Oct. 25, 1932. J. A. TOLEIK 1,884,920

METHOD AND APPARATUS FOR SORTING SHEET STOCK

Filed Dec. 31, 1926 2 Sheets-Sheet 1

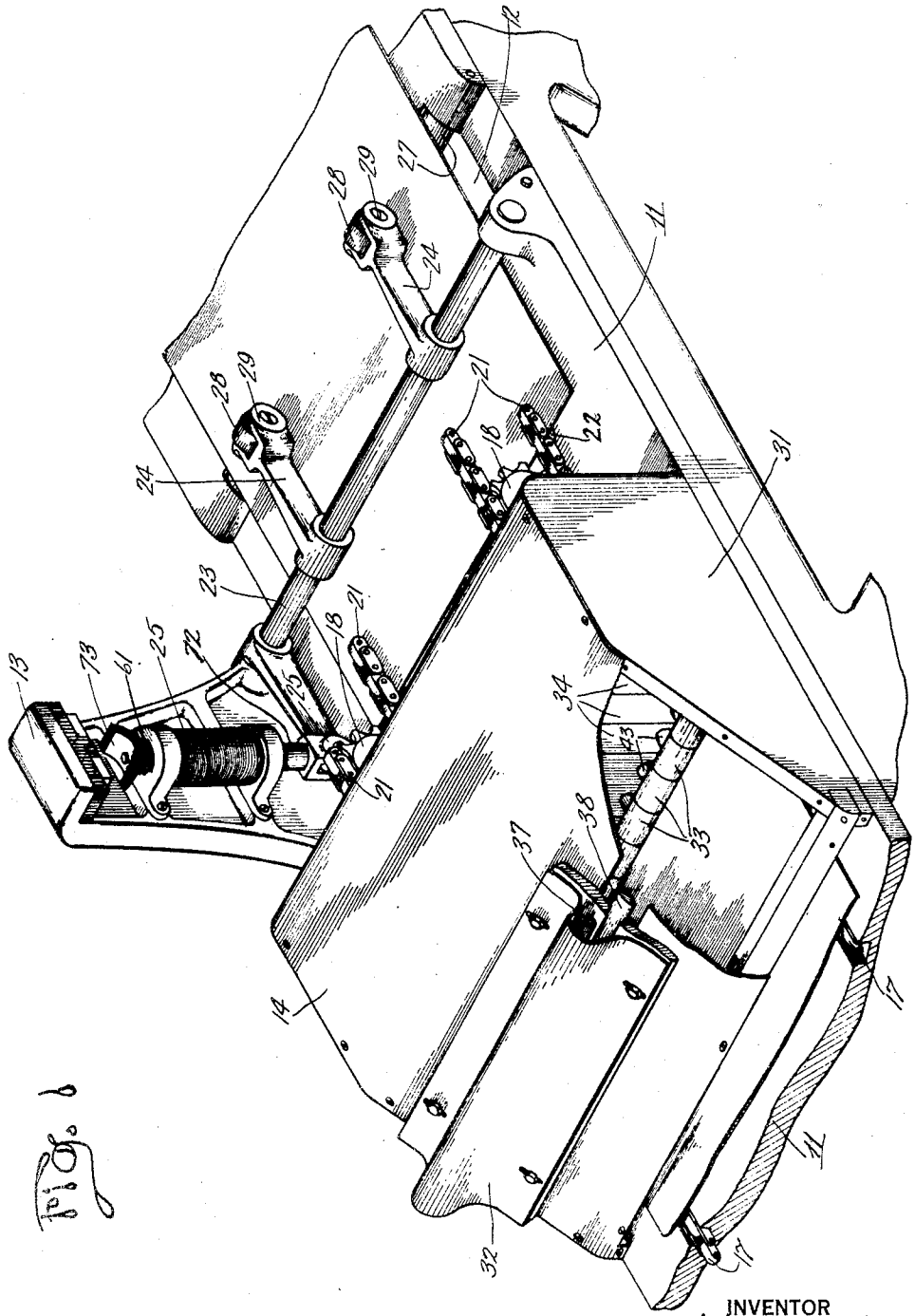


Fig. 1

INVENTOR
John A. Toleik
BY Munday, Clarke & Carpenter
ATTORNEYS

Oct. 25, 1932. J. A. TOLEIK 1,884,920

METHOD AND APPARATUS FOR SORTING SHEET STOCK

Filed Dec. 31, 1926 2 Sheets-Sheet 2

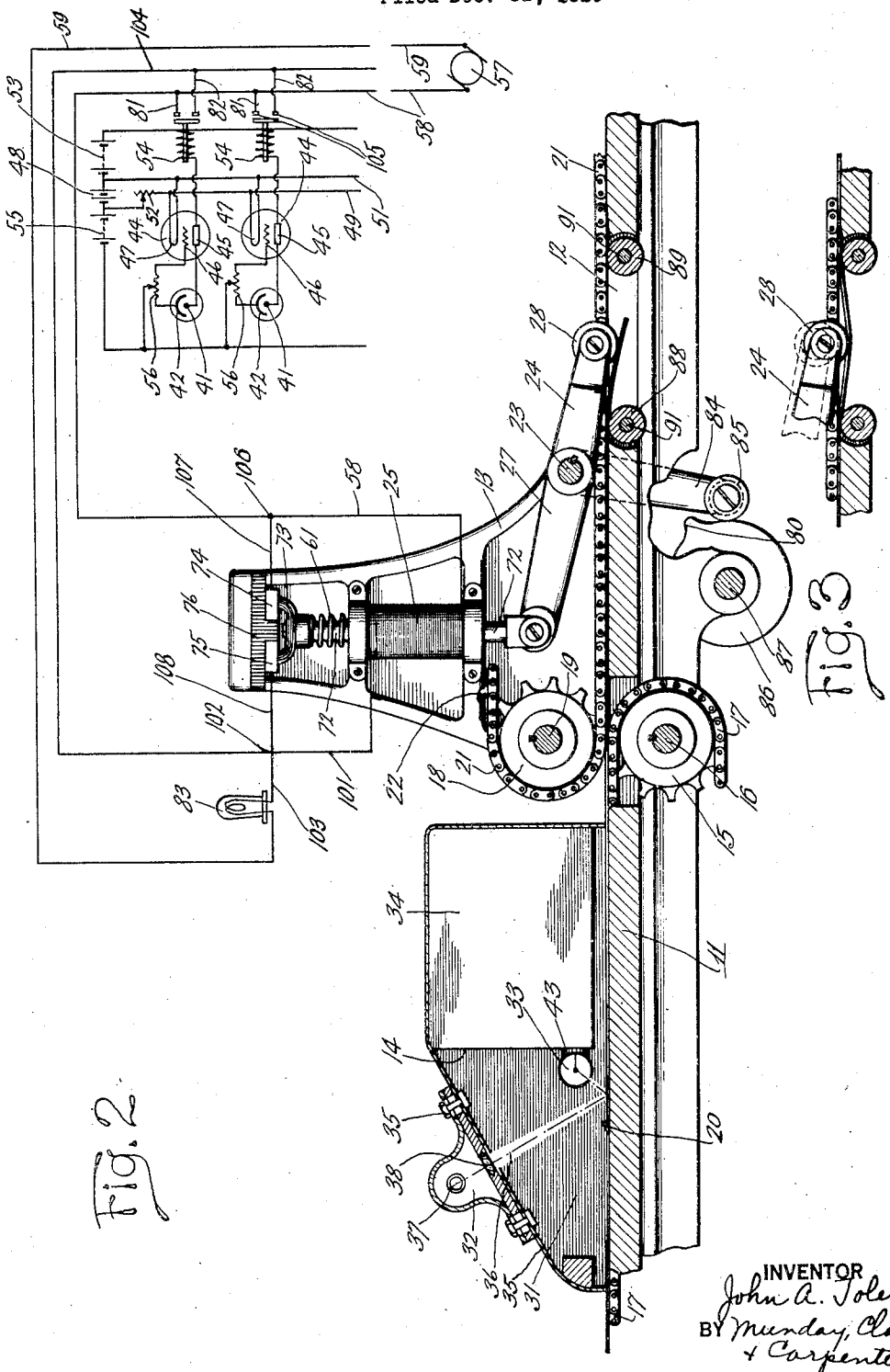


Fig. 2

Fig. 3

INVENTOR
John A. Toleik
BY Munday, Clarke & Carpenter
ATTORNEYS

Patented Oct. 25, 1932 1,884,920

UNITED STATES PATENT OFFICE

JOHN A. TOLEIK, OF WEST ORANGE, NEW JERSEY, ASSIGNOR TO AMERICAN CAN COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW JERSEY

METHOD AND APPARATUS FOR SORTING SHEET STOCK

Application filed December 31, 1926. Serial No. 158,311.

This invention relates in general to a method and apparatus for sorting sheet stock, such as tin plate, and for sorting the stock in accordance with the condition of the surface thereof to separate the sheets having imperfect surfaces from those having perfect surfaces. The invention is particularly adapted to detect waster spots in tin plate and to sort the sheets having them from the sheets of perfect surface.

The present method of sorting tin plate and the like is entirely by hand and the perfections must be noted by the eye of the person sorting the sheets. This method is expensive and on account of the personal element the sorting is subject to a great deal of variation so that the imperfect sheets are not always separated from the perfect ones. This results in serious manufacturing difficulties in a great many instances and serious loss when an imperfect sheet is used in the fabrication of articles in which perfect sheets are required.

