April 19, 1955 E. T. LORIG 2,706,625

APPARATUS FOR CONTINUOUSLY CENTERING A MOVING STRIP

Filed April 25, 1952

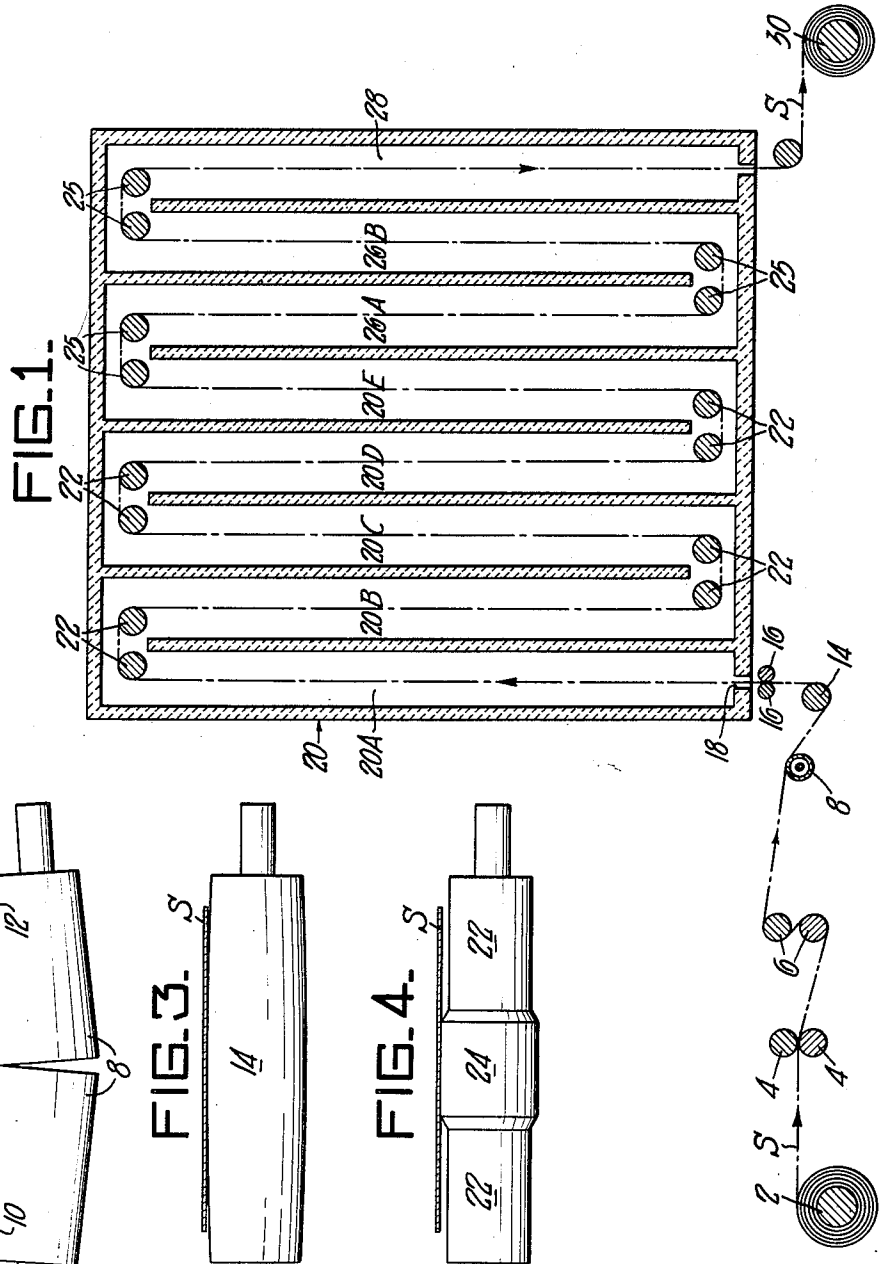


FIG. 1.

FIG. 2.

FIG. 3.

FIG. 4.

Inventor:
EDWIN T. LORIG,
by: Donald G. Dalton
his Attorney.

United States Patent Office 2,706,625 Patented Apr. 19, 1955

2,706,625

APPARATUS FOR CONTINUOUSLY CENTERING A MOVING STRIP

Edwin T. Lorig, Pittsburgh, Pa., assignor to United States Steel Corporation, a corporation of New Jersey

Application April 25, 1952, Serial No. 284,379

5 Claims. (Cl. 263—3)

This invention relates to apparatus for continuously centering a moving strip and is particularly adapted for centering a moving strip as it passes through a furnace such as an annealing furnace.

