March 19, 1940. T. R. RHEA 2,194,325

CLASSIFIER CONTROL SYSTEM

Filed March 8, 1938

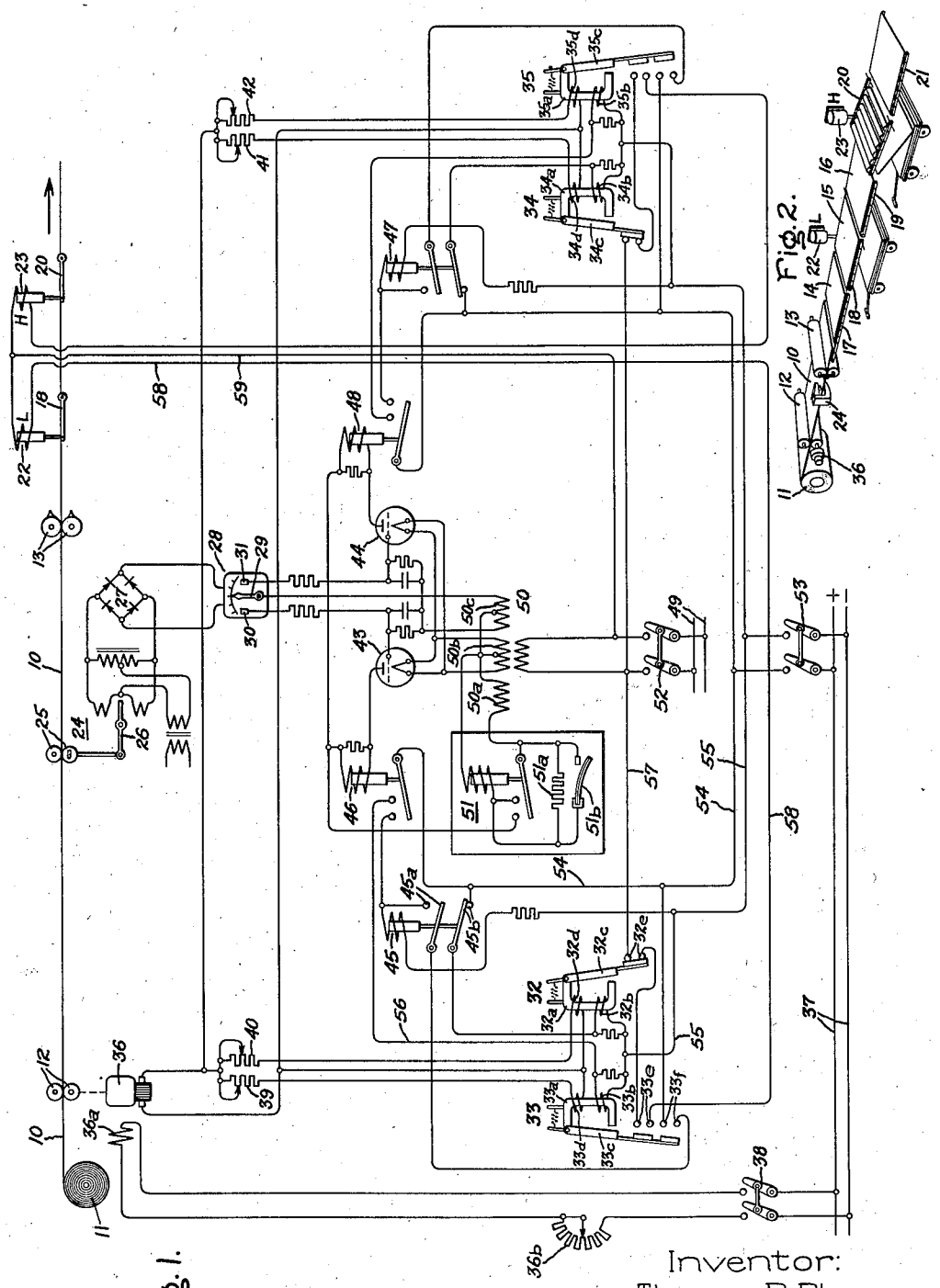


Fig. 1.

Fig. 2.

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Patented Mar. 19, 1940 2,194,325

UNITED STATES PATENT OFFICE

2,194,325

CLASSIFIER CONTROL SYSTEM

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Application March 8, 1938, Serial No. 194,720

11 Claims. (Cl. 209—82)

This invention relates to control systems, more particularly to classifier control systems and the like, and has for an object the provision of a simple, reliable and improved system of this character.

