May 2, 1950 A. E. KADELL 2,506,087

APPARATUS FOR INSPECTING AND SORTING SHEETS

Filed March 31, 1945 2 Sheets-Sheet 1

Fig. 1A

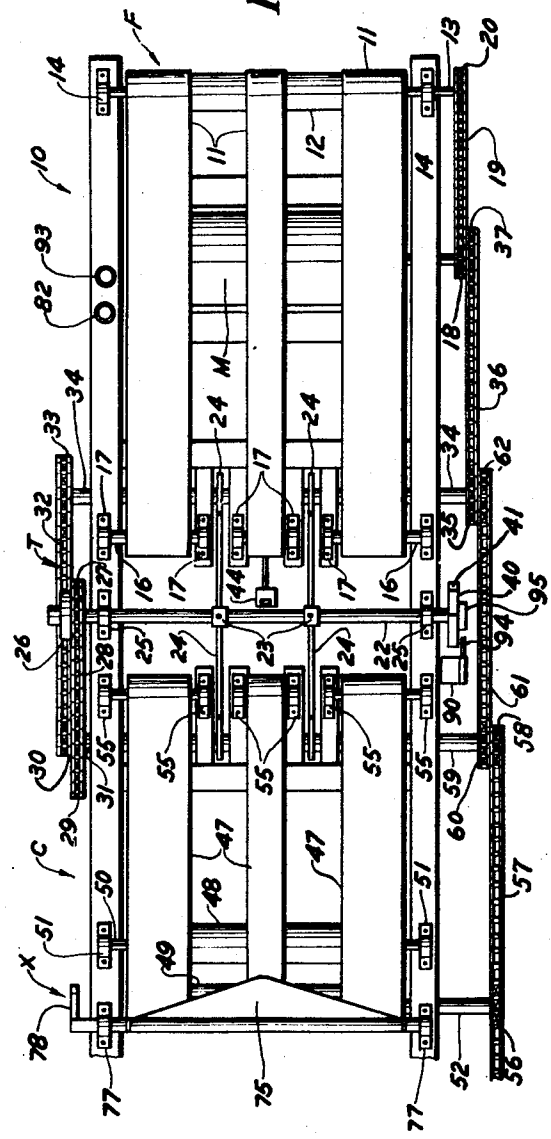
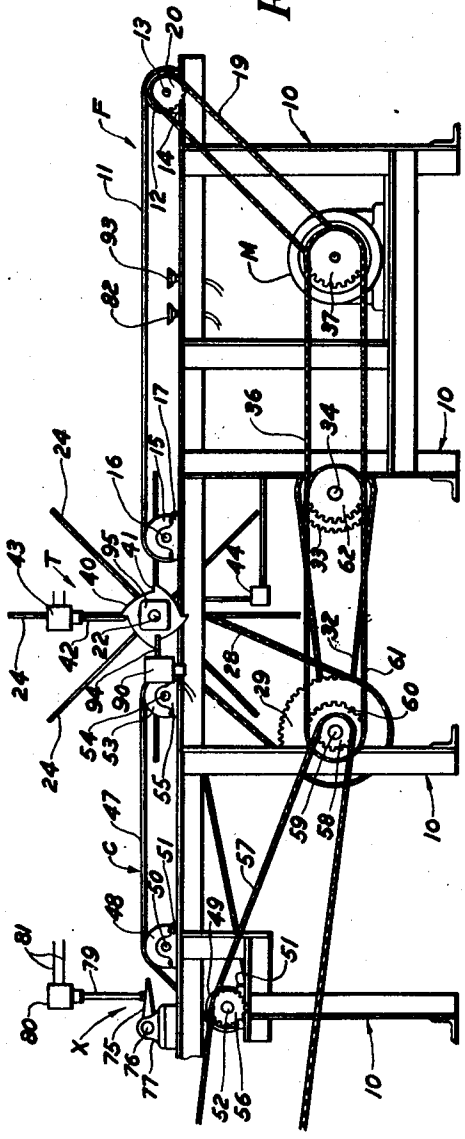


