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2 Sheets-Sheet 1



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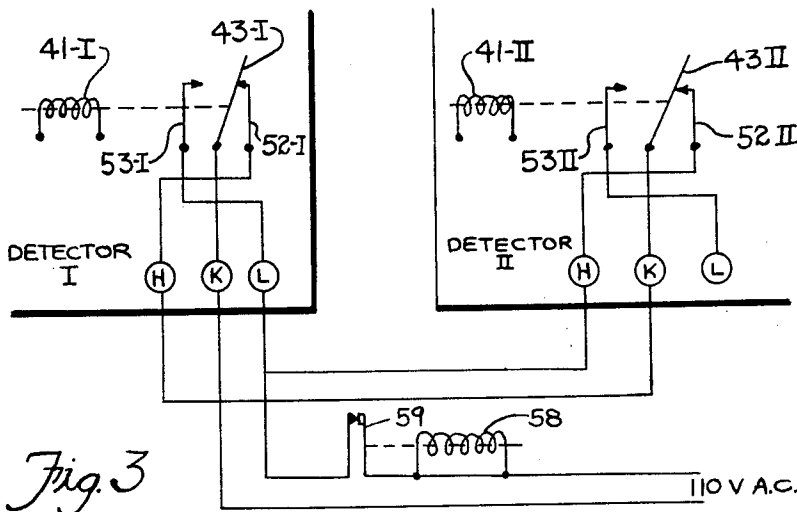
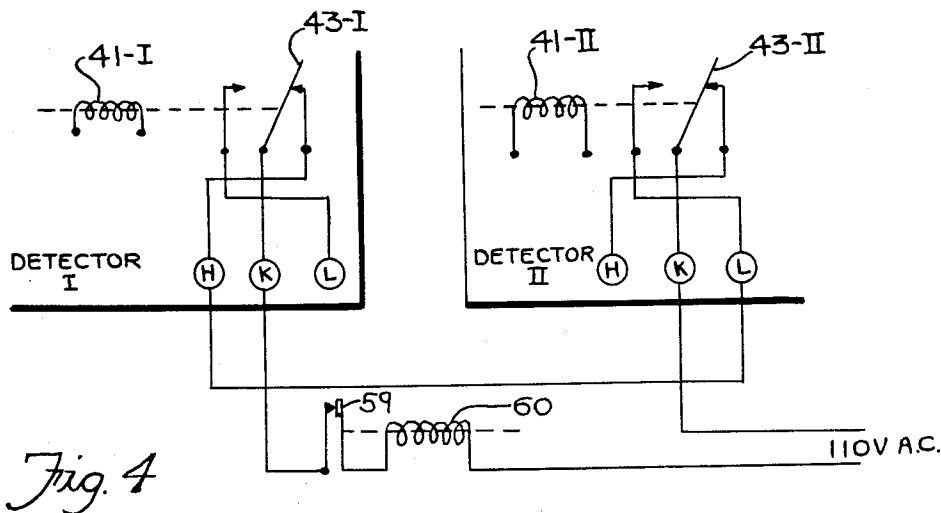
Dec. 18, 1962

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MAGNETIC DETECTOR

3,069,601

Filed Aug. 18, 1959

2 Sheets-Sheet 2



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MAGNETIC DETECTOR

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Filed Aug. 18, 1959, Ser. No. 834,573
11 Claims. (Cl. 317-149)

This invention relates to magnetic detectors and more particularly to apparatus for gauging or measuring thickness of ferro-magnetic sheet material.

There are numerous industrial applications for magnetic sheet thickness detectors and indicators. Such devices are very frequently employed to prevent the jamming or disabling of automatic sheet feeding machinery in the canning industry. Metal sheets comprising the blanks for the cans to be fabricated are fed along a conveyor belt to the processing equipment. In the event that two or more sheets should inadvertently stick together or otherwise enter the processing equipment in partially or fully superposed relationship, serious injury to the machinery may ensue unless means are provided for automatically shutting off the power whenever such a situation occurs. There are also numerous other applications for magnetic sheet thickness detectors and indicators; for example, such apparatus may be employed in conjunction with a servo system to provide automatic control of the thickness of rolled sheet material. Also equipment of this type may be useful in sorting metal sheet materials of different thicknesses.