More specifically the invention relates to classifier control systems in which conveyor means are provided for delivering a plurality of units of material to a receiving device, and in which means under the control of a detecting device are provided for diverting non-standard or unsatisfactory units to a second receiving device. Time element means are employed in systems of this character for interposing a time delay between the response of the detecting device and the opening or closing of the diverter so that satisfactory units between the detecting device and diverter will not be diverted to the receiving device for unsatisfactory units, and likewise so that unsatisfactory units will not be delivered to the receiving device for satisfactory units. If the delivery speed is changed, the time delay will be incorrect and a certain number of satisfactory and unsatisfactory units will be delivered to the wrong receiving devices. Accordingly, a further object of this invention is the provision of means for varying this time delay to compensate for adjustment in the delivery speed.

In carrying the invention into effect in one form thereof, means are provided for delivering a plurality of units of material to a receiving device, and means under the control of a deviation detecting device are provided for diverting non-standard units to a second receiving device an interval of time after response of the detecting device, together with means responsive to the speed of the material for varying the time interval in accordance with the delivery speed.

An important aspect of this invention is the provision of a control system for classifying steel sheets into groups in accordance with their thicknesses. For certain uses of sheet steel, uniformity of gauge is an important consideration, and consequently, purchasers of steel sheets for such uses specify that the gauge must be held within certain tolerances. Sheets having a gauge within these tolerances are satisfactory and sheets having a gauge outside these tolerances are unsatisfactory. If too large a number of unsatisfactory sheets are included with the satisfactory sheets, the manufacturer is in danger of losing the business to a competitor whose equipment is capable of producing sheets having a greater uniformity of gauge. Accordingly, a further object of this invention is the provision of a classifier control which operates to "pass" the satisfactory sheets and to "reject" the unsatisfactory sheets, and in which means are provided for minimizing the number of unsatisfactory sheets that become included with the satisfactory sheets. On the other hand, diversion of satisfactory sheets to the "rejects" pile increases the manufacturer's costs unnecessarily, and a still further object of this invention is the provision of means for minimizing the number of satisfactory sheets that are diverted to the pile of unsatisfactory sheets.

In illustrating the invention in one form thereof, it is shown as embodied in a control system for classifying sheets on a cold strip mill shear table into three groups; i. e. (1) satisfactory thickness, (2) light thickness, and (3) heavy thickness.

For a better and more complete understanding of the invention reference should now be had to the following specification and to the accompanying drawing in which Fig. 1 is a simple, diagrammatical representation of an embodiment of the invention, and Fig. 2 is a simple, diagrammatical view in perspective that illustrates the structure and physical arrangement of parts of the system.

Referring now to the drawing, a length of material 10 is unwound from a reel 11 and fed through pinch rolls 12 to a flying shear 13 which severs unit lengths from the end of the strip to produce a plurality of sheets 14, 15, and 16, etc. A sheet conveyor having sections 17, 18, 19, 20, and 21 delivers the sheets to a lot counter and stagger piler (not shown).

The pinch rolls 12, shear 13, and conveyor sections 17, 18, 19, 20, and 21 are driven by suitable driving means at a speed that is preferably substantially constant. For example, these elements may be driven by a Ward-Leonard drive, i. e., by individual direct-current motors supplied from an adjustable voltage generator. In a drive of this character, the motors operate substantially in step with each other so that for all practical purposes the pinch rolls, shear and conveyor sections may be considered to be tied together mechanically.

For the purpose of diverting unsatisfactory sheets from the satisfactory sheets that are being conveyed to the lot counter and stagger piler, conveyor sections 18 and 20 are pivoted for rotation in a clockwise direction about the forward edge as illustrated in Fig. 2, thus constituting diverting means or traps. In the interest of simplicity, only two diverters are illustrated but any desired number may be employed. These diverters are provided with solenoids 22 and 23 respec-

tively which, when energized, serve to open the diverters and when deenergized serve to close the diverters.