Fig. 2A



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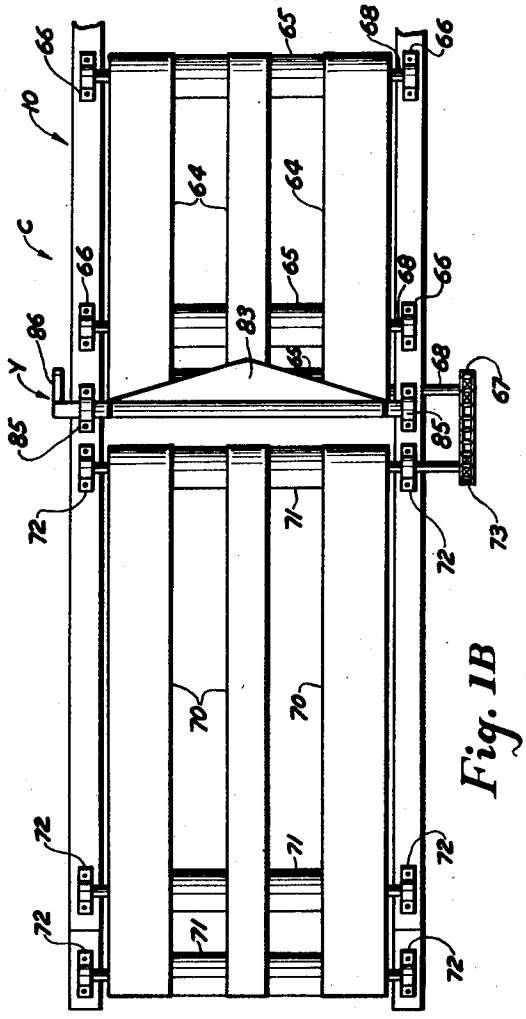


Fig. 1B

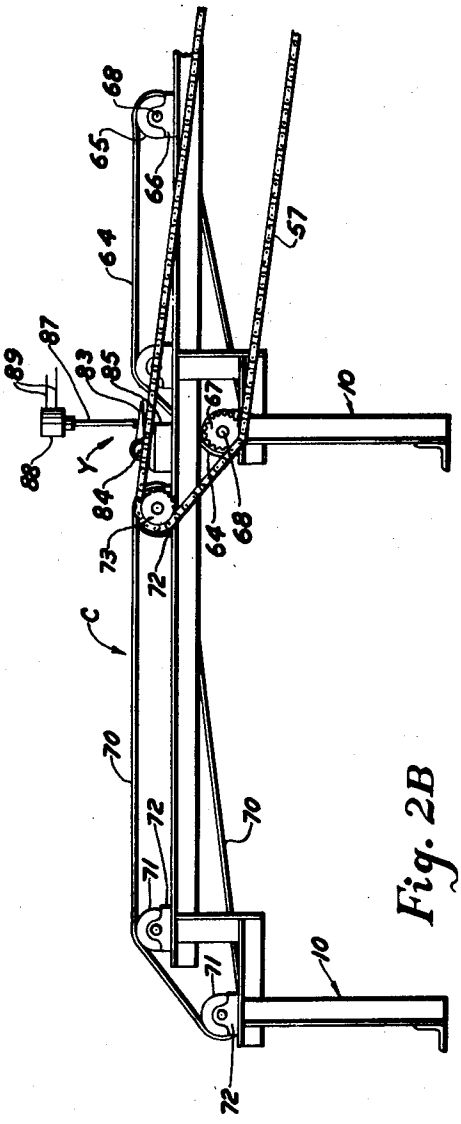


Fig. 2B

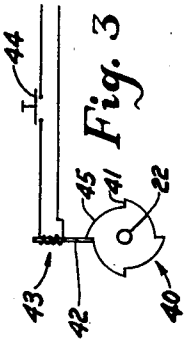


Fig. 3

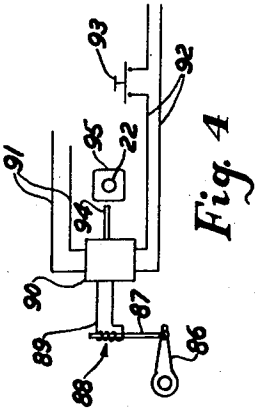


Fig. 4

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# UNITED STATES PATENT OFFICE

2,506,087

## APPARATUS FOR INSPECTING AND SORTING SHEETS

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Application March 31, 1945, Serial No. 585,988

8 Claims. (Cl. 214—11)

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This invention relates to apparatus for inspecting and sorting sheets, for example tin plate, and more particularly relates to such an apparatus for successively turning the sheet to permit visual inspection of the opposite faces of each sheet and for then sorting the sheets according to grade or quality.

