This invention relates generally to systems for recording process information and more particularly to a novel method and means for recording dimensionally-related variations in one or more physical properties of a material. Many industrial processes are concerned with forming raw material into a final salable product. Paper machines, steel rolling mills, plastic extruders, and cigarette factories, among others, are but a few of these processes. All of these processes require monitoring of various phases in order to assure a product well within a desired specification. For example, in the paper-making process, operating personnel must be constantly aware of varying variables such as basis weight and moisture content of the paper. At various points along the process, it is desirable to provide a record of the various parameters. The present invention provides apparatus for controlling process comprising a preferred embodiment of the present invention.

FIG. 3 is a schematic diagram partly diagrammatic showing the bridge circuitry of the recorder shown in FIG. 2; FIG. 4 is a schematic diagram of a control circuit for properly sequencing the operation of the measuring and recording system shown in FIG. 2. FIG. 5 is a sketch useful in explaining the operation of the present invention; FIG. 6 is a front elevational view of a pen-lifting assembly used in the recorder shown in FIG. 2; FIG. 7 is a sectional view of FIG. 6; and FIG. 8 is an enlarged end elevational view of an actuator for the pen-lifting assembly shown in FIG. 6. Referring to the drawings, and specifically to FIG. 1, the present invention provides apparatus for presenting information from both a basis weight gauge 10 and a moisture gauge 12 on a movable chart 14. A recorder controller 16 is connected to a scanning controller 18 which moves the gauges 10 and 12 back and forth over a sheet to be measured. The mechanical linkage coupling the controller 16 to the gauges 10 and 12 is represented by the dotted lines 24 and 26, a supply 28 supplies power for the controller 18.

FIG. 9 is a partial perspective view, partly diagrammatic, of a measuring and recording system for a paper-making process comprising a preferred embodiment of the present invention.

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A recorder sequentially provides a first trace 30 indicative of variations in basis weight of the sheet being measured and a second trace 32 indicative of variations in moisture content of the sheet. The resulting graph depicts a dimension of the sheet being measured, such as the width, in the x-direction and instantaneous values of the measured variable in the y-direction. Furthermore, the traces 30 and 32 are arranged in dimensional coincidence so that both the basis weight and the moisture content are at any point across the sheet readily observable. Since there is usually a desired target value for each variable, it is desirable to draw a horizontal line after each curvilinear trace for purposes of comparison. Referring to FIG. 2, a traversing gauge mounting bracket 40 is shown in non-contacting engagement with a traversing paper sheet 38. The mounting bracket consists of an upper arm 42 and a lower arm 44 which is slidably mounted on a rail 46. The lower arm carries a radiation source housing 48 at the end thereof. While the upper arm carries a radiation detector housing 50 in vertical alignment with the radiation source, a conductor 52 carries an electrical signal generated in accordance with well-known principles of radiation absorption and proportional to the basis weight of the sheet 38. On the downstream side of the detector housing 50 is mounted a moisture detector 54 such as that disclosed in Serial No. 41,975 or others commercially marketed. The detector 54 provides over conductor 56 an electrical signal representative of sheet moisture.

The bracket 40 is driven by a reversible traversing motor 69 through a chain-and-sprocket assembly. In and out-limit switches 62 and 64 are mounted on the rail 46 and are actuated by the gauge mounting bracket 40 whenever the edges of the sheet 38 are embraced by the ends of the arms 42 and 44. The scanning controller 18 not only energizes the traversing motor 66 but also provides for a dwell time at the end of each scan.

The recorder 20 includes a chart roll 66 and a dual pen carriage 68 slidably mounted on a guide rod 70. The two pens of the 38 are emulated in the manner that manufactured and commercially marketed. However, it is noted that the pens are not independently movable across the chart 19 as is usually the case. The pens are mounted one behind the other, are integrally moveable with the carriage 68, and are filled with two distinguishably colored inks such as red and blue.

The present invention provides apparatus for controlling
recorder 20 to obtain the aforesaid traces. A single pen drive is coupled to the traversing motor 60 to move the carriage 68 back and forth across the chart paper 14. Therefore, each position of the carriage across the chart corresponds to a particular location of the gauge housings 59 or 54 across the paper sheet 38. The instantaneous displacement of the chart roll 65 is determined by a function selecting the chart controller unit 72. The input to unit 72 comprises the weight-functional and moisture-functional signals carried by lines 52 and 56 respectively. Unit 73 is connected to the scanning controller 18 and delivers information which will be read out during any given scan of the gauge mounting bracket 40. A pen selector 74 serves to position only one of the pens in marking relationship with the chart 14 at one time by actuating a pen lifting solenoid 76. The pen selector switches from one pen to the other preferably at the end of each out scan.