It is an important object of my invention to detect imperfection, as waster spots, mechanically and automatically and to automatically separate the sheets having them from the sheets that meet the requirements of the use for which the sheets are needed.

Another important object of the invention is the provision of an apparatus which is highly sensitive and capable of detecting imperfections or spots of small dimensions on the surface of the sheet, such as waster spots of approximately 1/8" in diameter and which may be adjusted to detect even smaller imperfections upon occasion.

Another important object of my present invention is the provision of an apparatus, for the above-described purpose, for certain and positive action, which will be fully automatic and capable of continued operation without attention; and which will consist of few and simple parts not likely to require frequent repair, replacement or readjustment.

Numerous other objects and advantages of the invention will be apparent as it is better understood from the following description, which, taken in connection with the accompanying drawings, discloses a preferred embodiment thereof.

Referring to the drawings,

Figure 1 is a perspective view of an apparatus embodying my invention, having portions thereof broken away to show details of construction and showing sheets of stock in different stages or positions in the machine;

Fig. 2 is a longitudinal sectional view of the apparatus shown in Fig. 1 taken substantially along the center line of the machine and illustrating the action thereof, and including a wiring diagram or diagram of the electrical apparatus and connections; and

Fig. 3 is a fragmentary detail showing the discharge lever in changed position or set to discharge the following sheet.

