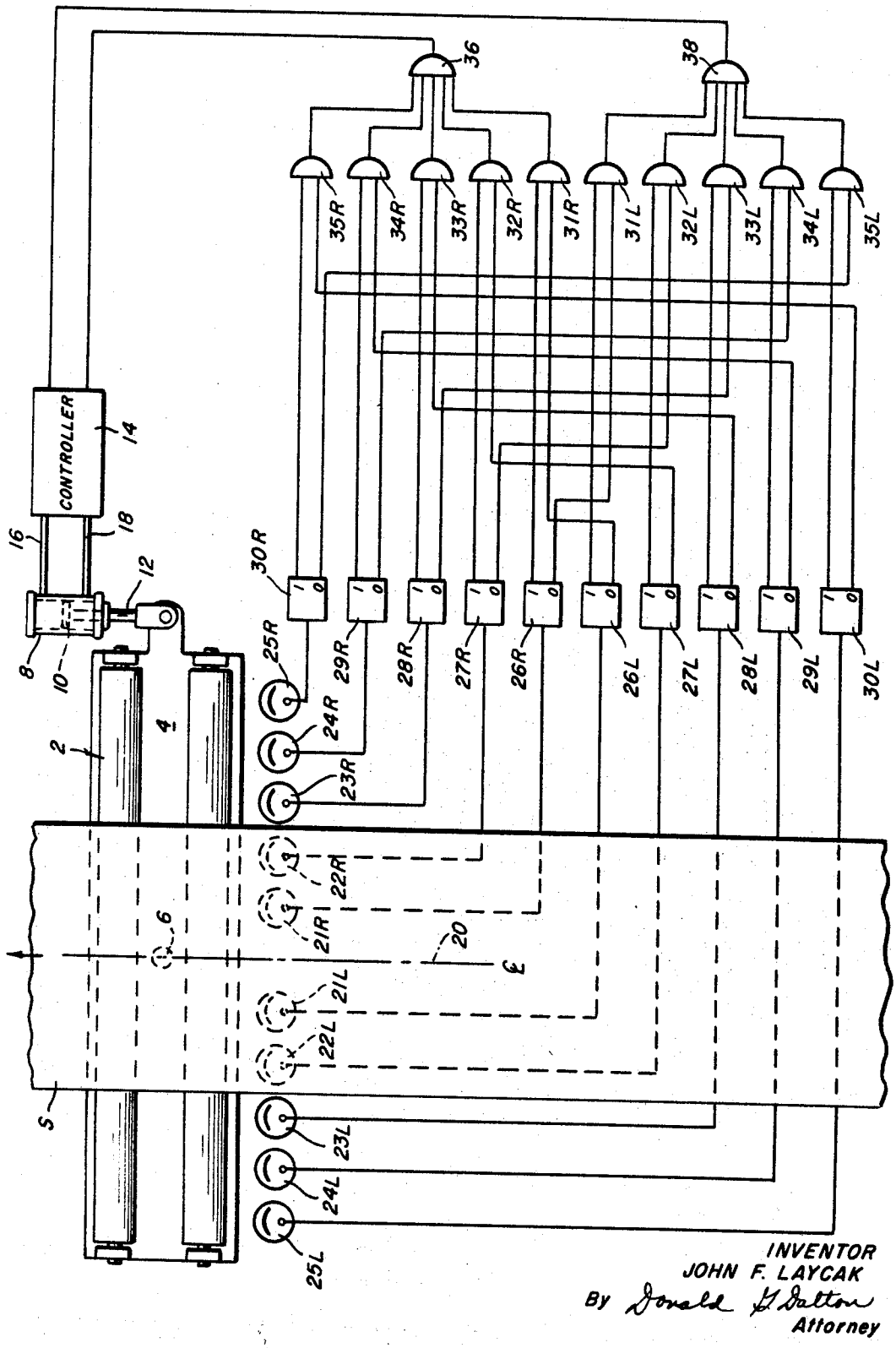
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APPARATUS FOR AUTOMATICALLY CENTERING MOVING STRIP

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APPARATUS FOR AUTOMATICALLY CENTERING MOVING STRIP

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ABSTRACT OF THE DISCLOSURE

Apparatus for maintaining a moving strip centered including a plurality of pairs of spaced sensors with the sensors in each pair spaced symmetrically on opposite sides of the desired center line. Each sensor has its output connected to a bi-stable element. The signals from the bi-stable elements are connected through a gating system to a controller which in turn causes centering of the strip when it has moved off center.

This invention relates to apparatus for maintaining the position of moving strip or web about a fixed center line in a conveying or processing line. In most continuous processes it is necessary or desirable to maintain the moving strip symmetrically about a predetermined longitudinal line, continuously and automatically, regardless of the changing dimension of the product. For instance, in order to minimize strip damage and production loss in a steel strip mill, moving strip must be kept symmetrically displaced about the center line of the rolls over which it passes. Side guides, side guide rolls, self-centering rolls, and steering rolls all can be used for this purpose. There are many ways of controlling steering rolls and most rely on expensive equipment for reliability, but there are very few systems that are relatively simple and at the same time responsive to varying strip widths.

It is therefore an object of my invention to provide apparatus for automatically maintaining strip about a fixed center line in a strip processing line.

Another object is to provide such apparatus that automatically adjusts for strips of varying width.

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

The single figure is a schematic view of the apparatus of my invention.