Briefly, since a more detailed description of operation appears hereinafter in reference to FIGS. 3 and 4, the sequence of events occurs in the following order: Assume that the red marking pen initially engages the chart 14. The gauge mounting bracket begins an out scan in the direction indicated. Basis weight variations in the sheet cause the chart roll 66 to rotate and counter-rotate. As the pen carriage moves across the chart 14 a profile of the cross-sheet variations in basis weight appears as a curvilinear trace 76. When the gauge mounting bracket has completed its traverse of the sheet 38 it stops. Whereupon the pen selector 74 changes to the blue marking pen. The chart roll 66 is rotated until the blue pen is positioned at a desired or target value for the basis weight of the sheet being measured. As the gauge mounting bracket starts a return or in scan after a brief dwell time, the position of the chart roll 66 is maintained. A horizontal line indicative of the target value for the basis weight of the sheet 34 is provided during the in scan of the gauge mounting bracket 40.

At the completion of the in scan, another dwell of the mounting bracket is initiated and chart 14 is unidirectionally advanced a predetermined distance. When the dwell time has elapsed, the function switching and chart controller unit 72 selects moisture-functional signals on line 56 to be read out. Now, the chart roll 66 responds to variations in the moisture content of the sheet 38 as another out scan is initiated. Curvilinear trace 80 is drawn on the chart. During the dwell time, at the completion of the second out scan, the pen selector removes the blue pen from the chart and places the red pen in marking registration therewith. Chart roll 66 assumes an angular position relative the red pen nib corresponding to a target value for the moisture content of the sheet 38. And this new position of roll 66 is maintained during the second in scan.

The sequence is automatically repeated during succeeding scans of the gauge mounting bracket 40. With this scheme the pens are continually being used so they do not clog up; each curvilinear trace is readily distinguishable from the other; and comparisons of the measured variable with its target value are facilitated by using a different color for each trace. It may be desirable to observe only one function at a time. Apparatus is described hereinafter for selecting three different modes of recorder readout: basis weight only, moisture only, or alternatively both. Regardless of the mode, the pen selector 74 switches from one pen to the other to continue the aforesaid advantages.

Detailed circuitry is shown in FIGS. 3 and 4 for accomplishing the objects of the present invention. It is noted that each relay coil is given a reference numeral and construction of a given relay are labeled with the reference numeral of the actuating coil followed by a lower case letter. A different lower case letter is used to distinguish between different contacts of the same relay.

Referring now to FIGS. 3 and 4, for convenience the circuit is divided into several different sections, each labeled with a different Roman numeral. In FIG. 3, section I is a gauge position indicator bridge circuit and section II is a chart drive bridge circuit. In FIG. 4, section III includes a gauge traversing motor and the relay control circuit therefor. Section IV is a dwell timer for initiating both the in scan of gauge mounting bracket 40 as well as the sequencing of the operation of recorder 20.

Generally, sections V through X control the switching of the various slidewires and target potentiometers into the bridge circuit of section II and the operation of the pen solenoids. Specifically, section V connects one of the target potentiometers into the bridge at the end of each scan. Section VI is a chart clutch solenoid for decoupling the chart roll 66 from its drive means during return or in scans. Section VII comprises a chart slidewire arm centering relay. Section VIII rotates the chart roll 66 through a predetermined angular displacement at the end of each return scan. The function to be read out on recorder 20 is selected by a rotary stepper included in a profile selecting section IX. And section X comprises a pen selecting solenoid circuit operating in conjunction with sections V and IX which changes marking pens.

The circuit of FIG. 3, section I comprises a multi-turn potentiometer 81 and a recorder pen slidewire 82 connected in parallel by means of a pair of end-adjusting potentiometers 84 and 86. The movable arms of the potentiometers 81 and slidewire 82 are connected to the input of a servo amplifier 88. Operating potential for the bridge is provided by lines 89 and 92 connected to the secondary of a transformer 94. The primary of transformer 94 is connected to a source of A.C. voltage generally shown at 96. The arm of potentiometer 81 is mechanically linked as at 98 to the gauge traversing motor 60 to move across potentiometer 81 as the gauge moves across the sheet to be measured. Any differences in potential of the arms of potentiometer 81 and pen slidewire 82 are amplified at 88 to actuate a pen drive motor 100. Motor 100 is mechanically linked to the movable pen slidewire arm and to the pen carriage 68. As the gauge traverses the sheet 38, pen motor 100 moves the pen slidewire arm to diminish the input to the servo amplifier 88. An indicator 102 may be mounted on the pen carriage 68 to be in registration with a scale 104 of a length corresponding to the lateral dimension of sheet 38. It can be seen that the indicator 102 follows the position of the gauge mounting bracket 40 back and forth across the sheet 38.

