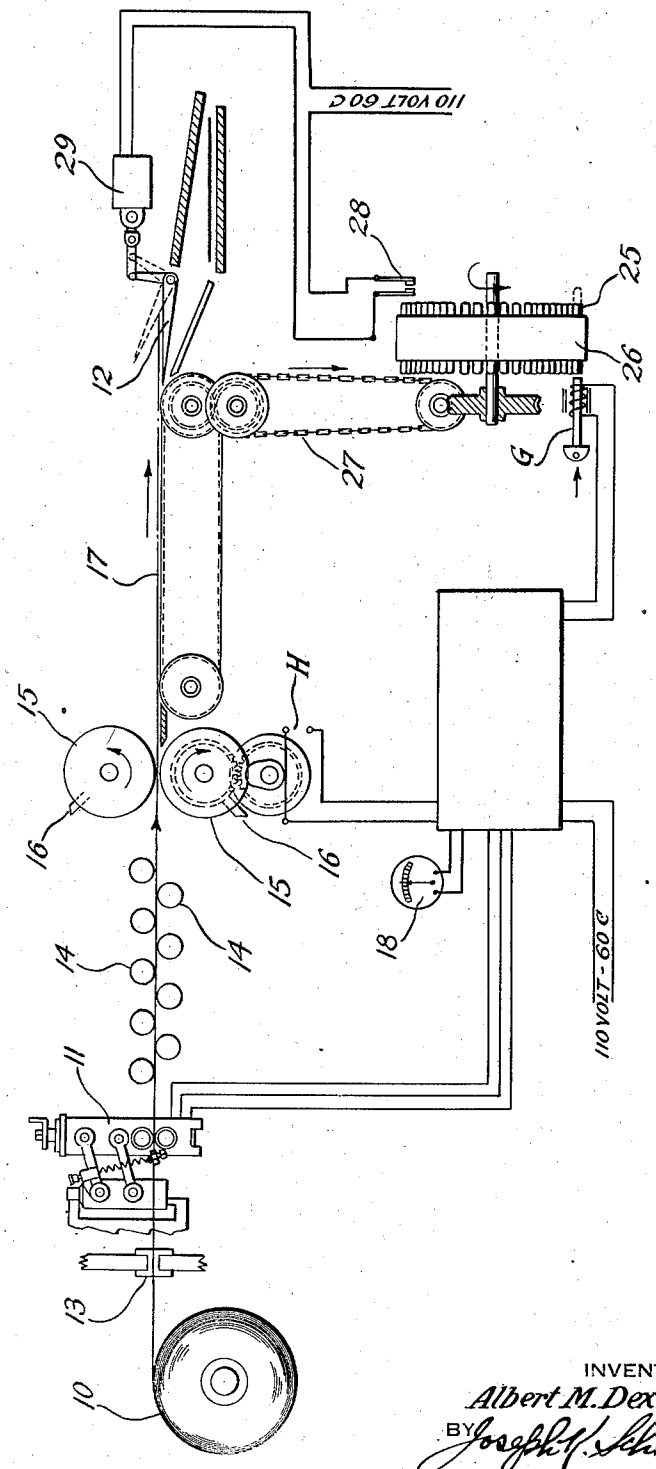
Nov. 28, 1944. A. M. DEXTER, JR 2,363,577

SHEARING AND CLASSIFYING MECHANISM FOR METAL STRIP

Filed Feb. 26, 1942 2 Sheets-Sheet 1

Fig. 1




INVENTOR
Albert M. Dexter, Jr.
BY Joseph J. Schofield
ATTORNEY

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Filed Feb. 26, 1942 2 Sheets-Sheet 2

