Jan. 10, 1956 G. H. RENDEL 2,730,348

EDGE SCANNER FOR STRIP MATERIAL

Filed May 14, 1952 3 Sheets-Sheet 1

FIG. 1.

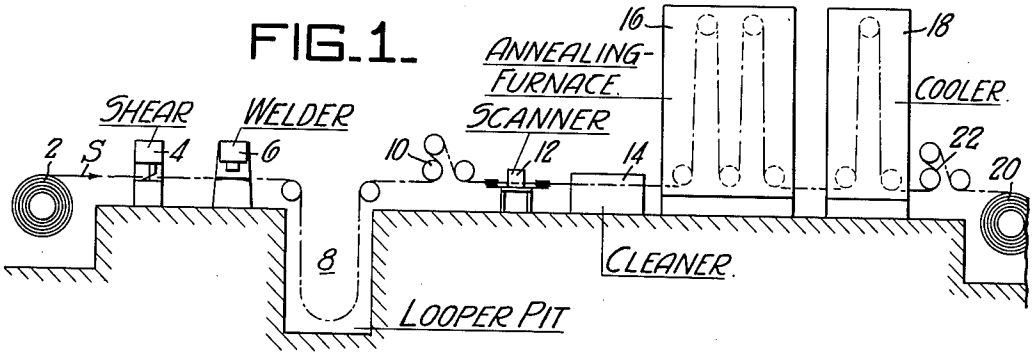
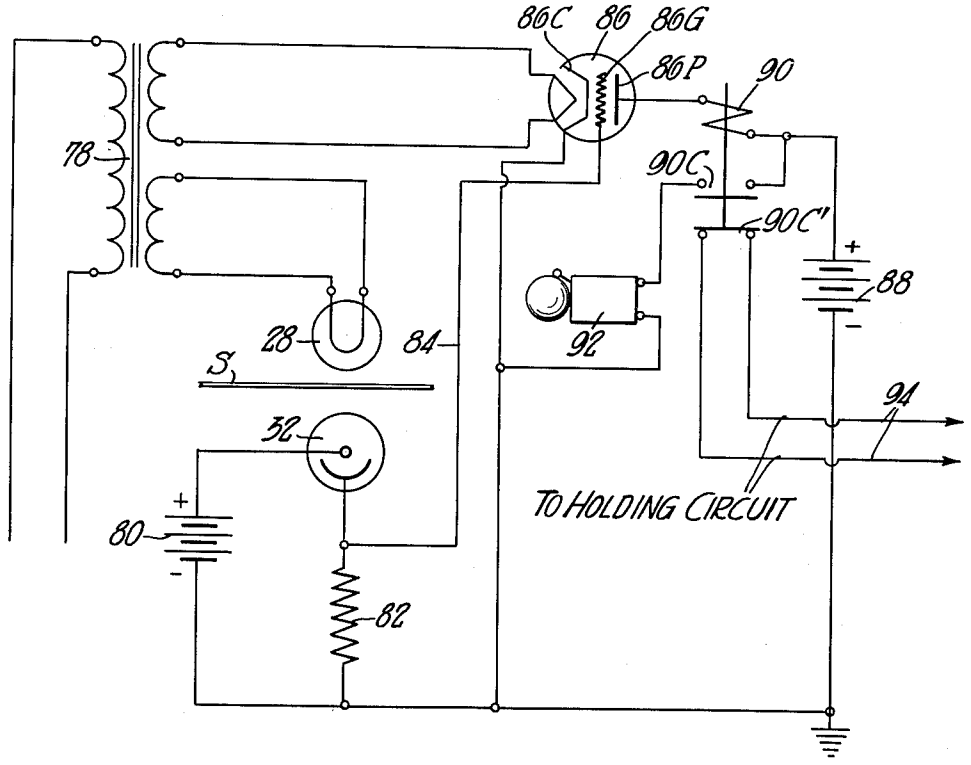


FIG. 7.