The chart drive is coupled to a similar bridge circuit. Referring to section II, there is included a chart slidewire 106, a basis weight slidewire 108, a moisture slidewire 110, a basis weight target potentiometer 112 and a moisture target potentiometer 114. A pair of equivalent resistances 116 and 118 are connected between lines 90 and 92, one resistance having a variable tap 116a. A servo amplifier 120 actsuate a chart drive servo motor 122 mechanically coupled as at 124 to the movable chart slidewire arm 166a and a shaft 126. The chart roll 66 may be decoupled from the shaft 126 by means of an electromechanical clutch 128. One input of servo amplifier 120 is connected to the chart to be measured. The other input may be selectively connected in a manner described hereinafter to the movable arms of the slidewires 106, 110, the target potentiometers 112, 114, variable resistor 116 or to the junction of resistors 116 and 118 at an equal potential with respect to both lines 90 and 92. The chart motor 122 positions the chart slidewire arm 166a to diminish the input to the servo amplifier 120.

A basis weight measuring servo 130 may be used to drive the arm of slidewire 108 and a moisture measuring servo 132 may be used to drive the arm of slidewire 110. Reference may be had to U.S. Letters Patent 2,790,945 for a description of the basis weight measuring servo employed at 130. The construction of the moisture meas-
uring servo 122 will become immediately apparent. Briefly, each slidewire arm is positioned across the slidewire resistance associated therewith in accordance with the measured value of the respective physical properties of the sheet 36.

With reference now in detail to FIG. 4, power source 96 provides operating potential for the relays via lines 149 and 152. A forward relay 144 and a reverse relay 146 in section III control the direction of rotation of traversing motor 60. A dwell timer 148 such as manufactured and marketed by the Allen-Bradley Company, Melrose, Illinois, under the trade name "Cycle-Flex" is included in section IV. Sections V through VIII include a target relay 150 energized only during out scans by the forward relay 144 in section III, the chart clutch solenoid 128, a centering relay 152 and a chart stepping relay 154. Section IX comprises a conventional rotary stepper having an actuating coil 156, a plurality of alternately commonly connected contacts 156a-156f and a rotor arm 158. A profile selecting relay 160 may be connected between lines 149 and 152 by the rotor arm 158.

The explanation of the operation of the system is facilitated by reference to FIGS. 5 through 7, wherein are shown two successive scans A and B are represented. Moving to the right of the diagram represents an out scan, while moving to the left represents an in scan. Reference is made hereinafter to operations occurring at times T1-T2. The time at which the gauge assumes a given position is denoted on the diagram at appropriate points.

At the beginning of a sequence, time T1, in-limit switch contacts 62a energize the motor forward control relay 144 which is held by contacts 144a. Contacts 145b close to start the gauge traverse and contacts 145c close to energize the target relay 150. In the chart drive bridge section II, contacts 150a open and contacts 150b close to connect the basis weight slidewire 160 into the servo amplifier 120. Contacts 150c open and contacts 150d close to keep the pen solenoid 76 energized. For purposes of explanation, it is assumed that whenever the solenoid 76 is energized the red marking pen scribes the chart 14. Conversely, whenever solenoid 76 is deenergized, the blue marking pen scribes the chart 14. The chart slidewire arm 106a follows the movements of the arm of the slidewire 108. Therefore, a cross-sheet basis weight profile is drawn on the chart.

At time T2 when the gauge attains its full-out position, out-limit switch contacts 62b close to stop the traversing motor 60. Out-limit switch contacts 64b open to stop the target relay 150, and the pen solenoid 76 is deenergized since contacts 150b open when the target relay 150 is deenergized. Accordingly, the blue pen is lowered on the chart 14. Now the input of servo amplifier 120 is connected to the arm of the basis weight target potentiometer 112 through contacts 150a and 160d. The chart slidewire arm 106a positions according to the setting of target potentiometer 112 and the position of the chart roll 65 is indicative of the target value for basis weight.

