July 8, 1958 H. R. MILLER 2,842,361

AUTOMATIC STRIP ALIGNMENT CONTROL

Filed Feb. 13, 1956 2 Sheets-Sheet 1

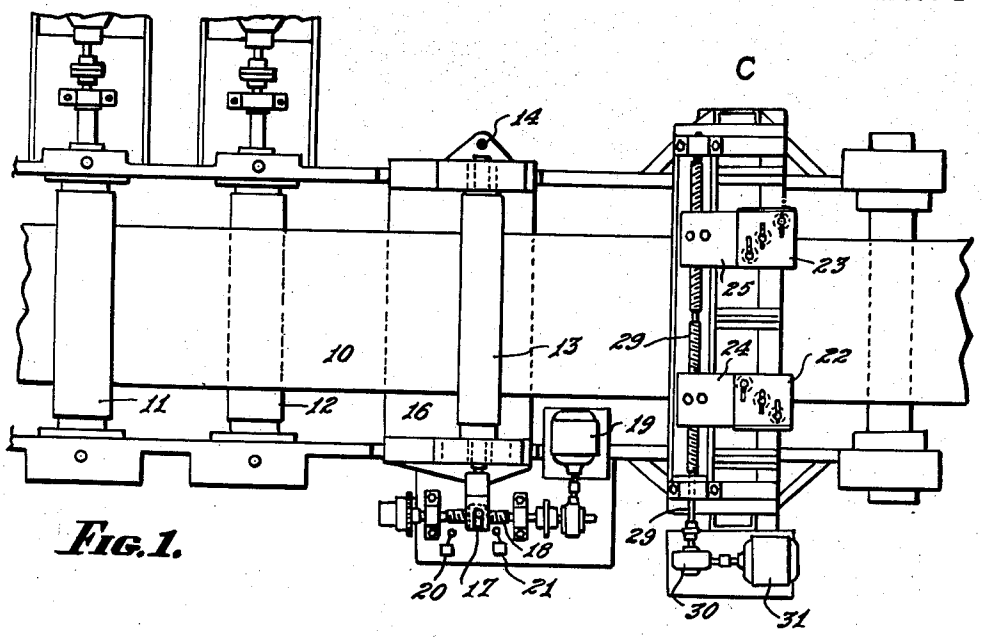


FIG. 1.

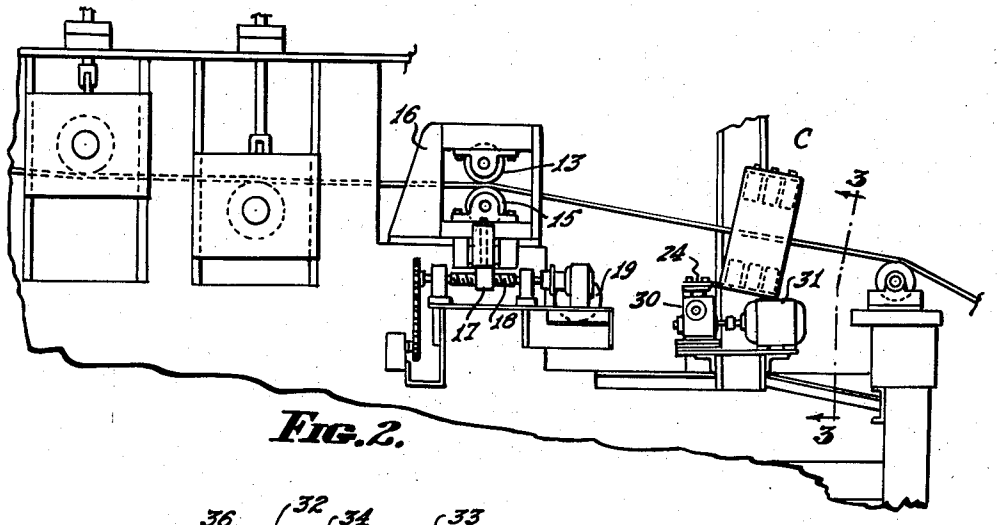


FIG. 2.