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EDGE SCANNER FOR STRIP MATERIAL

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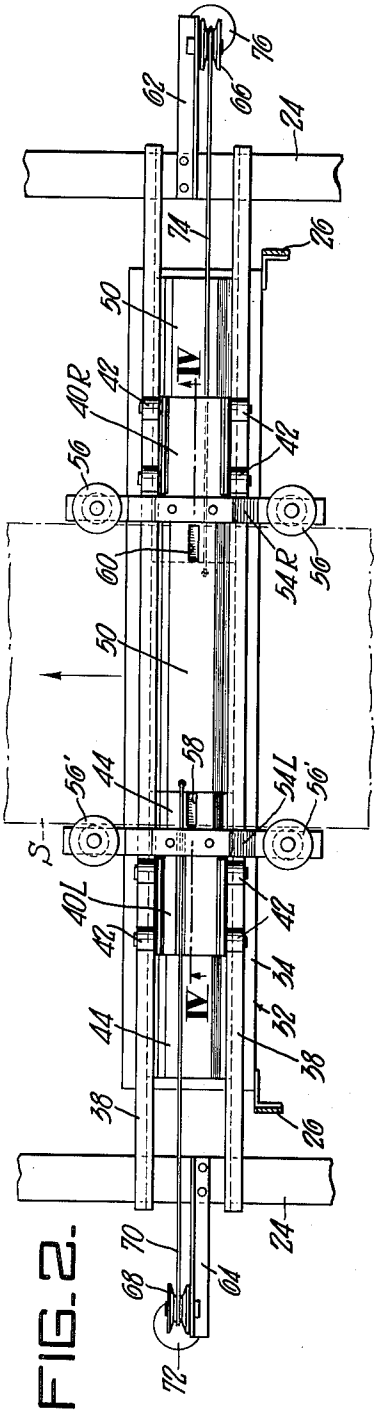


FIG. 2.

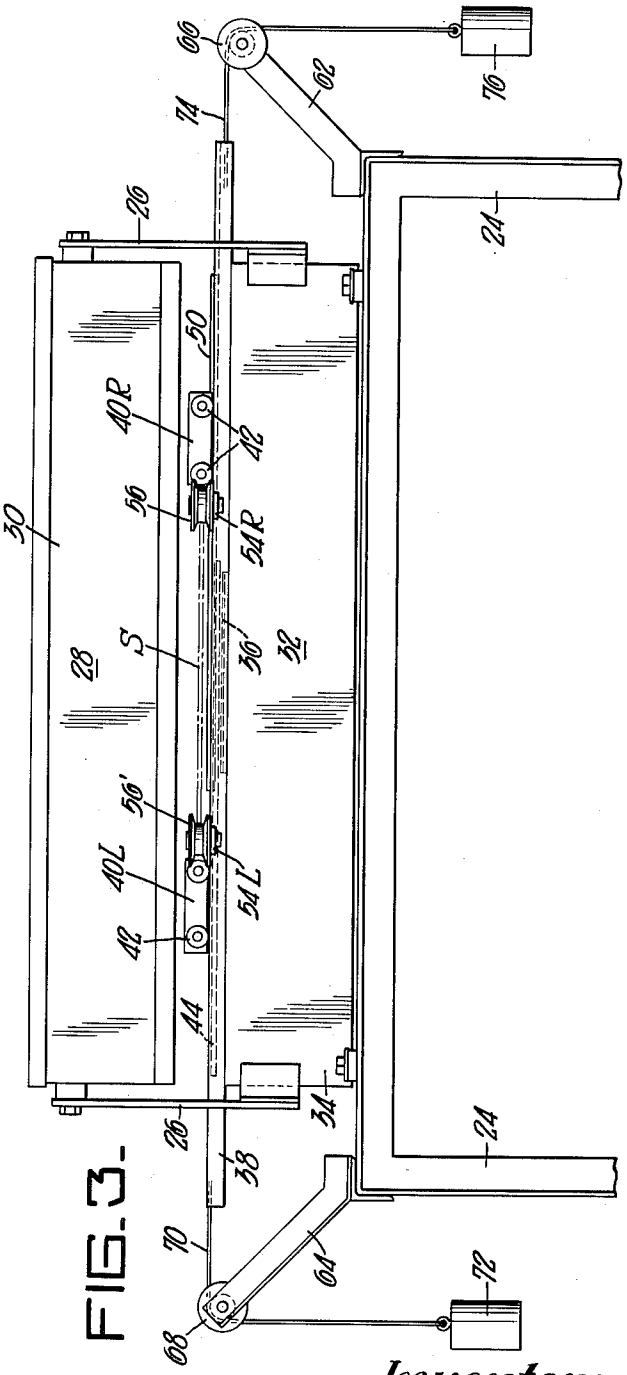


FIG. 3.

