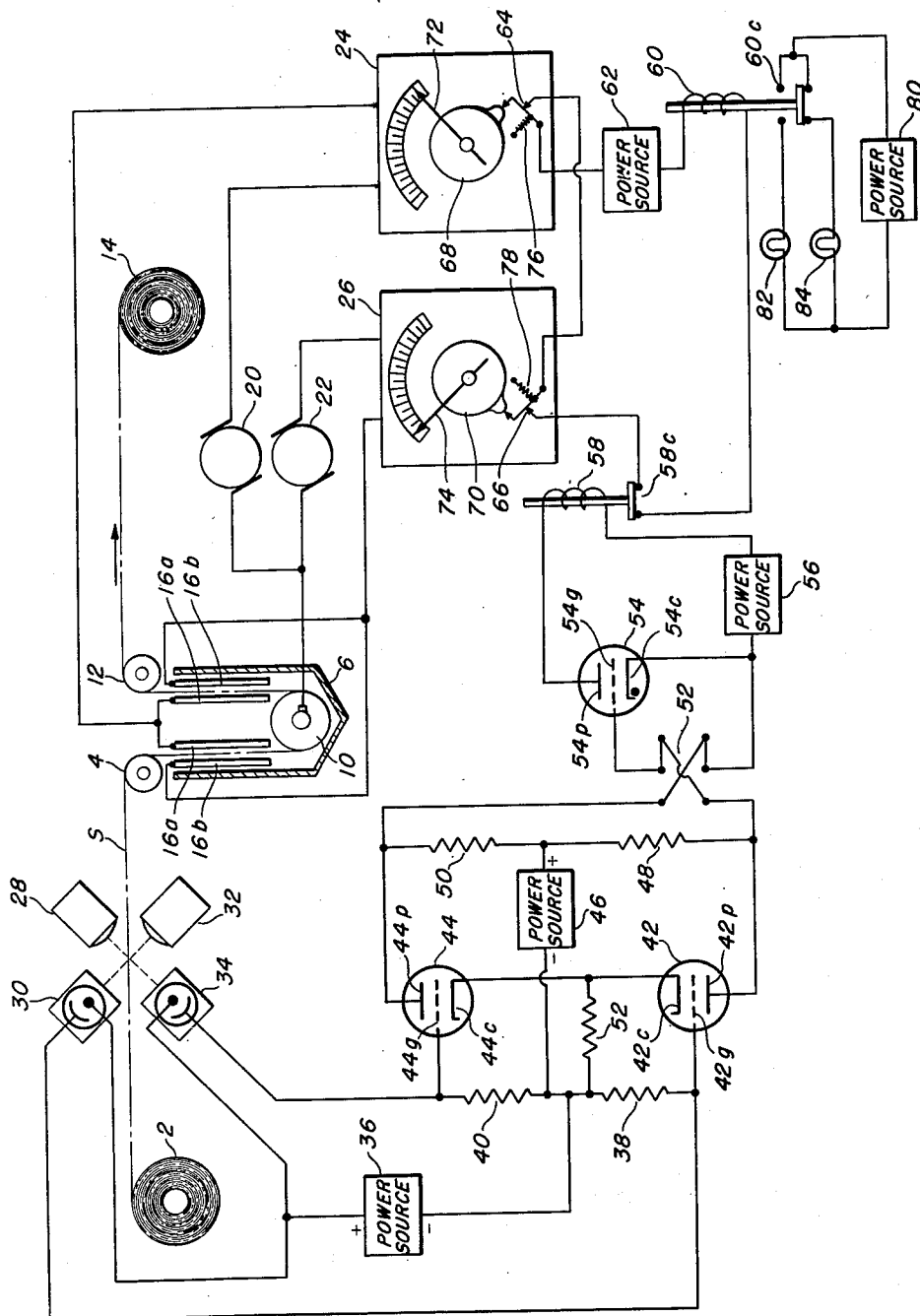


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APPARATUS FOR IDENTIFYING OPPOSITE
SIDES OF A MOVING STRIP
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APPARATUS FOR IDENTIFYING OPPOSITE SIDES OF A MOVING STRIP

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This invention relates to apparatus for identifying opposite sides of a moving strip and more particularly for indicating whether or not one side of a steel strip is properly roughened with respect to the other side and/or whether or not the correct weight of coating is being applied to the opposite sides of the steel strip in an electrolytic tinning line. In the manufacture of differentially coated electrolytic tin plate it is necessary to provide distinctive marking on one side of the plate so that each side may be identified as to light or heavy coating. One common method of marking is to roughen one side of the steel strip with a special roll in the tempering operation before plating. A heavy coating often is then applied to the smooth side and a light coating to the rough side. After being plated it is still possible to recognize the rough side so that a positive lasting identification of the light and heavy sides is provided. In the plating process it is possible to run the strip with either side up and it is also possible to put the heavy coating on either the top or bottom side. In some instances a coil of strip which has by-passed the roughening operation is processed in the tinning line and the fact is not noted until much of the material has been coated. It is extremely important that the customer know which side has the heavy coat and which side the light coat. It will be seen that there is a possibility of a strip being coated improperly, being marked improperly or not being marked at all. In some instances it is desirable to examine the roughened strip prior to its use in the electrolytic tinning line to determine whether or not the relative roughness of the strip is that desired.

