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2,497,149

APPARATUS FOR HANDLING SHEETS DURING INSPECTION

Filed Dec. 21, 1943

2 Sheets-Sheet 1

FIG. 1.

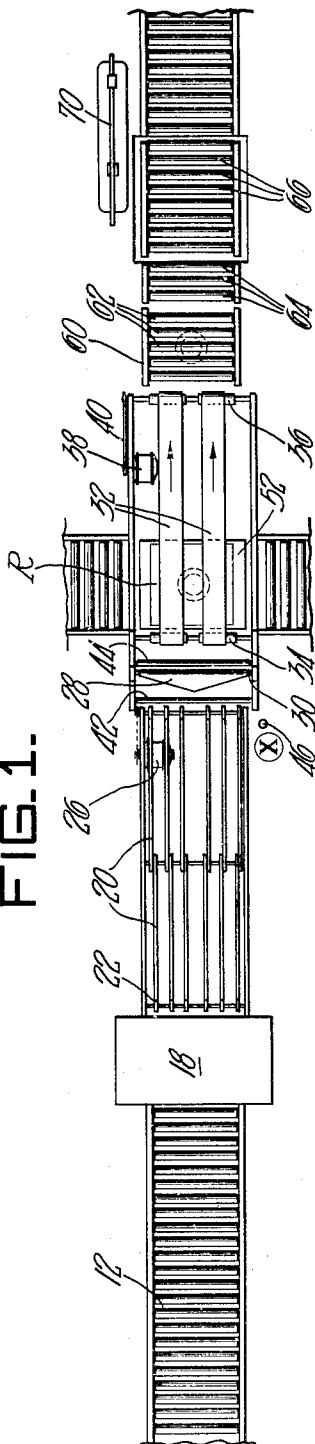
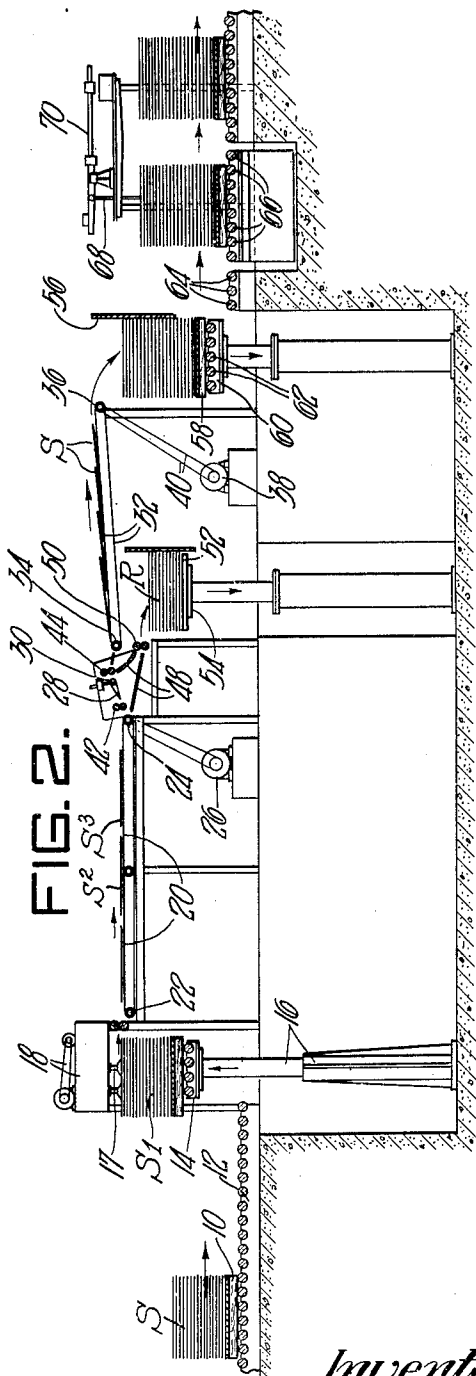


FIG. 2.



