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CONDITION CONTROL SYSTEM WITH STEPPED RESPONSE

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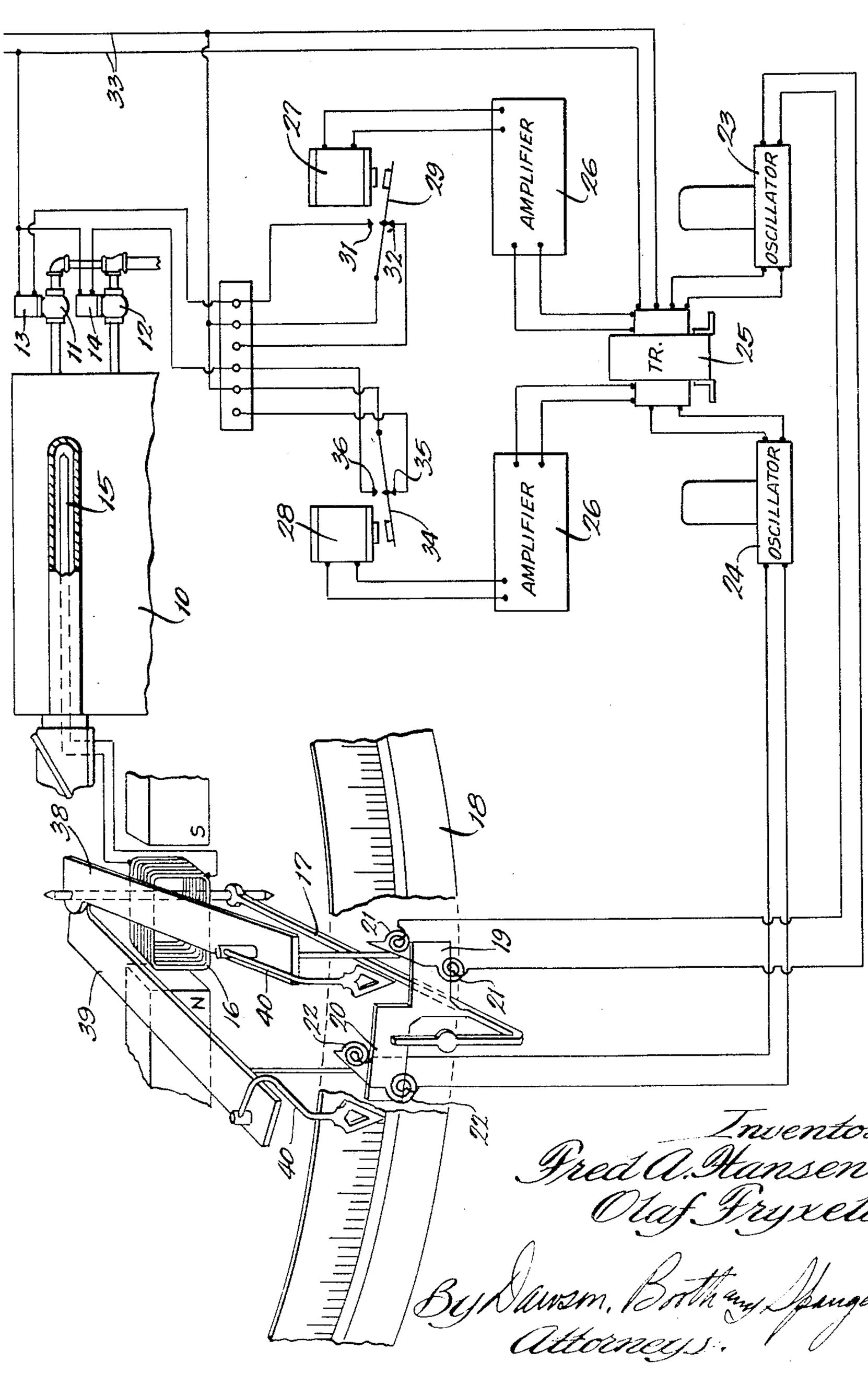


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## CONDITION CONTROL SYSTEM WITH STEPPED RESPONSE

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3 Claims. (Cl. 236—69)

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This invention relates to control systems and more particularly to electrical systems for controlling a variable condition such as temperature, pressure, flow or the like.

One of the objects of the invention is to provide a control system which will maintain a condition in a given control range and which will effect a control operation tending to return the condition to the range upon a departure therefrom.

Another object is to provide a control system in which the control range can be easily and quickly adjusted throughout wide limits.

Still another object is to provide an electrical control system having high, low and neutral control positions and in which the range of the neutral position can easily be adjusted.

The above and other objects and advantages of the invention will be more readily apparent from the following description when read in connection with the accompanying drawing, in which the single figure is a diagrammatic view of a control system embodying the invention.

The instrument, as shown, is adapted to control the temperature of a furnace 10, although any other condition such as pressure, flow or the like could equally well be controlled. The furnace 10 is heated by fuel burners supplied with fluid fuel such as gas through valves 11 and 12 controlled by solenoids 13 and 14. Temperature of the furnace is indicated by a thermocouple 15 connected to the coil 16 of a galvanometer to produce a movement of the coil proportional to changes in furnace temperature. The galvanometer includes a pointer 17 connected to the coil to be moved thereby and swinging over an arcuate scale 18 to indicate the temperature of the furnace. The pointer 17 carries near its free end a stepped metal flag having stepped portions 19 and 20 which are offset both vertically and horizontally with respect to each other.

