Feb. 4, 1941. G. W. CRISE ET AL 2,230,612

ELECTRIC CONTROL DEVICE

Filed March 28, 1936 2 Sheets-Sheet 1

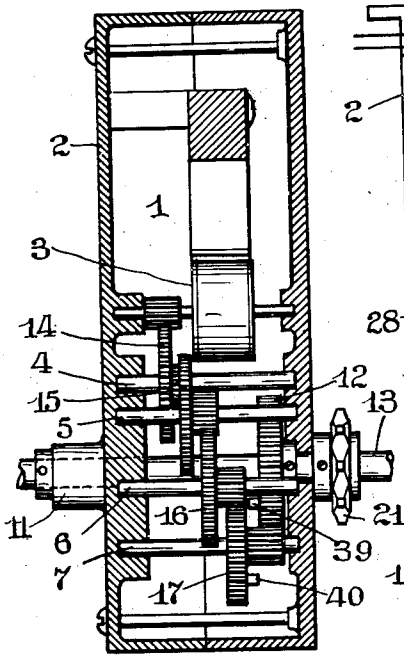


Fig.2.

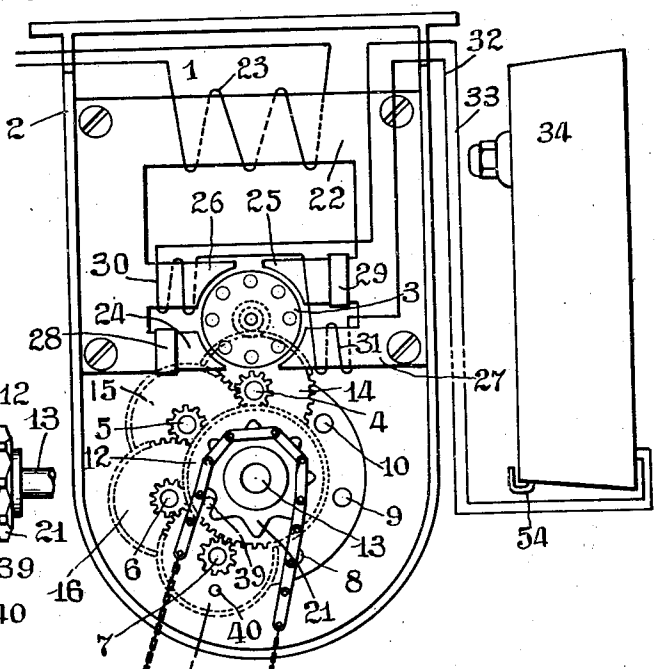
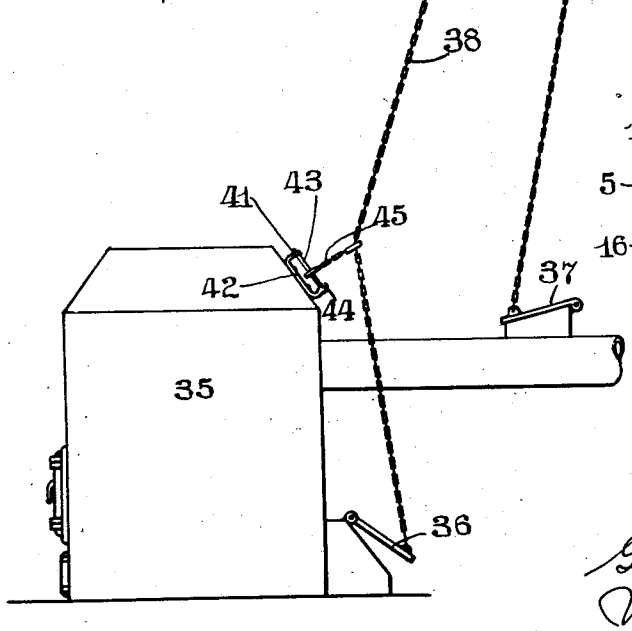


Fig.1



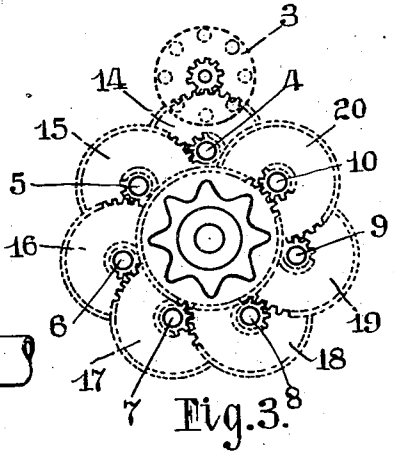


Fig.3.