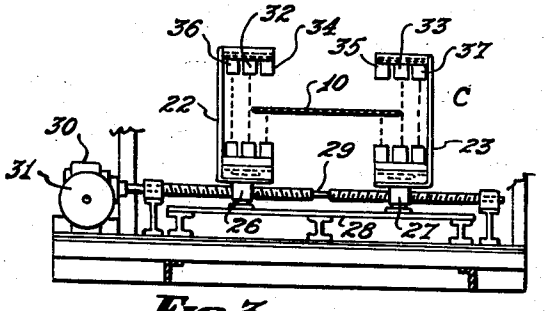


FIG. 3.

INVENTOR.
HAROLD R. MILLER,
BY
Allen & Allen
ATTORNEYS.

July 8, 1958 H. R. MILLER 2,842,361

AUTOMATIC STRIP ALIGNMENT CONTROL

Filed Feb. 13, 1956 2 Sheets-Sheet 2

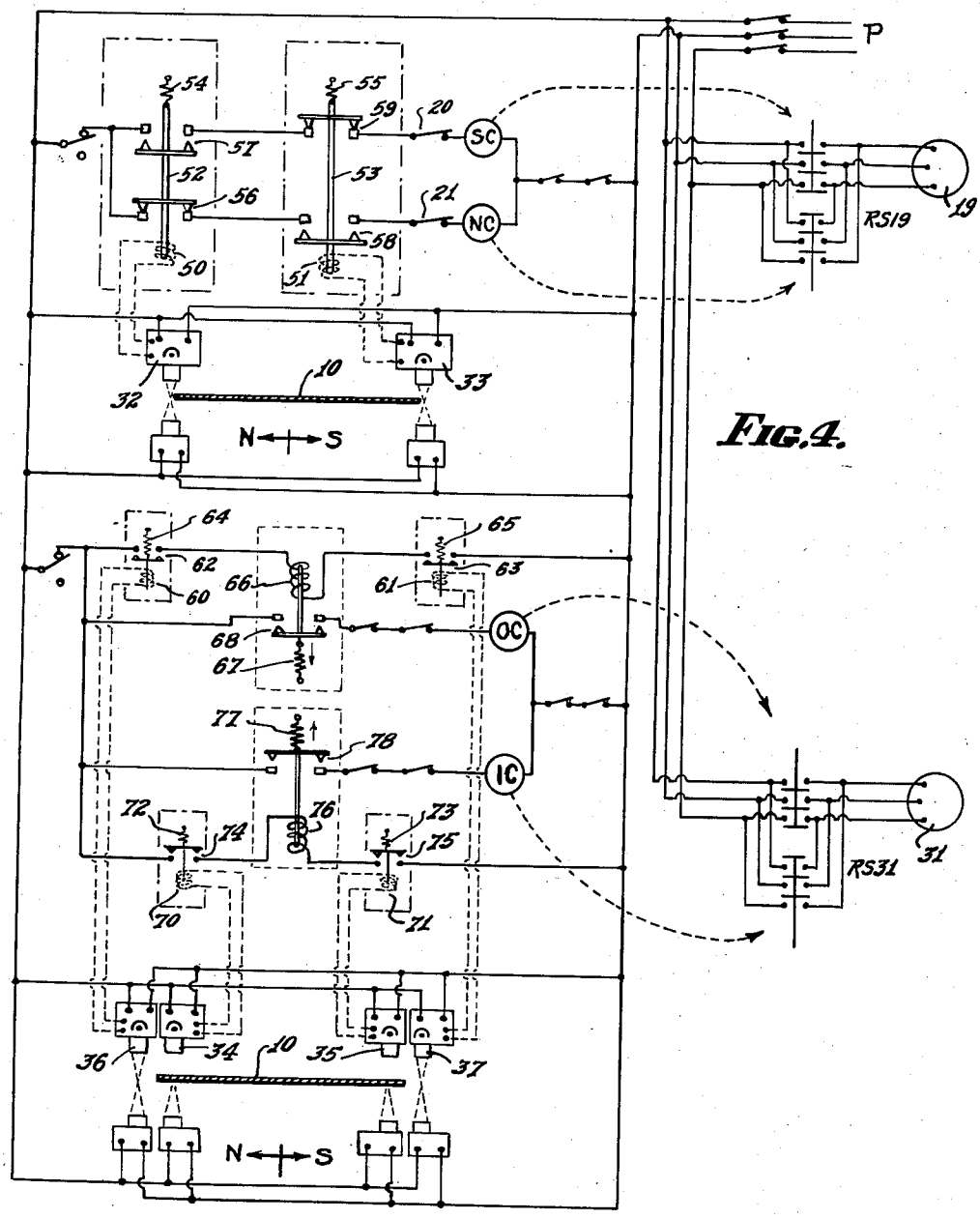


FIG. 4.