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EDGE SCANNER FOR STRIP MATERIAL

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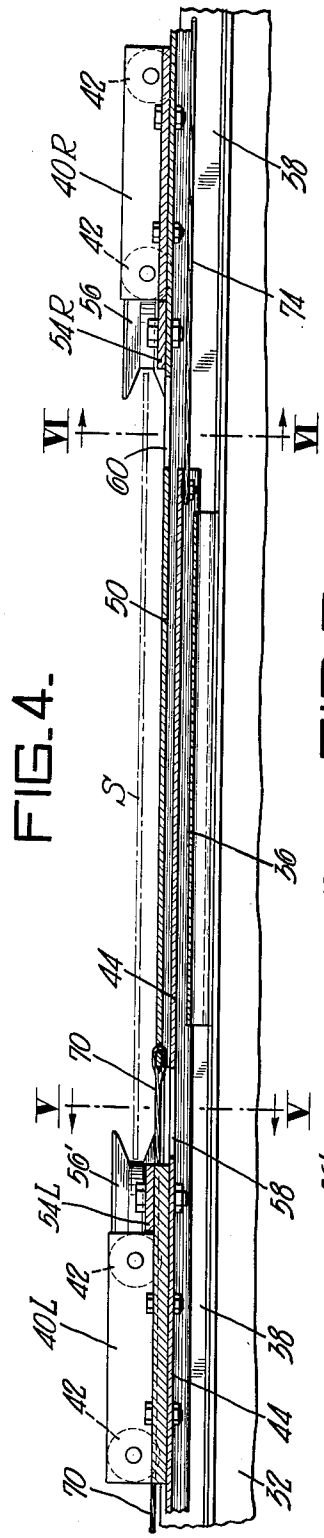


FIG. 4.

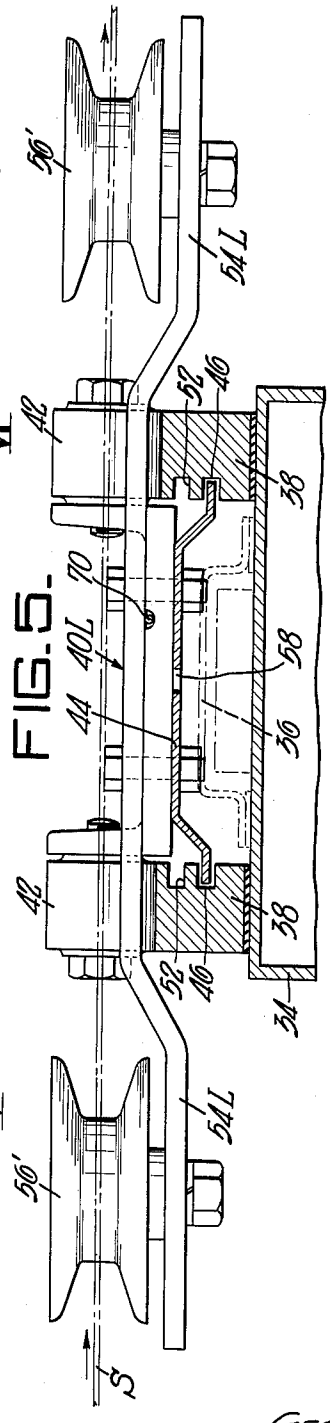


FIG. 5.

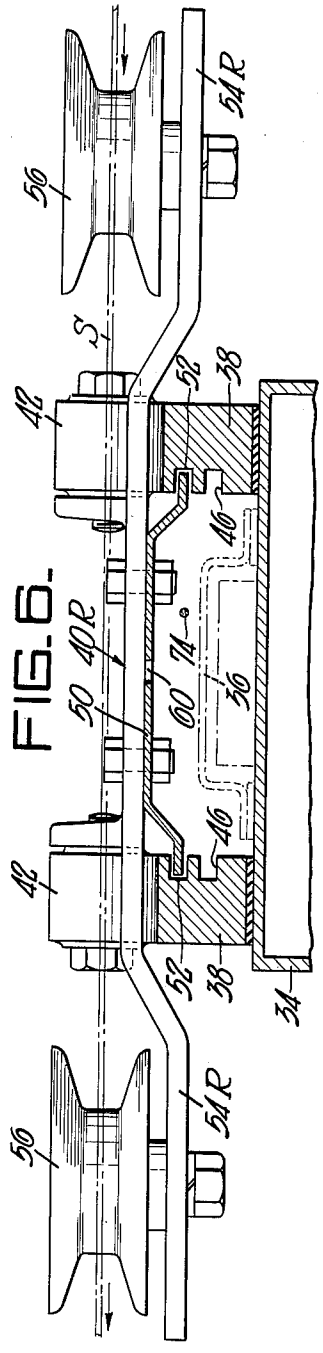


FIG. 6.