In the manufacture of tin plate, sheets are produced of different grades and the sheets must be inspected and sorted into, for example, three groups comprising prime sheets which are substantially free from flaws; "menders" which contain imperfections but which can be salvaged by reprocessing or other treatment; and scrap which is detinned. Such sheets often are inspected by workers who manually turn each sheet to inspect both sides and then sort the sheet into piles according to grade. Machines have been used to a certain extent to inspect and sort such sheets but in general, these machines are relatively complicated and expensive and are often difficult to operate.

While the present invention will be described in connection with inspecting and sorting tin plate, the invention is not limited to such material and can be used for inspecting and sorting self-sustaining sheets of other materials such as steel, paper and the like.

It is an object of this invention to provide an improved machine for rapidly and accurately inspecting and sorting a succession of sheets; to provide such a machine which includes an improved mechanism for turning and exposing both sides of the sheet to view for inspection; to provide such a machine which includes an improved arrangement for sorting the sheets after being inspected; to provide such a machine including improved control means; and to provide such a machine which is economical to construct and which can be operated by one person.

The present invention provides a machine including a conveyor for delivering a succession of single sheets to a turning mechanism which turns and exposes both sides of the sheets to view and which is automatically operated by movement of a sheet into position to be turned. The sheets are successively moved away from the turning mechanism along a path and deflector means are provided for selectively deflecting the sheets from the path of normal movement. Improved control means are provided for actuating the deflecting means so that the sheets can be more readily and rapidly sorted into groups according to grade.

These and other objects and advantages will become more apparent from the following de-

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tailed description taken with the accompanying drawings, in which:

Figures 1—A and 1—B together are a plan view of a machine embodying the principles of the present invention;

Figures 2—A and 2—B together are a side elevational view of the machine of Figures 1—A and 1—B;

Figure 3 is a schematic representation of means for controlling the operation of the sheet turning mechanism of the machine of Figures 1—A and 1—B; and,

Figure 4 is a schematic representation of the control means for operating one of the sheet sorting deflectors of the machine of Figures 1—A and 1—B.

Referring to the drawings which show a preferred embodiment of the invention, the apparatus comprises a conveyor F for successively feeding a plurality of single sheets of the same and different grades of tin plate to a sheet turning mechanism T which turns and exposes both sides of each sheet for inspection. After being inspected, the sheets are deposited on a second conveyor C which moves them away from the mechanism T and along a path. Both of the conveyors F and C and the sheet turning mechanism T are driven by a single electric motor M. Two deflector mechanisms X and Y are interposed between sections of the conveyor C for selectively deflecting sheets of certain grades from their normal path of movement, and are controlled by the operator while located adjacent the turning mechanism T and in position to observe the quality of the sheets as they are turned. The sheets may be successively fed onto the conveyor F by any suitable sheet feeding apparatus, not shown, or the sheets may be placed on the conveyor F by hand, though manually feeding the sheets is undesirable because of the additional labor required. The positioning of conveyor F at the discharge end of a tinning and branning machine, in the case of hot dip tin plate, or at the discharge end of a shearing line, in the case of electrolytic tin plate, will result in the most economical handling of the plate.

The conveyor F is supported by the machine frame 10 and includes three spaced, relatively narrow belts 11, all of which extend about a single wide roll 12 mounted on a shaft 13 rotatably supported in bearings 14 on base 10. The opposite end of each of the belts 11 extends about a separate, relatively narrow, corresponding roll 15 mounted on a shaft 16 supported in a pair of bearings 17 on frame 10. A sprocket 18 mounted

on the shaft of motor M is connected to a sprocket 20 keyed to shaft 13 by a chain 19 so that as the motor M rotates in a counter-clockwise direction, the shaft 13 rotates in the same direction to move a sheet placed on the belts 11 of conveyor F toward the left to the sheet turning mechanism T.

The sheet turning mechanism T is intermittently rotatable and comprises a shaft 22 having fastened thereon two spaced sheet holders 23, each of which includes a hub portion and eight radially extending arms 24 spaced apart 45°. The radial arms 24 extend between belts 11 and two of the radial arms are so positioned as to receive a sheet moving along the conveyor F. The shaft 22 is rotatably mounted in a pair of bearings 25 on the frame 10. A slip clutch 26 is mounted on and connected to shaft 22 and one side of the slip clutch 26 is fastened to a sprocket 27. The sprocket 27 is not directly connected to shaft 22 and is connected by chain 28 to sprocket 29 on shaft 31. Shaft 31 is connected by sprocket 30 and chain 32 to sprocket 33 on shaft 34 which has a sprocket 35 mounted on its opposite end and connected through chain 36 to sprocket 37 on the shaft of motor M. Normally the motor M runs continuously and continuously applies torque through the slip clutch 26 to the shaft 22. The amount of torque tending to turn shaft 22 and holders 23 can be varied by adjusting slip clutch 26.