Inventors

George W. Crise

Wilford P. Crise

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Fig.4.

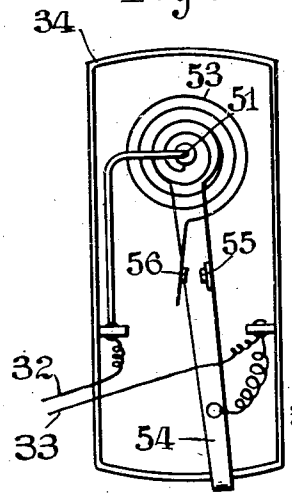


Fig.5.

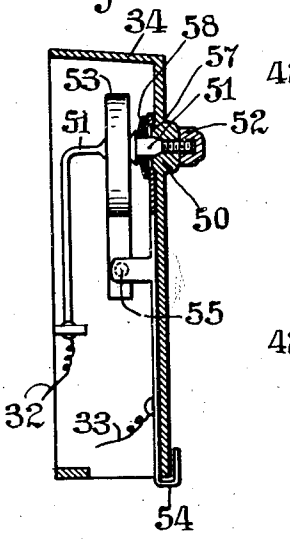
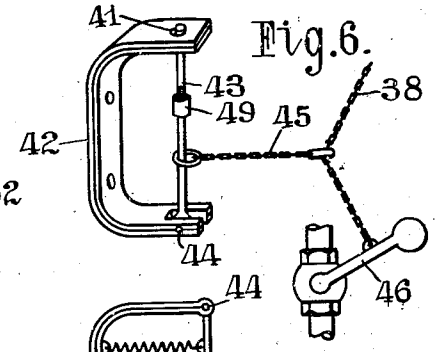


Fig.6.



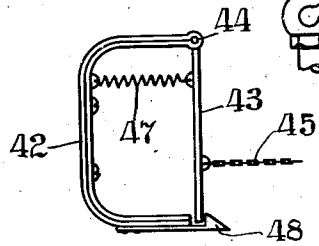


Fig.7.

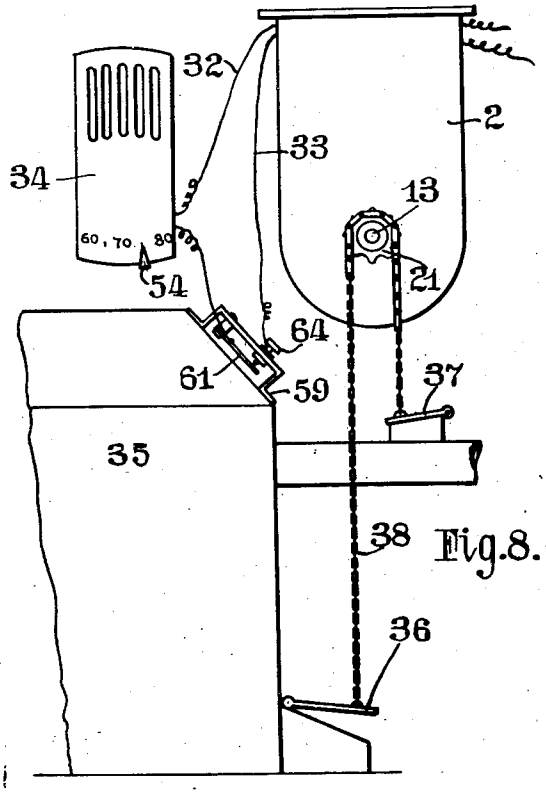


Fig.8.

