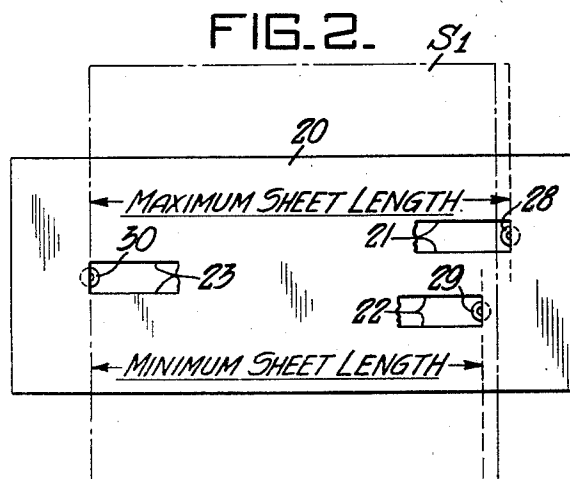
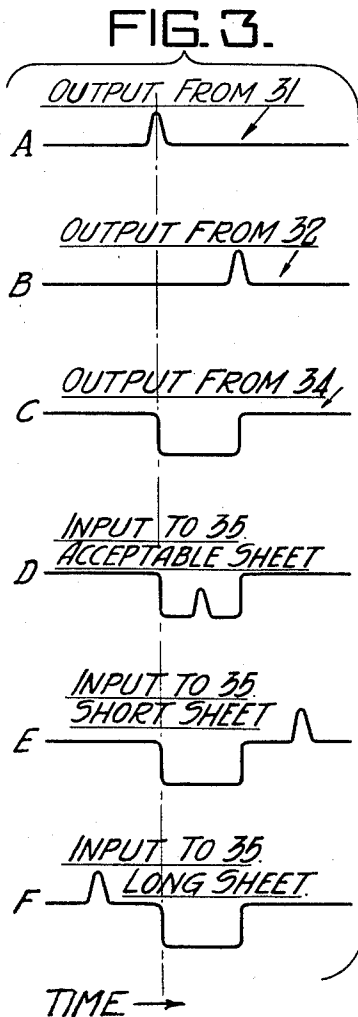
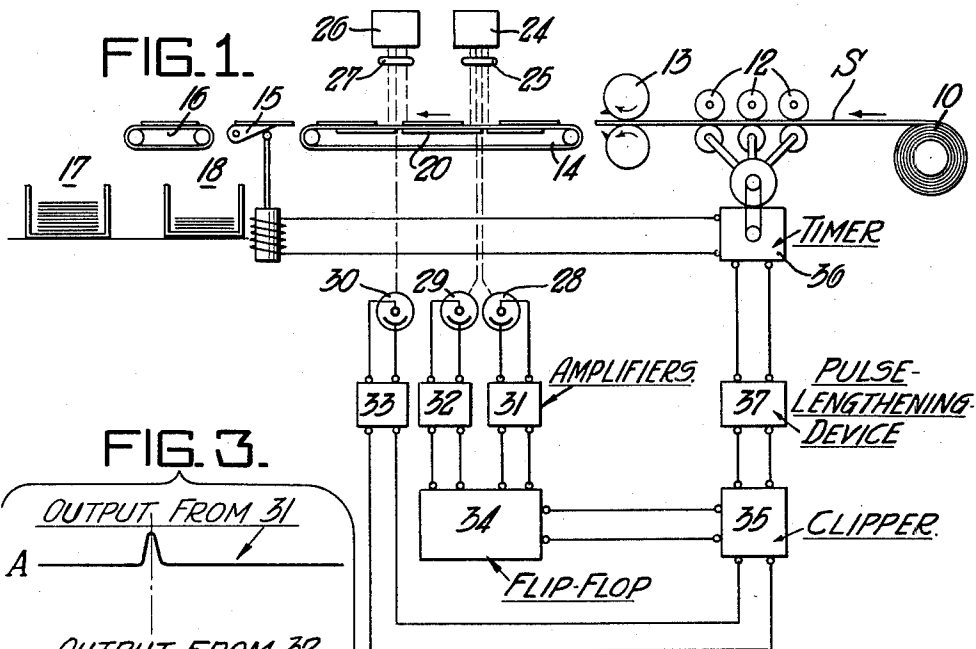


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W. E. COLEMAN ET AL
METHOD AND APPARATUS FOR CLASSIFYING
SHEETS ACCORDING TO LENGTH
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2,933,185



Inventors:
WILLIAM E. COLEMAN and
THOMAS A. McLAUCHLAN,
by: Donald G. Dalton
their Attorney.

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2,933,185

METHOD AND APPARATUS FOR CLASSIFYING SHEETS ACCORDING TO LENGTH

William E. Coleman, Monroeville, and Thomas A. McLauchlan, Pittsburgh, Pa., assignors to United States Steel Corporation, a corporation of New Jersey

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1 Claim. (Cl. 209—82)

This invention relates to an apparatus and method for classifying sheets according to length.