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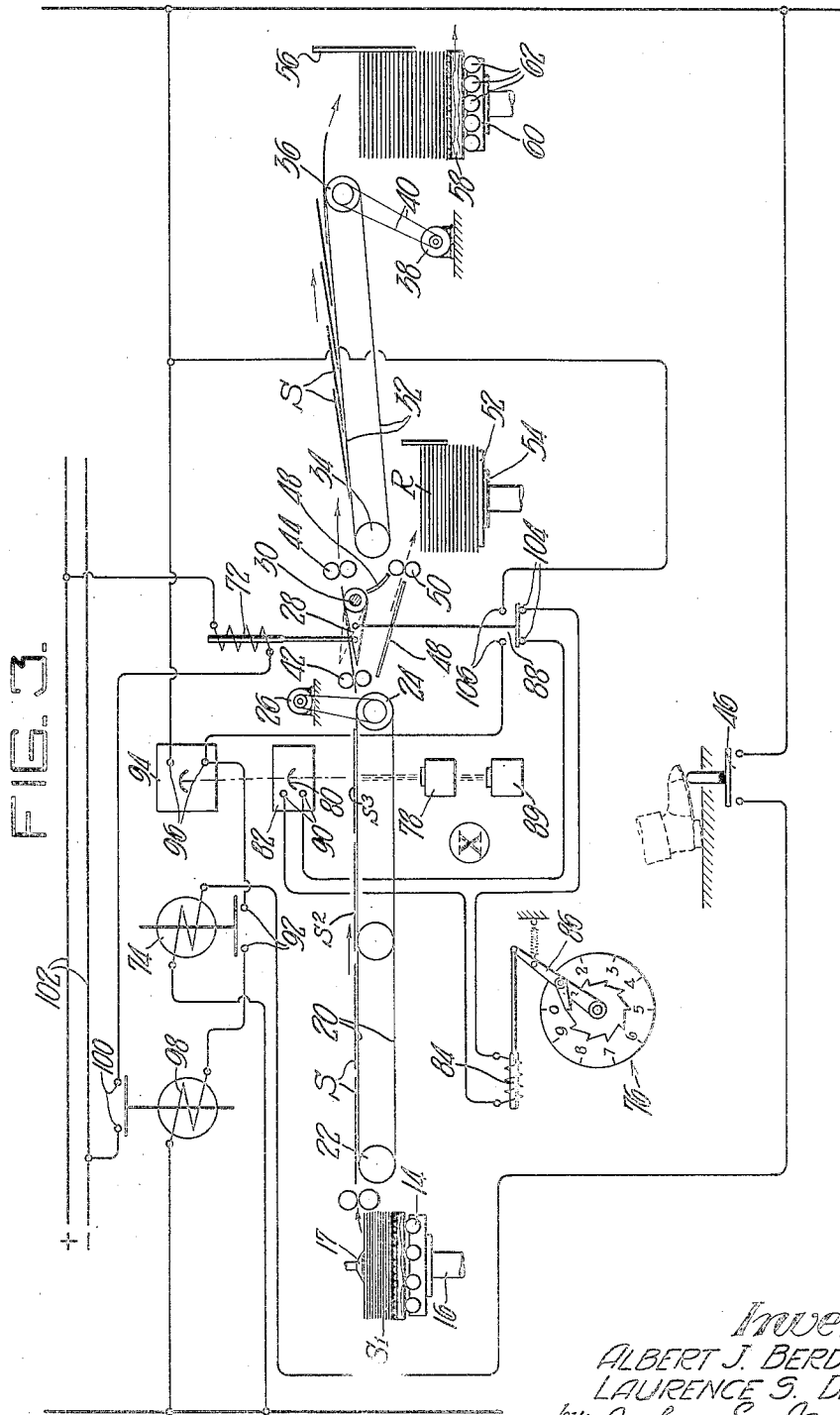
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APPARATUS FOR HANDLING SHEETS DURING INSPECTION

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5 Claims. (Cl. 235—98)

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The present invention relates to an improved method and combination of apparatus which makes possible the high-speed visual inspection of batches of metal sheets. While not limited thereto, our invention is peculiarly well suited for inspecting and classifying ferrous metal sheets which have been coated with a thin layer of tin.