After a brief dwell time, timer 148 times out to close contacts 148a. The motor reverse control relay 146 picks up through out-limit switch contacts 64d which are closed when the mounting bracket 48 dwells in the full-out position. Contacts 148a serve to hold relay 146 energized to energize the chart clutch solenoid 128. Since the chart cannot move, the blue pen follows the returning gauge drawing a straight line at the basis weight target. While the gauge returns, contacts 148d close to energize the chart slidewire arm centering relay 152. Contacts 152a open and contacts 152b close to 152c juncture of resistors 116 and 126 to the input of servo amplifier 120. Whereupon servomotor 122 positions the chart slidewire arm 106a at the electrical midpoint of the chart slidewire 106. This procedure is necessary to provide a positional datum reference from which the chart may be advanced at the end of each scan. As soon as the gauge mounting bracket clears the out-limit switch 64 contacts 64a open to reset the dwell timer 148.

Eventually, the gauge attains the full-in position at time T3. The in-limit switch 63 is actuated by the gauge mounting bracket 49 and contacts 62b close. Dwell timer 148 begins timing. Timer contacts 148a open once again at the start of the timing period, thereby dropping relay 146 and stopping the gauge traversing motor 60. The chart clutch solenoid 123 is energized by contacts 146c enabling the motor 122 to move the chart 14. Contacts 123a open to drop out the chart slidewire arm centering relay 152. Contacts 123b close in series with in-limit contacts 62c to energize the chart stepping solenoid 154. Contacts 154a open and contacts 154b close to connect the movable arm 166a into the input of the servo amplifier 120. The servomotor 122 will advance the chart 14 until the arm 166a assumes a potential equivalent to that existing on the arm of resistor 116.

At time T4, timer 148 times out to close contacts 148b to start scan B. The motor forward control relay 144 is energized. In addition, timer contacts 148b in series with the stepper coil 156 and closed in-limit switch contacts 62d close to advance the rotor arm 153 onto contact 156b, energizing the profile selector relay 160. Contacts 160a close and contacts 160b open. The pen solenoid 76 tends to pick up; however, contacts 150c open to remove power when the target relay 150 is energized through contacts 144c. The pen solenoid 76 remains deenergized and the blue pen continues to scribe the chart 14. As the gauge mounting bracket 48 moves away from the full-in position the in-limit switch is no longer actuated. Switch contacts 64d, 64e, and time all open to respectively reset dwell timer 148, to drop the chart stepping relay 154 and to remove power from the stepper coil 156.

As soon as the gauge begins scan B, since relay 150 is again energized, contacts 150b close. However, now since the profile selector relay 160 is energized, it is the arm of the moisture slidewire 119 which is connected to the input of servo amplifier 120 via closed contacts 160d. Therefore, during the out scan of B the movements of the arm of slidewire 119 are traced in blue upon the chart.

The gauge mounting bracket 49 reaches the full-out position at time T5. The chart dwell timer 148 is started and it is the arm of the moisture target potentiometer 134 which is connected to the input of servo amplifier 120 through contacts 150a and profile selector relay contacts 160a. The pen solenoid 76 becomes energized as relay contacts 150c close in series with contacts 160a of the profile selector relay 160. The red pen engages the chart to draw the moisture target value upon the chart 14 subsequent to the chart roll decoupling operation described hereinafter. Dwell timer 148 times out to start the in scan of B at time T6. Contacts 148b close but the stepper 156 cannot pulse since in-limit switch contacts 62a remain open. Relay 156 closes the arm 166a of the chart slidewire 106.