My present invention contemplates the projection of light rays onto the shiny surface of the sheets as they pass a given point to reflect to photoelectric cells, as selenium or the like, and to control the feeding action from said cells. When a waster spot passes the point at which the rays strike the sheet the reflection is interrupted and the imperfect subject sheet is sorted out and discharged from the procession of sheets.

To accomplish this and to illustrate my invention, I have shown an apparatus or machine having a base or table 11 over which the sheets may be consecutively passed, and having an opening or slot 12 therein through which imperfect sheets may be discharged. A frame 13 extends up from the table 11, upon which means may be mounted for directing the imperfect sheets through the slot 12. Conveying means are provided for consecutively passing sheets over the table or over a surface thereof, which in the present instance includes sprockets 15 carried on a shaft 16 and suitably spaced apart, over which are trained chains 17 provided with suitable lugs 20 to engage the rear edge of the sheets. Similar sprockets 18 are preferably mounted above the sprockets 15 on a shaft 19 over which chains 21 run that are provided with one or more hooks or lugs 22 for advancing sheets across the table after they pass beyond the chains 17. The lugs 22 on the chains 21 are preferably of hook

form so that they will engage beneath the rear edge of the sheets to carry this edge of the perfect sheets across the slot 12. The chains 17 are thus arranged below the path of the sheets and the chains 21 above said path, whereby a defective sheet may be passed downward out of said path at a point beyond the chains 17.