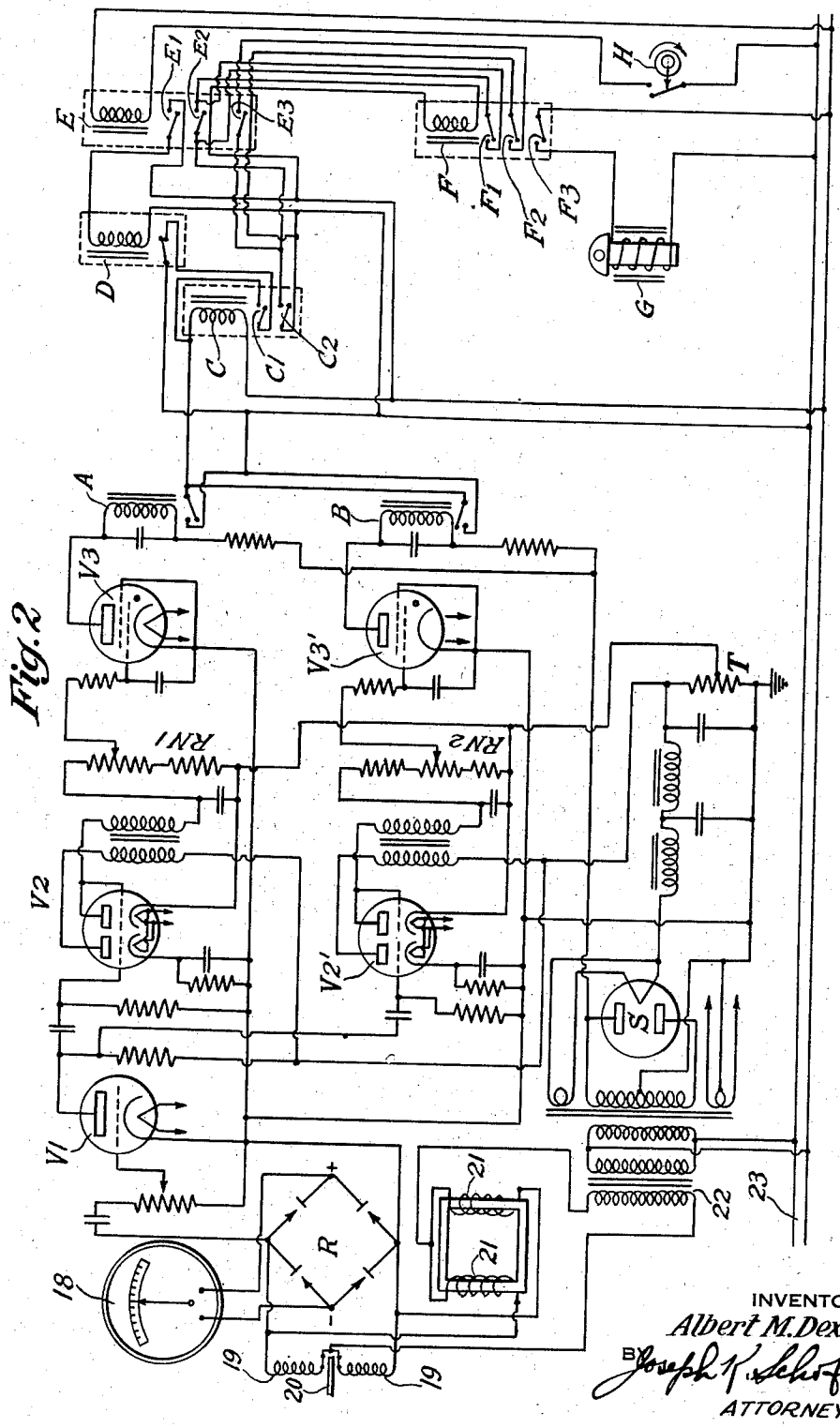


Fig. 2

INVENTOR
Albert M. Dexter, Jr.
BY Joseph V. Schofield
ATTORNEY

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2,363,577

## SHEARING AND CLASSIFYING MECHANISM FOR METAL STRIP

Albert M. Dexter, Jr., Hartford, Conn., assignor to Niles-Bement-Pond Company, West Hartford, Conn., a corporation of New Jersey

Application February 26, 1942, Serial No. 432,459

8 Claims. (Cl. 209—88)

This invention relates to mechanism for gaging the thickness of and classifying material in accordance with variations in the gage readings of its thickness while the material, such as metal, is being cut up into sheets from an elongated strip.

A primary object of the invention is to gage the thickness of continuously moving material prior to its being sheared into sheets and to actuate a classifying gate at the end of a conveyor leading from a shearing device to segregate off-gage sheets from those that are within predetermined thickness limits.