Early attempts at providing thickness indication or detection for use in conjunction with automatic shut-off apparatus or servo systems of one sort or another employed mechanical feeler elements which were preset to be actuated only upon the approach or passage of sheet material of greater than a predetermined desired thickness. However, mechanical arrangements of this type are not particularly accurate and are easily thrown out of adjustment. Consequently, electrical systems were devised which exhibited greater sensitivity and reliability.

Thus, for example, it is known that a magnetic thickness detector or indicator may comprise an open core electromagnet disposed in the path of the ferro-magnetic sheet metal blanks as they are transferred along a conveyor. As a metal can blank passes over the open end of the electromagnet, the flux within the core is increased and this gives rise to an increase in the voltage across the electromagnetic energizing coil. This increased voltage may be detected and employed in any desired way as a control signal to effect a control operation or to give visual or audible indication of the presence of the sheet metal. If desired, the device may be set up in such a way that only sheet metal of greater than a predetermined thickness will give an output signal of sufficient magnitude to perform the desired control operation; thus, the control signal developed in the presence of two superposed sheets may be employed to deenergize a power circuit or perform any other desired control operation. However, such devices as have been heretofore employed, have been extremely critical in their adjustments and have been incapable of detecting sufficiently fine thickness differences and variations to accommodate all of the required applications for devices of this sort. In many installations it has been necessary to recheck and reset the associated control circuit at very frequent intervals, in order to maintain the accuracy and stability imposed by present day production techniques and requirements.

It is accordingly a principal object of the present invention to provide a magnetic thickness detector or indicator which avoids one or more of the disadvantages of prior art devices.

It is an additional object of the invention to provide a

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new and improved magnetic thickness detector or indicator which is considerably more stable and less critical in its operation than prior art devices of this type.

Another object of the invention is to provide a new and improved metal thickness detector or indicator which may be employed to detect very minute differences or changes in thickness, of the order of one thousandth of an inch, with complete reliability over a wide range of sheet metal gauges due to an improved sensing amplifier.

A more specific object of the present invention is to provide a magnetic thickness detector or indicator incorporating "fail-safe" provisions in the event of failure of an electron discharge device embodied therein or the energization source associated therewith.

It is a further and particular object of the invention to provide a preferred embodiment of an electronic gauging device in which a pair of magnetic thickness detectors or indicators are combined in a unique circuit to reject over and under gauge sheet metal stock.

The present invention is a continuation-in-part of my co-pending application Serial Number 552,557 for a Magnetic Detector, filed December 12, 1955, and now Patent No. 2,994,015.

The particular features of the invention which are believed to be novel are set forth in detail in the accompanying claims. The invention, together with further objects and advantages thereof, may more readily be understood, however, by reference to the following description taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a schematic circuit diagram of a magnetic thickness detector or indicator constructed in accordance with the present invention and adapted specifically for use as a double sheet detector or the like;

FIG. 2 is a circuit arrangement in which two double sheet detectors shown in FIG. 1 are combined for the rejection of over gauge and under gauge sheet stock;

FIG. 3 is a simplified schematic circuit diagram of a portion of the FIG. 2 arrangement, showing the detail of the rejection control operating circuit; and

FIG. 4 is a simplified schematic circuit diagram covering a modification of FIGS. 2 and 3.

In FIG. 1, a magnetic detector head 1 is placed below a moving conveyor belt 2 which is powered by any suitable mechanical or electrical drive arrangement and usually includes an electric motor (not shown). The motor may drive the conveyor belt in the direction indicated by the arrow over a path passing directly over the magnetic detector head 1. Ferro magnetic sheet metal elements such as metal can blanks 3 are individually supplied to the conveyor 2 in any suitable manner, usually by means of automatic feeding from a magazine or hopper (not shown), and occasionally two or more of the metal can blanks may stick together or otherwise be supplied to the conveyor in superposed or overlying relationship as indicated at 4.

Magnetic detector head 1 is preferably constructed as an open-core transformer comprising a laminated central core 5 supported within a housing or casing 6 of non-metallic material such as Bakelite or other suitable plastic. The upper end of the laminated core 5 projects through the plastic housing 6 and is flush with the upper surface thereof; the other end of the core terminates in a base or cap 7 constructed of iron or other ferro-magnetic material. The primary and secondary windings 8 and 9, respectively, of the transformer are wound on laminated core 5 with the secondary winding 9 in the upper portion of the housing closest to the open end of core 5.