In general, the invention involves feeding single sheets in succession from the top of a pile; moving the sheets in single file along a horizontal path to permit inspection; visually inspecting one side of the sheet, usually the top, as it passes horizontally; diverting off-grade sheets from said path; causing the good sheets to travel along said path in overlapping or shingled relation to facilitate piling; piling the good sheets in superposed relation, and automatically counting only the good sheets while they are en route to the station where they are piled.

The above described method is a marked improvement over the primitive method which has been employed for many years in most tin mills for the inspection of tin plate. The prior practice has generally involved the employment of a large force of girls working at a table or bench. A stack of several hundred tin-coated sheets is delivered to each girl, who visually examines the top surface of each sheet, moves it from the stack, then turns it over and examines the bottom surface, putting the prime sheets in one pile and the imperfectly coated sheets in another pile. This is a slow, laborious, and costly operation.

After the manual inspection and sorting of sheets heretofore practiced, they have been manually counted by a second operator and piled by hand into packages or bundles of the proper number for shipment. This double handling of the sheets results in additional possibility for damage and the method of counting is subject to error. By the use of our invention, the good sheets are automatically counted as they pass the inspection station, and this "count" is checked by the weighing step performed at the scale. Thus a more reliable determination is made of the number of sheets in a given batch or base box.

The present invention permits the high-speed mechanical handling of the sheets from the start of the operation to the finished sorting or weighing, and yet a critical visual inspection by the human eye is made possible.

For a full and complete understanding of all aspects of the invention, reference should be made to the accompanying drawings, the follow-

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ing detailed disclosure, and the appended claims.

In the drawings:

Figure 1 is a plan view on a greatly reduced scale, showing the chief components of suitable mechanism utilized in the practice of the novel method.

Figure 2 is a sectional elevation of the apparatus shown in Figure 1.

Figure 3 is a schematic diagram showing the essential elements of the mechanism used in carrying out our method and diagrammatically illustrating the control means which make possible the necessary coordination thereof.

Referring in detail first to Figures 1 and 2 of the drawings, a skid 10 carries a stack of sheets S which may be regarded as ferrous metal sheets coated with a layer of tin, although it will be understood, of course, that the herein claimed invention can be used for inspecting and sorting other types of material. The loaded skid is moved along a roller conveyor 12 and thus transferred to an elevator 14 adapted to be actuated by a hydraulic cylinder 16 so as to bring the topmost sheet to a position for operative engagement by pneumatic fingers 17 of a conventional feed mechanism 18 to transfer it to a conveyor belt 20 trained around pulleys 22 and 24. This belt conveyor is herein referred to as an inspection conveyor, and is preferably driven at a speed of 360 feet per minute by a motor 26. The feeding device 18 and pneumatic fingers 17 are of known construction. Suffice it to say that this conventional mechanism is capable of intermittently delivering sheets from the stack on the elevator 14 to the continuously driven inspection conveyor 20 in spaced relation, as shown in Figures 2 and 3. The elevator 14 is of known construction, and automatically feeds upwardly to keep the topmost sheet in position for proper coaction with the feeding fingers 17. As the sheets pass an inspection station indicated by the circled X in Figure 1, an inspector observes the condition of the coating on the upper side thereof.