In classifying sheets cut from strip material as it is being sheared and stacked it is important, if any part of what will become an individual sheet is off-gage either by being above or below a predetermined thickness, that the classifier gate be actuated to classify the sheet, after being sheared, with other off-gage sheets and not with sheets that are of correct thickness. Sheets may be extremely long or short and the off-gage portion of a sheet (gaged before it is sheared) may be adjacent either the front or the trailing edge. The classifier gate therefore must be actuated whenever an off-gage portion is detected before the front edge of that particular sheet passes the classifying gate. This actuation of the gate must take place at the proper time regardless of what particular portion of the sheet has been indicated to be off-gage and regardless of the length of the sheet.

It is an object, therefore, of the invention to gage a strip of material continuously prior to its being sheared into individual sheets and to provide a variable time delay means to actuate a classifier gate in time to divert an off-gage sheet when it reaches the classifier gate regardless of the length of the sheet being sheared and regardless of what portion of the sheet is indicated to be off-gage.

A feature of the invention that is important is that a circuit is closed momentarily for each cutting movement of the shear blade or drum and at a particular position in the cycle of movement of the shearing member, this circuit energizing a solenoid to position a pin or other setting member if any off-gage material has been detected within the length of a single sheet, and the pin or other setting member, after a predetermined but adjustable period of time to permit the sheet to pass along a conveyor, serves to close a circuit to actuate the classifier gate to divert the off-gage sheet from the path of the normal sheets.

Another object of the invention is to close an auxiliary control circuit as soon as a portion of a strip being sheared is indicated to be off-gage, this control circuit remaining closed until the solenoid for operating the pin setting device is energized by the rotation of the shear drum to close the circuit of this solenoid. At that instant the pin positioning solenoid is operated to position the pin to close the classifier gate circuit. Immediately after this takes place, both the control circuit and solenoid operating circuit open and remain open until another off-gage indication occurs. In any case, however, the classifier gate does not operate until the pin actuated by an off-gage indication of the strip has moved in timed relation to the conveyor to a position to close the gate operating circuit. This latter time delay may be varied in accordance with the distance between the shear blade and the gate.

With the above and other objects in view, the invention may include the features of construction and operation set forth in the following specification and illustrated in the accompanying drawings.

In the accompanying drawings annexed hereto and forming a part of this specification, I have shown the invention embodied in a shearing and classifying mechanism for metal in strip form, but it will be understood that the invention can be otherwise embodied and that the drawings are not to be construed as defining or limiting the scope of the invention, the claims appended to this specification being relied upon for that purpose.

In the drawings:

Figure 1 is a diagrammatic view in elevation of a shearing and classifying mechanism in which the present invention is incorporated; and

Fig. 2 is a diagram of the electrical circuits therefor.

In the above mentioned drawings I have shown but one embodiment of the invention which is now deemed preferable, but it is to be understood that changes and modifications may be made within the scope of the appended claims without departing from the spirit of the invention.

Briefly, and in its preferred aspect, the invention may include the following principal parts: First, a continuously operating gage mounted to contact opposite surfaces of the strip being sheared and classified in advance of the shearing members; second, shearing mechanism preferably and as shown in the form of rotating drums in which are inserted cooperating cutting blades; third, a conveyor belt for advancing the

individual sheets, after being sheared, to the classifier; fourth, a classifier gate positioned at the end of the conveyor belt; fifth, a contactor closed momentarily once during each cutting movement of the shears; sixth, a mechanical timing device having movable members and operated in timed relation to the speed of the conveyor belt; seventh, means to effect movement of said members when the gage indicates that the strip thickness is above or below a predetermined dimension and the shear operated switch is closed; and eighth, a circuit closed when a displaced movable member in the timing device passes a switch positioned at a predetermined distance from the displacing means, this latter circuit energizing a solenoid to actuate the classifier gate.

Referring more in detail to the figures of the drawings, there is shown at 10 a roll of strip material such as thin steel which is to be gaged, sheared into sheets of any predetermined length and classified in accordance with variations in its thickness. Sheets having a thickness throughout their length within predetermined limits for which a gage 11 is adjusted are stacked together after passing over a classifier gate 12; and sheets, any portion of which is above or below these predetermined limits, are diverted by the classifier gate 12 actuated by the gage 11 through circuits presently to be described so that the off-gage sheets may be separately stacked.