Primary winding 8 of the magnetic detector head is energized from a suitable source of alternating current such as the secondary winding 10 of a power transformer

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11, the primary winding 12 of which may be connected to a 115-volt 2-wire or 230-volt 3-wire power source, such as the 60-cycle public utility power lines (not shown).

Secondary winding 9 of magnetic detector head 1 is connected across the input terminals of a full-wave bridge rectifier 13 which is preferably of the selenium dry-disc type. The negative output terminal of the rectifier is connected to a filter condenser 14 which is returned to the positive terminal thereof. The unidirectional or D.C. control voltage developed by rectifier 13 is further filtered by means of a series resistor 15 and a pair of parallel elements comprising a condenser 16 and resistor 17, and is applied between the control grid 18 and the cathode 19 of an electron-discharge device 20 which may constitute a simple triode amplifier tube.

The uni-directional or D.C. voltage developed by rectifier 13 and appearing across the parallel connection of filter condenser 16 and resistor 17 is applied across a resistive voltage divider through the series-connected resistors 21 and 22 to the voltage dividing junction of resistors 23 and 24 which are serially connected across the secondary coil 34. By means of a decade potentiometer element 25 and its associated selector switch arm 25', the resistors 23, 24 are connected across a further resistor 26. Resistor 26 is provided with a variable contact which is directly connected to cathode 19 of electron-discharge device 20, and is further connected by lead 27 to a plurality of series-connected resistors 28, 29 and 30 which are connected in the recited sequence between cathode 19 and a point of fixed reference potential, here shown as ground. Control grid 18 is connected to the junction between resistors 21 and 22 and the anode 31 of device 20 is directly connected to ground. Cathode 19 of device 20 is maintained at an appropriate unidirectional or D.C. voltage of negative polarity which is developed by a rectifier 32 and filter condenser 33 connected across a separate secondary winding 34 of power transformer 11.

The junction between resistors 28 and 29 is coupled through a current-limiting resistor 35 to the control grid 36 of a control device 37 which may constitute a conventional gas discharge device or thyatron. The cathode 38 of device 37 is directly connected to ground, and the anode or plate 39 is energized with alternating voltage supplied by an additional secondary winding 40 of power transformer 11. The plate circuit of device 37 includes the control winding 41 of a relay provided with a pair of moving contacts 42 and 43. The plate circuit of device 37 may also include a series-connected current limiting resistor 44 as well as an anti-chatter condenser 45 connected across relay coil 41. Moving contact 42 normally engages a fixed contact 46 which is connected through the filament of a red indicator lamp 47 to one side of secondary winding 10 of power transformer 11. When the relay is energized, moving contact 42 engages another fixed contact 48 which is connected through the filament of a green indicator lamp 49 to the same side of secondary winding 10. The moving contact 42 is connected through a series limiting resistor 50 to the other side of secondary winding 10. The filaments of devices 20 and 37 are energized from an additional secondary winding 51 of power transformer 11, as shown. Either one or the other of the indicator lamps 47 and 49 is always energized depending upon the instantaneous condition of moving contact 42 of control relay.

The position of contacts as shown in FIG. 1 is the position when a double sheet is detected or a tube fails, etc. Therefore, when moving contact 43 engages with fixed contact 52 the power circuit must open to stop the conveyor drive motor.

In normal operation, when acceptable sheets are passing, the thyatron 37 is conducting and relay is energized, so that moving contact 43 engages fixed contact 53, thus closing circuit to the driving motor. If a double sheet is detected, the thyatron 37 goes non-conducting, the relay

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coil is de-energized and moving contact 43 engages fixed contact 52, thus opening the power circuit and stopping the motor. The control circuit for effecting automatic deenergization of the conveyor motor may be completely conventional, and accordingly has not been shown. Other control operations may be effected by connecting an appropriate device across relay contacts 52, 43, 53 at the terminals H, K, L. For example, rather than opening the conveyor drive motor circuit, the control operation may be the actuation of a diverting solenoid or a throw out feed mechanism.

Secondary winding 10 is further utilized as a source of bias potential for device 37. A unidirectional or D.C. voltage of negative polarity is developed by a rectifier 54 and filter condenser 55 connected across the winding 10 of power transformer 11 after the series resistor 50. The unidirectional voltage thus developed is connected across the series arrangement of resistors 28 and 29 to provide a reference bias level for grid 36 of device 37.