The diverter solenoids 22 and 23 are under the control of a thickness deviation detecting device illustrated as a flying micrometer gauge 24. This gauge continuously measures the thickness of the passing strip and provides a continuous indication of the thickness. Although several types of gauges and other devices satisfactory for this purpose are available on the market, it is preferred to employ a variable air gap transformer type gauge. This type of gauge has a pair of contact rolls 25, one above and one below the strip. One of these rolls, the upper roll in the illustration; is fixedly mounted, and the other roll is mounted for movement with respect to the first roll in response to changes in the gauge of the strip. These rolls press on the strip at all times, and the movement of one with respect to the other is a measurement of variations in the thickness of the strip. This movement is transmitted to the movable magnetic vane member 26 of an air gap transformer type gauge head and, by means of a power unit which includes the necessary rectifying means 27, an indication of the strip thickness is produced on a contact-making microammeter 28 which is calibrated in any convenient units of strip thickness. This type of gauge is well known to the trade, and since its specific internal structural details constitute no part of the present invention, a more detailed description is omitted.

The electric gauge indicating instrument 28 is preferably equipped with a zero center movable contact member 29 and with two stationary contacts 30 and 31. In practice, these two stationary contacts preferably take the form of mercury cup contacts, the positions of which are adjustable with respect to the central position of the movable contact member 29. The movable contact member makes contact with the mercury cup on either side of the zero position, and this circuit closing feature is utilized for actuating a control of the diverter solenoids 22 and 23. The gauge is provided with means for initial adjustment so that the movable contact member 29 will be in the zero or central position when the contact rolls 25 are separated a distance equal to the desired thickness of the strip. Over size calibrations are on one side of the zero position, preferably the right side, and the under size calibrations are on the left side. Thus, if the strip is running at the correct gauge, the instrument will indicate zero, but if it runs over size, the movable contact member will swing to the right in proportion to the amount of the over size and conversely, if the strip is running under size, the movable contact member will swing to the left. The mercury cup contacts can be adjusted in position so that they make contact with the movable contact member at any desired point. In other words, if the total scale deflection to the right represents .005", the mercury cup can be adjusted so that it will make contact when the instrument indicates .005" or any other desired point such as .002". Thus the setting of the mercury cup depends upon the tolerance which is to be allowed.

When the movable contact member 29 engages the stationary contact member 30, the control is actuated to energize the diverter solenoid 22 and conversely, when the movable contact member engages the stationary contact member 31, the control is actuated to energize the diverter solenoid 23.

Assuming that diverter 18 is for sheets thinner than the correct gauge and diverter 20 is for sheets thicker than the correct gauge, diverter 18 will be referred to as the "light" diverter and diverter 20 as the "heavy" diverter. Likewise solenoid 22 will be referred to as the light diverter solenoid and solenoid 23 as the heavy diverter solenoid.

The control is so arranged that light diverter solenoid 22 is energized when movable contact member 29 engages stationary contact 30, and heavy diverter solenoid 23 is energized when movable contact member 29 engages stationary contact member 31.

Diverters 18 and 20 are returned to their normal or closed positions by suitable spring means (not shown).

For the purpose of interposing a time delay between the engagement of movable contact member 29 with stationary contact member 30 and the opening of diverter 18, a suitable electromagnetic time delay device 32 is provided. A similar electromagnetic time delay device 33 is provided for interposing a time delay between the separation of contacts 29 and 30 and the closing of diverter 18. Likewise, similar electromagnetic time delay devices 34 and 35 are provided for interposing time delays between the closing and opening of the microammeter contacts and the opening and closing of the heavy diverter 20.

Time delay relays 32, 33, 34 and 35 have U-shaped core members 32_a, 33_a, 34_a and 35_a upon which are mounted operating coils 32_b, 33_b, 34_b and 35_b respectively. These time delay relays also have movable contact members 32_c, 33_c, 34_c and 35_c which are biased by springs to the positions illustrated in the drawing.

The speed of the drive may be adjusted to vary the strip speed over a wide range. If the time setting of relays 32, 33, 34 and 35 is correct for one strip speed, it will be incorrect for other strip speeds. If the time setting of the relays is incorrect, the diverters 18 and 20 will open and close at the wrong time and this will result in the inclusion of unsatisfactory sheets with the satisfactory sheets and the diversion of satisfactory sheets to the reject pile. In order to compensate for adjustment in the speed of the strip, means are provided for varying the time delay setting of the relays 32, 33, 34 and 35 in accordance with the speed of the strip. These compensating means are illustrated as bucking coils 32_d, 33_d, 34_d and 35_d supplied from a variable voltage generator 36. The bucking coils 32_d, 33_d, 34_d and 35_d are arranged on the core structures of the time delay relays in such a manner that their magnetomotive forces oppose the magnetomotive forces of the operating coils 32_b, 33_b, 34_b and 35_b respectively.