INVENTOR.
HAROLD R. MILLER,
BY
Allen & Allen
ATTORNEYS.

United States Patent Office

2,842,361

Patented July 8, 1958

2,842,361

AUTOMATIC STRIP ALIGNMENT CONTROL

Harold R. Miller, Bon-Aire, Pa., assignor to Armco Steel Corporation, Middletown, Ohio, a corporation of Ohio

Application February 13, 1956, Serial No. 565,085

6 Claims. (Cl. 271—2.6)

This invention relates to automatic strip alignment control and more particularly to apparatus for maintaining the alignment of a strip of a great length which is being processed. Specifically, the invention is applicable to the processing of metallic strip wherein for one reason or another the strip may tend to wander to one side or the other and where it is desired to maintain the strip in a centrally aligned path.

Various devices have been proposed in the past for accomplishing the alignment of metallic strip and the specific apparatus for correcting the alignment of the strip does not form a part of the present invention. It has also been known to actuate the aligning apparatus in response to sensings made by sensing devices adapted to sense the position of the strip. With all such devices with which I am familiar, however, the sensing devices had to be adjusted by hand and when a strip of different width was to be processed, the position of the sensing devices had to be changed manually.

With the foregoing conditions in mind, it is an object of the present invention to provide apparatus of the character described together with automatic means for adjusting the sensing devices for different widths of strip. It is another object of the invention to provide automatic adjustment means as outlined above which will be relatively simple and foolproof in operation.

These and other objects of the invention which will be described in greater detail hereinafter or which will be apparent to one skilled in the art upon reading these specifications, I accomplish by that certain construction and arrangement of parts of which I shall now disclose an exemplary embodiment.

Reference is made to the drawings forming a part hereof and in which:

Figure 1 is a fragmentary plan view of a metal strip line showing a correcting roll and showing the control apparatus.

Figure 2 is a fragmentary elevational view of the same.

Figure 3 is a fragmentary cross-sectional view taken on the line 3—3 of Figure 2; and

Figure 4 is a wiring diagram useful in understanding the operation of the device.

Briefly, in the practice of my invention, I provide in combination with any desired correcting apparatus a control apparatus. The control apparatus is provided in two halves mounted on two carriages, which carriages may be moved apart or toward each other. On each carriage I provide three sensing elements. The pair of sensing elements constituted of the center element on each side actuate the correcting apparatus if the strip tends to wander off line to one side or the other. The inner and outer pair of sensing elements come into play when a narrower or wider strip passes through the line and are operatively arranged so that if a narrower strip is sensed, the two carriages carrying the sensing elements are caused to move toward each other to bring the center

pair of sensing elements into proper sensing position with respect to the strip edges. Conversely, if a wider strip is passing through the line, the outer pair of sensing elements will be activated to cause the two carriages to move apart so as again to bring the center pair of sensing elements into proper sensing position with respect to the strip edges.

Referring now in more detail to the drawings, I have shown a strip **10** which may be presumed to be passing through a processing line. Feed rollers are indicated at **11** and **12**. **13** indicates a correcting roll of the type which is pivoted at one end as at **14** and which at its other end may be moved to the right or left so as to skew the roll **13**. The strip, in passing under the roll **13**, passes over a roll **15** and the effect of skewing the rolls **13** and **15** is to cause the strip to tend to move in one direction or the other. It will be clear from a consideration of Figures 1 and 2 that the rolls **13** and **15** are mounted in a framework indicated generally at **16**, said whole framework being pivotally mounted at **14** and having at its other end a nut **17** engaging a screw **18**, which screw is actuated by means of a motor **19**. A pair of limit switches may be provided as at **20** and **21** to limit the amount of skewing of the rolls **13** and **15**. It will be understood that when the motor **19** rotates in one direction, the screw **18** will be turned in one direction and the nut **17** will travel toward the right or left and that when the direction of rotation of the motor **19** is reversed, the screw **18** will turn in the opposite direction, causing the nut **17** to move in the opposite direction. Movement of the nut is transmitted to the frame **16** whereby the rolls **13** and **15** are skewed in one direction or the other in relation to the pivot point **14**.