If the surface of the sheet is satisfactory, no action need be taken by the inspector, and the sheet therefore travels over the top surface of a deflector gate 28 which is mounted for pivotal movement on a shaft 30. Thus the prime or good sheets are fed to a lapping or carry away conveyor 32 trained over pulleys 34 and 36. The conveyor 32 is driven by motor 38 and belt 40, and its speed is from 40 to 50 per cent of the speed of the inspection conveyor. This speed differential causes the trailing end of each sheet to be overlapped in shingled relation by about 40 to 50 per

cent of the length of the leading end of the following sheet. The transfer of sheets past the gate 28 is effected by suitably driven pinch rolls 42 and 44. With the gate in the position illustrated in full lines in Figure 3, both pairs of pinch rolls 42 and 44 serve to feed the sheet to the conveyor 32. When the inspector detects an imperfect or rejectable sheet, he steps on a push button 46, hereinafter more fully referred to, for closing a circuit through an operating solenoid, which causes the gate 28 to rock clockwise to the dotted line position of Figure 3. With the gate in this position, the pinch rolls 42 will feed the rejected or imperfect sheet to the space between guide members 48, thus directing it to pinch rolls 50 which feed the sheet onto the reject pile R. This pile rests on a skid 52 supported by a hoist platform 54 adapted to be actuated by any suitable means.

The overlapped sheets traveling on the conveyor 32 are finally discharged, strike a stop plate 56 and thus are deposited on the skid 58 supported by a hoist platform 60. The platform 60 carries suitable conveyor rollers 62 to facilitate the transfer of the pile of good sheets to a set of conveyor rollers 64 located between it and similar conveyor rollers 66 which constitute part of a scale platform. This scale platform is adapted to be connected in a conventional manner by a connecting link 68 with a scale beam 70 so as to facilitate the determination of the weight of the sorted stack of good sheets.

After the sheets are inspected on one side, the entire pile of sheets may be placed in a turnover device and the pile revolved 180° so that the other side of each sheet may be similarly inspected by passing them again through the inspection process. It is optional whether both sides are so inspected especially in the case of electrolytically tin coated sheets which usually have similar coating characteristics on both sides of the sheet.

Figure 3 diagrammatically shows the essential elements of the apparatus used in carrying out the herein claimed invention, and illustrates the manner of coordinating this apparatus by the use of certain electrically controlled instrumentalities now to be more fully described.

The deflecting gate 28 is actuated by a gate solenoid 72. The energization of this solenoid 72 is under control of the foot-actuated push-button switch 46, and it is also under partial control of a photoelectrically controlled gate set-up relay 74, these controls being more fully referred to hereinafter. Within the range of vision of the inspector located at station X is a conventional form of counter such as shown at 76. Each time a sheet passes the inspection station, a beam of light from a light source 78 passes through the space between the two sheets on the inspection conveyor, thus transmitting an impulse to a photoelectric cell 80 which is the light-sensitive element of a relay indicated as a whole at 82. This relay 82 controls the circuit of a solenoid 84 or an equivalent electromotive device which has an operative mechanical connection, as diagrammatically indicated at 86, for imparting a counting impulse to the pawl and ratchet feed of the counter 76. An interlock switch indicated generally at 88 is operatively associated with the gate 28 and is so arranged that when the gate is moved to a position to reject a sheet, there will be no counting impulse transmitted to solenoid 84. Thus the net result is that only prime or good sheets are counted.

A light source 89 is adapted to direct a beam of

light to the gate control relay 94 later referred to. Thus it will be understood that the light-sensitive relays 94 and 82 cooperate with the light sources 78 and 89 to control respectively the counting operation and the operation of the classifier or sorting gate. These two relays 94 and 82 in practice are located transversely in alignment or crosswise of the conveyor, and in Figure 3, for convenience of illustration, we have shown one above the other in the same vertical line.