The frame 13 may be secured to the table in any suitable manner and is arranged to provide bearings for a cross shaft 23 upon which lever arms 24 may be arranged, substantially as shown. The frame 13 is also arranged to carry a solenoid magnet 25, the armature 72 of which is pivotally connected to a lever arm 27 fixed on the shaft 23 and which co-operates with the lever arms 24 and a spring 61 to provide a rocking lever for forcing the forward ends of an imperfect sheet 26 passing through the machine into the slot 12 (Fig. 2) so that further movement of the chains 21 will eject the sheet through the slot and thereby segregate the imperfect sheets. A roller 28 may be provided in an end 29 of the arms 24 to prevent scratching or marring the surface of the sheets. The roller 28 may be mounted in yielding or spring bearings or the arms 24 may be made flexible where the sheet stock to be separated is to heavy to permit of the required bending, as will be described.

Reference character 14 indicates means for detecting imperfect sheets as they are fed by the chains 17 and this means comprises a hood or chamber 31 above the sheet travel. A lamp box 32 is arranged on a front inclined wall 35 of the hood 31 and a lens 38 is inserted in the wall 35 to direct a light beam 36 downwardly and forwardly against the presented sheet surface so that the light beam strikes the sheet at an angle and will be reflected up at an angle if the sheet has its required shiny and unblemished surface.

Light sensitive devices 33 (electron emission photoelectric cells) are placed in the hood 14 in position to receive the reflected light rays from the sheets and to control electrical currents for sorting the sheets. These cells 33 are preferably in small units, each detecting a small strip of sheet surface. They are mounted in brackets 43 upon a housing 34 provided to contain certain electrical parts and wiring, to be presently described.

The actual sorting of the sheets is accomplished by directing the imperfect sheets through the slot 12 and permiting the perfect ones to be fed across it by the conveyer chains 21. The lever arms 24 are normally held in the elevated position (shown in dotted lines in Fig. 3) while perfect sheets are passing through the machine. The electro-magnet 25, normally energized, holds the arm 24 elevated. When, however, a sheet with a waster spot is detected in the hood 14 the magnet 25 is deenergized and a spring 61 on armature stem 72 lifts the lever arm 27 and depresses arms 24, moving the rolls onto the forward edge of the imperfect sheet or into position to be engaged thereby so that this edge is deflected down through the slot as shown in Fig. 2. Rollers 88 and 89 on cross shafts 91 are arranged at opposite slot sides to facilitate the sheet feeding.

Having been once depressed, the arms 24 remain down until positively reset by a resetting mechanism which acts in timed relation to the sheet feed and just prior to the passage of each sheet edge into the hood 14. This mechanism comprises a cam 86 on a shaft 87 suitably geared into the power system of the machine. This cam has an active part 80 adapted to engage a roll 85 on an arm 84 fixed on shaft 23 moving the parts to normal position where the magnet 25 retains them until another imperfection or waster spot is detected.