Adjacent the correcting roll apparatus, I provide a control apparatus indicated generally at C. The apparatus C comprises a pair of carriages **22** and **23**. The carriages are mounted on brackets **24** and **25** and these brackets carry the nuts **26**, **27** and means to engage the rail **28**. The nuts **26** and **27** engage allochirally threaded portions of the screw **29** so that if the screw **29** is rotated in one direction, the carriages **22**, **23** are caused to approach each other and when the screw **29** is rotated in the opposite direction, the carriages are caused to move apart. The screw **29** is rotated through a gear reducer **30** by means of a motor **31**.

From a consideration of Figures 1 to 3 inclusive, it will be clear that each of the carriages **22** and **23** carries three sensing elements. These sensing elements specifically comprise in each case a light source and a photocell. The six light sources may either be disposed above the strip and the six photocells below, or vice versa. The center sensing elements of each group of three, and indicated at **32** and **33**, are positioned adjacent the strip edges and are connected, as will hereinafter be outlined, to the motor **19** to cause it to rotate in one direction or the other when one or the other of the light beams of the sensing elements **32**, **33** is interrupted. Thus, the sensing elements **32**, **33** control the operation of the motor **19** to maintain alignment of the strip. The inner pair of sensing elements **34** and **35** and the outer pair of sensing elements **36** and **37** are connected to the motor **31** in the manner to be described hereinafter, so that if a narrower strip is passing through the line and the light beams of the elements **34**, **35** can both pass the edges of the strip **10**, the motor **31** will be energized to rotate in such a direction to cause the carriages **22** and **23** to move toward each other to realign the elements **32** and **33** with the strip edges. If a wider strip passes through the line such that the light beams of the elements **36** and **37** are interrupted, the motor **31** is energized to rotate in

the opposite direction to cause the carriages 22 and 23 to move apart to bring the elements 32 and 33 back into proper sensing position.

Referring now to Figure 4, the connections of the various elements of the apparatus will now be described. A source of three-phase power is indicated at P and by means of this source, three-phase power is applied to the motors 19 and 31. In connection with the motor 19, there is provided a reversing switch RS19 and in connection with the motor 31 there is provided a reversing switch RS31. The switches RS19 and RS31 are shown in neutral position in the drawing and it will be understood that they are moved in one direction or the other by means of coils which are energized, as will be described hereinafter. The switch RS19 is moved upwardly by means of a coil SC and it is moved downwardly by a coil NC. Similarly, the switch RS31 is moved upwardly by means of the coil OC and is moved downwardly by the coil IC. For convenience in understanding the diagram, the sensing elements 32, 33 are shown in the upper portion of the diagram in closer relation to the motor 19, while the sensing elements 34, 35, 36 and 37 are shown in the lower portion of the figure adjacent the motor 31. The strip 10 has been shown twice in the drawing simply to show its relationship to the sensing devices and it will be understood that physically the sensing devices 32 to 37 are disposed as shown in Figures 1 to 3.

Considering the upper portion of the figure, the normal situation is shown where the strip just passes between the light beams of the two sensing devices 32 and 33, and both beams are uninterrupted. With both beams uninterrupted, current is flowing through the coil 50 and the coil 51 so that the plungers 52 and 53 are held in the position shown against the tension of the respective springs 54, 55. If now the strip wanders toward the left or north as indicated in the drawing, the light beam of the sensing device 32 will be interrupted so that the coil 50 will be deenergized and the spring 54 will cause the plungers 52 to move upwardly, opening the contacts 56 and closing the contacts 57. It will be noted by now that the arrangement of the switches controlled by the coils 50 and 51 is opposite, so that in normal operation two open circuits are provided to the coils SC and NC. When the contacts 57 close, since the contacts 59 are already closed, a circuit is completed through the "south" coil SC and this causes the switch RS19 to throw in the south direction to energize the motor 19 to rotate so as to move the correcting roll to cause the strip to move southward. As soon as the light beam of the sensing device 32 is again uncovered, the coil 50 will again be energized, closing the contact 56 and opening the contact 57 and reestablishing the situation shown in the drawing.

