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APPARATUS FOR INSPECTING AND CLASSIFYING FLAT STEEL PRODUCTS

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This invention relates to apparatus for inspecting and classifying flat steel products and particularly for inspecting and classifying electrolytic tin plate. In the making of electrolytic tin plate the strip is passed through the electrolytic tinning line where the tin coating is applied after which it is inspected for pin holes while still in strip form. Subsequently the strip is sheared into sheets with the sheets being classified into prime and reject products. Due to the high speed of strip travel, different sheet lengths, and the fact that the classifying pilers may be located some distance after the detector, it has always been difficult to reject only the sheet containing the pin hole. This is particularly true on lines which require slack loops of varying length between the detector and classifier. Conventional means of operating the classifier utilize a mechanical memory device which is synchronized with the speed of the strip and operates the deflector gate at approximately the right time to deflect the defective sheet. Such a device is described in the patent to Ladrach No. 2,217,342. Because of the high speed of strip travel, different sheet lengths, location of the classifying pilers and the variable slack loop mentioned above, it has been necessary to set the time of this device to deflect at least three sheets of the longest cut to insure that the defective sheet will be deflected. This requires that the sheets so deflected be reinserted in order to pick out the perforated sheets. In some instances the hole is so small that the inspector misses it and passes the sheet as a prime sheet.

It is therefore an object of our invention to provide apparatus for inspecting strip for pin holes and then classifying the sheets cut from the strip in which the perforated sheet is deflected to the reject piler.

Apparatus is provided to provide apparatus for sorting sheets of which there have a mark thereon.

These and other objects will become more apparent after referring to the following specification and attached drawings, in which the single figure is a schematic view of the inspection line and the controls therefor.

Referring more particularly to the drawings, the reference numeral 12 indicates an uncoiler for supporting a coil of strip 5. The strip passes from the uncoiler 12 through the electrolytic tinning line 4 into a looper pit 6, through measuring rolls 8 and shear 10 where the strip is cut into sheets S'. The prime sheets S' pass over a pair of belt conveyors 12 and 13, over a deflector gate 14 between the conveyors and into a prime sheet piler 16.

Defective sheets will be deflected by means of the deflector 14 into a reject piler 18. A light source 20 is provided above the strip S between the electrolytic tinning line 4 and the looper pit 6. A group of photocells 22 is arranged on the opposite side of the strip from the light source 20. An amplifier 24 is connected to photocells 22 with its output being connected to a magnetic impulser or marker 26 which produces a magnetic impulse to place a magnetic mark on the strip S adjacent the pin hole causing the impulse generated by photocells 22. The light source 20, photocells 22 and amplifier 24 are conventional equipment constituting a pin hole detector.

The magnetic impulser is located substantially in line with photocells 22, but is shown spaced therefrom for the purpose of illustration. Light sources 28 are arranged above the path of travel of sheets S' a short distance from the exit end of conveyor 12. Photocells 30 and 32 are arranged below the light sources 28. A magnetic impulse detector 34 is arranged on the same side of the path of travel of sheets S' as the photocells 30 and 32 and is located the length of one sheet from the photocell 30. For the purpose of clarity, the distances between photocells 30 and 32 and detector 34 are shown greater than their actual length. The magnetic impulse detector 34 is supported on a rack 36 which is mounted for movement toward and away from the photocell 30 in the guides 37. In order to have the distance between photocell 30 and magnetic impulse detector 34 equal to the length of one sheet the rack 36 is driven by means of a pinion 38 which is mounted on a shaft cut adjustment crank 40. Once the adjustment is made for a given speed and sheet length the rotating shear will not cause movement of pinion 38 and the position of detector 34 becomes stationary during the inspecting and shearing operations. It will be understood that other means may be provided for changing the position of the photocell 30 with respect to the magnetic impulse detector 34. The detector 34 is electrically connected to an amplifier 42 which in turn is connected to the grid 44G of a gas tube 44. The cathode 44C of tube 44 is connected to a resistor 46 and to an amplifier 48 which will amplify any magnetic impulse delivered thereto. The output of amplifier 48 is connected to the grid 50G of a gas tube 50. A D.C. power source 52 is connected to the plate 44P through a resistor 54 and to the plate 50P through a relay coil 56 which is provided with normally open contacts 56C. The contacts 56C are connected in series with a power source 58 and a solenoid 60 which operates the deflector gate 14. The photocell 30 is connected to an amplifier 62 which in turn is connected to the plate 44P. The photocell 32 is connected to an amplifier 64 which in turn is connected to the plate 50P.