The position of the pointer is sensed by reactance elements shown as inductance coils 21 and 22 which are mounted respectively adjacent the paths of movement of the flag portions 19 and 20. The coils 21 may be connected to the input or tank circuit side of an oscillator indicated generally at 23 and which may be similar to the oscillator more particularly described and claimed in the patent to Cohen No. 2,228,163. The coils 22 may be similarly connected to an oscillator 24, both oscillators being so arranged that when the flag is displaced from the coils the oscillator will be in tune, while when the flag is adjacent or between the coils, the oscillator will be detuned.

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The oscillators may be powered by a common transformer 25 and may be connected through amplifiers 26 to relays 27 and 28, respectively. The amplifiers 26 are preferably connected to the respective oscillators as described in Cohen Patent No. 2,228,163 so that when the oscillator plate current increases, the amplifier will cut off and the amplifier will conduct when the oscillator is oscillated and its direct plate current is at a minimum.

The relay 27 controls a switch having a movable blade 29 which normally falls away from the relay to engage a contact 32 and which is raised into engagement with a contact 31 when the relay is energized. In the circuit shown the contact 32 is a dead contact, although it could, if desired, be connected to an indicator or the like. The switch blade 29 is connected to one side of a power input circuit 33 and the contact 31 is connected through the winding 13 to the opposite side of the power input circuit. The relay coil 28 similarly controls a switch blade 34 which is connected to one side of the circuit 33 and which normally engages a dead contact 35. When the coil 28 is energized it pushes the switch blade up to engage a contact 36 connected through the solenoid 14 to the other side of the power circuit 33. In the position shown, both coils are deenergized to permit the valve 12 to close.

In operation of the apparatus as so far described, when the temperature in the furnace rises, the pointer 17 will swing to the right to move the flag 19 between the coils 21, the flag 20 remaining between the coils 22. As the flag portion 19 enters the coils 21, it detunes the oscillator 23 to de-energize the relay 27 so that the switch blade 29 will drop to the position shown to deenergize the solenoid 13 and close the valve 11. At this time both valves are closed so that no heat is supplied to the furnace. As the furnace temperature falls, the flag portion 19 moves away from the coils 21 to tune the oscillator 23 and close the circuit to the solenoid 13 to open the valve 11. At this time only the valve 11 is open which may be the normal operating condition. If the temperature should continue to fall with only the valve 11 open, the flag portion 20 will move away from the coils 22 tuning the oscillator 24 and energizing the relay 28. At this time the switch blade 34 will be raised to close the circuit through the solenoid 14 so that both valves will be open and the furnace temperature will increase.

The operating range of the instrument and the width of its neutral range, when only the valve

11 is open, may be determined by design by the spacing of the coils 21 and 22 and the horizontal lengths of the flag portions 19 and 20. To permit easy adjustment of the neutral range, the coils 21 are preferably supported on an arm 38 pivoted coaxially with the pointer 17. The coils 22 are similarly supported on an arm 39 and both arms may carry pointers 40 for movement over the scale 18 to indicate the positions of the arms.

With this construction the instrument can be set to maintain the furnace temperature at any desired value by simultaneously moving the arms 38 and 39 so that the pointers 40 indicate the value at which furnace temperature will be maintained. Since the arms are independently movable, the neutral range can easily be adjusted by separating the pointers 40 or by moving them closer together. In this way the amount of permissible movement of the pointer 17 in the neutral range to hold the valve 11 open and the valve 12 closed can readily be adjusted. Thus for some installations a neutral range of 50 or more degrees may be desirable, while for others a relatively narrow range comprising only a few degrees change may be required. By separating the pointers or by bringing them closer together, the width of the neutral range can be made any desired value within the limits of adjustment permitted by the lengths of the flag segments 19 and 20.

While one embodiment of the invention has been shown and described in detail herein, it will be understood that it is illustrative only and is not intended to be taken as a definition of the scope of the invention, reference being had for this purpose to the appended claims.

What is claimed is:

1. In a control system, a unit responsive to a condition to be controlled, a pointer moved by the unit in proportion to changes in the condition, a flag on the pointer having stepped portions spaced in a direction transverse to the path of movement of the pointer, a pair of reactance elements whose reactance is affected by proximity of the flag mounted adjacent the paths of movement of the stepped portions respectively, a pair of oscillator circuits connected to the reactance elements respectively to have their tuning and consequently their output currents controlled by proximity of the flag to the reactance elements, means mounting the reactance elements for individual adjustment parallel to the path of travel of the flag, and means controlled by the output currents of the oscillators to control the condition.



2. In a control system, a unit responsive to a condition to be controlled, a pivotally mounted pointer swung about its pivot by the unit in proportion to changes in the condition, a flag on the pointer having stepped portions spaced in a direction transverse to the path of movement of the pointer, a pair of individually movable arms pivoted coaxially with the pointer, reactance elements carried by the arms adjacent the paths of movement of the stepped portions respectively, oscillators connected to the reactance elements respectively to be tuned and detuned thereby as the flag portions recede from and approach the reactance elements, and control means connected to the oscillators to control the condition.

3. In a control system, a unit responsive to a condition to be controlled, a pivotally mounted pointer swung about its pivot by the unit in proportion to changes in the condition, a flag on the pointer having stepped portions spaced in a direction transverse to the path of movement of the pointer, a pair of individually movable arms pivoted coaxially with the pointer, reactance elements carried by the arms adjacent the paths of movement of the stepped portions respectively, oscillators connected to the reactance elements respectively to be tuned and detuned thereby as the flag portions recede from and approach the reactance elements, and control devices connected to the oscillators to be controlled by their output currents.

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