Referring more particularly to Figures 1—A, 2—A and 3, the means for controlling the intermittent rotation of the turning mechanism comprises a ratchet-shaped cam 40 with four notches 41 that is connected to shaft 22. Normally, the lower end of a rod 42 engages one of the cam notches 41 and serves as a pawl to prevent turning of shaft 22. The rod 42 is connected to a solenoid 43 which is energized by the closing of switch 44 to raise the rod 42 and permit shaft 22 to rotate in a counter-clockwise direction. The switch 44 is so positioned that when a sheet is moved by belts 11 into position to be raised by a pair of the radial arms 24, the sheet engages the switch 44 to close the switch and energize solenoid 43 to release the cam 40. As the shaft 22 starts to turn, the holders 23 move the sheet upward and away from switch 44 which permits it to open and de-energize solenoid 43 so that the rod 42 drops down and the lower end rides on one of the four smooth surfaces 45 until the rod engages the next notch 41 after the shaft 22 has rotated 90°. When the holders 23 and shaft 22 turn 90°, the sheet is turned on edge and the momentum causes the sheet to tip over against the next pair of radial arms 24 so that actually each sheet turns 135° instead of 90° which permits easy inspection of the sheet. When the next successive sheet engages switch 44, the shaft 22 again turns and deposits the first sheet on the conveyor C after rotating through about 45° and turns the second sheet through about 135°, as previously described. It will thus be apparent that alternate pairs of arms 24 are lifting arms which lift the sheets off conveyor F and are each followed by a pair of supporting arms which act to receive a sheet and support the same in an inspection position 135° away from the position of the sheets on conveyor F. This is due to the fact that when a sheet is lifted off conveyor F by a pair of lifting arms and movement of the lifting arms ceases after a 90° increment, the sheet is thrown forward by its own momentum to be received and supported upon the pair of supporting arms ahead of this pair of lifting arms.



In this position, the sheet is inclined so that an inspector located at an inspecting station where sheets on conveyor F can be inspected can easily inspect the opposite side of the sheet in the inclined inspection position. In the operative sense, therefore, each pair of lifting arms 24 and the associated supporting arms 24 following them in direction of rotation form unitary arm means acting in the combination to lift the sheets on their forward sides and to support the sheets in an inclined inspection position on their rear sides.

The conveyor C comprises three sections and the first section includes three spaced belts 47 which extend about two relatively wide rolls 48 and 49. Roll 49 is mounted on shaft 50 rotatably supported in bearings 51 and roll 49 is mounted on shaft 52 rotatably supported in similar bearings on frame 10. The opposite end of each belt 47 extends about a separate, relatively narrow, corresponding one of three rolls 53, each of which is mounted on a shaft 54 rotatably supported in a pair of bearings 55. A sprocket 56 on shaft 52 engages chain 57 which is driven by sprocket 58 on shaft 59. A second sprocket 60 keyed to shaft 59 engages a chain 61 which is driven by sprocket 62 on shaft 34. Shaft 34 is driven by the motor M in the manner hereinbefore described so that as the motor M rotates in a counter-clockwise direction, sprocket 56 rotates in a similar direction. The second section of the conveyor C includes three belts 64 extending about three similar, relatively wide rolls 65 each of which is mounted on a shaft 68 rotatably supported in a corresponding pair of bearings 66 on frame 10. A sprocket 67 is mounted on one of the shafts 68 as is shown more clearly in Figures 1—B and 2—B. The sprocket engages the chain 57 and is driven by the motor M. The third and last section of the conveyor C comprises three belts 70 extending around three similar rolls 71, each rotatably mounted in bearing 72 on frame 10. A sprocket 73 is mounted on one of the shafts of one of the rolls 71 and engages the chain 57 so that the motor M rotates the sprocket 73 and drives the belts 70.

Additional similar sections can be added to conveyor C or the number of sections can be reduced depending on the number of grades into which the plates must be sorted, all as more fully hereinafter described.