Prior to my invention it was difficult to continuously anneal wide light gauge steel strip at high speeds and low tensions. In the particular furnace to which my invention was first adapted the strip could travel at a rate no higher than approximately 400 ft. per minute prior to the application of my invention thereto. Even at this speed the strip tension was excessive and the strip would weave back and forth across the supporting rolls in the furnace. This weave was as much as 10 inches and the strip actually wore a groove into the refractory brick work. In addition to damaging the brick work it also caused damage to the strip edges since the brick dust would collect thereon. The lateral weaving also distorted the strip to form longitudinal welts, guttering and pinchers so that the anealed strip was not flat. A total of between 750 and 1000 pounds tension was also required at these relatively slow speeds. Thus it will be seen that continuous annealing of strip was inefficient because of the relatively slow speeds and high tensions required and also because the annealed strip was not flat and its edges were damaged to such an extent that in many instances the product was not usable. Similar difficulties were also encountered in other continuous strip processes.

It is therefore an object of my invention to provide apparatus for continuously processing strip in which the strip is kept centered under relatively low tensions and at high speeds.

This and other objects will be more apparent after referring to the following specification and attached drawings, in which:

Figure 1 is a schematic drawing of an annealing line incorporating my invention; and

Figures 2 to 4 are views of various rolls used in the annealing line.

Referring more particularly to the drawings, reference numeral **2** indicates an uncoiler for supporting a coil of strip S. The strip S passes from the uncoiler to a pair of alignment and self-centering rolls **4** such as disclosed in my Patent Nos. 2,592,581; 2,593,157 and 2,593,158. The strip passes either around or through the rolls **4** and then to a pair of bridle rolls **6** around which the strip passes and which determine the amount of back tension on the strip. From the rolls **6** the strip S passes to a self-centering roll **8** which is preferably of the type shown in my above mentioned Patent No. 2,593,157 or 2,593,158. The two sections of the roll must rotate in unison as disclosed in the rolls of the patents. This roll differs from the rolls shown in those patents in that it is provided with a hollow center as shown in Figure 2. Thus the strip instead of contacting the roll across the full width thereof lightly contacts the roll at the edges essentially at spaced points **10** and **12**. The strip S is preferably wrapped around an arc of approximately 45°. From the roll **8** the strip passes to a crowned roll **14** spaced a short distance therefrom. It will be seen that the strip in passing over the rolls **8** and **14** will contact the roll **8** at two points and roll **14** at one point which is located approximately at the center of the strip. This arrangement provides for fast and accurate centering and aligning of the strip with respect to the longitudinal center of the processing equipment as shown in Figures 2, 3 and 4 and is suitable for such purpose in any processing or strip handling equipment. From the roll **14** the strip passes between a pair of rolls **16** which seal the opening **18** into the furnace **20**. As shown, the furnace **20** has five heating chambers **20A**, **20B**, **20C**, **20D**, **20E**. A plurality of rolls **22** are provided in the furnace for supporting the strip in its travel therethrough. I have found that by providing the rolls **22** with a cylindrical strip supporting surface **24** of less width than the width of the strip S, accurate tracking or centering of the strip is provided in the furnace as long as the strip is accurately positioned as it enters the furnace.

Prior to my invention it was thought necessary to support the strip over its full width but I discovered that such an arrangement prevented the strip from remaining centered as it traveled through a processing line. This is especially true when the strip is being heated. Because the strip is colder than the roll and the gases in the furnace, that portion of the roll in contact with the strip will be colder than that part of the roll not in contact with the strip. This causes the roll to expand in such a fashion that it becomes concave. This differential in diameters between the center and end portions of the rolls causes the strip edges to elongate and contract simultaneously in the wrong direction to reduce lateral weaving and in fact increases the amplitude and speed of the weave. As the cold strip moves laterally over the rolls in one direction the edge moving away from the center pass line will contact more and more of the highly heated area of the roll surface while the opposite edge moves toward the center pass line and exposes more and more of the cold area of the roll surface. This alternate cooling and heating of each end of the roll bodies causes an alternate decrease and increase in diameter of the roll bodies with the increase in diameter at one end working in conjunction with the decrease in diameter at the opposite end to bow the strip laterally between pairs of rolls in an adverse direction, thus forcing the strip further off the center pass line on both sides alternately than when there is no temperature gradient between the roll surfaces and the strip. When the edges of the strip S are out of contact with the roll surface as shown in Figure 4, this does not occur and if there is any tendency of lateral movement in either direction the over-hanging edges of the strip become curved and bowed in the proper direction to effect center restoring over successive rolls. Any restraint or confinement of this lateral movement by edge guides or other edge confining apparatus between the narrow bodied rolls will of course prevent the proper curvature and bowing of the strip to effect center restoring.

