Sept. 12, 1944. M. W. CREW 2,357,877

ELECTRIC CONTROL GAUGE

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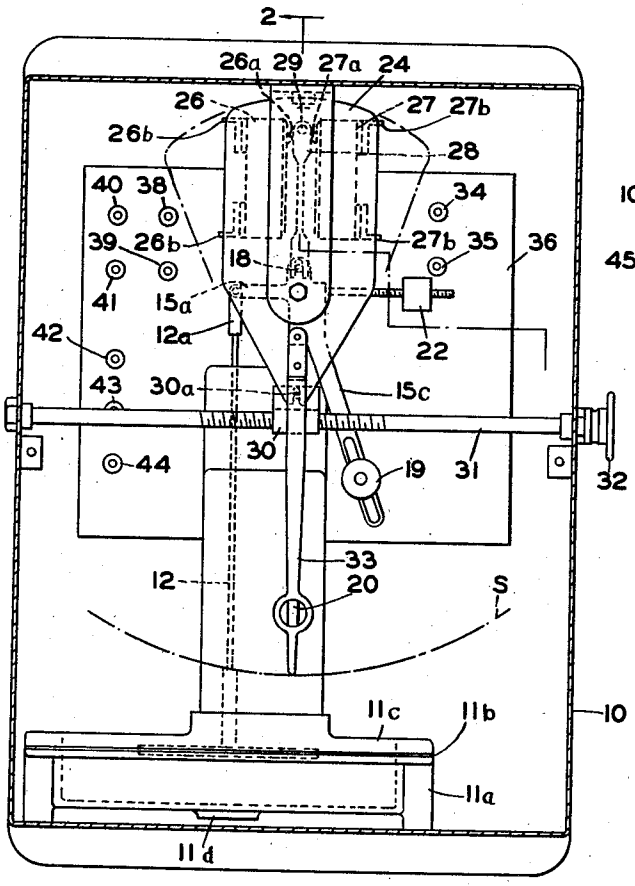


FIG.-1

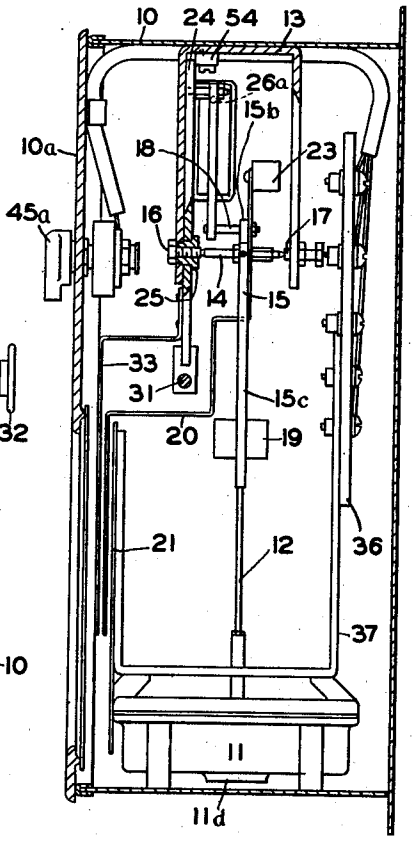


FIG.-2

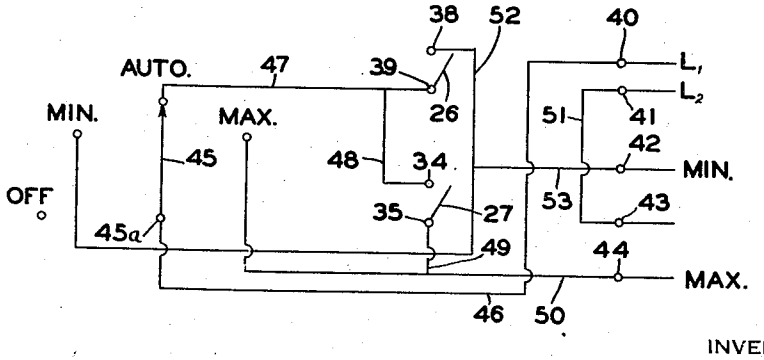


FIG.-3

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ELECTRIC CONTROL GAUGE

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6 Claims. (Cl. 200—56)

This invention relates to improvements in electrical draft and pressure control gauges.

An object of the present invention is to provide an instrument which accurately indicates a pressure or draft condition and provided with mechanism which can be set to control a predetermined draft or pressure as desired by means of electrically controlled apparatus. The control gauge may be set to hold a predetermined draft or pressure and any variation of the indicated draft or pressure from the predetermined setting causes a change in electric circuits connected with the gauge so as to return the controlled apparatus to the predetermined draft or pressure condition.