It is therefore an object of my invention to provide a signal system that will indicate whether or not the strip is being coated and marked properly.

Another object is to provide apparatus for indicating the relative roughness of opposite surfaces of a moving strip.

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 an electrolytic tinning line with my signal system incorporated therein.

Referring more particularly to the drawing, the reference numeral 2 indicates an uncoiler for supporting a coil of strip S. The strip S passes from the uncoiler 2 through various processing equipment, not shown, to a conductor roll 4 and then downwardly into a plating tank 6 where it passes around a conductor roll 10 and upwardly out of the tank around a third conductor roll 12 and hence to a coiler 14. A tin coating is electrically deposited on the strip by anodes 16a and 16b between which the strip S passes in the tank 6. It will be understood that in actual practice the tank 6 may be provided with more than the two passes shown. The anodes 16a coat the top of the strip and the anodes 16b coat the bottom of the strip. The plating current for the top anodes 16a is furnished by plating generator 20 and plating current for the bottom anodes 16b is furnished by the plating generator 22. The coating weight on the top of the strip is indicated by the coating weight meter 24 and that on the bottom of the strip is indicated by the coating weight meter 26. The meters 24 and 26 are of the type described in the patent to Rendel No. 2,603,595, dated July 15, 1952, with certain modifications that will be described later. As the strip S passes from the uncoiler 2 to the conductor roll 4 it passes two reflectometers, one of which is made up of a light source 28 and a photocell

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30 mounted above the strip, the other of which is made up of a light source 32 and a photocell 34 mounted beneath the strip. The amount of light reflected onto the two photocells is a measure of the respective roughness of the two sides of the strip. Direct current power source 36 supplies power to the photocells 30 and 34 and the current through the photocells will vary with the amount of light falling on them. This current passes through resistors 38 and 40, respectively, and develops a voltage across each of the resistors that is proportional to the current in the respective photocells. It should be understood that although photocells requiring an external power source are shown it is also possible to use photovoltaic cells that generate their own power. The voltage developed across each of the resistors 38 and 40 is applied to the grids 42g and 44g of vacuum tubes 42 and 44. These two vacuum tubes are connected in a conventional balanced amplifier circuit and are supplied with power from a direct power source 46. Resistors 48 and 50 serve as plate-load resistors and resistor 52 serves as a common cathode resistor in the circuit. A reversing switch 52 is connected between the plates 42p and 44p. The switch 52 is also connected between the grid 54g and cathode 54c of a gas tube 54. Plate 54p is supplied with power from an A. C. power source 56 through a relay coil 58 having a normally closed contact 58C. The contact 58C is connected in series with a relay coil 60, power source 62 and meter contacts 64 and 66 in meters 24 and 26, respectively. The contacts 64 and 66 are operated by cams 68 and 70, respectively, which are mounted for movement with indicating arms 72 and 74, respectively. Springs 76 and 78 open the contacts when the raised part of their respective cams moves too far in either direction to maintain the contacts in the closed position. The relay coil 60 is provided with contacts 60C which are connected in series with a power source 80. Lights 82 and 84 are connected to relay contacts 60C and to power source 80.

The operation of my device is as follows:

Assuming that the top side of the strip S should be smooth and covered with a thick coating and the bottom side rough and coated with a light coating, there will be more light reflected on photocell 30 than on photocell 34 when the system is operating correctly. If the voltage drop across resistor 38 is equal to that across resistor 40 it will indicate equal light reflection on each photocell and assuming that the tubes 42 and 44 have been properly matched the potential at plate 42p will be equal to the potential at plate 44p so that there will be no voltage applied to the reversing switch 52 and hence no voltage applied between the grid 54g and cathode 54c. The switch 52 is not necessary if the top side of the strip is always the smooth side, but in some instances the top side will be rough and the bottom smooth in which case the circuit can be set up for the reverse condition without having to reconnect the wires. With no output voltage between plates 42p and 44p there will be no voltage applied to the grid 54g and the tube 54 will conduct. When it conducts it energizes relay coil 58 and opens normally closed contact 58C. This will deenergize relay coil 60 and the contacts 60C will be in the position shown with lamp 84 lit, thus indicating that a strip which is smooth on both sides is passing through the tinning line. Audible signals may be substituted for the lamps 82 and 84. The operator will know that conditions are not satisfactory and will stop the line immediately. If a strip having its smooth side down rather than up is in the line the voltage drop across resistor 40 will be greater than the voltage drop across resistor 38 and the plate potential of tube 42 will be appreciably higher than that of tube 44 so that the grid 54g will be appreciably higher in potential than the cathode 54c. Under these conditions the tube 54 will conduct and the lamp 84 will be lit. If, under either of the above described conditions, the meters 24 and 26 indicate the desired thicknesses of tin coating the operator will know that the trouble is in the strip and not in the coating. In other words he will know that the position of the rough side is wrong or that the strip has not been roughened at all. If it is desired to determine only the relative roughness of opposite sides of the strip the switches 64 and 66 will be omitted