The operation of the device is as follows: The magnetic impulse detector 34 is automatically located the length of one sheet from the photocell 30 by means of the mechanism 36, 38 and 40. As the strip passes under the light source 20 nothing happens until a pin hole occurs. When this happens an impulse from photocells 22 is amplified by the amplifier 24 and will cause the magnetic impulser 26 to magnetize the sheet adjacent the hole for a length of perhaps two inches. This impulse is carried with that section of strip after it is sheared and will be detected by the pick-up head or impulse detector 34. The impulse from detector 34 is fed to the amplifier 42 where it is amplified and transmitted to the grid 44G of tube 44 which is normally held non-conducting by a bias voltage provided by amplifier 42. The pulse on the grid 44G will cause tube 44 to conduct current from power source 52 through resistors 48 and 54. This will produce a positive pulse of voltage at the cathode 44C and at the input of amplifier 48. The amplifier 48 will amplify and invert this pulse so that a negative pulse is impressed on the grid 50G of tube 50 which is normally held non-conducting by a bias from amplifier 48. This negative pulse will not affect the tube 50 but it will remain stored by reason of tube 44 until the leading edge of the marked sheet passes photocell 30 when a pulse will be generated as a result of the cutting off of the light from light source 28 and will be amplified in amplifier 62. This pulse will be transmitted as a negative pulse from amplifier 62 to the plate 44P and it is of sufficient magnitude to drive the plate potential below the cathode potential, thus extinguishing the tube 44. This will stop
the current flow in resistor 46 and result in a negative pulse input to amplifier 43 which in turn will transmit a positive pulse to the grid \(50G\) and cause the tube \(50\) to fire. When tube \(50\) fires current passes from the power source \(S2\) through relay coil \(56\) and thus closing contacts \(56C\).

This will energize the solenoid \(60\) causing the gate \(14\) to open and deflect the deflecting sheet into the pile \(18\). When the trailing end of the bad sheet passes the photocell \(32\) a pulse is generated which will be amplified in amplifier \(64\). The amplified pulse is transmitted to the plate \(50P\) as a negative pulse which extinguishes the tube \(50\), thus de-energizing relay coil \(56\) and solenoid \(60\). De-energization of solenoid \(60\) causes gate \(14\) to close. The photocell \(30\) is mounted close to photocell \(32\) so that the sheet must move nearly its complete length before the deflector gate \(14\) closes.

In place of applying a magnetic mark to the strip \(S\) any other type of marking which is capable of remaining on the strip may be applied. For example, colored, quick drying material could be applied to the strip and a detector designed for color sensitivity could be substituted for the magnetic detector \(34\).

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

We claim:

1. Apparatus for inspecting and classifying flat products which comprises a pin hole detector, means for passing the flat product in strip form through the pin hole detector, marker actuated by said pin hole detector when a pin hole appears in the strip for applying a mark to the strip adjacent the pin hole, a sheaf for cutting the strip into sheets, a mark detector adjacent the path of travel of the sheets, a deflector located along the path of travel of the sheets beyond said detector, a photocell located approximately the length of one sheet from said detector on the side thereof adjacent said deflector, means for actuating said deflector when one end of a sheet with a mark thereon cuts off light to said photocell to deflect said sheet out of the normal path of travel, said circuit including means for storing a signal from said detector in response to the said mark on the marked sheet passing the detector, and means connecting said photocell to said last named means to deactivate said means for storing a signal when the leading edge of the marked sheet reaches said photocell so that said deflector actuating means in actuated.

2. Apparatus for inspecting and classifying flat products according to claim 1 including a second photocell located between said detector and first photocell, and means connected to said second photocell and actuated by the trailing edge of said last named sheet for returning said detector to its normal position after the last named sheet has passed thereby.

3. Apparatus for inspecting and classifying flat products according to claim 1 including means responsive to the length of said sheets for adjusting the position of said detector along the path of travel of the sheets.