Modern practice in manufacturing metal sheets involves passing metal strip at speeds of 1,000 f.p.m. or more through a flying shear which severs it into individual sheets of specified length. As the strip approaches the shear, it is inspected for certain defects, such as pinholes and improper thickness, and the inspection devices automatically operate deflectors located beyond the shear for diverting sheets imperfect in these respects. However, at the speeds encountered it is difficult to ensure that all sheets are cut exactly to proper length, and we are aware of no previous classifier capable of measuring the length of rapidly moving sheets and diverting those of improper length. Miscut sheets produce difficulty in subsequent processing and hence desirably are eliminated, yet the usual practice is to check only a few sample sheets by manual measurement.

An object of our invention is to provide a classifier which automatically determines whether the length of rapidly moving sheets is within a specified tolerance range, and diverts sheets whose length is outside this range.

A further object is to provide a sheet classifier which includes photoelectric means for checking the length of rapidly moving sheets without need for mechanically moving parts, and deflecting means automatically controlled by the photoelectric means for eliminating off-length sheets.

A further object is to provide a sheet classifying method which automatically eliminates sheets whose length is outside a prescribed tolerance range.

In accomplishing these and other objects of the invention, we have provided improved details of structure, a preferred form of which is shown in the accompanying drawing, in which:

Figure 1 is a diagrammatic view of a shear line for metal strip equipped with a classifier constructed in accordance with our invention;

Figure 2 is a plan view of a calibration plate embodied in our classifier; and

Figure 3 is a graph which shows the characteristics of electric signals generated in the classifier circuit.

Figure 1 shows a shear line which includes successively an uncoiler 10, a roller leveler 12, a flying shear 13, and a conveyor 14, all of which per se can be of any standard or desired construction. Strip S travels from the uncoiler 10 through the roller leveler 12 and flying shear 13. In passing the shear the strip is cut into individual sheets S₁ which are delivered to the conveyor 14. A deflector 15, which constitutes an element of our classifier, is situated at the exit end of this conveyor. Normally the deflector allows prime sheets to pass thereover to another conveyor 16 and a prime piler 17, but it can be operated to divert imperfect sheets to a reject piler 18. For simplicity we have shown the deflector as a mechanically movable gate, but it is apparent that other types could be used, such as magnetic rolls like those shown in Coleman and Rendel Patent No. 2,814,398. Commonly a line of this type

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would include other conventional devices, such as side trimming knives, a pinhole detector, and a thickness gauge, but for simplicity we have omitted parts not needed for an understanding of the present invention. Also the shear line could follow and constitute part of some other processing line, such as an electrolytic tinning line, in which event the uncoiler would be at some remote location.

In accordance with our invention, an opaque calibration plate 20 is mounted under the carrying flight of the conveyor 14. As shown in Figure 2, this plate contains two longitudinally offset slots 21 and 22 adjacent its entry end and a third slot 23 adjacent its exit end. The entry ends of slots 21 and 22 and the exit end of slot 23 are accurately machined. The distance between the machined edges of slots 21 and 23 equals the maximum permissible sheet length, while that between the machined edges of slots 22 and 23 equals the minimum. Sheets longer than this maximum or shorter than this minimum are rejected as off-length. To permit adjustment in these lengths, the calibration plate can be equipped with adjustable slides for regulating the positions of the machined edges of the slots, or the plate can be removed and replaced with a plate having differently positioned slots. It is also apparent that largely equivalent results could be obtained by reversing the slot arrangement, although we prefer that shown since it produces sharper signals.

As shown in Figure 1, a light source 24 and optionally a collimating lens 25 are positioned above the conveyor 14 to cast light beams through both slots 21 and 22 whenever no sheet S₁ covers these slots. Similarly a light source 26 and optionally a collimating lens 27 are positioned to cast a light beam through slot 23 whenever it is uncovered. Phototubes 28, 29, and 30 are located directly under the machined edges of the slots 21, 22, and 23 respectively. Current flows in these phototubes as long as no sheet covers their respective slots, but otherwise current flow is effectively cut off. Phototubes 28 and 29 are connected to amplifiers 31 and 32 which generate momentary positive signals when the phototubes are exposed to light. Phototube 30 is connected to an amplifier 33 which generates a momentary positive signal when the phototube is darkened. The amplifiers 31 and 32 are connected to a "flip flop" 34. The amplifier 33 and flip flop 34 are connected to a clipper amplifier 35. The amplifiers, flip flop, and clipper amplifiers are not shown in detail since they follow well-known principles. Nevertheless, an explanation of the way a flip flop operates can be found in a paper by Eccles and Jordan entitled "A Trigger Relay Utilising Three-Electrode Thermionic Vacuum Tubes" published in the Radio Review, volume I, page 143 (December 1919), and a clipper amplifier in Rideout "Active Networks" published by Prentice Hall, Inc. (1954).