Referring more particularly to the drawing, reference numeral 2 indicates a rotatable steering roll located in a strip processing line. The rolls 2 are mounted in a supporting frame 4, which is pivotally mounted on a pivot support 6. It will be understood that the pivot support may be arranged at 90° from that shown without changing the operation. A web or strip S is supported for longitudinal movement over the rolls 2. A fluid cylinder 8 having a piston 10 therein has its piston rod 12 pivotally connected to frame 4. A controller 14 controls flow of fluid through conduits 16 and 18 to opposite sides of piston 10 so as to rotate the roll 2 about pivot support 6, thus causing movement of the strip S transversely of its longitudinal travel so as to maintain it on center line 20. The parts so far described are conventional and various types of sensors arranged at the strip edges have been used to operate controller 14.

According to my invention I provide a plurality of pairs of sensors 21R–21L, 22R–22L, 23R–23L, 24R–24L, and 25R–25L, which are spaced apart on opposite sides of fixed center line 20 with the sensors in each pair being the same distance from the center 20. While five sensors are shown in each series, the number and exact arrangement of the sensors is determined by the dead zone required for desired accuracy, range of strip widths to be

covered, nature of material, surroundings, and strip travel speed. While phototubes are shown, sensors may be of other types, such as photocells, magnetically actuated proximity switches, or contact switches all of which give an electrical signal indicating the presence of strip. Also sensors giving a pneumatic signal may be used. Pairs of bi-stable logical elements 26R–26L to 30R–30L are connected to the outputs of sensors 21R–21L to 25R–25L, respectively. The bi-stable logical elements 26R–26L to 30R–30L may be flip flop multivibrators, but are preferably Schmitt triggers which will give a one (1) state output when the sensor indicates strip is present and zero (0) state output when a strip is not present. Pairs of AND gates 31R–31L to 35R–35L are associated with bi-stable logical elements 26R–26L to 30R–30L, respectively. The (1) state outputs of Schmitt triggers 26R to 30R are connected to AND gates 31R to 35R, respectively, and the (0) state output thereof to AND gates 31L to 35L, respectively. The (1) state outputs of Schmitt triggers 26L to 30L are connected to AND gates 31L to 35L, respectively, and the (0) state output thereof to AND gates 31R to 35R, respectively.

The outputs of half of the AND gates 31R to 35R are connected to an OR gate 36 and the outputs of the other half of the AND gates 31L to 35L are connected to OR gate 38. The outputs of OR gates 36 and 38 are connected to the controller 14 so as to move the piston rod 12 in opposite directions.

In operation, the strip S passing over the sensors 21R to 25R and 21L to 25L will result in a one (1) state output of bi-stable elements 26R, 26L, 27R and 27L, whose sensors are covered by the strip S and a zero (0) state output of the remaining bi-stable elements whose sensors are not covered by the strip. Where the same output occurs from both bi-stable elements of a symmetrical pair, such as 28R and 28L, there will be no output from either AND gate 33R or 33L associated with these particular bi-stable elements and sensors. Thus, when the strip S is symmetrical about the center line 20 as shown each sensor supplies the same signal as the corresponding sensor in the other set and no signal appears at OR gates 36 or 38. Hence, roll 2 will not move.

However, if the strip S moved to the left so that sensor 23L is covered and sensor 22R is uncovered, the output of Schmitt trigger 28L changes to a one (1) state and the output of Schmitt trigger 27R changes to a zero (0) state. AND gate 32L and 33L will then both supply "drive right" signals through OR gate 38 to controller 14. This will actuate piston 10 and rotate the steering roll 2 around its pivot 6 so as to return the strip S to the center position. When the strip returns to its center position, the "drive right" signal from OR gate 38 ceases, stopping movement of steering roll 2. Movement of the strip to the other side of center will generate a "drive left" signal at OR gate 36 in a similar manner.

It will be seen that this system requires no adjustments for centering strips of different widths, and it will automatically center the strip so long as there is at least one sensor beyond each edge of the strip.

The control is also readily adaptable to wind-up and pay-off reels when edge control or edge tracking is required.

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

I claim:

1. Apparatus for maintaining an elongated strip about a fixed longitudinal center line comprising a plurality of pairs of sensors spaced apart on opposite sides of the fixed center line with the sensors in each pair being the

same distance from the fixed center line, each sensor adapted to provide signals indicating the presence and absence of strip, a pair of bi-stable elements associated with each pair of sensors, means connecting the output of each sensor in a pair to one of the associated bi-stable elements, a pair of gates associated with each pair of bi-stable elements, means connecting the first output of each bi-stable elements in a pair to one of the associated gates and its second output to the other associated gate, two gates, one connected to the outputs of one gate in each pair and the other connected to the outputs of the other gate in each pair, and means responsive to the outputs of the last two named gates to move the strip to a position centered over the fixed center line.

2. Apparatus according to claim **1** in which the signals from the sensors are electrical signals, and the bi-stable elements are Schmitt triggers.

3. Apparatus according to claim **2** in which the pairs of gates are AND gates and the two gates are OR gates.

4. Apparatus according to claim **3** in which the means responsive to the outputs of the last two named gates to move the strip to a position centered over the fixed center line includes a pivoted roll over which the strip passes, a controller connected to the output of the last two named gates, and means operable by said controller to move said pivoted roll about its pivot.

5. Apparatus according to claim **1** in which the means responsive to the outputs of the last two named gates to move the strip to a position centered over the fixed center line includes a pivoted roll over which the strip passes, a controller connected to the last two named gates, and means operable by said controller to move said pivoted roll about its pivot.

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