4. Apparatus for inspecting and classifying flat products according to claim 3 including a second photocell located between said detector and first photocell, and means connected to said second photocell and actuated by the trailing edge of said last named sheet for returning said detector to its normal position after the last named sheet has passed thereby.

5. Apparatus for sorting sheets some of which have a mark thereon comprising means for conveying said sheets end to end in spaced relationship, a mark detector adjacent the path of travel of said sheets, a detector located along the path of travel of the sheets beyond said detector, a photocell located approximately the length of one sheet from said detector on the side thereof adjacent said deflector, means for actuating said deflector, and a circuit for actuating said last named means when one end of a sheet with a mark thereon cuts off light to said photocell to deflect said sheet out of the normal path of travel, said circuit including means for storing a signal from said detector in response to the said mark on the marked sheet passing the detector, and means connecting said photocell to said last named means to deactivate said means for storing a signal when one end of the marked sheet reaches said photocell so that said deflector actuating means is actuated.

6. Apparatus for sorting sheets according to claim 5 including a second photocell located between said detector and first photocell, and means connected to said second photocell and actuated by the trailing edge of said last named sheet for returning said detector to its normal position after the last named sheet has passed thereby.

7. Apparatus for inspecting and classifying flat products which comprises a pin hole detector, means for passing the flat product in strip form through the pin hole detector, a marker actuated by said pin hole detector when a pin hole appears in the strip for applying a mark to the strip adjacent the pin hole, a sheaf for cutting the strip into sheets, a mark detector adjacent the path of travel of the sheets, a deflector located along the path of travel of the sheets beyond said detector, a photocell located approximately the length of one sheet from said detector on the side thereof adjacent said deflector, electrical means for operating said deflector to divert a sheet from its normal path of travel, an electronic tube for controlling flow of current to said last named means, said electronic tube including a grid, means connected to said mark detector for applying a negative pulse to the grid of said tube when a sheet with a mark so applied thereon passes said detector, and means including part of said last named means connecting said tube and said photocell for applying a positive pulse to the grid of said tube to fire said tube when the leading edge of said last named sheet cuts off light to said photocell whereby the said sheet is deflected out of the normal path of travel.

8. Apparatus for inspecting and classifying flat products according to claim 7 including a second photocell located between said detector and first photocell, means connected to said second photocell and actuated by the trailing edge of the said marked sheet for applying a negative pulse to the plate of said tube to extinguish the same and open the circuit to said electrical means to return said detector to its normal position after the last named sheet has passed thereby.

9. Apparatus for inspecting and classifying flat products which comprises a pin hole detector, means for passing the flat product in strip form through the pin hole detector, a marker actuated by said pin hole detector when a pin hole appears in the strip for applying a mark to the strip adjacent the pin hole, a sheaf for cutting the strip into sheets, a mark detector adjacent the path of travel of the sheets, a deflector located along the path of travel of the sheets beyond said detector, a photocell located approximately the length of one sheet from said mark detector on the side thereof adjacent said deflector, electrical means for operating said deflector to divert a sheet from its normal path of travel, an electronic tube for controlling flow of current to said last named means, said electronic tube including a grid, means connecting said tube and said photocell for applying a positive pulse to the grid of said tube when a sheet with a mark so applied thereon passes said detector, said impulse causing said second tube to conduct, means for applying a negative pulse to the grid of said first tube when the second tube conducts, means connected to said second tube for applying a negative pulse to the plate of said second tube to extinguish said tube when the leading edge of said last named sheet reaches said photocell, and said
means for applying a negative pulse being responsive to
the extinguishment of said second tube for applying a
positive pulse to the grid of the first tube to fire the same
and deflect the last named sheet out of the normal path
of travel.

10. Apparatus for inspecting and classifying flat prod-
ucts according to claim 9 including a second photocell
located between said detector and first photocell, means
connected to said second photocell and actuated by the
trailing edge of the said marked sheet for applying a nega-
tive pulse to the plate of said first tube to extinguish the
same and open the circuit to said electrical means to re-
turn said deflector to its normal position after the last
named sheet has passed thereby.

References Cited in the file of this patent

UNITED STATES PATENTS

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