If the strip moves toward the south and obstructs the light beam of the device 33, the coil 51 will be deenergized so that the spring 55 can move the plungers 53 to close the contacts 58 and open the contacts 59. Since the contacts 56 are already closed, this completes a circuit to the "north" coil NC and the motor 19 will be energized to rotate in the opposite direction. The limit switches 20 and 21 will be understood to throw the switch RS19 into neutral at the extreme permissible movement of the correcting roll.

Turning now to the lower portion of the figure, the strip is shown in the same position as in the upper part of the figure with the carriages properly spaced for the sensing elements 32, 33 to sense the strip edges. At this normal situation, it will be observed that the light beams of the sensing devices 36 and 37 are uninterrupted while the light beams of the devices 34 and 35 are obstructed. In this situation, the coils 60 and 61 are energized and hold the contacts 62 and 63 open against the tension of the springs 64 and 65. Since the contacts 62 and 63 are open, the coil 66 is not energized and its spring 67 holds the contacts 68 open. In this situation, therefore, the "out" coil OC is not energized. Similarly, with the light beams of the devices 34 and 35 obstructed, the coils 70 and 71 are not energized and, therefore, the springs 72 and 73 hold the contacts 74 and 75 open. Since the contacts 74 and 75 are open, the coil 76 is not energized and the spring 77 holds the contacts 78 open. The "in" coil IC is therefore not energized and with neither OC nor IC energized, the switch RS31 is in the neutral position shown.

If now a narrower strip passes through the apparatus, the beams of the devices 34 and 35 will no longer be obstructed. As soon as these beams impinge upon the respective photocells, the coils 70 and 71 are energized causing the contacts 74 and 75 to close. This completes a circuit through the coil 76, causing the contacts 78 to close and establishing a circuit through the "in" coil IC. The coil IC throws the switch RS31 in a direction to cause the motor 31 to rotate to move the carriages 22 and 23 toward each other and the carriages will continue to move toward each other until the light beams of the devices 34 and 35 are again interrupted.

If now a wider strip enters the apparatus and obstructs the beams of the devices 36 and 37, the coils 60 and 61 will be deenergized and the springs 64 and 65 will then act to close the contacts 62 and 63. The closing of these contacts establishes a circuit through the coil 66 which is thus energized and which causes the contacts 68 to close, establishing a circuit through the "out" coil OC. When the "out" coil is energized, the switch RS31 is thrown in the opposite direction, causing the motor 31 to rotate in a direction to move the carriages 22 and 23 away from each other. The carriages will continue to move away from each other until the beams of the devices 36 and 37 are no longer obstructed. It will be understood that suitable time delay devices may be added to permit the motor 31 to over-run slightly in both directions, so that the carriages 22 and 23 will come to rest at a position with the devices 32 and 33 properly related to the strip edges. It will also be clear that switches for manual operation may be provided as shown.

From the foregoing description, it is believed that the operation of the device will be clear and it will be understood that numerous modifications may be made without departing from the spirit of the invention.

Having now fully described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In combination, in a strip line, a pair of aligning rolls between which the strip passes, means to skew said aligning rolls to cause the strip to move laterally, laterally adjustable strip edge sensing means to sense lateral movement of the strip and operatively connected to said skewing means to skew said rolls to cause said strip to return to proper alignment, adjusting means for adjusting the distance between said strip edge sensing means, and means to sense the passage of wider and narrower strip and operatively connected to said adjusting means to move said strip edge sensing means to proper sensing position.