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EDGE SCANNER FOR STRIP MATERIAL

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Application May 14, 1952, Serial No. 287,791

17 Claims. (Cl. 263—3)

This invention relates to an edge scanner for strip material and more particularly to a scanner for detecting flaws in the edges of a steel strip prior to annealing the strip. In a conventional continuous annealing line the strip is successively uncoiled, cleaned, heated, cooled and recoiled. The strip travels at speeds of approximately 1000 ft. per minute through the annealing line and may reach a temperature of about 1200° F. to 1300° F. The strip is drawn through the annealing line by means of pulling rolls under a tension which may be as high as 2000 lbs. per square inch. Because of this high tension the strip frequently breaks in the heating zone of the furnace. When this happens there is considerable delay because of the time required to rejoin the broken ends of the strip. I have found that a great deal of this breakage is due to defects which extend to the edges of the strip.

It is therefore an object of my invention to provide a device for detecting cracked edges or similar flaws near the edges of the strip prior to the entry of the strip into the heating zone of an annealing line.

Another object is to provide such a device that will give an audible or visual signal when a defect occurs and/or will stop the line.

Still another object is to provide such a device that can be used with strip of various widths.

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

Figure 1 is a schematic view of a strip annealing line;

Figure 2 is a plan view of the scanner of my invention;

Figure 3 is an end view of Figure 2;

Figure 4 is an enlarged sectional view taken on the line IV—IV of Figure 2;

Figure 5 is an enlarged sectional view taken on the line V—V of Figure 4;

Figure 6 is an enlarged sectional view taken on the line VI—VI of Figure 4; and

Figure 7 is a schematic wiring diagram of the electrical circuit used with my invention.

Referring more particularly to Figure 1 of the drawings, reference numeral 2 indicates an uncoiler for supporting a coil of strip S. From the uncoiler 2 the strip S passes through a shear 4 and welder 6 to a looper pit 8. From the looper pit 8 the strip passes through drag bridle 10 and edge scanner 12. The strip then passes through a cleaning tank 14 to the annealing furnace 16 where it is heated to the annealing temperature. The heated strip is cooled in a cooler 18 and recoiled by a coiler 20. A drive bridle 22 is provided between the cooler 18 and coiler 20.

A framework 24, located beneath the path of travel of the strip S, supports the edge scanner. A pair of spaced apart brackets 26 extend upwardly from the framework 24 above the strip S and supports a light source 28. The light source 28 may consist of two or more spaced apart light bulbs located in a shielded box 30. A photoelectric device 32 which may consist of two or more spaced apart photocells mounted in a shielded box 34 is mounted

on the framework 24 beneath the light source 28. The apparatus so far described is conventional for detecting pin holes and is similar to that disclosed in the Hags Patent No. 2,395,181, dated February 19, 1946. As best shown in Figures 5 and 6 U-shaped stationary shield 36 is mounted on the box 34 and is located in the central part of the path of strip travel. The shield 36 prevents light from the light source 28 from shining on the photocells 32 over a considerable area of the strip. The width of the shield 36 also determines the minimum width of the strip that can be inspected in the device. A pair of spaced apart tracks 38 are mounted on the framework 24 and are arranged transversely of the direction of strip travel. A pair of carriages 40R and 40L are mounted for movement on the tracks 38, one on each side of the path of strip travel. Each of the carriages 40R and 40L is provided with four wheels 42. The carriage 40L supports a shutter 44 having its side edges received in grooves 46 on opposed sides of tracks 38. The carriage 40R supports a shutter 50 having its side edges received in grooves 52 located above grooves 46. The carriage 40R supports a bracket 54R which carries strip guide wheels 56. The carriage 40L supports a bracket 54L which carries strip guide wheels 56'. The shutters 44 and 50 are provided with light slots 58 and 60, respectively. Brackets 62 and 64 are supported by the framework 24 and extend upwardly and outwardly therefrom. Sheaves 66 and 68 are mounted at the ends of brackets 62 and 64, respectively. A cable 70, which has one end attached to the shutter 50 and the other end attached to a counterweight 72, passes over the sheave 68. A similar cable 74, which has one end attached to shutter 44 and the other end attached to the counterweight 76 passes around the sheave 66.