When the full-in position of scan B is attained at time T8, the chart roll 66 is connected to chart motor 122 through the clutch 128 and the chart is advanced in accordance with the position of the arm 166a of variable resistor 116. At the end of the dwell time, coil 156 is pulsed through timer contacts 148b and closed in-limit contacts 62d. The stepper rotor arm 158 advances one position to contact 156e. Profile selector relay 160 is dropped. The pen solenoid 76 tends to drop out when contacts 160b open, but it is picked up by contacts 156d which close when the in scan. The red pen remains on the chart 14 and the initial circuit conditions exist as the foregoing sequence is automatically repeated.
7 The operation of the circuit has been described wherein the automatic presentation of basis weight and moisture information prevailed; however, it may be desirable to record only one variable or the other while maintaining the automatic switching feature of the present invention. To this end, a three-position switch 152 is utilized. With the switch in position 1, the automatic mode prevails; in position 2, the basis weight readout; and in position 3, the moisture readout. Referring to the chart drive bridge section II, it is seen that the chart deck 162A is lifted off the chart roll of either the basis weight sliderwire 160 or the moisture sliderwire 110. Likewise, deck 162B is locked on the arm of either the basis weight target potentiometer 112 or the moisture target potentiometer 114. Therefore, regardless of the state of the profile selector relay 160, only one function or the other is read out. Referring to the pen selector section X, with the arm of switch 152 in position 2 the pen solenoid 76 is energized during out scans and deenergized during in scans. In position 3, the switch 152 serves to deenergize the pen solenoid 76 during out scans and to energize it during in scans. It is observed that the profile selector 160 has no function when switch 152 is thrown to either position 1 or position 3.

Referring to FIGS. 6, 7, and 8, the mechanical construction of the pen lifting mechanism of the present invention is now described. A pair of spaced end members 164 and 166 are joined by a pair of spacers 168 and 170, each provided with a shoulder and a threaded portion at opposite ends thereof. Nuts as at 172 serve to secure the spacers 168, 170 to the end members 164, 166. Pen lifting rods 174 and 176 are inserted between the end members and the entire assembly is rotatably mounted between walls 178, 180 of the recorder housing. The assembly may be provided with end axles 162, 164 journal bearings as at 180 located in each of the walls 178, 180.

Referring to FIG. 7, in two-pen recorders it is customary to mount the pens by providing a pair of offset guide rods 186, 190 for slidably mounting a red pen carriage 192, and a blue pen carriage 194. A red pen 196 is of considerably greater length than a blue pen 198 to extend in front thereof. The carriages 192, 194 are normally driven through individual pulley and cord arrangements (not shown); however, with the system of the present invention, the carriages are driven as a unit. The pen lifting rod 174 is passed under red pen 196 and under blue pen 198. With reference now to FIG. 8, the pen solenoid 76 is preferably of the rotary type. An actuating stud 200 extends from the pen solenoid 76 to engage a slot 202 provided in the end member 164. Slots 204 and 206 may be provided to removably support the pen lifter rods 174, 176. When the solenoid is energized the stud 200 moves to the dotted line position 200a, whereupon the lifter rods 174, 176 are respectively lowered and raised.

Although there is shown and described a preferred embodiment of the present invention, modifications may be made without departing from the true scope and spirit of the invention.

What is claimed is:
1. Apparatus for recording the profile characteristic of at least one physical property of a material with a movable chart and marking stylus movable with respect thereto, comprising means for measuring the variations in said physical property across said material in the plane of said profile, means for displacing said marking stylus across said chart to correspond with the point of measurement across said dimension, means for positioning said chart in accordance with the magnitude of said measured physical property, means for scribingsaid chart in accordance with a color coded to a target signal proportional to a desired value of said measured property, means for positioning said chart in accordance with said target signal, means for displacing said marking stylus in the opposite direction after said entire material dimension has been measured, means for scribingsaid chart with a different colored ink to provide a trace of said target value, and means for repeating said steps.
2. Apparatus as set forth in claim 1 further including means for alternately measuring and recording a second physical property of said material, means for scribingsaid chart marking of said second physical property with said same color as said target trace of said first physical property, and means for presenting said chart markings in vertical alignment on said chart.
3. In the combination of a traversing gauge and a strip chart recorder for providing successive plots of the profile of a variable measured by said said gauge across the width of a sheet, said recorder having an indicator movable across said chart in synchronism with a corresponding traversing movement of said gauge across said sheet width, said chart being movable orthogonally with respect to said indicator movement to register changes in the measured value of said variable, the improvement comprising a servomechanism for driving said chart to a position proportional to a signal applied to said servomechanism, means controlled by said gauge for generating a first signal indicative of the measured value of said variable, manually adjustable means for generating a second signal indicative of a desired value of said variable, means for generating a third signal indicative of a selected separation distance along said chart between said successive plots, programmed switching means for applying said first, second and third signals seriatim to said servomechanism, and means energized in response to said gauge reaching the limit of said traversing movement across said sheet width for advancing said programmed switching means.
4. In the combination of a traversing gauge and a strip chart recorder for providing successive plots of the profile of a variable measured by said said gauge across the width of a sheet, said recorder having an indicator movable across said chart in synchronism with a corresponding traversing movement of said gauge across said sheet width, said chart being movable orthogonally with respect to said indicator movement to register changes in the measured value of said variable, the improvement comprising a servomechanism, a chart drive mechanism, a clutch connecting said servomechanism to said chart drive mechanism whereby said chart is driven to a position proportional to said servomechanism, means controlled by said gauge for generating a first signal indicative of the measured value of said variable, manually adjustable means for generating a second signal indicative of a desired value of said variable, means for generating a third signal indicative of an index position of said servomechanism, means for generating a fourth signal indicative of a selected separation distance along said chart between said successive plots, programmed switching means for applying said first, second, reference and third signals individually and in a sequence to said servomechanism, means energized in response to said gauge reaching the limit of said traversing movement across said sheet width for advancing said programmed switching means, and means controlled by said programmed switching means for disengaging said clutch while at least one of said second, third and reference signals is applied.
5. In the combination of a traversing gauge and a strip chart recorder comprising one dimension of said material in the plane of said profile, means for displacing said marking stylus across said chart to correspond with the point of measurement across said dimension, means for positioning said chart in accordance with the magnitude of said measured physical property, means for scribingsaid chart with a color coded to a target signal proportional to a desired value of said measured property, means for positioning said chart in accordance with said target signal, means for displacing said marking stylus in the opposite direction after said entire material dimension has been measured, means for scribingsaid chart with a different colored ink to provide a trace of said target value, and means for repeating said steps.
means controlled by said gauge for generating a first signal indicative of the measured value of said variable, manually adjustable means for generating a second signal indicative of a desired value of said variable, means for generating a third signal indicative of a selected separation distance along said chart between said successive plots, programmed switching means for applying said first, second and third signals serially to said servomechanism, means energized in response to said gauge reaching the limit of said traversing movement across said sheet width for advancing said programmed switching means, and a delay timer interconnected with said programmed switching means for delaying said advancing thereof to permit said servomechanism to come to rest in response to one of said signals before a succeeding signal is applied.