2. In combination, in a strip line, a pair of aligning rolls between which the strip passes, means to skew said aligning rolls to cause the strip to move laterally, laterally adjustable strip edge sensing means to sense lateral movement of the strip and operatively connected to said skewing means to skew said rolls to cause said strip to return to proper alignment, adjusting means for adjusting the distance between said strip edge sensing means, means to sense the passage of wider strip and operatively connected to said adjusting means to move said strip edge sensing means apart to proper sensing position, and means to sense the passage of narrower strip and operatively connected to said adjusting means to move said strip edge sensing means toward each other to proper sensing position.

3. In a strip line, in combination with apparatus for aligning a moving strip, control mechanism for actuating

said aligning apparatus, comprising a pair of carriages, one adjacent each edge of the strip to be aligned, power means for moving said carriages toward or away from each other, each carriage carrying a set of three sensing elements, the two center sensing elements constituting a control pair for energizing said aligning apparatus, the two inner sensing elements constituting a first carriage separation adjusting pair, operative connections from said first adjusting pair to said power means to cause said carriages to approach each other when a narrower strip is passing through the line, to bring said control pair to proper sensing position, and the two outer sensing elements constituting a second carriage separation adjusting pair, operative connections from said second adjusting pair to said power means to cause said carriages to move apart when a wider strip is passing through the line, to bring said control pair in proper sensing position.

4. In a strip line, in combination with apparatus for aligning a moving strip, control mechanism for actuating said aligning apparatus, comprising a pair of carriages, one adjacent each edge of the strip to be aligned, power means for moving said carriages toward or away from each other, each carriage carrying three sets of sensing elements each constituted of a light source and a photocell, the center light source and photocell of each carriage constituting a control pair for energizing said aligning apparatus, the two inner light sources and photocells constituting a first carriage separation adjusting pair, and the two outer light sources and photocells constituting a second carriage separation adjusting pair, an electric circuit including said power means, and means to energize said circuit to actuate said power means in a direction to move said carriages toward each other upon interruption of the light beams of the two inner light sources, and means to energize said circuit to actuate said power means in a direction to move said carriages apart upon interruption of the light beams of the two outer light sources.

5. In combination with a strip alignment control mechanism having a pair of strip edge sensing elements operatively connected to said mechanism to maintain alignment of said strip, a pair of carriages, power means to cause said carriages to move toward or away from each other, one of said strip edge sensing elements being mounted on each of said carriages, a second pair of sensing elements, one mounted on each of said carriages and spaced closer together than said strip edge sensing elements, said second pair of sensing elements being activated when a narrower strip is passing through the line and being operatively connected to said power means to cause said carriages to approach each other and return said strip edge sensing elements to proper sensing position with respect to the strip edges, and a third pair of sensing elements, one mounted on each of said carriages and spaced farther apart than said strip edge sensing elements, said third pair of sensing elements being activated when a wider strip is passing through said line and being operatively connected to said power means to cause said carriages to move farther apart and return said strip edge sensing elements to proper sensing position with respect to the strip edges.

6. In combination with a strip alignment control mechanism having a pair of strip edge sensing elements each comprising a light source and a photocell operatively connected to said mechanism to maintain alignment of said strip, a pair of carriages, power means to cause said carriages to move toward and away from each other, one of said light sources and one of said photocells being mounted on each of said carriages, a second pair of sensing elements each comprising a light source and a photocell, one of said second pair mounted on each of said carriages inwardly of the elements of the first pair, the light beams of said second pair being interrupted until a narrower strip is passing through the line, an electric circuit including said power means and arranged, upon cessation of interruption of said light beams to energize said power means to cause said carriages to approach each other and return said first pair to proper sensing position with respect to the strip edges, and a third pair of sensing elements each comprising a light source and a photocell, one of said third pair mounted on each of said carriages outwardly of the elements of the first pair, the light beams of said third pair being interrupted when a wider strip is passing through the line, the interruption of the light beams of said third pair energizing said power means to cause said carriages to move apart and return said first pair to proper sensing position with respect to the strip edges.

References Cited in the file of this patent

UNITED STATES PATENTS

2,210,925	Hill	Aug. 13, 1940
2,548,590	Cook	Apr. 10, 1951
2,630,319	Heilman et al.	Mar. 3, 1953