from the connection between power source 62 and contacts 58C. If the top side of the strip in the line is smooth and the bottom side rough the potential across resistor 38 will be appreciably greater than that across resistor 40 and the plate potential of tube 42 will be appreciably lower than that of tube 44. Under these conditions the grid of gas tube 54 will be appreciably lower in potential than its cathode and the tube will not conduct. Thus the relay contacts 58C will remain closed. If the coating thickness on the top of the strip is greater than or equal to that of the coating thickness on the bottom of the strip or if the coating thickness on either side is not within the limits set on the meters 24 and 26 at least one of the contacts 64 and 66 will be open and the relay coil 60 will not be energized. Thus the contact 60C will be in position shown and the lamp 84 will be lit indicating improper operation. The operator will then stop the line.

On the other hand if the correct coating is being applied to both sides of the strip a circuit will be completed through the coil 60, thus moving its contact arm to complete a circuit through the lamp 82. When the lamp 82 is lit it indicates that the system is operating satisfactorily. Although a gas tube operated relay is described it is theoretically possible to operate the relay directly from the potential developed by the photocells or directly from the potential developed between the plates 42p and 44p. However, it is desirable to have the additional sensitivity provided by the amplification of the tubes 42 and 44 and the sharp control point provided by tube 54.

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. In a processing line for applying a different thickness of coating material to opposite sides of a strip having one relatively rough and one relatively smooth side, the combination therewith of apparatus for determining whether the proper coatings are being applied to the proper surfaces of a strip passing therethrough; said apparatus comprising a first coating thickness meter for indicating the thickness of coating applied to the first side of the strip, a second coating thickness meter for indicating the thickness of coating applied to the second side of the strip, a first switch associated with said first meter, said first switch being closed when a predetermined coating is being applied to the first side of the strip, a second switch associated with said second meter, said second switch being closed when a predetermined coating is being applied to the second side of the strip, means for determining the relative roughness of opposite surfaces of the strip, a third switch, means operable by said last named means for closing said third switch when the relative roughness of opposite surfaces of the strip is that desired, a circuit including said three switches connected in series, and means operable by the closing of said three switches for indicating that the proper coatings are being applied to the proper surfaces of the strip.

2. In a processing line for applying a different thickness of coating material to opposite sides of a strip having one relatively rough and one relatively smooth side, the combination therewith of apparatus for determining whether the proper coatings are being applied to the proper surfaces of a strip passing therethrough; said apparatus comprising a first coating thickness meter for indicating the thickness of coating applied to the first side of the strip, a second coating thickness meter for indicating the thickness of coating applied to the second side of the strip, a first switch associated with said first meter, said first switch being closed when a predetermined coating is being applied to the first side of the strip, a second switch associated with said second meter, said second switch being closed when a predetermined coating is being applied to the second side of the strip, two reflectometers one on each side of the strip, each of said reflectometers including a photosensitive device, means for obtaining a voltage impulse proportional to the output of the first of said photosensitive devices, means for obtaining a voltage impulse proportional to the output of the second of said photosensitive devices, means connecting said voltage impulses in opposed relationship, a third switch, means operable by said last named means for closing said third switch when the relative roughness of opposite surfaces of the strip is that desired,

a circuit including said three switches connected in series, and means operable by the closing of said three switches for indicating that the proper coatings are being applied to the proper surfaces of the strip.