Material unwound from the roll 10 passes first through cleaning strips 13 and then between the opposed rollers of gage 11 such as an "electrolimit" gage. After passing the gage 11 the material passes through feeding and straightening rolls 14 and then is sheared by means of revolving shear drums 15 within which are placed cooperating shearing blades 16. After being sheared the separated sheets pass along a conveyor belt 17 to the classifier gate 12. In the position of the gate 12 shown in full lines, sheets within the gaging limits for which the mechanism is set are passed over the gate 12 to be stacked by means not shown. If any portion of a sheet has been indicated by the gage 11 to be off-gage, that is, above or below predetermined gage readings for which the gage 11 has been set, the gate 12 is raised to the position indicated in dotted lines so that the off-gage or defective sheet is passed below the gate 12 to be stacked separately from the qualified sheets. It will be understood that the movement of the strip and the rotation of the shearing drums 15 will be adjusted to cut the strip into sheets of the desired length.

As stated above and as shown in the drawings, the gage 11 through which the strip passes before being sheared is an "electrolimit" gage and visually indicates variations in thickness by varying positions of the pointer of a milliammeter or other electric indicating instrument 18 (see Fig. 2) over a dial or scale. This instrument 18 as shown in the diagram is coupled electrically to induction coils 19 between which is disposed an armature 20 the position of which between the coils is varied by variations in thickness of the strip being gaged and sheared. As this type of gage is fully described in the patent to Terry et al. No. 2,115,351, granted April 26, 1938, further description is thought to be unnecessary.

Variable voltages within the coils 19 are induced by different positions of the armature 20 and the resultant voltage in the coils 19, after being rectified, biases the pointer of the indicating instrument 18. Coils 19 are parts of a bridge circuit including fixed coils 21, the circuit being energized from a transformer 22, the primary winding of which is connected to a suitable A. C. source 23.

The resultant A. C. voltage across the terminals of coils 19 which is applied across rectifier R is proportional to the unbalance of the gage bridge circuit which includes the coils 19 and is proportional to variations in thickness of the sheet steel as indicated by the gage 11. This A. C. voltage from the terminals of coil 19 is amplified in vacuum tube V1 and is further amplified in the first triode unit of a duplex tube V2. The output of this triode unit is fed into the second triode unit of duplex tube V2 which is operated as a diode. By the rectification action of this diode a D. C. voltage is developed across resistor network RN1. Tube V3, preferably a gas-filled Thyratron, is connected to this network so as to leave a positive voltage on its grid, this voltage being taken from the tap on a grounded bleeder resistor T. The positive voltage is impressed on this resistor by tube S acting as a rectifier. This positive voltage on the grid of tube V3 is opposed by the D. C. voltage developed across resistor network RN1 by the action of the diode unit of V2. The net voltage on the grid of V3 is, therefore, the difference between these two voltages, and it is this difference that causes Thyratron V3 to ignite and extinguish. When V3 is ignited by sufficient voltage difference, relay A, presently to be more fully described, is closed as its coil is energized. The circuit V2—RN1—V3 constitutes a first measuring circuit.

Vacuum tubes V2' and V3' are operated similarly to tubes V2 and V3. V2 and V3 being used when the strip is undersize or below a predetermined thickness, and V2' and V3' when the strip is oversize. The only difference in the two circuits is in the resistor networks RN1 and RN2 which are adjusted respectively to bias their Thyratrons V3 and V3' differently so that they will ignite at different voltages from the gage bridge and energize the relay coils A or B. The circuit V2'—RN2—V3' constitutes a second measuring circuit. Vacuum tube V1 is an amplifier common to both circuits.