Between the first and second sections of the conveyor C there is provided a deflector mechanism X which can be tilted to deflect a sheet moving along the conveyor C downwardly between the sections of the conveyor into a pile or container therebelow or which can be positioned, as shown more clearly in Figures 1—B and 2—B, to permit the sheet to continue along the conveyor C. The deflector mechanism X comprises a blade 75 mounted on a shaft 76 supported in bearings 77 on frame 10. An arm 78 is mounted on one end of the shaft 76 and is connected to the lower end of a rod 79 of solenoid 80. Solenoid 80 is connected through wires 81 to a push button switch 82 which is connected to a source of electric current and which is located so as to be readily accessible to the operator standing at the inspection station. When the push button 82 is closed, the solenoid 80 is energized to lift the deflector blade 75 and deflect a sheet or sheets moving along on the belts 47 downwardly between the first and second sections of the conveyor. When the push button 82 is released, the solenoid 80 is de-energized and the deflector blade 75 returns to the position shown in the drawing to permit

movement of a sheet along the conveyor C and its path of travel without interference.

The deflector mechanism Y, which is located between the second and third sections of the conveyor C, comprises a deflector blade 83 mounted on shaft 84 supported in bearings 85 on frame 10. An arm 86 is fastened to shaft 84 and is also connected to the lower end of rod 87 of solenoid 88. The solenoid 88 is connected by wires 89 to a time delay mechanism 90, as shown diagrammatically in Figure 4. The adjustable time delay mechanism 90 is connected by wires 91 to a source of electric power and is also connected through wires 92 to a push button 93 located adjacent push button 82. The time delay 90 includes a switch arm 94 extending toward a square cam 95 on shaft 22, and is so constructed and arranged that the end of the arm 94 is moved to close a switch in the mechanism 90 by movement of a corner of the cam 95 into engagement with the arm 94. It is only when the switch 93 is closed and when a corner of the cam 95 engages the switch arm 94, that the circuit to mechanism 90 is completed. When the operator manually closes switch 93 and when the shaft 22 rotates to deposit the inspected sheet on the first section of the conveyor C, the time delay mechanism 90 is energized and after a predetermined period, which is the period required for a sheet to travel along on belts 48 and 64 to the deflector mechanism Y from the turning mechanism T, the solenoid 88 is energized for a brief period to raise the deflector blade 83 so that the sheet is deflected downwardly between the second and last sections of the conveyor C to a pile or container therebelow. The time delay means 90 is required because of the time interval a sheet takes in traveling along the conveyor C from the turnover mechanism T to the deflector mechanism Y and will only deflect one sheet unless the operator continues to press button 93 to deflect more than one sheet.

Any suitable time delay mechanism may be used and my invention is not limited to a particular type of relay. The time delay means may be similar to that shown and described in United States Patent No. 2,217,342, issued October 8, 1940, to A. G. Ladrach. The purpose of time delay means 90, or its equivalent, is to cause the deflector mechanism Y to be actuated after the control switch 93 is closed and a period after the sheet has been deposited on the conveyor C, this period being equal to the time required for a sheet to move from the turning mechanism to the deflector Y. Without the time delay means, the deflector mechanism Y would tend to deflect sheets other than the one which the operator intended to deflect.

When sheets are being sorted, the operator stands within reach of the push button switches 82 and 93 and in position to readily observe the sheets as they are successively turned to expose both sides of each for inspection after being fed one at a time onto the right hand end of the conveyor F. When each sheet is moved into position above two of the horizontal, radial arms 24 extending between belts 11, the sheet engages switch 44 to close it and energize solenoid 43 whereupon the shaft 22 turns to raise the sheet. As the sheet is raised, switch 44 opens and the previously mentioned horizontal, radial arms move the sheet to the vertical position where the momentum causes it to flop over where it is supported by the next pair of radial arms 24 so that the operator can readily inspect the bottom