As shown in Figure 7, the light source 28 receives its power from a transformer 78. A battery 80 has its positive side directly connected to the photocell 32 and its negative side connected to the photocell 32 through a resistance 82. A wire 84 connects the resistance 82 to the grid 86G of an amplifying tube 86. The plate 86P of tube 86 is connected to the positive side of a battery 88 through a relay coil 90 which is provided with normally open contacts 90C and normally closed contacts 90C'. The negative side of the battery 88 is connected to the cathode 86C of the tube 86. An audible alarm 92 is connected in series with normally open contacts 90C. The contacts 90C' are connected in series with holding circuit 94 for the annealing line control. The strip S is fed through the annealing line with the ends of the coils of strip being sheared and fastened end to end in the usual manner.

The operation of the device is as follows: The strip guide wheels 56 and 56' will always be in contact with the edges of the strip S since the carriages 40R and 40L are continuously urged toward the strip center line by means of the counterweights 72 and 76, respectively. When inspecting the edges of a strip of minimum width, the carriages 40R and 40L will assume the position shown in Figure 2. In this position the inner ends of the slots 58 and 60 will extend to the edges of the stationary shield 36 and only that portion of the strip covered by the slots 58 and 60 will be exposed to inspection. When a defect occurs in either edge of the strip, light from the light source 28 will strike the photocell 32. When this occurs the normally negative bias on the grid 86G will become positive causing the tube 86 to conduct. This energizes relay coil 90 which closes contacts 90C, thus causing the alarm 92 to sound. At the same time contacts 90C' open, thus deenergizing the holding circuit 94 and causing the strip S to stop moving through the annealing line. When a strip wider than that shown in Figure 2 is being annealed the carriages 40R and 40L will be forced outwardly along the tracks 38 and the overlapping shields

44 and 50 will move with respect to one another and will act in conjunction with stationary shield 36 to prevent inspection of any part of the strip except that above the slots 58 and 60. It will be seen that the right-hand end of the shutter 44 is aligned with the left-hand end of slot 60 and that the left-hand end of shutter 50 is aligned with the right-hand end of slot 58 when inspecting a strip of minimum width. When inspecting a strip of maximum width the right-hand end of shutter 44 will be above the left-hand end of shield 36 and the left-hand end of shutter 50 will be above the right-hand end of shield 36. It is evident that some damage to the strip will occur due to overheating after stoppage, but this damage is much less than the damage which occurs when the strip breaks in the furnace making it necessary to shut down the furnace and rethread the strip therethrough.

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 inspecting the side edges of a longitudinally moving strip comprising a light source on one side of each of said edges, a light responsive device on the opposite side of each of said edges, a pair of carriages mounted for movement transversely of the path of travel of the strip, and a shutter mounted on each of said carriages, each of said shutters having a slot therein extending transversely of the path of travel of said strip adjacent the edges thereof.

2. Apparatus for inspecting the side edges of a longitudinally moving strip comprising a light source on one side of each of said edges, a light responsive device on the opposite side of each of said edges, a pair of carriages mounted for movement transversely of the path of travel of the strip, strip edge guide wheels on each of said carriages, means for urging said carriages toward one another, and a shutter mounted on each of said carriages, each of said shutters having a slot therein extending transversely of the path of travel of said strip adjacent the edges thereof.

3. Apparatus for inspecting the side edges of a longitudinally moving strip comprising a light source on one side of each of said edges, a light responsive device on the opposite side of each of said edges, a pair of carriages mounted for movement transversely of the path of travel of the strip, a shutter mounted on each of said carriages, each of said shutters having a slot therein extending transversely of the path of travel of said strip adjacent the edges thereof, and a stationary shield mounted centrally of the path of travel of said strip in a different plane than said shutters.