In operation, the circuit of FIG. 1 differs from that of applicant's aforementioned co-pending application in that the rectifier 13 and the additional thyatron grid bias developed at rectifier 54 are of such a polarity that devices 20 and 37 are both normally conducting when detector head 1 is sensing the presence of any ferro-magnetic material of a predetermined thickness. This provides a marked improvement in that the circuit of the present invention affords a "fail-safe" provision. Thus, the relay 41 will be deenergized in the event of failure of either of the electron-discharge devices 20 or 37, or by failure of the power line energization source connected to the primary winding 12 of power transformer 11. By adjustment of the range selector decade 25, 25' and the vernier potentiometer 26, the detector circuit of the present invention may be set to deenergize relay 41 upon the presence of double sheets of ferro-magnetic material or the presence of such material which is over a predetermined gauge or thickness.

The alternating voltage appearing across the secondary winding 34 of power transformer 11 is rectified by device 32 to provide a unidirectional positive bias voltage across condenser 33. At the same time, the alternating voltage developed across the secondary winding 10 is applied to the primary winding 8 of magnetic detector head 1. The voltage induced in secondary winding 9 of detector head 1 is rectified by device 13 and filtered by resistors 15, 17 and condensers 14, 16 to provide a D.C. or unidirectional control voltage whose amplitude is dependent upon the presence or absence of ferro-magnetic material within the field of the open-core transformer of magnetic detector head 1. In the absence of any ferro-magnetic material within the field of the open-core transformer or magnetic detector head, the voltage developed across resistor 17 is only a few volts negative with respect to ground. Thus, in the quiescent condition (in the absence of any ferro-magnetic sheet material in the vicinity of magnetic detector head 1), the voltage divider comprising resistors 21, 22, 23 and 24 receives a small negative D.C. control voltage at its upper terminal and a considerably larger positive D.C. bias voltage at its lower terminal at resistor 15. The positive D.C. bias voltage is applied to cathode 19 of electron-discharge device 20 to condition that device for the cut-off of electron space current to anode 31. However, the voltage applied between control grid 18 and cathode 19, in the quiescent condition from diode 32, is a substantial positive voltage, biasing device 20 for anode current conduction. In this condition of the circuit, positive D.C. voltage is applied through resistor 35 to control grid 36 of thyatron 37, thus conditioning control tube 37 to fire and energize relay 41. Thus, in the quiescent state green indicator lamp 49 is illuminated and the control circuit for the conveyor drive system remains energized through contacts 43 and 53 of the control relay.

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When a single sheet of ferro-magnetic material, such as stainless steel or the like, is placed in juxtaposition with magnetic detector head 1, as illustrated at 3 in the drawing, the flux concentration in laminated core 5 is greatly increased and the output voltage developed across secondary winding 9 is correspondingly increased. This leads to a considerably larger negative D.C. voltage developed at the output of rectifier 13 and filter, 14, 15, 16 and 17, lowering the potential of control grid 18 with respect to cathode 19 but not to an extent sufficient to cause any substantial cut-off of electron space current in device 20. Because the voltage developed by rectifier 32 remains substantially unchanged at a rather high positive value, the potential applied to control grid 36 of control tube 37 over lead 27 and resistor 35 is also decreased proportionately, but not to the extent required to quench the gas discharge in tube 37; consequently, control relay 41 remains in an energized condition and the conveyor continues to operate.

However, in the presence of a pair of superposed metal sheets, as indicated at 4, the voltage developed by secondary winding 9 of magnetic detector head 1 is further increased and the D.C. control voltage developed by rectifier 13 and applied to voltage divider 21, 22, 23 and 24 is a sufficiently large negative voltage to lower the potential of control grid to a level sufficient to cut off the electron space current between cathode 19 and anode 31. In this condition, electron-discharge device 20 functions as a D.C. amplifier in a cathode follower type circuit, the output load impedance of which constitutes the series combination of resistors 28, 29, 30 and a variable shunt portion of the bias circuit of resistor 26. The cathode follower action and resulting D.C. amplification causes the voltage at the junction between resistors 28 and 29 to decrease and even to attain a negative value. When this negative voltage is applied through resistor 35 to control grid 36 of thyatron 37, deionization within the envelope occurs and the gas discharge quenches to deenergize relay 41. This breaks contact 42, 48 to extinguish green indicator lamp 49, and establishes contacts 42, 46 to illuminae red indicator lamp 47 indicating the presence of an undesirable condition, e.g., a pair of superposed sheet metal elements on the conveyor 2. At the same time, contacts 43 and 53 are broken to open the conveyor drive circuit and automatically stop the equipment before the improper condition can result in any substantial damage. Other control functions may also be performed in response to firing of thyatron 37, as is well understood in the art.