Measuring relay A will be closed whenever its coil is energized by firing of tube V3 which occurs when the gage 11 indicates that the strip is undersize or below gage, and measuring relay B is closed whenever its coil is deenergized which occurs when the gage 11 indicates that the strip is oversize. Relay A is normally open, that is, is open when the strip being gaged is within predetermined limits, but is instantly closed when V3 ignites simultaneously with the indication from the gage 11 that the strip is under gage and energizes its coil. The contacts of relay B are normally open, that is, they are open when the strip is within predetermined limits, as tube V3' is normally firing and energizing its coil. The contacts of relay B are closed when V3' extinguishes simultaneously when the gage indicates over-gage and deenergizes its coil. When the gage indicates undersize both tubes V3 and V3' conduct and relay A is closed. When the gage indicates oversize both tubes V3 and V3' are extinguished and relay B is closed by gravity. When the gage indicates the strip to be within predetermined tolerances, V3 is extinguished and V3' is conducting so that both relays A and B are open.

The contacts on relays A and B are paralleled

so as to energize the coil of a tolerance relay C when either A or B is closed, that is when V3 fires or V3' is extinguished in accordance with the strip going either over- or under-gage. Through the holding circuit comprising the holding contact on relay D and contact C1 of relay C, the coil of relay C locks itself in. Contact C2 is therefore held closed whenever relay A or B is closed by the strip going off-gage, and continues closed even though A or B then opens. The circuit connected to contacts C2 constitutes a preparatory circuit which is closed when relay C is energized. Through the action of rotary switch H actuated by the shear drum and momentarily closed once for each sheet regardless of its length, relay E is energized once for each sheet. Relay E is a course relay whose action is determined by the course of movement of the strip and constitutes electromagnetic control means for controlling the actuation of the classifying gate. It will be seen, therefore, that when the preparatory circuit connected to contacts C2 is closed by the closing of either relay A or B, and then H closes, contact E2 will also close, completing the circuit to the coil of relay F. When the coil of relay F is energized, solenoid G is also energized through contact F3 to actuate a setting pin presently to be referred to.

Contact F1 paralleIs contact E2 for the purpose of maintaining current to the coil of relay F after drum switch H opens, thus deenergizing relay E and consequently opening E2; this taking place only when the steel strip is indicated by gage 11 to be off-gage (either above or below its limits), thus actuating either relay A or B closed. The circuit connected to contacts F1 constitutes interlocking means for keeping relay F closed after relay E opens, as long as an off-gage condition is indicated.

Contact F2, in series with contact E3, parallels C2 for the purpose of maintaining the current to the coil of relay F after relay A or B opens. Relay A or B would open if the steel strip returned to within its limits at this time, which would otherwise deenergize relay F. Relay F is thus maintained in an energized condition if the contacts of either relay A or B are kept closed, even while relay E is alternately closed and opened by switch H.

Also relay F is kept energized even if A or B opens, until switch H opens again for the first time after relays A or B open. When switch H closes for the first time after relays A or B open, the coil of relay E is thereby energized, thus closing switch E1 which energizes re-set and holding relay D. This opens the normally closed contact of re-set and holding relay D, thus breaking the interlock through holding contact C1 of the coil of relay C. Contact E3, however, because it closes at the same instant that E1 closes, is able to short across contacts C2 before relay D is able to pick-up and break the interlock of relay C, thus the relay F is kept energized through contacts E3 and its own contacts F2.

When the switch H opens, E is deenergized, and contact E3 opens, thus breaking the current to the coil of relay F through contacts E2, E3, and F2. The entire system is thus restored to its original condition and remains in that condition until there is another off-gage indication.

The rotary switch H is arranged so that it closes substantially at the instant the trailing edge of what will be an individual sheet after shearing has passed the gage rolls and yet should allow the circuit to lock-in before the switch H opens again. Switch H also should open before the leading edge of what will be the next sheet after shearing enters the gage rolls.

To summarize the operation of these circuits: The strip may go off-gage and then immediately return on-gage again. When this happens relay C will lock-in, but the closing of its relay contacts will not immediately effect the solenoid G as this effect must wait until rotary switch H closes. When H does close, solenoid G immediately will be energized and will stay energized until H again opens. The period during which the switch H remains closed during the cycle of operation of the shear drum is extremely short and much less than the time taken by one sheet length, however short, to pass through the gage 11. The circuit is then restored to its original condition instantaneously with the opening of switch H.