The electric cells 33 may be any suitable devices which will control the flow of current in a circuit in which it may be connected, in accordance with the density of light rays impinging thereagainst or penetrating the cell, and to illustrate my invention I have shown diagrammatically such a device that is commonly known as a photoelectric cell having spaced electrodes 41 and 42 either of which may be the anode or the cathode. The space between the electrodes may contain any substance which will conduct current in accordance with the density of the reflected light rays impinging thereagainst or penetrating the substance. In Fig. 2 is disclosed the at present preferred wiring and electrical parts provided to enable the light sensitive elements 33 to control the magnet 25. The showing is diagrammatic and it will be understood that the parts, connections, etc. are located in the present instance in housing 34. For detecting current flow in the cells 33 and controlling the magnet 25, I employ vacuum tubes of the thermionic valve type and commonly known as three-element vacuum tubes. These are indicated at 44 and each has a plate 45, a grid 46 and a heating filament 47. The filaments 47 of the tubes may be energized or heated by a suitable battery 48 and suitably connected to a common circuit indicated by wires 49 and 51 controlled by a variable resistance element 52. A positive potential is maintained on the plates 45 and on the electrodes 41 of the cells 33 by means of a battery 53, the positive pole of which is connected to the plates through the winding of one or more solenoids or relays 54 and the negative pole is connected to the wire 51 of the filament circuit. A battery 55 is or may be provided for maintaining a negative potential on the grids 46 of the tube 44 and the electrode 42 of the cells 33, the positive pole of the battery 55 being connected to the negative pole of the battery 48 and the negative pole of the bat-

tery 55 being connected to the grids 46 and electrodes 42 through variable biasing resistance elements 56.

The delivery of current to the magnet 25 is controlled by the solenoid relays 54 in such fashion that current is continuously delivered to the magnet 25 so long as the light beam is reflected with full intensity against the photo-electric cells 33. The magnet 25 receives its current from any suitable source of electric power, a generator 57 being disclosed on the drawings for the purposes of illustration. The opposite pole of this generator is connected by a wire 58 to the solenoid from which it passes through a wire 101 to a junction 102 thence a wire 103 through a lamp 83. From the lamp 83 the circuit is completed through wire 59 to the generator.

Means are provided at each relay 54 to short circuit the current passing through the magnet 25 when a waster spot is detected in the head 14. These means comprise two contacts 105 arranged at each relay 54 and adapted to be thrown into electrical contact by the armature of such relay. The contacts 105 are connected by wires 81 and 82 respectively with the lead 58 and a second wire 104. Current now flows through a short circuit past the magnet 25 as follows: wire 58, wire 81, contacts 105, wire 82, wire 104 to junction 102 and thence back through the lamp 83 to the generator 57. The establishment of this circuit immediately results in the spring 61 moving up the armature of magnet 25.

The upper end of armature stem 72 carries a contact bridge member 73 adapted to engage two contacts 74 and 75 arranged in an arbor 76 at the top of the frame 13. As soon as the waster spot has passed the zone of detection, the contacts 105 brought into electrical connection are electrically separated and current then immediately flows through a circuit as follows: wire 58 to a contact 106 which is connected by wire 107 with contact 74. From the contact 74 the circuit continues through contact 73 and 75 and from the contact 75 by a wire 108 to contact 102 from whence the current is completed on around through the lamp back to the generator as already described.

It will thus be manifest that all of the circuits from the generator pass through the lamp 83 protecting the generator against sparking by reason of the short circuiting and that the operation of the generator may be continuous without damage to the apparatus, the light 83, receiving current during the normal operation of the sheet feeding in series with the magnet 25 and direct from the generator when imperfect sheets are detected, provides a visible signal of the condition of the sheets fed through the detecting and sorting mechanism.

In order that there may be no movement of the arm 24 to bring the roller 28 to sheet ejecting position because of variation in the photo-electric or light sensitive cells 33, the upper surface of the table 11 is preferably finished or polished to a reflective power of the surface of the perfect sheet of metal it is intended to feed through the apparatus.

The width of each photoelectric cell 33 is determined by the amount of light that it is desired to make use of in detecting a spot of a given size. For example, if the total amount of light entering the cell 33 is considered 100% and if its width is, for example, one inch, then if it is desired to detect a waster spot, this being dull and poorly reflecting, having a width $\frac{1}{8}''$ it is evident that a spot of this size would cut off or fail to reflect that amount of light and the total volume of light entering the cell would be approximately 87½%. It has been found that a photo-electric cell is sufficiently sensitive to a change of light equal to 10% and that upon such a change there is a sufficient variation in the impulses in the cell to cause or permit mechanical operation of a relay or other suitable form of mechanism for performing a function or work. In my apparatus therefore (as clearly illustrated in Fig. 1) I have provided a series of cells 33 each of which is connected with a separate control unit.