surface of the sheet. The next sheet moving along conveyor F causes the turning mechanism to turn another 90° and turn this next sheet 135°, as previously described. The first sheet is deposited on the belts 47 of the first section of the conveyor C after the turning mechanism has rotated through 45°. If the first sheet is scrap, the operator presses button 82 as the sheet is deposited on the belts 47 to energize solenoid 88 and raise the deflector blade 77 so that the sheet, after moving along on belts 47, strikes blade 77 and is deflected downwardly between the first and second sections of the conveyor. If the sheet is a "mender," then the operator presses switch button 93 and when the turning mechanism rotates 45° so that switch arm 94 is actuated by cam 95 and the sheet is deposited on conveyor C, the circuit for time delay mechanism 90 is closed. The operator can release switch button 93 after the sheet has been deposited on the conveyor C. The sheet then moves along the conveyor C and approaches the deflecting mechanism Y and the time delay 90 automatically energizes solenoid 88 to tilt the deflector blade 83 upwardly at the proper moment so as to deflect the sheet downwardly between the second and third sections of the conveyor C. If the tin plate is a prime sheet, the operator does not press either one of the switches 89 or 93 and the plate moves along the conveyor C to the end of the conveyor where it is stacked with the other prime sheets. Thus, the operator can readily inspect both sides of the sheets and can readily sort them into groups according to grade.

Any suitable type of containers may be provided beneath the turning mechanisms X and Y and at the end of the conveyor C for receiving and stacking the sheets in condition for transportation to other locations.

Having described a preferred embodiment of my invention in detail, it is to be understood that various modifications may be made therein and that some features may be used without others, all without departing from the spirit and scope of my invention except as set forth in the accompanying claims.

I claim:

1. Apparatus for sorting sheets comprising means for turning such a sheet and exposing both sides of the sheet; means for moving a sheet along a path away from said sheet turning means; a deflector for deflecting a sheet from said path; a manually operable switch; and a second switch operable by said sheet turning means on turning a sheet, said switches being so connected to each other and to said deflector that only after both switches are closed does said deflector deflect a sheet from said path.

2. Apparatus for inspecting and sorting sheets comprising conveyor means for successively moving such sheets along a path; means for successively turning and depositing a series of such sheets on said conveyor means; deflector means disposed along said path for selectively deflecting sheets from said conveyor and said path; and control means operatively connected to said turning means and to said deflector means for actuating said deflector means a predetermined period after a selected sheet has been deposited on said conveyor, said control means including a manually operable switch and being so constructed and arranged that said deflector is actuated a predetermined period after both said switch is manually operated and said selected sheet has been deposited on said conveyor means.

3. Apparatus for inspecting and sorting a plurality of sheets according to grade, said machine comprising means for moving such sheets along a path; means for successively turning and exposing both sides of such sheets and for successively depositing such sheets on said sheet moving means; deflector means disposed in said path of movement at a distance from said turning means and operable to permit movement of a sheet along said path and operable to deflect a sheet from said path; control means operatively connected to said sheet turning means and including a time delay mechanism for operating said deflector means a predetermined period after a sheet has been deposited on said moving means, said period being substantially equal to the time required for a sheet to move along said path from said turning means to said deflector means; and a manually operated switch connected to said control means so that said control means only operates said deflector after said manually operated switch is closed.

4. Apparatus for sorting a plurality of sheets according to grade, said apparatus comprising, in combination, conveyor means for moving such sheets along a path; means operable to successively deposit such sheets on said conveyor means; deflector means disposed along said conveyor means and in said path of movement at a distance from said sheet depositing means, said deflector being movable to an inoperative position to permit movement of the sheets along said conveyor means and said path and being movable to a deflecting position to deflect a sheet from said path; and control means for controlling the movement and position of said deflector, said control means including, a time delay means, a manually operable switch connected to said time delay means, and a second switch operatively connected to said time delay means and to said sheet depositing means, said second switch being adapted to be closed by said sheet depositing means as it moves to a position to deposit a sheet on said conveyor, said control means being so constructed and arranged that said deflector means is moved to the deflecting position a predetermined period after both of said switches are simultaneously closed.

5. Apparatus for inspecting and sorting a succession of sheets according to grade, said apparatus comprising, in combination, means for successively delivering sheets to a sheet turning means and into a position to be turned; conveyor means for moving the sheets away from the turning means along a path; means disposed between said delivery means and said conveyor means for successively turning such sheets and depositing them on said conveyor means; switch means connected to said turning means and operable by a sheet when in the position to be turned to cause said sheet turning means to turn said sheet; deflector means disposed along the path of movement of said sheets away from said turning means; control means including a manually operable switch for said deflector means and operatively connected to said turning means, said control means being so constructed and arranged as to operate said deflector a predetermined period after operation of both said switch and said turning means to deposit a sheet on said conveyor means.