If the strip goes off-gage and stays off-gage, solenoid G will be energized as soon as switch H closes. Should the strip still be off-gage when H opens, the solenoid G will remain energized without interruption. The solenoid G will remain energized until H opens for the first time after the strip has returned to an on-gage condition. As soon as the strip is again on-gage the circuit will be restored to normal. During all the time solenoid G is energized, setting pins 25 will continue to be moved to a switch closing position, one pin or more being moved for each individual sheet.

If the strip should go off-gage at the very moment that H closes, the effect of this closing will carry immediately through and solenoid G will become energized and stay energized until H again opens for the first time after the strip has returned to an on-gage condition. As soon as this switch H opens, the circuit will resume its normal condition and return the gate 12 to its lower position.

Any off-gage indication by the gage 11, whether it occurs adjacent the leading or trailing edge of what will become a single sheet when sheared from the strip, will energize the coil of relay C and set the circuits to energize relay F and operate solenoid G as soon as relay coil E has been energized by closing of the shear operated rotating switch H. Also promptly after the switch H opens the circuits will return to normal if the gage again indicates "on-gage," so that the only sheets separated by the classifier gate 12 will be those having off-gage indications.

The above description covers the mechanism and circuits employed for effecting operation of the solenoid G which effects movement of the setting pins or members 25 in a mechanical time delay mechanism. The time delay mechanism is shown diagrammatically in Fig. 1 and may be similar to that shown and described in the patent to Ladrach 2,217,342 granted October 8, 1940. In this form of delay mechanism a drum 26 is slowly rotated by connections 27 from the conveyor and in timed relation to the speed of travel of the conveyor. The particular means shown for rotating the drum include a chain drive from a pulley over which the conveyor passes which drives a worm meshing with a worm gear rotatable with the drum. The movable members or pins 25 are inserted about the periphery of the drum and extend parallelly with the drum axis in a circular series. These pins 25 are contacted by and moved to the right as seen in this figure whenever solenoid G is energized. When the drum 26 has rotated a distance corresponding to

the distance from the leading edge of a sheet to the classifier gate 12, the pins 25 laterally moved to the position shown in dotted lines close switch 28 in the circuit for the gate-closing solenoid 29. By varying the speed of rotation of the drum 26 and by varying the angular distance between the position where the pins 25 are actuated by solenoid G and the position where the pins 25 close switch 28, the delay can be widely varied.

I claim as my invention:

1. In classifying apparatus for classifying sheet material, means for feeding sheet material along a designated route, an inspection station on said route and a shearing station on said route for shearing said material into desired lengths, a classifying station comprising a classifying gate for selectively delivering sheared sheets into a perfect stack or an imperfect stack, said inspection station comprising inspection means electrically responsive to the condition of said material as to a desired characteristic thereof, electrical means connected to said inspection means and comprising controlled contacts and being adapted to close its said contacts upon observation at said inspection station of a departure from an established standard tolerance for said characteristic, a holding circuit for said electrical means for retaining its contacts closed, cyclically actuated switch means controlled by said feeding means and actuated to be closed at the moment of the passage past said inspection station of the trailing edge of each of said lengths, electromagnetic gate actuating means for displacing said gate for selectively delivering sheets into a desired stack, a preparatory circuit controlled by the contacts of said electrical means, electromagnetic control means connected for actuation by said switch means, means actuated by said electromagnetic control means for completing said preparatory circuit and immediately thereafter opening said holding circuit so as to prepare said electrical means for the inspection of the succeeding length, and means controlled by the completion of said preparatory circuit for actuating said gate actuating means.

2. In classifying apparatus for classifying sheet material, means for feeding sheet material along a designated route, an inspection station on said route and a shearing station on said route for shearing said material into desired lengths, a classifying station comprising a classifying gate for selectively delivering sheared sheets into a perfect stack or an imperfect stack, said inspection station comprising inspection means electrically responsive to the condition of said material as to a desired characteristic thereof, electrical means connected to said inspection means and comprising controlled contacts and being adapted to close its said contacts upon observation at said inspection station of a departure from an established standard tolerance for said characteristic, a holding circuit for said electrical means for retaining its contacts closed, cyclically actuated switch means controlled by said feeding means and actuated to be closed at the moment of the passage past said inspection station of the trailing edge of each of said lengths, electromagnetic gate actuating means for displacing said gate for selectively delivering sheets into a desired stack, a preparatory circuit controlled by the contacts of said electrical means, electromagnetic control means connected for actuation by said switch means, means actuated by said electromagnetic control means for completing said preparatory circuit and for maintaining the same closed as long as said switch means is closed, said last mentioned actuated means also serving immediately after completing the preparatory circuit for opening said holding circuit so as to prepare said electrical means for the inspection of the succeeding length, and means controlled by the completion of said preparatory circuit for actuating said gate actuating means.