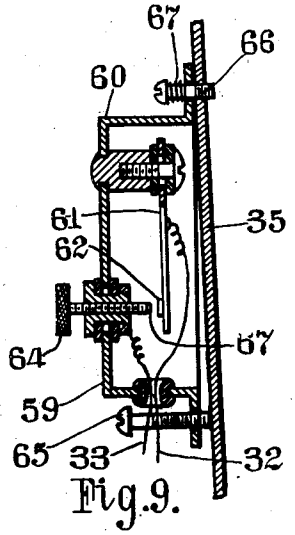


Fig.9.

Inventors

George W. Crise.

Wilford P. Crise

Patented Feb. 4, 1941

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UNITED STATES PATENT OFFICE

2,230,612

ELECTRIC CONTROL DEVICE

George W. Crise and Wilford P. Crise, Mount Vernon, Ohio, assignors to Crise Electric Manufacturing Company, Mount Vernon, Ohio, a corporation of Ohio

Application March 28, 1936, Serial No. 71,410

4 Claims. (Cl. 172—278)

This invention relates to improvements upon the subject matter of our application for patent for variable screen shaded pole motor and method of operating the same filed January 19, 1933, Serial Number 652,528.

The principal object of our present invention is to provide improved means and method of temperature regulation for furnaces, valves, doors or dampers, stokers or the like in combination with our improved single phase alternating current motor reversible by making or breaking a single contact thermostat and having split poles with opposing shading screens. This application is a continuation-in-part of our application Ser. No. 652,528, filed January 19, 1933, now Patent No. 2,134,685 issued November 1, 1938.

Another object of our invention is to make use of our single phase induction motor preferably characterized by the fact that so long as the field is energized, it will continue to rotate substantially constantly either in one direction or the other. This being accomplished by providing opposing shading screens mounted upon the pole pieces of the motor, one of which is a permanently short-circuited screen and the other being a wound screen with the circuit thereof extending remotely from the motor and provided with a single contact thermostat switch arranged to make and break the circuit thereof. In this manner when the thermostat switch is open the motor will rotate in one direction under the influence of the permanent shading screens and when the single contact thermostat switch makes contact, thereby energizing the screens of larger shading capacity, the motor will immediately reverse its direction of rotation against the shading effect of the permanently short-circuited screen of lesser shading capacity.

The larger shading screen being of sufficent shading capacity to reverse the direction of the magnetic shifting through the pole pieces and to provide for the desired speed in the opposite direction. Therefore, one object of the present invention is to do away with temperature differential such as would exist if two reversing windings were connected to a double circuit thermostat of the so-called open-contact type.

The foregoing and various other objects, the combination of elements and advantages of the invention and method of operation will be apparent from the following detailed description of the preferred embodiment thereof, and will be more particularly pointed out in the claims appended hereto.

In the drawings, wherein like symbols refer to like parts, Fig. 1 is a front view of the motor including the thermostat and furnace. Fig. 2 is a sectional view of motor shown in Fig. 1. Fig. 3 is a view of the preferred gear arrangement used in our motor. Fig. 4 is a front view and Fig. 5 a side view of the thermostat used in Fig. 1. Figs. 6 and 7 are enlarged views of the safety members used in connection with Fig. 1, and Figs. 8 and 9 illustrate modifications.

In Figs. 1 and 2 we show the motor 1 mounted in gear case 2 having a series of equally spaced bearings 4 to 10 concentrically arranged around the center drive shaft bearing 11 carrying the final drive gear 12. The said bearings are placed to receive the shafts of the concentrically arranged gears and pinions 14 to 17 assemblies as shown. There is thus formed a continuous speed reduction gear train from the armature assembly 3 to the final drive shaft 13 which carries the final drive gear 12 and sprocket wheel 21. It will be observed that by adding or omitting gears and adjusting the final drive gear 12 endwise to engage the pinion of the last of the series of the concentrically arranged gears, a variety of gear ratios may be obtained. It will be observed that the gears 18, 19 and 20, Fig. 3, are omitted from the construction as embodied in Fig. 1.

In Fig. 3 we show an eight step gear reduction by adding the gears 18, 19 and 20 in which case the final drive gear 12 engages the pinion of the gear assembly 20.

It will be obvious for example that by placing a second pinion on the shaft of gear 5 at its right end, it would engage final drive gear 12, then by omitting gear 7, a gear shifting means would be provided which could be utilized by merely sliding gear 12 endwise to alternately engage the pinion of gear 6 and the new pinion added to gear assembly 5.