The generator 36 is provided with a field winding 36_a which is excited from a suitable source of constant excitation represented in the drawing by the two supply lines 37 to which it is arranged to be connected by means of switch 38. The tachometer generator 36 is driven through suitable gearing (not shown) from the pinch rolls 12 or, if desired, it may be driven through gearing from one of the conveyor sections, so that its voltage varies in accordance with the speed of the sheet material.

Adjustable resistors 39 and 40 are included in the connections between the armature of tach-

ometer generator 36 and the bucking coils 33_d and 32_d respectively, and similar adjustable resistors 41 and 42 are included in the connections between bucking coils 34_d and 35_d. These adjustable resistors are for the purpose of initially adjusting the individual time settings of time delay relays 32, 33, 34 and 35. For a given setting, the time delay that one of these relays will produce is dependent upon the total magnetic flux in the core. With the maximum steady strip speed, this flux will be the difference between the flux due to the main coil supplied from the constant voltage source 37 and the flux produced by the bucking coil supplied from the tachometer generator 36. The greater the speed of the strip, the less will be the time delay required between the actuation of the microammeter contacts and the opening or closing of the diverters. Accordingly, the greater the strip speed, the greater will be the voltage of the tachometer generator 36 and the smaller will be the magnetic flux in the cores of the timing relays 32, 33, 34 and 35, which as pointed out is the difference between the flux produced by the main operating coils and the flux produced by the bucking coils. Likewise, the lower the strip speed, the greater will be the flux in the cores of the timing relays. Since the time delay in the drop-out operation of the relays depends upon the time required for the flux to decay in the core structures after the main operating coils have been deenergized, and since this depends upon the amount of flux present in the core structures, it will be seen that the time delay settings of the relays 32, 33, 34 and 35 are automatically varied in accordance with the speed of the sheet material.

An adjustable calibrating resistor 36_b is connected in circuit with the field winding 36_a of generator 36. Adjustment of this resistor serves to adjust the voltage of generator 36 and thereby to effect simultaneous adjustment of the time settings of all the time delay relays.

Suitable electric valves 43 and 44 are provided for amplifying the current produced when the movable contact member 29 of the microammeter 28 engages either of the stationary contacts 30, 31. A pair of control relays 45 and 46 controlled by electric valve 43 are provided for sequencing the opening and closing of time delay relays 32, 33, and a similar pair of relays 47, 48 under the control of electric valve 44 are provided for sequencing the opening and closing of time delay relays 34, 35. Although the electric valves 43, 44 may be of any suitable type, they are illustrated as being of the three-electrode type into the envelope of which a small quantity of an inert gas is introduced after exhaust. The presence of this gas within the tube serves to convert the usual pure electronic discharge into an arc stream, thus constituting the tube an electrostatically controlled arc rectifier. These electric valves are supplied from an alternating current source represented by the supply lines 49 to which they are connected through a power transformer 50 having a primary winding and three secondary windings 50_a, 50_b, and 50_c. Power for heating the cathodes of the electric valves is supplied from the secondary winding 50_b, and power for the cathode-anode circuits of the valves is supplied from the secondary winding 50_a, whereas the voltage for the grid circuits of the valves is supplied from the secondary winding 50_c. Suitable protective means 51 illustrated as a contactor having normally open contacts in the cathode-anode circuits and a thermostatic member 51_b in circuit with the operating coil of the contactor are provided for preventing destruction of the cathodes by maintaining the cathode-anode circuits open until the cathodes have become heated to the correct temperature.

Obviously, this invention includes the use of any other sensitive types of relays, such for example as a telephone type relay, in place of the electric valves 43, 44.

The flying micrometer gauge 25 is located ahead of the shear 13 at a point that will give about two seconds time interval of strip travel to the first diverter 18, and about two and one-half or three seconds time interval for the sheets to reach the second diverter 20. The adjusting resistors 39, 40, 41, and 42 are adjusted to give corresponding time settings for the time delay relays 32, 33, and 34, 35.