3. In classifying apparatus for classifying sheet material, means for feeding sheet material along a designated route, an inspection station on said route and a shearing station on said route for shearing said material into desired lengths, a classifying station comprising a classifying gate for selectively delivering sheared sheets into a perfect stack or an imperfect stack, said inspection station comprising inspection means electrically responsive to the condition of said material as to a desired characteristic thereof, electrical means connected to said inspection means and comprising controlled contacts and being adapted to close its said contacts upon observation at said inspection station of a departure from an established standard tolerance for said characteristic, a holding circuit for said electrical means for retaining its contacts closed, cyclically actuated switch means controlled by said feeding means and actuated to be closed at the moment of the passage past said inspection station of the trailing edge of each of said lengths, electromagnetic gate actuating means for displacing said gate for selectively delivering sheets into a desired stack, a preparatory circuit controlled by the contacts of said electrical means, electromagnetic control means connected for actuation by said switch means, means actuated by said electromagnetic control means for completing said preparatory circuit and for maintaining the same closed as long as said switch means is closed, said last mentioned actuated means also serving immediately after completing the preparatory circuit for opening said holding circuit so as to prepare said electrical means for the inspection of the succeeding length, and means controlled by the completion of said preparatory circuit for actuating said gate actuating means.

4. In classifying apparatus for classifying sheet material, means for feeding sheet material along a designated route, an inspection station on said route and a shearing station on said route for shearing said material into desired lengths, a classifying station comprising a classifying gate for selectively delivering sheared sheets into a perfect stack or an imperfect stack, said inspection station comprising inspection means electrically responsive to the condition of said material as to a desired characteristic thereof, electrical means connected to said inspection means and comprising controlled contacts and being adapted to close its said contacts upon observation at said inspection station of a departure from an established standard tolerance for said characteristic, a holding circuit for said electrical means for retaining its contacts closed, cyclically actuated switch means controlled by said feeding means and actuated to be closed at the moment of the passage past said inspection station of the trailing edge of each of said lengths, electromagnetic gate actuating means for displacing said gate for selectively delivering sheets into a desired stack, a preparatory circuit controlled by the contacts of said electrical means, electromagnetic control means connected for ac-

tuation by said switch means, means actuated by said electromagnetic control means for completing said preparatory circuit and immediately thereafter opening said holding circuit so as to prepare said electrical means for the inspection of the succeding length, and means controlled by the completion of said preparatory circuit for actuating said gate actuating means, said last mentioned actuated means further acting to shunt said contacts of said electrical means so as to prevent the opening of the completed preparatory circuit in the event that the length registers off standard at the moment when said switching means is operated.

5. In classifying apparatus for classifying sheet material, means for feeding sheet material along a designated route, an inspection station on said route and a shearing station on said route for shearing said material into desired lengths, a classifying station comprising a classifying gate for selectively delivering sheared sheets into a perfect stack or an imperfect stack, said inspection station comprising inspection means electrically responsive to the condition of said material as to a desired characteristic thereof, electrical means connected to said inspection means and comprising controlled contacts and being adapted to close its said contacts upon observation at said inspection station of a departure from an established standard tolerance for said characteristic, a holding circuit for said electrical means for retaining its contacts closed, cyclically actuated switch means controlled by said feeding means and actuated to be closed at the moment of the passage past said inspection station of the trailing edge of each of said lengths, electromagnetic gate actuating means for displacing said gate for selectively delivering sheets into a desired stack, a preparatory circuit controlled by the contacts of said electrical means, electromagnetic control means connected for actuation by said switch means and having a controlled circuit comprising serially connected therein said preparatory circuit, said controlled circuit being connected for actuating said gate actuating means, interlocking means actuatable upon actuation of said control means for keeping said controlled circuit in condition for maintaining said gate actuating means in operated condition as long as an off standard observation is registered at said inspection station notwithstanding the return of said control means to unactuated condition.

