FIG. 5) which is concentric with respect to the swivel axis 15 of the swivel 11. Indicia including markers extending axially on the surface of the circular edge 30 indicate the angular position of the swivel 11 about the axis 15 and thus the feed angle of the roll 1.

The pointer 24 comprises a wire that extends across the indicia on each of the dials 22 and 23, and transversely of a window 31 through which the indicia on the dials 22 and 23 may be received by an operator. The window 31 as seen in FIG. 1 is formed by a rectangular opening in the lower end of a link 32 which is supported by a pivot pin 33 for pivotal movement about an axis that coincides with the toe axis 16. The pivot pin 33 is supported by the shaft 19 and projects centrally and axially from one end thereof. At its upper end the link 32 has a pivot connection 34 to one end of a link 35, the other end of which has a pivot connection 36 with the upper end of a bar 37 that is secured to the end plate 38 in a position extending vertically upwardly therefrom. The pivot 7, member 5 and parts 32-37 form a pantograph linkage that operates to hold the link 32 and thus pointer 24 in a position parallel to the vertical bar 37 upon pivotal movement of the member 5 to adjust the clearance 8 of the roll 1.

In a similar manner the feed angle dial 23 rotates with the swivel member 11 and the indicia on its end face move relative to the stationary wire 24 which thus operates to indicate change in the feed angle of the roll 1. In a similar manner the toe angle dial 22 rotates with the swivel member 11 and the indicia on its circular edge move relative to the stationary wire 24 which thus operates to indicate change in the toe angle of the roll 1. It should be noted that adjustment of the toe angle by rotation of the swivel 12 about the axis 15 also rotates the feed angle dial 23 about the axis 16, and this will cause a small change in the feed angle reading provided by the position of the dial 23 with respect to the indicator pointer 24. However, this change in feed angle reading, as indicated by the wire 24 upon adjustment of the toe angle, will not be troublesome in practice since the toe angles of all rolls will be adjusted by like amounts and the resulting changes in the feed angle indications for each of the rolls will be identical. The exact feed angle may be read at any time by using the zero point on the toe angle dial 22 as an indicator pointer for the feed angle dial 23.

From the foregoing it will be apparent that the indicator of this invention does not require any motion transmitting mechanism for its operation to indicate the feed and toe angles of work-rolls in a seamless tube mill. In this respect attention is directed to the fact that the only moving parts of the indicator of this invention are the rails 22 and 23 which are mounted directly on the parts with respect to which they are to indicate relative angular positions. In addition to the simplified construction provided by this arrangement it should be noted that feed and toe angle readings are furnished conveniently at the point where operators will be working when adjusting the feed and toe angles of the rolls.

While one embodiment of my invention has been shown and described, it will be apparent that adaptations and modifications may be made without departing from the scope of the appended claims.

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