For the purpose of illustration it may be assumed that the flying micrometer gauge 24 and the contact-making microammeter 28 are adjusted to hold a gauge of .010"±.0003". In other words, the gauge and contact-making microammeter are so set that if the strip thickness decreases to .0097", movable contact member 29 will engage stationary contact member 30 and the light diverter 18 will be opened, whereas if the strip thickness increases to .0103", the movable contact member 29 will engage stationary contact member 31 and the heavy diverter 20 will be opened. For strip thicknesses between these tolerances the movable contact member 29 will be out of engagement with both of the stationary contacts 30, 31, and both diverters 18 and 20 will be closed so that the sheets will be delivered to the stagger piler for satisfactory sheets.

With the foregoing understanding of the apparatus and its organization in the completed system, the operation of the system itself will readily be understood from the following detailed description.

The system is placed in operation by closing the switches 38, 52, and 53. In its closed position, switch 52 connects the primary winding of power transformer 50 to the A. C. source 49. After an interval of time sufficient for the cathodes of electric valves 43, 44 to become heated to the correct temperature, the heating element 51_a of the cathode protection unit heats the thermostatic element 51_b and causes it to close its contacts to complete an energizing circuit for the operating coil of relay 51. Relay 51 closes its contacts in response to energization and thereby closes the cathode-anode circuits of valves 43, 44. As long as the movable contact member 29 of the microammeter remains in its central position, the voltage applied to the grids of valves 43, 44 is sufficiently negative to render both valves non-conducting.

In the closed position of switch 53, an energizing circuit is established for the operating coil 32_b of time delay relay that is readily traced from the positive side of source 37 through left-hand pole of switch 53, conductor 54, lower contacts of relay 45, operating coil 32_b of relay 32, and thence by conductor 55 and the right-hand pole of switch 53 to the negative side of source 37. In response, the armature member 32_c of relay 32 is moved to the attracted position in which it interrupts the contacts 32_c.

The drive for the pinch rolls 12, shear 13 and conveyor sections is started in the usual manner and the strip is fed to the shears at a speed which has been determined to be best suited to the material. Assuming that the gauge 24 has been set

to produce a zero indication on the microammeter 28 when the gauge of the strip is .010", both light and heavy diverters 18 and 20 will be closed as long as the gauge of the strip remains at .010" and the severed sheets 14, 15, 16, will be delivered to the lot counter and stagger piler (not shown) at the right-hand end of the conveyor.

However, if the gauge of the strip should decrease to .0097" as measured between the rolls 25 of the gauge head, the movable contact member 29 of the microammeter will swing to the left to engage stationary contact 30 and thereby apply a positive voltage to the grid of electric valve 43. As a result, valve 43 becomes conducting and supplies current to the operating coil of relay 46 which thereupon closes its contacts. In the closed position of relay 46, energizing circuits are established for sequencing relay 45 and for time delay relay 33. The circuit for relay 45 is traced from the positive side of the source 37 to the conductor 54, thence through left-hand stationary contact of relay 46, and operating coil of relay 45 to the conductor 55 and the negative side of source 37. The circuit for relay 33 is traced to the conductor 54 as before and thence through the right-hand stationary contact of relay 46, conductor 56, operating coil of relay 33 to conductor 55 and the negative side of source 37. In response relay 33 closes both of stationary contacts 33_e and 33_f without time delay. Relay 45 in response to energization closes its upper contact 45_a and opens its lower contact 45_b. The upper contact 45_a completes a holding circuit for the operating coil of relay 45 independent of the contact of relay 46. Contact 45_b in opening interrupts the circuit for the main operating coil 32_b of time delay relay 32. At this instant the flux in the core structure of relay 32 is the difference between the flux produced by the operating coil 32_b and the flux produced by the bucking coil 32_d supplied from tachometer generator 36. After the interval of time required for this difference flux to decay the spring of relay 32 causes the armature member 32_c to drop out and to close stationary contacts 32_e and thereby complete an energizing circuit for the diverter solenoid 22. This circuit is traced from the upper side of A. C. source 49 through switch 52, conductor 57, contact 32_e of time delay relay 32, contact 33_e of time delay relay 33, conductor 58, diverter solenoid 22, conductor 59 to the lower side of source 49. The time delay between the response of the gauge 24 and the closing of contact 32_e of time delay relay is just sufficient to allow all of the unsevered strip between the gauge rolls 25 and the shear 13, as well as the severed sheets on the conveyor to pass diverter 18. At the expiration of this time interval diverter 18 is opened and the unsatisfactory thin gauge sheets are diverted from the conveyor to the hand truck beneath diverter 18.