The counting operation is effected by the light beam passing through the space or gap between each sheet, thus causing the light-sensitive tube or cell 80 in the relay 82 to operate the latter. Thus relay 82 closes a circuit across its contacts 90, energizing counter-actuating solenoid 84, thereby imparting a counting impulse to the counter 76. Thus only the good or prime sheets that pass over the sorter gate 28 are counted while en route to the lapping conveyor 32. The rejects or bad sheets are diverted to the reject pile R, when the inspector presses his foot down on the push-button 46. When this push-button is operated, the gate set-up relay 74 closes a circuit across contacts 92. The relay 94 causes contacts 96 to close after light is admitted thereto from the light source 89. A known form of time delay is incorporated in the relay 94, so that the closing of the circuit across contacts 96 is delayed for the interval of time required for the forward end of the sheet to almost reach the gate 28 before the circuit is closed at contacts 96. After the circuit is closed at contacts 96, gate-opening relay 98 is energized, closing a circuit across contacts 100, thus completing a circuit through gate-operating solenoid 72 from direct current supply lines 102. Thus the deflector gate is raised to direct a bad sheet to the reject pile R. When the gate is thus actuated, movement is transmitted mechanically to the switch indicated generally at 88. The contacts 104 of this switch, when opened by the deflecting movement of the gate, open the circuit of counter-actuating solenoid 84, thus preventing the counting of bad sheets. The switch also includes an additional set of contacts 106 which are included in a shunt connection around the contacts 96 of the relay 94. This arrangement permits the operator to hold the gate open to direct any desired number of sheets to the reject pile merely by keeping his foot on the push-button 46.

The circuit arrangements illustrated also permit the rejecting of a single sheet by momentarily depressing the push-button 46. This action is obtained by using relays with an adjustable time-delay action so that they will remain closed for a definite time and open after the lapse of a predetermined time interval. Such time delay intervals are desirable to provide for the opening and closing of the gate in proper relation to the position of the sheet as it approaches the gate. These time delay devices are well-known pieces of electrical equipment obtainable from various manufacturers, and the details thereof are therefore not more fully shown and described herein.

In order for defective sheets to be rejected and not counted, in accordance with the novel method and apparatus herein claimed, each defective sheet, as designated at S² in Figure 3, must be inspected at a predetermined position (i. e., opposite inspection station X, Figure 3) on conveyor belt 20. When a defective sheet arrives at the inspection station at the predetermined position indicated at S², push button 46 is de-

pressed by the operator. This actuates gate set-up relay 74, closing a circuit across contacts 92. When sheet S³, which represents a good sheet, has passed the light ray from source 78, photocell 80 is energized by the projected light beam, thus closing contacts of relay 82 and completing a circuit through the counter-actuating solenoid 84 and contacts 104 of switch 88. In this manner, sheet S³, being a good sheet, is counted. Simultaneously, photoelectric cell 94 is energized from light source 89 after sheet S³ has cleared the light beam. However, photocell 94 is equipped with a time delay device which delays closing of contacts 96 until the tail end of each sheet has passed through feed rolls 42. At this time, contacts 96 close, completing a circuit through contacts 92 and gate opening relay 98. Energizing of relay 98 closes contacts 100, which in turn energizes gate opening solenoid 72, causing deflector gate 28 to raise. As previously stated, good sheet S³ has passed through feed rolls 42 before the above circuits are completed, and with the raising of gate 28 to the dotted position of Figure 3, defective sheet S² is deflected into the reject pile. When the tail end of defective sheet S² has cleared the light path of light source 78, photoelectric cell 80 is energized. However, the circuit of counter solenoid 84 has been broken by raising of gate 28, since the gate is mechanically connected to switch 88 and any upward motion of this mechanical connection opens the circuit at contacts 104, thus interrupting the counter circuit. In this manner, despite the fact that cells 80 and 94 are simultaneously exposed to light, cell 80 cannot close the circuit of counter solenoid 84 when the deflector gate 28 is in the dotted line position of Figure 3 to direct sheets into the reject pile. Hence only good sheets are counted.