6. Apparatus for inspecting both surfaces of each of a succession of sheets comprising a first conveyor means for successively moving a series of sheets with one surface uppermost forwardly along a path to a position to be turned to expose the other surface to permit inspection of the other surface; a second conveyor means for removing the sheets; and sheet turning means between said two conveyor means for successively lifting each sheet from the position to be turned and for turning the sheet through an arcuate path to expose the opposite surface of the sheet uppermost and for then depositing the sheet on the second conveyor, said sheet turning means including a shaft rotatable about an axis located in a plane parallel with the path of sheet travel, said axis extending in a direction normal to the path of sheet travel, power actuated means for intermittently rotating the shaft at a predetermined speed and in angular increments of 90 degrees each, a plurality of radially extending sheet lifting and supporting arm means angularly spaced apart about the shaft, the plurality of arm means including sheet lifting arm means angularly spaced 90 degrees apart about the shaft, each successively occupying a position to lift a sheet from the position to be turned and to turn the sheet upon rotation of the shaft, and a sheet supporting arm means adjacent and at an acute angle in advance of each sheet lifting arm means, first control means operable on movement of each successive sheet into position to be turned to cause the power actuated means to rotate the shaft and cause the arm means in lifting position to lift and turn the sheet which operated the first control means, and second control means operable upon rotation of the shaft through 90 degrees to stop the shaft, the speed and the angle of rotation of the shaft being such that upon stopping the shaft the momentum of the lifted sheet turns the sheet into engagement with the supporting arm means adjacent and at an acute angle in advance of the lifting arm means which lifted the sheet, the supporting arm means adjacent to and in advance of each sheet lifting arm means being in position upon stopping of the shaft by the second control means to engage the turning sheet and support the sheet in an inclined position with the opposite surface facing upwardly and toward the first conveyor means to permit inspection of this opposite surface, the position of the sheet and its supporting arm means being such that rotation of the shaft through the next increment will deposit the lifted sheet on the second conveyor means whereby each successive sheet operates the first control means to cause the shaft to rotate and deposit the next preceding sheet on the second conveyor means and to move the operating sheet to the inclined inspection position so that when a sheet is being supported in the inclined inspection position no other sheet is carried by the plurality of arm means.

7. Apparatus for inspecting both surfaces of each of a succession of sheets comprising a first conveyor means for successively moving a series of sheets with one surface uppermost along a path to a position to be turned to expose the other surface to permit inspection of the other surface, a second conveyor means for removing the sheets, and sheet turning means between said two conveyor means for successively lifting each sheet from the position to be turned, stopping the sheet in an inclined inspection position in which the opposite surface of the sheet is exposed uppermost, the sheet in the inspection position being turned more than 90 degrees but not more than about 135 degrees from the position to be turned, and then depositing the

sheet on the second conveyor, said sheet turning means including a rotatable shaft, power actuated means for intermittently rotating the shaft at a predetermined speed and in angular increments of not more than 90 degrees each, a plurality of radially extending arm means angularly spaced apart about the shaft, each arm means including a sheet lifting means and a sheet supporting means, the sheet lifting means being angularly spaced apart about the shaft the number of degrees equal to the angular increments, and the sheet supporting means of each arm means being less than 90 degrees ahead of the sheet lifting means of the following arm means in direction of rotation of the sheet turning means, each lifting means successively occupying a position to lift a sheet from the position to be turned and to turn the sheet upon rotation of the shaft, first control means operable on movement of each successive sheet into position to be turned to cause the power actuated means to rotate the shaft and cause the sheet lifting means in lifting position to lift and turn the sheet which operated the first control means, and second control means operable upon rotation of the shaft through one of said angular increments to stop the shaft, the speed and the increment of rotation of the shaft being such that upon stopping the shaft the momentum of the lifted sheet turns the sheet into engagement with the sheet supporting means next ahead of the sheet lifting means which lifted the sheet to support the



sheet in the inclined inspection position to permit inspection of this opposite surface, whereby when a sheet is stopped in the inclined inspection position, no other sheet is between the sheet in the inspection position and the next succeeding sheet successively moved by the first conveyor means to the position to be turned.

8. Apparatus as claimed in claim 7, characterized by the fact that the position of the sheet and the sheet supporting means supporting the same in inspection position is such that rotation of the shaft through the next increment will deposit the lifted sheet on the second conveyor means.

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