In motor 1, the character 22 is the field member which is energized by primary coil 23 that in turn causes a magnetic flux to thread the armature 3 through the split pole projections 24, 25, 26 and 27. On the diagonally opposite pole sections 24—25 there are provided permanent shading coils or screens 28—29 that cause magnetic shifting and a resultant counterclockwise rotation of the armature 3 by the conventional shaded pole principle. On pole sections 26—27 there are wound shading coils or screens 30—31 respectively of sufficiently larger shading capacity to magnetically reverse the direction of shifting through the fixed screens 28—29 and in opposition to their shading effect thereby causing the armature to reverse and turn in a clockwise direction when the said wound shading coils 30—31 are made effective by closing their circuit through the leads 32 and 33 by means of the single contact thermostat switch 34.

No unshaded pole sections are provided in the spaces between pole sections 24 and 26 or between pole sections 25 and 27, thereby compelling all magnetic shifting to thread both the permanent

and the wound shading means. There is no other path by which such magnetic shifting may travel and therefore, the direction of magnetic flow through the armature and pole pieces is reversed.

At 35 is shown a furnace equipped with a draft door 36 and check damper 37 both being connected to sprocket wheel 21 by means of sprocket chain assembly 38.

From the foregoing, it will be seen that when thermostat 34 breaks the circuit of screen coils 32—33 due to reduced temperature surrounding it, the motor armature 3 will operate under the sole influence of the fixed screens 28—29 turning the sprocket wheel 21 clockwise, lifting draft door 36 and closing check 37 thereby increasing the fire and heat produced by the furnace 35. As soon as the temperature surrounding the thermostat 34 has reached a sufficient level to cause it to remake contact and close the circuit of wound screen leads 32—33 the motor armature 3 will reverse due to reverse phase splitting through the pole projections 24, 25, 26 and 27 under the predominating shading influence of the wound screens 30—31 thereby closing the draft door 36 and opening check damper 37.

Stopping pin 39 on final drive gear 12 is so located as to interfere with the stopping pin 40 carried as a part of the driving gear 7 when the sprocket wheel 21 has rotated through the desired range of travel in either direction, thereby limiting the opening of the draft doors 36 and 37. By placing these stopping pin in various positions and in various combinations of gears a desired range of travel may be secured.

A particular advantage of this arrangement lies in the fact that the stopping force is applied not on the final drive gear 12 but further up the gear train as per the present illustration between gears 16 and pinion of gear assembly 6 where the torque and consequent strains are greatly reduced. The action between the two pins 39 and 40 is one in which one pin overtakes the other and by gentle pressure produces in effect, a second and much higher gear ratio between gear assembly 7 and gear 12, thereby causing gear 12 to stall under the opposing influence of the slow moving pinion of gear assembly 7 with which it is in mesh. In this manner, since both stopping pins 39 and 40 rotate in the same direction at the same time, but at different rate of speeds, no matter how fast the speeds of travel, when the pins meet the motor is stalled with much less strains between said pins than would be the case if the pins moved in opposite directions.

Numeral 42 designates a safety device (shown more in detail in Fig. 6) which may be used to close the draft door 36 in case the furnace 35 should become overheated due to failure of other regulating equipment. It comprises the U-shaped bimetallic frame 42 as shown to which is hinged the pin 43 at its lower end 44 and to which pin is attached the short chain linkage 45 that in turn holds the slack out of the drive chain 38. It will be obvious that since the upper end of pin 43 is held in place by passing through an opening 41 in the upper end of the bimetallic frame 42 (for convenience the opening 41 could be cut through the side of the bimetal 42 to form a notch for reclosing the pin 43), that when the temperature of the furnace reaches a dangerously high predetermined temperature the frame member 42 will spread open, thereby releasing pin 43 and closing the draft door 36.

In Fig. 6 we have shown the safety device arranged to close a valve 46 which may be used to supply fuel to the furnace 45. Of course, such valve may be used to convey steam, hot or cold water or the like and any suitable type of regulating elements may be used and operated in like manner. 49 shows a turn buckle or the like which serves to increase or decrease the length of the pin to cause the release of the same at a different selectable temperature.