Conventional full bodied cylindrical rolls **25** support the strip S over its full width after it is brought to the annealing temperature. After the strip S passes from chamber **20E** it passes into a holding zone **26A** and **26B** and then into a cooling zone **28**. The conventional full bodied rolls **25** in holding zone **26** and cooling zone **28** absorb heat from the hotter strip in contact therewith, thereby expanding the rolls where contacted by the strip but not at the exposed ends which remain comparatively cool. This is the reverse action to that occurring in the strip heating chambers. Thus the rolls **25** in absorbing heat from the contacting strip shape themselves properly to maintain the strip on center. Eventually the strip S is recoiled on the coil **30**. It will be understood that conventional looping pits, strip welding apparatus and the like may be inserted in the annealing line where found advisable.

While my invention has been described in reference to annealing apparatus it will be apparent that my apparatus may be used in other processes in which continuous strip passes over a number of rolls. Therefore, other adaptations and modifications may be made without departing from the scope of the following claims.

I claim:

1. Apparatus for continuously processing strip comprising means for centering and aligning the strip laterally of its path of travel prior to its entry into the processing equipment, and two series of narrow-bodied rolls in different planes arranged in staggered relationship so that the strip passes thereover in a tortuous path, each of said

rolls having a cylindrical strip supporting surface of considerable less width than the width of the strip, said strip passing successively around said rolls so that the amount of wrap of the strip around the rolls will be sufficient to change the direction of travel of the strip, said strip being unconfined laterally as it passes between the narrow-bodied rolls.

2. Apparatus for continuously processing strip comprising an uncoiler from which the strip is uncoiled, and a plurality of rolls over which the strip passes, said rolls including at least one self-centering and aligning roll for centering the strip laterally of its path of travel and a plurality of narrow-bodied rolls arranged in different planes in staggered relationship so that the strip passes thereover in a tortuous path, each of said narrow-bodied rolls having a cylindrical strip supporting surface of considerable less width than the width of the strip, said strip passing successively around said narrow-bodied rolls with the amount of wrap of the strip around the narrow-bodied rolls being sufficient to change the direction of travel of the strip, said strip being unconfined laterally as it passes between the narrow-bodied rolls.

3. Apparatus for continuously heating strip comprising a heating furnace, a plurality of narrow-bodied rolls arranged in spaced apart relationship in said furnace, part of said rolls being mounted at the bottom of said furnace and part in the top of said furnace with the strip passing thereover in a tortuous path, each of said rolls having a cylindrical strip supporting surface of considerable less width than the width of the strip, said strip passing successively around said rolls with the amount of wrap of the strip around the rolls being sufficient to change the direction of travel of the strip, and means for centering and aligning the strip laterally of its path of travel prior to its entry into the furnace, said strip being unconfined laterally as it passes between the narrow-bodied rolls.

4. Apparatus for continuously processing strip comprising means for providing back tension to the strip, means between said back tension means and the processing equipment for centering and aligning the strip with respect to the longitudinal center of the processing equipment, and two series of narrow-bodied rolls in different

planes arranged in staggered relationship so that the strip passes thereover in a tortuous path, each of said rolls having a cylindrical strip supporting surface of considerable less width than the width of the strip, said strip passing successively around said rolls so that the amount of wrap of the strip around the rolls will be sufficient to change the direction of travel of the strip, said strip being unconfined laterally as it passes between the narrow-bodied rolls.

5. Apparatus for continuously processing strip comprising an uncoiler for supporting a coil of strip to be processed, processing equipment, means between the uncoiler and processing equipment for centering and aligning the strip with respect to the longitudinal center of the processing equipment, means between the uncoiler and the centering means for providing back tension to the strip, a plurality of narrow-bodied rolls arranged in spaced apart relationship in said processing equipment, part of said rolls being mounted adjacent the bottom of said processing equipment and part adjacent the top of said processing equipment with the strip passing thereover in a tortuous path, each of said rolls having a cylindrical strip supporting surface of considerable less width than the width of the strip, said strip passing successively around said rolls with the amount of wrap of the strip around the rolls being sufficient to change the direction of travel of the strip, said strip being unconfined laterally as it passes between the narrow-bodied rolls.

References Cited in the file of this patent

UNITED STATES PATENTS

878,815	Martin	Feb. 11, 1908
1,890,065	Meehan	Dec. 6, 1932
1,992,989	Burns	Mar. 5, 1935
2,534,973	Ipsen et al.	Dec. 19, 1950
2,592,581	Lorig	Apr. 15, 1952
2,593,157	Lorig	Apr. 15, 1952
2,593,158	Lorig	Apr. 15, 1952

FOREIGN PATENTS

432,622	Germany	Aug. 24, 1926