These cells are preferably located close to the surface of the table to obtain the maximum benefit from the beam and a minimum of interference through stray light beams.

The conveyer chain 17 may be arranged to receive the sheet stock from any usual stack feed device and conveys the sheets over the top surface of the table 11 substantially as shown and through the focused light beams and beneath the housing 31. If the sheet be perfect there will be no change in the light rays since the surfaces of the sheet and table are of substantially like reflecting power and do not cause the light rays to deflect from the cells and the sheet will pass on out of the housing 31 and be engaged by the conveyer 21 and carried across the top surface of the table to a suitable discharge where the sheets may be restacked in any suitable manner. If the sheet is not perfect the light beams will be either deflected from their normal course or varied in density by the power of reflection so that there will be a change of current flow in at least one of the cells 33. When this occurs there will be a change in the potential on the corresponding grid 46 of one of the tubes 44 which will cause a magnified change of current flow in the plate circuit of the corresponding relay 54 which will operate to short circuit the magnet 25 so that it will be deenergized and permit the spring 61 to move the lever arm 24 about the shaft 23 or from normal position to the position shown (Fig. 2) to cause the imperfect sheet to be

projected down through the slot 12, as shown, from which it may be conveyed to any suitable position or stacking device in any suitable manner.

When a waster spot has been detected the arm 24 has moved down by the spring 61 as already described into position to deflect the end of the imperfect sheet downwardly through the slot 12. The parts stay in this relation until the cam 86 resets them, which resetting action does not occur until after practically the entire sheet has passed through the slot. This shifting or resetting of the lever 24 takes place just prior to the moving of the forward edge of the succeeding sheet into position adjacent the slot.

The resetting of the arm 24 under the action of the cam 86 interrupts the circuit through the contacts 74—73—75 and since at this time the contacts 105 are open the circuit which passes through the winding of magnet 25 (already described) is reestablished and normal operation of the apparatus continued until another waster spot causes the sorting out of the sheet having it.

It is thought that the invention and many of its attendant advantages will be understood from the foregoing description, and it will be apparent that various changes may be made in the form, construction and arrangement of the parts without departing from the spirit and scope of the invention or sacrificing all of its material advantages, the form hereinbefore described being merely a preferred embodiment thereof.

I claim:

1. An apparatus for sorting sheet stock, comprising, means directing a focused light beam to a predetermined point, an endless chain conveyer continuously moving sheets through the light beam and having means to engage the rear edge of and propel the sheet, and means operable by variations of the reflections of the light beam from the surface of the sheets for sorting the sheets in accordance with the condition of the surface thereof.

2. An apparatus for sorting sheet stock, comprising, means directing a focused light beam to a predetermined point, an endless chain conveyer continuously passing sheets through the light beam in a plane that will cause the light beam to be reflected from the surface of the sheet stock at an angle and having means to engage the rear edge of and propel the sheet, and means interrupting the reflected light rays and controlled by variations thereof for separating the sheets.

3. An apparatus for sorting sheet stock, comprising, an endless chain conveyer continuously conveying sheets in a horizontal plane and having means to engage the rear edge of and propel the sheet, and means directing a focused light beam angularly onto said sheets for detecting imperfect sheets.

4. An apparatus for sorting sheet stock, comprising, an endless chain conveyor continuously conveying sheets in a single plane and in processional order and having means to engage the rear edge of and propel the sheet, means for diverting imperfect sheets from said plane, and light controlled means for governing said last mentioned means.

5. An apparatus for sorting sheet stock, comprising, an endless chain conveyo · continuously conveying sheets in a single plane and in processional order and having means to engage the rear edge of and pr .l the sheet, means for diverting imperfect sheets from said plane, and means controlled by light reflections from the surfaces of the sheets for controlling said last mentioned means.

