APPARATUS FOR MAINTAINING A LOOP OF CONTINUOUS STRIP AT ENTRY END OF A PROCESSING LINE

Bryant Bannister, Dormount, and John E. Beatley, Churchill, Pa., assignors to United States Steel Corporation, a corporation of New Jersey

Application February 28, 1952, Serial No. 273,844

1 Claim. (Cl. 271—2.1)

This invention relates to the disposition and handling of the loop of steel strip which it is necessary to accumulate at the head of a line of continuous processing equipment, in order to permit successive coils of strip to be welded together end-to-end without stopping the travel of strip through the line. In particular, the invention concerns provisions for handling skelp as it is unrolled from coils for entry into a continuous furnace and subsequent passage through the stands of forming and welding rolls used for the continuous butt-welding of pipe.

It has been the practice for many years to pay out skelp on the floor away from the entrance end of a continuous furnace feeding the forming and welding stands of a pipe mill, bend it into a loop and bring it back to enter the furnace. Usually a large floor area is set aside for this purpose. In an attempt to reduce the area required, it has been proposed to throw the strip into a second loop which is re-entrant with respect to the single loop used formerly. This is not practical for strip of heavier gages, however, because of the limit to the curvature which it can assume without permanent deformation which is undesirable. Thus any reduction in area permitted by shortening the floor space required would be offset to a large extent by the increased width necessary for the second loop. Another problem has been the variation in the back tension or drag on the strip entering the furnace, with changes in the length of the loop.

We have invented a novel method and apparatus for handling and disposing of the skelp loop, which permits a substantial reduction in the floor space required and maintains the skelp entering the furnace under substantially constant tension, despite variations in the size of the loop. According to our invention, we provide means for holding the loop of skelp in a vertical plane, i.e., with one run or strand in substantially vertical alignment with the other, yet permitting it to elongate or shorten without interfering with the continuous feed of skelp into the furnace. The outgoing run or strand of the loop is preferably uppermost and the return run or strand approaches the furnace at a lower level. We suspend the upper run of the loop by magnetic conveyor rollers, the return run being carried on ordinary rollers or skids. The magnetic rollers are positioned to support the upper run of the skelp above the floor level while the return run is preferably accommodated in a trench below the floor. We further provide a traveling carriage for drawing out the loop to maximum length after one coil has been welded to the preceding coil, preparatory to stopping the coiling, unrolled, for the welding of the next coil thereto.

A complete understanding of the invention may be obtained from the following detailed description and explanation which refer to the accompanying drawings illustrating the present preferred embodiment. In the drawings:

Figures 1 and 1a together constitute a vertical section, largely diagrammatic, of the apparatus of our invention in association with a conventional skelp-uncoiling and end-welding apparatus, a continuous furnace and a pipe-forming and welding mill, shown in elevation;

Figure 2 is a transverse section to an enlarged scale, taken along the plane of line II—II of Figure 1;

Figure 3 is a view similar to Figure 1 showing a modification;

Figure 4 is a partial plan view thereof, and

Figure 5 is a view similar to Figure 2, of the modification.

Referring now in detail to the drawings and, for the present to Figures 1 and 2, a continuous furnace 10 heats skelp 11 to a temperature suitable for welding and delivers it to a forming and welding mill, the first stand of which is indicated at 12. Skelp to be heated in the furnace is received in the form of coils of strip. The strip is unwound from a coil, while the latter is supported on an uncoiler 13, by pinch rolls 14 and is then passed through a roller leveler 15. A squaring shear 16 and an end welder 17 are provided to permit the ends of successive coils to be cropped and joined. Pinch rolls 18, beyond the welder, control the travel of the strip rearwardly from the furnace to form a loop of strip sufficient to permit continued travel of strip through the furnace while the trailing end of a coil is held stationary during the time required for joining to it the leading end of the succeeding coil.

The apparatus described so far is conventional and forms no part of our invention.

To maintain and handle the slack loop of strip, we employ a plurality of magnetic conveyor rollers 19 disposed in a line extending rearwardly from pinch rolls 18. The magnetic rollers are journeled in bearings 20 mounted on brackets 21 and 21' upstanding from the floor. These brackets extend as cantilevers toward each other from opposite sides of a trench 23 in the floor. Each roller is driven by a motor 22 through a reduction gear 24. The magnetic rollers should, of course, be designed to exert sufficient magnetic attraction to suspend the upper run of a loop of steel strip to the height of the trench 23, to be welded and should be close enough to each other to suspend the lightest gage strip without excessive sagging therebetween. It will be understood that strip fed out by pinch rolls 18 comes into tangential contact with the magnetic rollers progressively at their lowest points where-by the upper run or strand of the loop of strip indicated at 24, is suspended as the loop increases in length, the rollers being driven at a peripheral speed corresponding to that at which strip is fed rearwardly by the pinch rolls. The construction of magnetic conveyor rollers is known and need not be described in detail here. They may be electro-magnetic or equipped with permanent magnets.

To insure proper engagement of the strip with the rollers and to pull the loop out to its maximum length, we provide spaced rails 25 extending beneath rollers 19 and a wheeled automotive carriage 26 traveling therealong. The carriage has a driving motor 27 thereon and supporting rollers 28 engaging the under surface of the upper run of the loop of strip. The carriage travels back and forth on the rails as the loop lengths and shortens during the complete cycle of joining a coil to its predecessor and then fully uncoiling it. The rails are mounted on suitable supports not shown, e.g., brackets on the walls of trench 23 where the rails are below floor level and on upstanding cantilever brackets where they are above the floor.