All of the individual units of apparatus shown herein are of well-known and conventional design, and no claim is made herein for any such units per se. Our invention resides particularly in the novel combination of apparatus and the method performed thereby. In short, the claimed invention is directed to a novel sequence of steps which are carried out by a novel combination of conventional units of apparatus. Although the combination of apparatus shown and described has been demonstrated by actual use to be highly desirable, the embodiment illustrated and described is merely an example, and it is within the scope of the appended claims to use other equivalent apparatus.

We claim:

1. In combination, an inspection conveyor, means for delivering sheets thereto singly and in spaced relation, a lapping conveyor for delivering sheets to a sheet piler, sheet-feeding means between the inspection conveyor and the lapping conveyor, means for driving the two conveyors at different speeds to cause the sheets delivered to the lapping conveyor to overlap one another, a deflector gate between said conveyors coacting with said sheet-feeding means and effective in one position to direct sheets to said lapping conveyor and in another position to direct sheets to a discharge station, an electrically powered device for moving said gate to said positions, manually operated means at an inspection station for controlling the actuation of said gate-moving device, an electrically actuated counter, a light-sensitive relay effective to control transmission of an impulse to operate said counter

each time a sheet passes the inspection station, and means operated by the movement of said gate for preventing such transmission of an impulse when the gate is moved to the position in which it directs a sheet to said discharge station, whereby only the sheets directed to the lapping conveyor by said gate are counted.

2. In combination, an inspection conveyor, means for delivering sheets thereto singly and in spaced relation, a lapping conveyor for delivering sheets to a sheet piler, sheet-feeding means between the inspection conveyor and the lapping conveyor, means for driving the two conveyors at different speeds to cause the sheets delivered to the lapping conveyor to overlap one another, a deflector gate between said conveyors coacting with said sheet-feeding means and effective in one position to direct sheets to said lapping conveyor and in another position to direct sheets to a discharge station, an electrically powered device for moving said gate to said positions, a manually operated push-button, means in a circuit controlled by the push-button controlling the energization of said gate-moving device, a counter, an electrically powered device for actuating the counter, a light-sensitive relay controlling said counter-actuating device, and means actuated by said gate controlling the circuit of said relay so that a counting impulse is transmitted to the counting mechanism only when the gate is in a predetermined position.

3. In combination, an inspection conveyor, means for delivering sheets thereto singly and in spaced relation, a lapping conveyor for delivering sheets to a sheet piler, sheet-feeding means between the inspection conveyor and the lapping conveyor, means for driving the two conveyors at different speeds to cause the sheets delivered to the lapping conveyor to overlap one another, a deflector gate between said conveyors coacting with said sheet-feeding means and effective in one position to direct sheets to said lapping conveyor and in another position to direct sheets to a discharge station, a solenoid adapted to move the gate, a gate set-up relay, a gate-opening relay, a light-sensitive gate-control relay, an electrical counter-actuating device, a light-sensitive counter-controlling relay, a gate-actuated switch having one set of contacts in circuit with the power source for said gate-control relay and another set of contacts controlling the circuit to said counter-controlling relay, said last-named relay having a pair of contacts controlling a circuit including said counter-actuating device, and a manually operated switch controlling a circuit for energizing said gate set-up relay, the gate set-up relay having a pair of contacts in a circuit controlling the energization of said gate-opening relay.

4. The apparatus defined by claim 2 characterized by said counting mechanism including an energizing circuit and said last-mentioned means being a switch in said circuit operated by said gate.

5. Sheet-inspection and classifying apparatus comprising a substantially horizontal inspection conveyor, a carry-away conveyor in alignment therewith but spaced therefrom, a deflector gate pivotally mounted between said conveyors for tilting movement between two positions, adapted in one position to guide sheets onto the carry-away conveyor and in the other to divert them to a piler therebelow, means for operating the gate from one position to the other, manual control

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means for the gate-operating means, counting mechanism normally actuated by the passage of sheets along the inspection conveyor and a switch actuated by the gate effective to suspend operation of the counting mechanism temporarily.
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