6. An apparatus for sorting sheet stock, comprising, an endless chain conveyor continuously conveying sheets in a single plane and in processional order, means for diverting imperfect sheets from said plane, and means including photo-electric cells arranged in a series transversely of the sheet for control by variations in light reflections from the sheets for controlling said last mentioned means.

7. An apparatus for sorting sheet stock, comprising, an endless chain conveyor continuously conveying the sheets in a single plane and in processional order, means for diverting imperfect sheets from said plane, and means for controlling said last mentioned means for directing a focused light beam onto the sheets and light sensitive devices arranged in a series transversely of the sheet for control by reflections of the light beam from the surfaces of the sheets.

8. An apparatus for sorting sheet stock, comprising, means for conveying the sheets in a single plane and in processional order, means for diverting imperfect sheets from said plane, and means including a magnet and armature and electric circuit for controlling said last mentioned means, light generating apparatus arranged to project light onto the surfaces of the sheets at an angle to the surface of the sheets, and electrical devices arranged in series transversely of the sheet for detecting variations in the light and affecting said electric circuit.

9. An apparatus for sorting sheet metal in accordance with the condition of the surface thereof, comprising, a base having a reflecting surface, means directing light rays onto said surface and at an angle to the plane thereof, means for passing the sheet stock consecutively over said surface and through the light rays, and means for separating the sheets in accordance with the condition of the surfaces thereof, said means being con-

trolled by reflections of the light beams from the surfaces of the sheet stock.

10. An apparatus for sorting sheet metal in accordance with the condition of the surface thereof, comprising, a base having a reflecting surface, means directing light rays onto said surface and at an angle to the plane thereof, means for passing the sheet stock consecutively over said surface and through the light rays, and means for separating the sheets in accordance with the condition of the surface thereof, said means including a light sensitive device arranged in the path of the normally reflected light and for control by variations in the density of the reflected light.

11. An apparatus for sorting sheet metal stock, comprising, a table having a slot therein, conveying means moving the sheets in processional order across said slot, a device adapted to engage imperfect sheets in said processional order and direct them into said slot and light-sensitive means controlling the operation of said engaging device.

12. An apparatus for sorting sheet metal stock, comprising, a table having a slot therein, conveying means moving the sheets in processional order across said slot, and a device adapted to engage imperfect sheets in said processional order and direct them into said slot, said means comprising an electrically operated pivoted lever, and light-sensitive means controlling the operation of said lever.

13. An apparatus for sorting sheet metal stock, comprising, a table across which the sheets to be sorted are moved in processional order and having a slot, a detecting device for determining sheet imperfections, and an electrically controlled lever controlled by said detecting device for directing said imperfect sheets through said slot.

14. An apparatus for sorting sheet metal stock in accordance with the condition of the surface thereof, comprising, a table across which the sheets are adapted to be moved in processional order and having a slot through which imperfect sheets are to be directed, a light sensitive device controlled by the surface condition of said sheets, and means acting under the influence of said light sensitive device for directing imperfect sheets through said slot.

15. An apparatus for sorting sheet metal stock in accordance with the condition thereof, comprising, a table over which said sheets are adapted to be moved in processional order and having a slot therein, a device for directing sheets through said slot, electrical means holding said device in inoperative position to permit sheets to pass said slot, and a light sensitive device controlled by the surface condition of the sheets for in turn controlling said electrical means.

16. An apparatus for sorting sheet metal stock in accordance with the condition of the surface thereof, comprising, means for moving the sheets consecutively along a predetermined path, detecting means for detecting imperfections in the surface of the sheet while the sheet is passing along said path, mechanical means for deflecting imperfect sheets from said path, and electrical means controlled by said detecting means for preventing operation of said mechanical means to permit the free passage of perfect sheets.