The clipper amplifier 35 is electrically connected to a timer 36 through a pulse lengthening device 37. The timer can be of any suitable standard construction, such as a pinwheel or a magnetic recording track, shown respectively in Ladrach Patent No. 2,217,342, and Camp application Serial No. 258,700, filed November 28, 1951. One example of a suitable pulse lengthening device is shown in Figure 2 of Coleman Patent No. 2,655,620. The timer is driven at a speed proportional to that of the line from any suitable source therein, such as the roller leveler 12. As hereinafter explained, the clipper amplifier actuates the timer whenever an off-length sheet is detected. The timer is electrically connected to the deflector 15 to actuate the latter after an appropriate delay to divert the off-length sheet to the reject piler 18.

In operation, assume first that a sheet S₁ has reached a position on the conveyor 14 where it overlies both slots

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21 and 22, but not slot 23. Both phototubes 28 and 29 are darkened and do not conduct appreciable current. Presently the trailing edge of this sheet passes the machined edge of the slot 21, whereupon the amplifier 31 generates a momentary positive signal. An instant later the trailing edge passes the machined edge of the slot 22, whereupon the amplifier 32 generates a second momentary positive signal. The first positive signal acts on the flip flop so that the latter commences to generate a prolonged negative signal, while the second positive signal acts thereon to terminate this negative signal. Referring to Figure 3, the peaks in curves A and B represent the two signals from the respective amplifiers, while the depression in curve C represents the negative signal from the flip flop.

The negative signal of course persists for an interval commencing when the trailing edge of a sheet passes the machined edge of slot 21 and terminating when the trailing edge passes the machined edge of slot 22. If the sheet is of acceptable length, its leading edge passes the machined edge of slot 23 during this same interval. If the sheet is too short or too long, its leading edge passes the latter slot after the negative signal has terminated or before it starts. The amplifier 31 generates a momentary opposing positive signal when the leading edge of the sheet passes the edge of slot 23.

The clipper amplifier 35 is biased normally to cut off, and it conducts if any positive signal is transmitted to it. However, negative signals to the clipper amplifier from the flip flop 34 overcome positive signals thereto from the amplifier 31, provided they arrive simultaneously. Referring again to Figure 3, the coinciding peak and depression in curve D represent the input to the clipper amplifier if the sheet is of acceptable length and the positive and negative signals coincide, while curves E and F represent the input if the sheet is too short or too long. In the latter two instances the positive signal represented by the peak arrives after or before the negative signal represented by the depression. If the clipper amplifier becomes conductive, it acts through the pulse lengthening device 37 on the timer 36 to initiate subsequent operation of the deflector 15 to reject a sheet as off-length.

From the foregoing description it is seen that our invention affords a simple apparatus and method for classifying sheets according to length. The structure can be modified readily to eliminate only overlength or underlength sheets or to classify each separately from sheets of permissible length. Use of our classifier eliminates any possibility of miscut sheets in the primes, and makes unnecessary any manual measurement of samples.

While we have shown and described only a single em-

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bodiment of our invention, it is apparent that modifications may arise. Therefore, we do not wish to be limited to the disclosure set forth but only by the scope of the appended claim.

We claim:

The combination, with a conveyor adapted to carry sheets of a specified length, each sheet having two opposed transverse edges, of a classifier for eliminating off-length sheets comprising a deflector normally allowing sheets of acceptable length to pass but operable to divert off-length sheets, a calibration plate having a pair of slots offset in the direction of sheet travel and a third slot spaced from said offset slots in the direction of sheet travel, phototubes opposite the respective slots, means for casting light beams at said phototubes through said slots, the phototubes opposite said offset slots responding to the passing of one transverse edge of each sheet twice with an interval therebetween, the phototube opposite said third slot responding to the passing of the other transverse edge during this interval for sheets of acceptable length and outside this interval for off-length sheets, amplifiers connected to the respective phototubes and adapted to generate signals on passing of a sheet edge, a flip flop connected to the two amplifiers that generate signals on passing of the same edge of the sheet and adapted to generate a signal for the duration of the interval between these signals, a clipper amplifier connected to the other amplifier and to said flip flop, a timer driven at a speed proportional to said conveyor, means connecting said clipper amplifier and said timer for actuating the latter when the phototube opposite said third slot responds outside said interval, and means connecting said timer and said deflector for operating the deflector following actuation of said timer.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 2,933,185

April 19, 1960

William E. Coleman et al.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 3, line 12, after "two" insert -- positive --.

Signed and sealed this 13th day of September 1960.

(SEAL)

Attest:

KARL H. AXLINE
Attesting Officer

ROBERT C. WATSON
Commissioner of Patents