6. In classifying apparatus for classifying sheet material, means for feeding sheet material along a designated route, an inspection station on said route and a shearing station on said route for shearing said material into desired lengths, a classifying station comprising a classifying gate for selectively delivering sheared sheets into a perfect stack or an imperfect stack, said inspection station comprising inspection means electrically responsive to the condition of said material as to a desired characteristic thereof, electrical means connected to said inspection means and comprising controlled contacts and being adapted to close its said contacts upon observation at said inspection station of a departure from an established standard tolerance for said characteristic, a holding circut for said electrical means for retaining its contacts closed, cyclically actuated switch means controlled by said feeding means and actuated to be closed at the moment of the passage past said inspection station of the trailing edge of each of said lengths, electromagnetic gate actuating means for displacing said gate for selectively delivering sheets into a desired stack, a preparatory circuit controlled by the contacts of said electrical means, electromagnetic control means connected for actuation by said switch means and having a controlled circuit comprising serially connected therein said preparatory circuit, said controlled circuit being connected for actuating said gate actuating means, interlocking means actuatable upon actuation of said control means for keeping said controlled circuit in condition for maintaining said gate actuating means in operated condition as long as said switch means is closed notwithstanding the opening of the contacts of said electrical means, and means associated with said control means and with said holding circuit of said electrical means operable upon actuation of said control means for opening said holding circuit after the actuation of said interlocking means has been completed.

7. In classifying apparatus for classifying sheet material, means for feeding sheet material along a designated route, an inspection station on said route and a shearing station on said route for shearing said material into desired lengths, a classifying station comprising a classifying gate for selectively delivering sheared sheets into a perfect stack or an imperfect stack, said inspection station comprising inspection means electrically responsive to the condition of said material as to a desired characteristic thereof, electrical means comprising a tolerance relay having normally open control contacts and being connected to said inspection means and being adapted to energize and close said tolerance relay upon observation at said inspection station of a departure from an established standard tolerance for said characteristic, a re-set relay having its contacts normally closed, holding contacts and a holding circuit for said tolerance relay and connected through the contacts of said re-set relay, cyclically actuated switch means controlled by said feeding means and being arranged to be actuated to close at the moment of the passage past said inspection station of the trailing edge of each of said lengths, a course relay having its actuating winding connected to said switch means and having normally open control contacts, eelctromagnetic setting means comprising a setting relay, means controlled by actuation of said setting means for displacing said gate for selectively delivering sheets into a desired stack, a control circuit connected to the actuating winding of said setting means and being connected in series through the control contacts of said tolerance relay and said course relay, normally open auxiliary contacts for said course relay connected to the actuating winding of said re-set relay, a first set of holding contacts for said setting relay connected in parallel with the control contacts of said course relay, a second set of holding contacts for said setting relay, and an interlocking holding circuit connected to said second set of holding contacts and connected to the control contacts of said tolerance relay and comprising connected in series a normally open interlocking set of contacts for said course relay, said course relay and re-set relay being so constructed and arranged that upon actuation of said course relay said interlocking set of contacts close before said auxiliary contacts cause actuation of said re-set relay to open the holding circuit of said tolerance relay.

8. Classifying apparatus as set forth in claim 1, said electrical means comprising a first measuring circuit and a first measuring relay thereby actu-

ated and having open contacts when unactuated, said first measuring circuit being arranged to respond to observation of a deficiency in said desired characteristic beyond the standard tolerance by actuating said first measuring relay to close the contacts thereof, said electrical means further comprising a separate second measuring circuit and a second measuring relay thereby actuated and having closed contacts when unactuated, said second circuit being arranged to maintain said second measuring relay energized in response to observation of tolerable values of the desired characteristic and to deenergize said second relay in response to observation of excess of said desired characteristic beyond the standard tolerance, said electrical means further comprising an actuating winding for its said controlled contacts and said actuating winding being connected in parallel to the contacts of said first and second measuring relays.

ALBERT M. DEXTER, JR.