The return run or strand of the loop 24 rides on conveyor rollers 29 disposed at the bottom of trench 23. The conveyor slopes downwardly at a slight angle for a purpose which will appear shortly. The conveyor has side guides in the form of rollers 30 journaled substantially
vertically on opposite sides thereof. The rollers 19 are disposed on the same slope as conveyor 29 to maintain a constant vertical spacing therebetween. This should be at least twice as great as the smallest radius to which the heaviest gage of strip to be welded may be bent without permanent deformation, i.e., the maximum natural curvature. An upwardly inclined conveyor 31 extends from the lower end of conveyor 29 to the level of the entrance of the furnace 10. As clearly shown in Figure 2, the upper and lower runs of the strip loop are in approximate vertical alinement at all points and the loop may thus be described as lying in a vertical plane.

The heated strip is pulled through the furnace by the roll stands of the forming and welding mill 12. To lessen the danger of parting the strip which has little tensile strength when highly heated, it is important to avoid substantial variations in the back tension or drag on the strip entering the furnace. The arrangement shown is well adapted to accomplish this. The downward slope of conveyor 29 is made such that the strip thereon is on the verge of moving by gravity. As a result, the back tension on the strip entering the furnace is only that needed to pull it up conveyor 31 and this is constant regardless of the length of the loop.

After one coil has been joined to its predecessor, the loop 24 will be at its minimum length and carriage 26 retracted accordingly. The strip can then be fed by pinch rolls 18 at a rate such as to build up the loop to maximum length in preparation for welding the next coil. For this reason, pinch rolls 18 are driven by a variable-speed motor and the speed of rollers 19 is preferably varied correspondingly. Operation of the carriage is also properly coordinated with the length of the loop. Rollers 19 may be provided with automatic means for de-energizing them successively as the loop is shortened and re-energizing them as it lengthens.

Figures 3 through 5 show a modified form of the invention generally similar to that of Figures 1 and 2 but differing therefrom in that carriage 26 has a single sheave 32 with a radius equal to that of the natural bend of the strip (maximum curvature without permanent deformation) and trench 23 has skids 33 on the bottom thereof. In addition, the strip is pulled up the slope from the bottom of the trench around a guide sheave 34 by pinch rolls 35 which overcome the friction of skids 33. Thus the bottom of the trench 23' need not slope downwardly. A tensiometer 36 of known construction controls the speed of the motor driving pinch rolls 35 to maintain constant the back tension on the strip entering the furnace. This tends to prevent breakage in the furnace which might otherwise result from jerks or sudden changes in back tension or even gradual changes caused by elongation and shortening of the loop.

The drive for carriage 26 includes a slip clutch 37 whereby motor 27' thereof may be constantly energized. Thus when the loop has been pulled out to maximum length, the clutch slips permitting continued rotation of the motor. The clutch, of course, is set to exert torque sufficient to overcome the inertia of the loop and urge the carriage to the position farthest possible away from the furnace 10.

It will be apparent from the foregoing that our invention is characterized by important advantages. By disposing the slack loop in a vertical plane, the amount of floor space required is reduced to a minimum. The back tension on the strip is maintained constant either by the downward slope of the conveyor supporting the lower run of the loop or by providing pinch rolls to pull it up the incline immediately adjacent the furnace. In either case, substantial variation in back tension or drag with change in the loop length is avoided and the danger of breakage of the heated strip is minimized.

Although we have disclosed herein the preferred practice of our invention, we intend to cover as well any change or modification therein which may be made without departing from the spirit and scope of the invention.

We claim:

In apparatus for maintaining a loop of ferro-magnetic strip of variable length extending horizontally from the entrance end of a line of continuous processing apparatus, the combination with means for feeding out strip from a coil in a direction away from said processing apparatus above floor level and a plurality of spaced magnetic rollers positioned in a horizontal series long enough to accommodate the maximum length of loop, so as to be engaged at the bottom by said strip whereby said rollers suspend a portion of the strip forming the upper run of said loop, of means below said rollers disposed in a trench below floor level supporting a portion of the strip descending in a curved path from the level of said rollers and returning toward the processing apparatus as the lower run of said loop, an inclined conveyor ascending from said trench to said entrance end, means for pulling strip up said conveyor and a tensiometer responsive to the tension on the strip entering said processing apparatus controlling said pulling means.

References Cited in the file of this patent

UNITED STATES PATENTS

<table>
<thead>
<tr>
<th>Patent Number</th>
<th>Inventor</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>503,830</td>
<td>Cook</td>
<td>Aug. 22, 1893</td>
</tr>
<tr>
<td>2,183,798</td>
<td>Thiess</td>
<td>Dec. 19, 1939</td>
</tr>
<tr>
<td>2,196,192</td>
<td>Broadfield</td>
<td>Apr. 9, 1940</td>
</tr>
<tr>
<td>2,278,136</td>
<td>Otis et al.</td>
<td>Mar. 31, 1942</td>
</tr>
<tr>
<td>2,357,389</td>
<td>Fern</td>
<td>Sept. 5, 1944</td>
</tr>
<tr>
<td>2,412,648</td>
<td>Rendel</td>
<td>Dec. 17, 1946</td>
</tr>
<tr>
<td>2,576,074</td>
<td>Nachtman</td>
<td>Nov. 20, 1951</td>
</tr>
</tbody>
</table>