Another object of the present invention is to provide in a control gauge of the type described an electric switch adapted to make or break a contact upon the slightest change in the pressure control device, together with means for adjusting the position of the electric switch relative to the control device so that a predetermined pressure or draft condition may be maintained.

Other objects and advantages of the present invention will be apparent from the accompanying drawing and description and the essential features thereof will be set forth in the claims.

In the drawing, Fig. 1 is a front elevational view of my improved mechanism with the front cover of the gauge housing removed so as to better show the parts; Fig. 2 is a sectional view of the same taken along the line 2—2 of Fig. 1; while Fig. 3 is a wiring diagram showing a typical use of the gauge.

In the housing or box 10 is mounted a pressure or draft control chamber 11 comprising a hollow base member 11*a* having its top wall entirely or partially formed of a flexible diaphragm member 11*b* held in place by a top frame member 11*c*. It will be understood that a conduit is connected to the threaded boss 11*d* leading to the apparatus in which a given draft or pressure condition is to be maintained. For instance, I contemplate that the device here shown in one application may be used to control the draft in a boiler setting by varying the position of the draft control damper by means of an electric motor which may be operated to open or close the damper by means of the electric switches of my improved gauge, as will be hereinafter more fully explained. Connected to the central portion of the diaphragm 11*b* is a rod 12 extending vertically upward and having at its upper end a clevis 12*a* for connection to the indicating and control mechanism as will later appear.

Secured to the top of the housing 10 is an inverted U-shape bracket 13 which at its lower end supports the shaft 14 of an oscillatable member 15. The shaft 14 is supported in a substantially frictionless manner by mounting its pointed ends in cone cups 16 and 17. The member 15 is rigidly fixed on the shaft 14 by means of the nuts indicated. To a lateral arm 15*a* of this member is connected the clevis 12*a* for the purpose of transmitting the movement of diaphragm 11*b* to the oscillatable member 15. An upwardly extending boss 15*b* of the member 15 carries a pin 18 adapted to operate a switch actuator as will later appear. Another arm 15*c* of the member 15 supports an adjustable weight 19. A dial pointer 20 is rigidly secured to the member 15 and extends downwardly and forwardly in front of a dial 21, the scale of which is indicated diagrammatically at S, Fig. 1.

Means is provided for accurately counterbalancing the parts movable with the pointer 20 so that this pointer will accurately indicate the pressure in the chamber 11 on the dial 21. To this end a counterweight 22 is supported on a screw extending from the member 15 opposite the arm 15*a*. By adjusting the counterweight 22 one is able to accurately counterbalance the oscillatable member 15, the rod 12 and the dead weight, if any, of the diaphragm 11*b*. Another counterweight 23 is adjustably mounted on an arm extending vertically upward from the member 15 immediately back of the boss 15*b*. This arm and the counterweight 23 have been omitted from Fig. 1 to avoid confusion. The member 23 may be adjusted so as to accurately counterbalance the pointer 20. The arrangement of these parts is such that if it were not for the weight 19 the pointer 20 would remain in any position on the scale S to which it might be moved. Weight 19 then acts as a pendulum tending to return the pointer 20 to the left-hand end or zero end of the scale S when the pressure or draft in the chamber 11 is in fact zero. Obviously then the position of the pendulum weight 19 on the arm 15*c* will govern the movement of the pointer 20 over the graduations of the scale S in response to changes in pressure conditions in chamber 11.

A bracket 24 is oscillatably mounted on a pivot coaxial with the shaft 14. For this purpose a pivot screw 25 is threaded into the bracket 13 around the cone cup screw 16. The bracket 24 has a bearing on a shoulder of the screw 25. Fixed to the bracket are a pair of switches 26 and 27 having their control buttons 26*a* and 27*a*

spaced apart on opposite sides of and closely adjacent the switch actuator **28**. This actuator is pivotally mounted on a pin **29** secured in the bracket **24**. If necessary or desirable a roller **54** may be affixed to the upper wall of the U-shape bracket **13** so as to guide the oscillation of the bracket **24**. The lower end of the actuator **28** is bifurcated to engage the pin **18**.