3. In a processing line for applying a different thickness of coating material to opposite sides of a strip having one relatively rough and one relatively smooth side, the combination therewith of apparatus for determining whether the proper coatings are being applied to the proper surfaces of a strip passing therethrough; said apparatus comprising a first coating thickness meter for indicating the thickness of coating applied to the first side of the strip, a second coating thickness meter for indicating the thickness of coating applied to the second side of the strip, a first switch associated with said first meter, said first switch being closed when a predetermined coating is being applied to the first side of the strip, a second switch associated with said second meter, said second switch being closed when a predetermined coating is being applied to the second side of the strip, two reflectometers one on each side of the strip, each of said reflectometers including a photosensitive device, means for obtaining a voltage impulse proportional to the output of the first of said photosensitive devices, means for obtaining a voltage impulse proportional to the output of the second of said photosensitive devices, means connecting said voltage impulses in opposed relationship, a third switch, means operable by said last named means for closing said third switch when the relative roughness of opposite surfaces of the strip is that desired, a relay coil, a power source, said relay coil, power source and switches being connected in series, contacts operable by said relay coil, and signal means connected in series with said contacts for indicating whether the proper coatings are being applied to the proper surfaces of the strip.

4. In a processing line for applying a different thickness of coating material to opposite sides of a strip having one relatively rough and one relatively smooth side, the combination therewith of apparatus for determining whether the proper coatings are being applied to the proper surfaces of a strip passing therethrough; said apparatus comprising a first coating thickness meter for indicating the thickness of coating applied to the first side of the strip, a second coating thickness meter for indicating the thickness of coating applied to the second side of the strip, a first switch associated with said first meter, said first switch being closed when a predetermined coating is being applied to the first side of the strip, a second switch associated with said second meter, said second switch being closed when a predetermined coating is being applied to the second side of the strip, two reflectometers one on each side of the strip, each of said reflectometers including a photosensitive device, means for obtaining a voltage impulse proportional to the output of the first of said photosensitive devices, means for obtaining a voltage impulse proportional to the output of the second of said photosensitive devices, means for amplifying each of the voltage impulses, means connecting said amplifying means in opposed relationship, a relay coil having a normally closed contact, a power source and an electronic tube connected in series with said relay coil, means for impressing the output of said last named means on the grid of said electronic tube, said electronic tube being connected to conduct when no voltage is applied to its grid, a circuit including said switches and relay contacts connected in series, and means operable by the closing of said switches and relay contacts for indicating that the proper coatings are being applied to the proper surfaces of the strip.

5. In a processing line for applying a different thickness of coating material to opposite sides of a strip having one relatively rough and one relatively smooth side, the combination therewith of apparatus for determining whether the proper coatings are being applied to the proper surfaces of a strip passing therethrough; said apparatus comprising a first coating thickness meter for indicating the thickness of coating applied to the first side of the strip, a second coating thickness meter for indicating the thickness of coating applied to the second side of the strip, a first switch associated with said first meter, said first switch being closed when a predetermined coating is being applied to the first side of the strip, a second switch associated with said second meter, said second switch being closed when a predetermined coating is being applied to the second side of the strip, two

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reflectometers one on each side of the strip, each of said reflectometers including a photosensitive device, means for obtaining a voltage impulse proportional to the output of the first of said photosensitive devices, means for obtaining a voltage impulse proportional to the output of the second of said photosensitive devices, means for amplifying each of the voltage impulses, means connecting said amplifying means in opposed relationship, a relay coil having a normally closed contact, a power source and an electronic tube connected in series with said relay coil, means for impressing the output of said last named means on the grid of said electronic tube, said electronic tube being connected to conduct when no voltage is applied to its grid, a second relay coil, a power source, said second relay coil, power source, switches and relay contact being connected in series, contacts operable by said second relay coil, and signal means connected in series with said last named contacts for indicating whether the proper coatings are being applied to the proper surfaces of the strip.

6. Apparatus for indicating the relative roughness of opposite surfaces of a moving strip having one relatively rough and one relatively smooth side comprising two reflectometers one on each side of the strip, each of said reflectometers including a photosensitive device, means for obtaining a voltage impulse proportional to the output of the first of said photosensitive devices, means for obtaining a voltage impulse proportional to the output of the second of said photosensitive devices, means connecting said voltage impulses in opposed relationship, a

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switch, means operable by said last named means for closing said switch when the relative roughness of opposite surfaces of the strip is that desired, and means operable by said switch for indicating that the relative roughness of the opposite surfaces of the strip is that desired.

7. Apparatus for indicating the relative roughness of opposite surfaces of a moving strip having one relatively rough and one relatively smooth side comprising two reflectometers one on each side of the strip, each of said reflectometers including a photosensitive device, means for obtaining a voltage impulse proportional to the output of the first of said photosensitive devices, means for obtaining a voltage impulse proportional to the output of the second of said photosensitive devices, means for amplifying each of the voltage impulses, means connecting said amplifying means in opposed relationship, a relay coil having a normally closed contact, a power source and an electronic tube connected in series with said relay coil, means for impressing the output of said last named means on the grid of said electronic tube, and means operable by said switch for indicating that the relative roughness of the opposite surfaces of the strip is that desired.

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