The system of FIG. 1 provides considerably increased dependability, stability, and much greater flexibility in operation than previously known magnetic thickness detectors or indicators. In the event of failure of devices 20 or 37, or the failure of energization of primary winding 12, the relay 41 will be de-energized and break contacts 43, 53 to automatically stop the conveyor equipment.

Decade elements 25 and switch 25', and the vernier potentiometer resistor 26 may be employed as a sensitivity control to preset the apparatus for any desired thickness of ferro-magnetic sheet material. In many commercial canning operations, metal can blanks of about eight or nine thousandths inch thickness are conventionally employed. To set up the circuit to accommodate sheet metal of this or any other desired gauge, a single thickness of such sheet metal is placed over magnetic detector head 1, the range selector control comprising the ganged switch arms of 25, 25' is placed in the extreme counter-clockwise position shown in FIG. 1, and the movable contact arm of the vernier potentiometer 26 is moved to the extreme left as viewed in the drawing. Device 20 will thus be biased to cut-off, and the red indicator lamp 47 will be lighted. Next advance the range selector step-by-step in a counterclockwise direction until the green or clear indicator lamp 49 lights and the red is extinguished.

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Now turn the range selector back one step, lighting the red indicator again and extinguishing the green. Advance the vernier potentiometer arm until the red light is replaced by the green. Placing a second metal sheet over detector head 1 will change the indication to red. The equipment is now accurately and reliably established to detect any condition of overlapping thicknesses of sheet metal on the conveyor as it passes over the magnetic detector head. This is the correct adjustment for effecting a control operation by means of an appropriate circuit connected at terminals H, K, L.

Much of the added sensitivity provided by the arrangement of the present invention as compared with previously known systems including that of my co-pending application is attributable to the use of the sensitive bias control of the D.C. amplifier tube 20 by means of elements 25, 25' and 26, and the bias generator 32. By employing a sharp cut-off amplifier tube 20 and by suitably arranging the bias voltages applied to the opposite ends of the voltage divider 21, 22, 23 and 24, it can be assured that amplification of the control voltage is achieved only when the undesired condition occurs. In other words, in the presence of a single sheet of ferro-magnetic material, the amplifier tube 20 means conducting and thus contributes nothing to quench the conduction of thyatron 37. On the other hand, as a pair of superposed ferro-magnetic sheets approach the magnetic detector head, the voltage applied to control grid 18 decreases to a sufficient extent to block anode current flow in device 20 and thus develop a considerable negative D.C. voltage across the output impedance 28, 29, 30 of the cathode follower comprising tube 20. This negative voltage augments the considerably smaller voltage appearing at the grid of control tube 37 by virtue of the bias provided by element 54 across part of this voltage divider, and provides positive deionization of the gas discharge tube whenever an undesired condition is encountered. In this connection, the use of a limiting resistor 35 in the grid circuit of thyatron 37 is of considerable advantage in providing an increased sensitivity for the system. With resistor 35 in circuit the amplified control voltage appearing across the series combination of resistors 28, 29, 30 need only become sufficiently negative to quench the gas discharge when the potential of anode 39 is cyclically negative; the presence of resistor 35 inhibits the flow of grid circuit current and prevents such voltage from rising before gas discharge has been fully quenched, thus preventing erratic firing of the control thyatron.

Merely by way of illustration and in no sense by way of limitation, the system of FIG. 1 may be constructed with components having the following characteristic values and type designations:

Electron-discharge device 20	Triode section of a type 6AQ6 tube.
Thyatron 37	Type 2D21
Resistor 15	ohms 2,700
Resistor 17	do 4,700
Resistor 21	do 470,000
Resistor 22	do 470,000
Resistor 26	do 50,000
Resistor 23	do 6,800
Resistor 24	do 47,000
Decade 25	do 50,000
Resistor 28	do 47,000
Resistor 29	do 2,200
Resistor 30	do 82,000
Resistor 35	megohms 1
Resistor 44	ohms 1,000
Resistor 50	do 22
Condenser 14	microfarads 0.5
Condenser 16	do 0.25
Condenser 33	do 16
Condenser 45	do 1.5
Condenser 55	do 16

The control relay may be of standard construction comprising 3,000-ohm energizing coil 41 and adjusted to pull in with 8 milliamperes energizing coil current.