As soon as the gauge of the strip becomes heavier than at .0097 inch, the gauge 24 responds and the movable contact 29 swings out of engagement with stationary contact 30, thereby rendering valve 43 non-conducting. Relay 46 is deenergized and opens its contacts, and as a result the energizing circuit for the main operating coil of time delay relay 33 is interrupted. The energizing circuit for the relay 45, however, remains closed through its own upper contact 45_a. After an interval of time required for the flux in the core of relay 33 to decay, the spring of this relay moves the armature member 33_c to open the contacts 33_e and 33_f. When contacts 33_f are open the locking circuit for relay 45 is interrupted and its contacts drop to the position illustrated in the drawing. In the open position of contacts 33_c, the energizing circuit for diverter solenoid 22 is interrupted and diverter 18 is closed by its spring. The time delay interposed by relay 33 between the separation of contacts 29 and 30 on the microammeter and the closing of the diverter 18 is just sufficient for all of the thin gauge material between the gauge rolls 25 and the diverter 18 to pass under the diverter before it is closed.

In the closed position of lower contact 45_b of relay 45, the energizing circuit for the operating coil 32_b of time delay relay 32 is re-established and its armature is moved to interrupt the contacts 32_e and thereby to leave the apparatus in a reset condition for a subsequent operation.

If the gauge of the strip 10 increases to .0103 inch or more and again decreases to less than .0103 inch the movable contact member 29 of the microammeter will engage the stationary contact 31 and subsequently separate therefrom in response to the changes in gauge and the relays 34, 35, 47 and 48 will function in a manner similar to that described in the foregoing, to open the diverter 20 and subsequently close it after time intervals sufficient to allow the conveyor to become cleared of all the material and sheets between the gauge rolls 25 and the diverter 20.

If the speed of the shear and conveyor is adjusted to a new value the voltage generated by generator 36 will change to a corresponding value. This change in voltage which is supplied for the bucking coils of the time delay relays 32, 33, 34 and 35, will produce a corresponding change in the flux in the core structures of these relays, and this in turn will result in changing the time settings of the relays so that the time delays which they interpose in the operation of the diverters 18 and 20 will be correct for the new speed. If the speed of the drive is increased the voltage of the generator will be increased, the effect of the bucking coils will be strengthened, the flux in the core structures of the relays will be decreased, and the time settings of the relays will be decreased. Thus, if the speed of the driver is increased, the time intervals interposed by the time delay relays are automatically decreased.

Similarly, if the speed of the drive is decreased, the time intervals interposed by the time delay relays in the operation of the diverters will be correspondingly increased.

Although in accordance with the provisions of the patent statutes, the principle of this invention has been explained together with the best mode in which it is now contemplated applying that principle, it will be understood that the apparatus and connections shown are merely illustrative and that the invention is not limited thereto, since alterations and modifications will readily suggest themselves to persons skilled in the art without departing from the true spirit of this invention or from the scope of the annexed claims.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A classifier control system comprising a conveyor for delivering a plurality of units of material to a receiving device, means for diverting units from said conveyor to another receiving device, means for detecting deviations of said

material from a standard and an electrical time element device set in operation by said detecting means for actuating said diverting means after an interval of time, and electrical means responsive to the speed of said material for producing a control voltage to vary the time setting of said electrical time element device thereby to vary said time interval.

2. A classifier control system comprising in combination, means for delivering units of material to a receiving device, a diverter for diverting units from said delivering means to a second receiving device, means responsive to deviation of said material from a standard, and an electromagnetic time element device set in operation thereby for effecting actuation of said diverter after a predetermined interval of time, and means responsive to the speed of said material for producing a control voltage varying with said speed to vary the time setting of said time element device.

3. A classifier control system comprising in combination, a conveyor for delivering a plurality of units of material to a receiving device, means for diverting units from said conveyor to a second receiving device, means responsive to deviation of said material from a standard and an electromagnetic time element device having an operating coil controlled thereby for actuating said diverting means after an interval of time, said time element device also having an opposing coil, and means for varying said time interval comprising means for supplying to said opposing coil a voltage varying with the speed of said conveyor.