The position of the bracket **24** about its pivot is controlled by a nut **30** threaded upon a bar **31** which is rotatably mounted in the opposite side walls of the housing **10** and manipulated by a knob **32**. A pin **30***a* on the nut engages in a slot on the lower end of the bracket **24**. A pointer **33** is rigidly fastened to the bracket **24** and extends parallel to the pointer **20** so as to be read upon the same scale S. In Fig. 1 the pointer **33** is set to control the draft at a point in the mid portion of the scale S and the pointer **20** is set to indicate a neutral position of the switches **26** and **27**, i. e., the device is satisfied and the control gauge is inoperative at the moment.

A typical wiring diagram illustrating the use of this device is shown in Fig. 3. Referring back for a moment to Fig. 1, it will be understood that the binding posts **27***b* of switch **27** are connected by flexible wires to binding posts **34** and **35** on a board **36** which is supported on a suitable bracket **37** mounted on the pressure chamber structure **11**. In a like manner the binding posts **26***b* of switch **26** are connected to the binding posts **38** and **39**. Service wires L_1 and L_2 from a source of electric current are connected to the binding posts **40** and **41**. The binding posts **42**, **43** and **44** are connected to the electrical apparatus to be controlled. For instance in the application of the device to draft control above mentioned, it is assumed that the draft damper would be opened and closed by a reversible motor, the common wire for which is connected to the binding post **43**, the wire for operating the motor in direction to close the damper would be connected to the post **42**, and the wire for operating the motor in direction to open the damper would be connected to post **44**. A switch blade **45** is controlled by a button **45***a* mounted on the front cover **10***a* of the housing **10**. Several contacts are provided for the switch blade **45** as indicated in Fig. 3. The position of the switch blade there shown is on the button for automatic control which will presently be described. Buttons are also provided for maximum or minimum, and an "off" position of the switch is shown also.

The operation of my improved device is as follows: With the parts in the position shown in full lines in Fig. 1, if the draft decreases the pointer **20** will move in a clockwise direction or toward the left on the dial scale S. This will cause the pin **18** to move in a clockwise direction which in turn will move the actuator **28** in a counterclockwise direction to press against the button **27***a* so as to close switch **27**. Referring now to Fig. 3, a circuit is contemplated from L_1 through line **46**, switch blade **45**, lines **47** and **48**, switch **27**, lines **49** and **50** to binding post **44**, then through the winding of the control motor back to binding post **43** and through line **51** back to the other side of the supply line L_2 at binding post **41**. This will operate the control motor in a direction to open the damper and to increase the draft so that the pointer **20** will return toward alinement with the set pointer **33** or to the position of the parts shown in full line in Fig. 1, whereupon switch **27** will open and the control apparatus will stop.

If the draft should increase, the pointer **20** will move in a counterclockwise direction or toward the right on the scale S. This will move pin **18** in a counterclockwise direction which will oscillate the actuator **28** in a clockwise direction engaging the switch button **26***a* so as to close switch **26**. Referring to Fig. 3, the circuit will then be from the line L_1 and binding post **40** through line **46**, switch blade **45**, line **47**, switch **26**, lines **52** and **53** to binding post **42**, thence through the motor winding to binding post **43** and through line **51** and binding post **41** back to the line L_2. This will operate the control motor in a direction to close the damper which will decrease the draft and cause the return of pointer **20** to the position of Fig. 1 so as to open switch **26** and stop the control motor. Thus the tendency is at all times to operate the control motor upon an increase or decrease of draft from the condition indicated by the pointer **33** to return the draft conditions to that predetermined by the setting of the pointer **33**.

By rotating the knob **32** the nut **30** can be moved to the right or left away from the position of Fig. 1 so as to oscillate the bracket **24** to either one of the dot-dash positions partially shown to the left and right of the full line position of Fig. 1. This of course will carry the switches and the actuator along with the bracket so as to set the device to control any draft desired.

It should be understood that the switches **26** and **27** are preferably of a character like that shown in Patent No. 1,960,020, granted May 22, 1934, to P. K. McGall. These switches require only an extremely slight movement of the control buttons **26***a* and **27***a* to cause full operation of the switches. Furthermore they require very little pressure on the control buttons for the operation of the switches and therefore practically no load upon the diaphragm **11***b* and the connecting parts. In other words these switches are of such a type that the accuracy of the draft indicating pointer **20** is not affected at all for practical purposes. It will be noted that actuator **28** has a very long lever arm from **18** to **29** as compared to the lever arm from **26***a* or **27***a* to **29** so that the very light pressure necessary to operate the switch buttons requires a still lighter pressure at the point **18**. Furthermore such a slight movement of the diaphragm **11***b* is necessary to cause closure of either of the switches **26** or **27**, that the device may be set to operate on one one-hundredth or two one-hundredths of an inch water gauge change in draft pressure from the predetermined setting of the pointer **33**.