6. In the combination of a traversing gauge and a strip chart recorder for providing successive plots of the profile of a variable measured by said gauge across the width of a sheet, said recorder having an indicator movable across said chart in synchronism with a corresponding traversing movement of said gauge across said sheet width, said chart being movable orthogonally with respect to said indicator movement to register changes in the measured value of said variable, the improvement comprising a servomechanism for driving said chart to a position proportional to a signal applied to said servomechanism, means controlled by said gauge for generating a first signal indicative of the measured value of said variable, manually adjustable means for generating a second signal indicative of a desired value of said variable, means for generating a third signal indicative of a selected separation distance along said chart between said successive plots, programmed switching means for applying said first, second and third signals serially to said servomechanism, means energized in response to said gauge reaching the limit of said traversing movement across said sheet width for advancing said programmed switching means, a pair of chart marking elements carried by said indicator and alternately engageable with said chart to mark the same with two visually distinguishable traces, and means controlled by said programmed switching means for interchanging the engaged and disengaged positions of said pair on switching from said first to said second signal applied to said servomechanism.

7. In the combination of first and second traversing gauges and a strip chart recorder for providing successive plots of the profiles of first and second variables measured by said gauges across the width of a sheet, said recorder having an indicator movable across said chart in synchronism with a corresponding traversing movement of said gauges across said sheet width, said chart being movable orthogonally with respect to said indicator movement to register changes in the measured values of said variables, the improvement comprising a servomechanism for driving said chart to a position proportional to a signal applied to said servomechanism, means controlled by said gauges for generating first and second signals respectively indicative of the measured values of said first and second variables, manually adjustable means for generating third and fourth signals respectively indicative of desired values of said first and second variables, programmed switching means for applying said first, third, second and fourth signals serially to said servomechanism, means energized in response to said gauges reaching the limit of said traversing movement across said sheet width for advancing said programmed switching means, a pair of chart marking elements carried by said indicator and alternately engageable with said chart to mark the same with two visually distinguishable traces, and means controlled by said programmed switching means for interchanging the engaged and disengaged positions of said pair on switching from said first to said third and from said second to said fourth of said signals applied to said servomechanism.

References Cited in the file of this patent

UNITED STATES PATENTS

2,445,272 Keegan July 13, 1948
2,579,831 Keilbach Dec. 25, 1951
2,665,964 Olah et al. Jan. 12, 1954
2,909,660 Alexander Oct. 20, 1959
2,939,757 MacDonald et al. June 7, 1960