4. A classifier control system comprising in combination, a conveyor for delivering units of material to a receiving device, means for diverting units from said conveyor to a second receiving device, means responsive to variation of said material from a standard and an electromagnetic time element device provided with an operating coil controlled by said variation responsive means for opening said diverting means after an interval of time, a second electromagnetic time element device having an operating coil controlled by said variation responsive means for closing said diverting means after an interval of time, said time element device being provided with auxiliary coils for opposing the magnetism of said operating coils, and means for supplying a voltage varying with the speed of said conveyor to said opposing coils thereby to vary said time intervals.

5. A classifier control system comprising in combination with a device for severing sheet lengths from a length of moving material and means for feeding said material to said severing means, a conveyor for delivering the severed sheets to a receiving device, means for diverting sheets from said conveyor to a second receiving device, a device for detecting deviations in the thickness of the material from a desired value and an electromagnetic time element device set in operation thereby for actuating said diverting means after an interval of time, and means responsive to the speed of said material for varying the excitation of said time element device to vary said time interval.

6. A classifier control system comprising in combination with means for advancing a length of material, and a device for severing unit lengths therefrom, a conveyor for delivering said unit lengths to a receiving device, a diverter for diverting unit lengths differing from a standard thickness to a second receiving device, a gauge responsive to variations in the thickness of said material and an electromagnetic time element device provided with an operating coil controlled by said gauge for controlling the operation of said diverter a time interval after response of said gauge, and means for varying said time interval in accordance with the speed of said material comprising a generator driven at a speed proportional to the delivery speed of said material and an opposing coil on said time element device supplied from said generator.

7. A classifier control system comprising the combination with means for advancing a length of material and a device for severing unit lengths therefrom of a conveyor for delivering said unit lengths to a receiving device, a diverter for diverting unit lengths differing from a standard thickness to a second receiving device, a gauge responsive to variations in the thickness of said material and a pair of electromagnetic time element devices provided with operating coils controlled by said gauge, one of said time element devices for controlling the opening of said diverter and the other for controlling the closing of said diverter, and means for varying the time interval of said devices in accordance with the delivery speed of said material comprising a generator driven at a speed proportional to the delivery speed of said material and opposing coils on said time element devices supplied from said generator.

8. A classifier control system comprising in combination, a conveyor for delivering a plurality of units of material to a receiving device, a diverter for diverting units differing from a standard to a second receiving device, means for detecting variations in said material and an electromagnetic time element device provided with an operating coil controlled by said detecting means for controlling the opening of said diverter an interval of time after response of said detecting means to a deviation of said material from a standard, a second time element device having an operating coil controlled by said detecting means for controlling the closing of said diverter and resetting said first time element device an interval of time after response of said detecting means to a return of said material to standard, and means for varying said time intervals in accordance with the speed of said material comprising a generator driven at a speed proportional to the delivery speed of said material and opposing coils on said time element devices supplied from said generator.

9. A classifier control system comprising in combination, means for delivering units of material to a receiving device, means for diverting units to a second receiving device, means responsive to a variation of said material from a standard and an electromagnetic time element device set in operation by said variation responsive means for effecting the actuation of said diverting means after an interval of time, and means responsive to the speed of said material for varying the magnetization of said time element device to vary said time interval.

10. A classifier control system comprising in combination, means for delivering units of material to a receiving device, means for diverting units to a second receiving device, means responsive to variation of said material from a standard and a time element device set in operation by said variation responsive means for controlling the opening of said diverting means after

an interval of time, a second time element device set in operation by said variation responsive means for closing said diverting means after an interval of time, means for separately adjusting the time interval of each of said time element devices, means for simultaneously adjusting the time interval of said time element devices, and means responsive to the speed of said material for varying said time intervals inversely with the speed of said material.

11. A classifier control system comprising in combination, means for delivering units of material to a receiving device, means for diverting units to a second receiving device, means responsive to variations of said material from a standard and an electromagnetic time element device provided with an operating coil controlled by said variation responsive means for controlling the opening of said diverting means after an interval of time, a second electromagnetic time element device having an operating coil controlled by said variation responsive means for controlling the closing of said diverting means after an interval of time, said time element devices being provided with auxiliary coils for opposing the magnetism of said operating coils, means for varying said time intervals in accordance with the speed of said material comprising a generator driven by said material delivering means for supplying a voltage to said opposing coils, and an adjustable calibrating resistor for controlling the voltage supplied to said opposing coils for simultaneously adjusting the time intervals of said time element devices.

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