4. Apparatus for inspecting the side edges of a longitudinally moving strip comprising a light source on one side of each of said edges, a light responsive device on the opposite side of each of said edges, a pair of carriages mounted for movement transversely of the path of travel of the strip, strip edge guide wheels on each of said carriages, means for urging said carriages toward one another, a shutter mounted on each of said carriages, each of said shutters having a slot therein extending transversely of the path of travel of said strip adjacent the edges thereof, and a stationary shield mounted centrally of the path of travel of said strip in a different plane than said shutters.

5. Apparatus for inspecting the side edges of a longitudinally moving strip comprising a light source on one side of each of said edges, a light responsive device on the opposite side of each of said edges, a pair of carriages mounted for movement transversely of the path of travel of the strip, a shutter mounted on each of said carriages, each of said shutters having a slot therein extending transversely of the path of travel of said strip adjacent the edges thereof, and means for receiving the side edges of said shutters.

6. Apparatus for inspecting the side edges of a longitudinally moving strip comprising a light source on one side of each of said edges, a light responsive device on the opposite side of each of said edges, a pair of carriages mounted for movement transversely of the path of travel of the strip, a shutter mounted on each of said carriages, each of said shutters having a slot therein extending transversely of the path of travel of said strip adjacent the edges thereof, means for receiving the side edges of said shutters, and a stationary shield mounted centrally of the path of travel of said strip in a different plane than said shutters.

7. Apparatus for inspecting the side edges of a longitudinally moving strip comprising a light source on one side of each of said edges, a light responsive device on the opposite side of each of said edges, a pair of carriages mounted for movement transversely of the path of travel of the strip, strip edge guide wheels on each of said carriages, means for urging said carriages toward one another, a shutter mounted on each of said carriages, each of said shutters having a slot therein extending transversely of the path of travel of said strip adjacent the edges thereof, and means for receiving the side edges of said shutters.

8. Apparatus for inspecting the side edges of a longitudinally moving strip comprising a light source on one side of each of said edges, a light responsive device on the opposite side of each of said edges, a pair of carriages mounted for movement transversely of the path of travel of the strip, strip edge guide wheels on each of said carriages, means for urging said carriages toward one another, a shutter mounted on each of said carriages, each of said shutters having a slot therein extending transversely of the path of travel of said strip adjacent the edges thereof, means for receiving the side edges of said shutters, and a stationary shield mounted centrally of the path of travel of said strip in a different plane than said shutters.

9. Continuous strip processing equipment comprising means for heating said strip, said means being the sole heating means therefor, means for pulling the strip through the heating means under tension, means located on the entry side of said strip heating means for detecting defects in the side edges of said strip, and means operable by said detecting means when a defect occurs in said strip for deactivating said pulling means to stop movement of said strip through said processing equipment.

10. Continuous strip processing equipment according to claim 9 in which the detecting means includes a light source on one side of each of the strip edges, and a light responsive device on the opposite side of each of said edges.

11. Continuous strip processing equipment comprising means for heating said strip, means located on the entry side of said strip heating means for detecting defects in the side edges of said strip, and means operable by said detecting means when a defect occurs in said strip for stopping movement of said strip through said processing equipment, said detecting means including a light source on one side of each of the strip edges, a light responsive device on the opposite side of each of said edges, a pair of carriages mounted for movement transversely of the path of movement of said strip, and a shutter mounted on each of said carriages, each of said shutters having a slot therein extending transversely of the path of travel of said strip adjacent the edges thereof.

12. Continuous strip processing equipment according to claim 11 including strip edge guide wheels on each of said carriages, and means for urging said carriages toward one another.

13. Continuous strip processing equipment according to claim 11 including a stationary shield mounted centrally of the path of travel of said strip in a different plane than said shutters.

14. Continuous strip processing equipment according to claim 11 including strip edge guide wheels on each of said

carriages, means for urging said carriages toward one another, and a stationary shield mounted centrally of the path of travel of said strip in a different plane than said shutters.

15. Continuous strip processing equipment according to claim 11 including means for receiving the side edges of said shutters.

16. Continuous strip processing equipment according to claim 15 including a stationary shield mounted centrally of the path of travel of said strip in a different plane than said shutters.

17. Continuous strip processing equipment according to claim 15 including strip edge guide wheels on each of said carriages, and means for urging said carriages toward one another.

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