In FIG. 2, two double sheet or over gauge detectors of the type shown in FIG. 1 have been combined in a circuit arrangement to reject over gauge and under gauge sheet metal stock. The two complete detectors are designated as Detector I and Detector II in the figure. The magnetic detector heads 1-I and 1-II are positioned in a spaced apart relation beneath the conveyor 2, with each head connected to its corresponding unit by means of the four-conductor cables 56, 57. Connection of each detector head is by means of terminals A, B, C, D, which, as fully shown in FIG. 1, are the leads for the primary and secondary windings of each head.

Terminals E, F of each unit are connected in parallel to a source of energizing potential indicated as 115 volts, 60 cycles, to energize each primary winding 12 of the respective power transformers 11. As shown, the control operation terminals H, K, L of the detector units I and II are interconnected in a manner to be described in greater detail hereafter with regard to FIG. 3, and such connection includes the series arrangement of a feed cam switch 59 and a rejector solenoid winding 53.

Solenoid 53 operates, when energized by the 115 volt A.C. source, to actuate a diverting arm (not shown) which will sweep aside sheet metal stock pieces passing along conveyor 2 which are under gauge or over gauge before they reach the processing equipment. The feed cam switch 59 is a mechanical unit of conventional operation which is included in the conveyor system to sense the presence of a work piece in the feed system. If a sheet metal piece is missing the cam switch opens to prevent unnecessary operation of the rejector diverter arm by the solenoid 53. Cam switch 59 is located and adjusted to close when the leading edge of each metal sheet reaches the rejection station (not shown), and to remain closed, in the case of a reject, sufficiently long for proper actuation of the diverting arm.

FIG. 3 is a simplified partial diagram used to explain the operation and adjustment of the FIG. 2 over and under gauge rejection circuit. The control operation relay contacts 52, 43, 53 of each of the two FIG. 1 type units have been indicated in FIG. 3 with the identifying Roman numerals I and II corresponding to the detector units I and II of the FIG. 2 arrangement. Relay coils 41-I and 41-II, respectively, function as described with respect to FIG. 1, and thus the contact arms 43-I and 43-II are shown in the de-energized position to which they are spring-biased as indicated by the arrows. This is the position in which the red indicator lamps are illuminated.

Adjustment of the over and under gauge rejection circuit arrangement is as follows: place a desired gauge sheet over detector head 1-I and adjust the range and vernier controls of unit I so that the red indicator lights. Substitute an under gauge sheet over head 1-I and relay coil 41-I will be energized to pull contact arm 43-I to the left, lighting the green indicator lamp and closing the circuit between terminals K and L of unit I to energize relay 53 to divert the under gauge sheet. Adjust the controls of unit II with an over gauge sheet at detector head 1-II so that the red indicator of unit II lights. Over gauge and double sheets will now be rejected since relay 53 will be energized over the closed circuit between terminals H and K of both units II and I as shown in FIG. 3.

It will be seen that the detector unit I rejects under gauge pieces but passes the desired gauge, while detector unit II rejects all over gauge and double pieces but passes the desired gauge. When a desired gauge sheet is over detector head 1-II the relay coil 41-II will be energized to light the green indicator lamp of Unit II, but the sheet will not be diverted.

In practice the detector heads 1-I and 1-II, cam switch 59, and the diverter arm rejection station are so located

adjacent one another along the conveyor 2 that the control signals generated and the rejection action, if any, are all a function of the passage of a given sheet metal work piece.

In certain applications the rejector solenoid design is of the type which functions to divert a faulty work piece when de-energized. A solenoid of this type, which provides an additional "fail-safe" provision in the event of loss of the 115 v. A.C. energy, is shown as element 60 in FIG. 4. Adjustment of the FIG. 4 circuit arrangement to secure over gauge and under gauge rejection is the same as that previously described with regard to FIG. 3. Again, a desired gauge sheet will thus cause contact arm 43-I to remain in the right-hand position while contact arm 43-II will be drawn to its left-hand position. This completes the 115 v. circuit to energize solenoid 60 to pass the work piece. When an under gauge sheet is above detector heads 1-I and 1-II of FIG. 4 both contact arms 43-I and 43-II will be drawn to the left, breaking the circuit to solenoid 60 to actuate the diverting arm. Over gauge and double sheets will also be diverted; for both contact arms 43-I and 43-II will be to the right as indicated in FIG. 4, thus de-energizing solenoid 60.