I have thus provided a very accurate and sensitive draft indicator and a very sensitive draft control device which is adapted to hold a given draft condition within as close limits as could possibly be desired under the most exacting conditions. All of this is accomplished with the minimum number of operating parts in the control gauge and these parts are of rugged construction and very simply connected for their intended use. The switches **26** and **27** are adapted for use with the customary line voltages and therefore such current may be connected at the binding posts **40** and **41** and the device is ready to control any standard motor connected to the binding posts **42**, **43** and **44**.

The description herein is related to the use of my device for the control of draft, but it is equally useful for the control of pressure by a slight change in the linkage at the point **12**. A suitable linkage for substitution at this point so as to

adapt the device for pressure control is illustrated and described in my copending application Serial No. 383,965, filed March 18, 1941.

What I claim is:

1. A control gauge comprising means forming a pressure chamber and having a flexible diaphragm wall, an oscillatable member, connecting means for oscillating said member responsive to movement of said diaphragm wall, means for mounting a pair of switches having operating buttons spaced apart, said buttons being disposed in opposed relationship and directed towards each other, an actuator lever pivotally mounted between said buttons for alternatively operating one or the other of said switches, said lever having a shorter arm for engaging said buttons, and there being an operative connection between a longer arm of said lever and said oscillatable member.

2. A control gauge comprising means forming a pressure chamber and having a flexible diaphragm wall, an oscillatable member, connecting means for oscillating said member responsive to movement of said diaphragm wall, a dial pointer on said oscillatable member, means counterweighting said oscillatable member and connecting means and pointer so that all of these parts are in balance about the axis of member oscillation, a pendulum weight for governing oscillation of said member as pressure in said chamber varies, switch means fixed relative to said member, and means for operating said switch means by oscillating movement of said member.

3. A control gauge comprising means forming a pressure chamber and having a flexible diaphragm wall, a member oscillatable about a pivot, connecting means for oscillating said member responsive to movement of said diaphragm wall, a dial pointer on said oscillatable member, means counterweighting said oscillatable member and connecting means and pointer so that all of these parts are in balance about the axis of member oscillation, a pendulum weight for governing oscillation of said member as pressure in said chamber varies, a bracket mounted for oscillation about a pivot coaxial with said member pivot, two switches on said bracket having operating buttons spaced apart, an actuator between said buttons for alternatively operating one or the other of said switches, an operative connection between said member and said actuator, and means for holding said bracket in various adjusted positions about its pivot.

4. A control gauge comprising means forming a pressure chamber and having a flexible diaphragm wall, an oscillatable member, connecting means for oscillating said member responsive to movement of said diaphragm wall, means for mounting a pair of switches having operating buttons spaced apart, said buttons being disposed in opposed relationship and directed towards each other, said switches being operable by slight pressure on said buttons, an actuator lever having a shorter arm lying between and closely adjacent said buttons for alternatively operating one or the other of said switches by slight movement of said arm, and said lever having a longer arm operatively connected with said oscillatable member.

5. A control gauge comprising means forming a pressure chamber and having a flexible diaphragm wall, an oscillatable member, connecting means for oscillating said member responsive to movement of said diaphragm wall, a dial pointer on said oscillatable member, means counterweighting said oscillatable member and connecting means and pointer so that all of these parts are in balance about the axis of member oscillation, a pendulum weight for governing oscillation of said member as pressure in said chamber varies, means for mounting a pair of switches having operating buttons spaced apart, said switches being operable by slight pressure on said buttons, an actuator lever having a shorter arm lying between and closely adjacent said buttons for alternatively operating one or the other of said switches by slight movement of said arm, and said lever having a longer arm operatively connected with said oscillatable member.

6. A control gauge comprising means forming a pressure chamber and having a flexible diaphragm wall, an oscillatable member, connecting means for oscillating said member responsive to movement of said diaphragm wall, a dial pointer on said oscillatable member, means counterweighting said oscillatable member and connecting means and pointer so that all of these parts are in balance about the axis of member oscillation, a pendulum weight for governing oscillation of said member as pressure in said chamber varies, means for mounting a pair of switches having operating buttons spaced apart, said switches being operable by slight pressure on said buttons, an actuator lever having a shorter arm lying between and closely adjacent said buttons for alternatively operating one or the other of said switches by slight movement of said arm, said lever having a longer arm operatively connected with said oscillatable member, said switch mounting means being movable, means for holding said switch mounting means in various adjusted positions, and means adjacent said dial pointer for indicating the position of said switch mounting means.

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