17. An apparatus for sorting sheet metal stock in accordance with the condition of the surface thereof, comprising, a table having a slot therein, means for moving the sheets consecutively across said table, detecting means for detecting imperfect sheets, and a rocking lever for directing imperfect sheets through the slot in said table, said means including a rocking lever electrically held in a normal position permitting the free passage of sheets across said table and means operable on the release of the electrical holding means for moving said rocking lever to an operative position wherein it will cause imperfect sheets to be projected through said slot, said last mentioned means being adapted to prevent operation of the electrical holding means until the selected sheet is projected into the slot.

18. An apparatus for sorting sheet metal stock in accordance with the condition of the surface thereof, comprising, a table having a slot therein, means for moving the sheets consecutively across said table, detecting means for detecting imperfect sheets, means for directing imperfect sheets through the slot in said table, said means comprising, a rocking lever having a normal position permitting perfect sheets to pass freely across the table and an operative position causing the projection of imperfect sheets into the slot of the table, electrical means for holding said lever in the normal position, mechanical means for moving said lever to operative position when the electrical means is de-energized, and means associated with said means for preventing the re-energizing of said electrical means to hold said rocking lever in operative position.

19. An apparatus for sorting sheet metal stock in accordance with the condition of the surface thereof, comprising, a table having a slot therein, means for moving the sheets consecutively across said table, detecting means for detecting imperfect sheets, and means for directing imperfect sheets through the slot in said table, said means comprising a rocking lever having a normal position permitting sheets to pass freely across the table and an operative position causing the projection of sheets into the slot of the table, electrical means for holding said lever in the normal position, mechanical means for moving said lever to operative position when the electrical means is de-energized, and a cam operated device for restoring said lever to normal position and re-energizing the electrical holding

means after the selected sheet has been projected into the slot.

20. A method of sorting sheet stock, which consists in passing sheets in processional order through a tranverse series of beams of light, reflecting said beams from the shiny parts of said sheets, controlling an electric flow by the amount of the reflected beams, and causing the deflection from said order of insufficiently reflecting sheets by the agency of said electric flow.

21. An apparatus for sorting sheet stock, comprising, means directing a transverse series of focused light beams to a series of predetermined points, means for moving sheets through the light beams, and light-sensitive material controlled by the reflection of the light beams from the surface of the sheets, an electric circuit affected by said light-sensitive material, a relay controlled by said circuit, a second electric circuit controlled by said relay, a magnet in said second circuit, and sheet-sorting means controlled by said magnet.

22. The combination of a table having a surface of substantially the same light-reflecting property as have sheets to be passed over the same, an endless conveyer for propelling sheets over said table successively, light-sensitive means affected by light reflected from said sheets and from said table where there may be an interval between sheets and which is less affected by reflection of light from imperfect sheets, and means controlled by said light sensitive means for deflecting said imperfect sheets, whereby said deflecting means are not operated by light reflected from the table.

23. In an article-sorting device, a photosensitive cell, a source of light, means for causing an article to pass adjacent said cell and to reflect said light thereon, means responsive to a change in the illumination of the cell for influencing the travel of said articles after they have passed beyond said cell and means controlled by said responsive means whereby said influencing means is prevented from being actuated a plurality of times by the same article.

24. In an article-sorting device, a photosensitive cell, a source of light, means for causing articles to pass adjacent said cell and to reflect said light thereon, means responsive to a change in the illumination of said cell for determining the ultimate destination of said articles, means for preventing said determining means from being actuated a plurality of times by a single article and means controlled by said first mentioned means for periodically restoring said determining means to a normal state.

25. In an article-testing device, means for moving objects, means extending along a line transverse to said motion for responding to light reflected from said objects and a source of illumination extending parallel to said means.

26. A sorting device including a conveyor for carrying a plurality of articles, and electrically controlled means for examining each article for difference in shade between parts of the same article and causing the conveyor to discharge said articles in accordance therewith.

27. A device of the character described, including means to direct light from an article, a conveyor to carry a plurality of articles successively into coaction with said means, and means including a plurality of photosensitive cells simultaneously activated by the light, said means being operative according to the difference in activation of the cells, said means causing the conveyor to sort and discharge the articles according to the quantity of light transmitted therefrom.

JOHN A. TOLEIK.