Although the invention has been shown and described in connection with its preferred application as a magnetic double sheet detector, it is apparent that the invention may be utilized to equal advantage in conjunction with automatic thickness control systems, in magnetic thickness measuring devices and indicators, and in numerous other applications. In each instance, it is found that the system according to the present invention provides greatly increased sensitivity, flexibility, and reliability as compared with previously employed systems.

While the invention has been shown and described in connection with a presently preferred embodiment, it is apparent that numerous changes and modifications can be made, and the appended claims are therefore contemplated to cover all such variations and modifications as may occur to those skilled in the art to which the invention pertains.

What is claimed is:

1. Apparatus for indicating the thickness of magnetic stock comprising: means including a magnetic detector head for developing a first unidirectional control voltage of varying magnitude in dependence on the thickness of said magnetic stock; a voltage divider; means for impressing said unidirectional control voltage across a portion of said voltage divider; a first electron-discharge device having an anode, a cathode, and a control grid; means connecting said electron-discharge device in a cathode follower circuit having an output load impedance, means impressing a second unidirectional control voltage of variable magnitude and opposite polarity across a portion of said voltage divider, means coupling said control grid to a point on said voltage divider intermediate said first and second control voltage means, and means coupled to said cathode follower load impedance and including a second electron discharge control device responsive to a control voltage of a predetermined magnitude and polarity for performing a control function.

2. Apparatus as specified in claim 1, in which said voltage divider includes at least one variable resistance element connected to the cathode of said first electron-discharge device for regulating the sensitivity of said apparatus.

3. Apparatus as specified in claim 1, in which said second control voltage is a positive delay bias voltage applied across a portion of said voltage divider to render said first electron-discharge device conductive in the quiescent state of said apparatus, and in which said first control voltage is applied with negative polarity across a portion of said voltage divider to stop electron space current flow in said first electron-discharge device in response to a predetermined thickness of magnetic stock.

4. Apparatus as specified in claim 1, in which said

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last-named means performs its control function upon cessation of electron space current flow in said first electron-discharge device.

5. Apparatus for inspecting and indicating the thickness of ferro-magnetic stock and for actuating means to control movement of said stock comprising, in combination, a magnetic detector head including a two ended laminated central core, primary and secondary windings on said core, a ferro-magnetic yoke of predetermined thickness capping one end of said core, means to move said stock adjacent the other end of said core, means impressing a voltage of predetermined magnitude across said primary winding to induce in said secondary winding a voltage whose magnitude varies as a function of the thickness of said stock, electron-discharge means, means coupling said secondary winding to the input of said electron-discharge means including means for rectifying the voltage reserved from said secondary winding by said electron-discharge means, and indicating means and stock movement control means coupled to the output of said electron-discharge means.

6. Apparatus as specified in claim 5, in which said indicating means and said stock movement control means are operative upon cessation of electron space current flow in said electron-discharge device.

7. Apparatus for inspecting and indicating the thickness of ferro-magnetic stock which is over or under a predetermined standard thickness and for actuating means to control movement of said stock comprising, in combination, a first electronic thickness detector having output means to indicate one of two conditions accordingly as said inspected stock is under or equal to a standard thickness, a second electronic thickness detector having output means to indicate one of two conditions accordingly as said inspected stock is equal to or over a standard thickness,

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means to combine the outputs of said first and second detectors, and stock movement control means controlled by said combining means.

8. Apparatus for inspecting and indicating the thickness of stock which is over or under a predetermined standard thickness comprising, in combination, a first electronic thickness detector having output means to indicate one of two conditions accordingly as said inspected stock is under or equal to a standard thickness, a second electronic thickness detector having output means to indicate one of two conditions accordingly as said inspected stock is equal to or over a standard thickness, and means to combine the outputs of said first and second detectors.

9. Apparatus as specified in claim 7, in which said stock movement control means is actuated upon a cessation of supply power.

10. Apparatus as specified in claim 1, in which said second electron-discharge device performs its control function upon cessation of electron space current flow therein.

11. Apparatus as specified in claim 4, in which the second electron-discharge device of said last-named means performs its control function upon cessation of electron space current flow therein.

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