In Fig. 7 we have shown a modification of the device shown in Fig. 6, whereby it will reset itself whenever the load is taken off the chain linkage 45. For example, if the device shown in Fig. 7 is used in Fig. 1 it would relatch whenever the chain 38 becomes slackened by sufficient counter-clockwise rotation of sprocket wheel 21. The spring 47 should be of sufficient strength to relatch the pin 43 under the slight resistance of the latch member 48 when the chain 45 is slack, however, latch 48 is so placed under the lower arm of frame member 42 that it is forced clear of the lower end of pin 43 when the said frame member is expanded by heat, it being apparent that a reasonable weight, such as the load of the draft door 36 shown in Fig. 1, will be sufficient to swing open the pin 43 against the pull of the spring 47 when latch 48 is released by spreading of the bimetallic frame member 42, thereby closing the damper.

Figs. 4 and 5 show details of construction of the single contact thermostatic switch 34 used in Fig. 1 as connected with the leads 32—33 wherein 50 is a "bakelite" frame member carrying the mounting post 51 which is held in place by the acorn nut 52; said mounting post supports the bimetal element 53 and provides a rotatable calibrating adjustment for said thermostat. 54 is a metallic adjusting arm carrying the contact point 55 so placed as to engage the contact 56 riveted to the bimetal element 53. An adjusting arm 54 is pivoted around the projecting ring of the "bakelite" 57, said arm being frictionally held by the spring loaded insulating washer 58.

It will be obvious that the bimetal coil 53 will carry the contact point 56 into and out of contact with point 55 at times depending upon the temperature of the surrounding air and the setting of the adjusting arm 54, there being the same definite temperature for both opening and closing of the contact for each position of the adjusting arm 54. Because the bimetal element 53 is in the electrical circuit of the controlled current, due to its light construction, an appreciable amount of heat may be generated by its resistance when used in a low voltage circuit of moderate amperage, this gives rise to two possible effects: First, if the bimetal is so wound as to contract when heated, it will break its circuit at a lower room temperature than the temperature at which it makes contact due to the internal heat generated when in contact, thereby producing a time lag or temperature differential. Second, if the bimetal is so wound as to contract when cooled, it will break circuit at a lower temperature than that required to bring the points back into contact. This will give rise to an oscillating tendency or negative temperature differential which may be utilized to overcome sticking of contact points and produce more frequent operation of the drafts when a thermostat so designed is used on a heating system.

Fig. 8 shows a modification of our improved heat regulating system utilizing a compensating

high limit switch **59** whereby the maximum temperature to which the furnace may rise is influenced by the temperature of the surrounding air. In this instance, the controls are so arranged that the motor opens the draft door **36** when the thermostat circuit is closed, and closes the draft when the circuit is open. The thermostat switch **59** is arranged to open the control circuit when it exceeds a predetermined temperature, therefore causing the motor to close draft door **36** and open the check damper **37** and throttling the furnace or fire and reducing or attenuating the heat from the same independently of the setting or condition of the room thermostat **34**. A particular advantage of this system lies in its compensating effect in that it permits the furnace to rise to a higher temperature in zero weather when the air of the basement surrounding the thermostat **59** is relatively colder than it is in mild weather when less heat is required, this effect being particularly desirable on hot water furnaces where more time is required for heat to get from the furnace to the rooms to be heated. When thermostat **34** is set to about 70° F., the thermostat **59** should be set to desired temperature between 150° F. and 300° F., depending on the surrounding atmospheric conditions, ordinarily at about between 200° F. and 250° F.

Fig. 9 shows an enlarged view of our compensating surface switch **59** in which **60** is the case, **61** the bimetal element carrying the contact point **62** that engages the contact **63** of the adjusting screw **64** to produce the conventional thermostatic effect. **65** designates an adjusting screw to lift one end of the surface switch out of contact with the wall of the furnace **35** to reduce the rate of travel of heat to said surface switch and allow it to be affected by the temperature of the outside air to any desired extent.

It will be obvious that by varying the relative size of the fixed and wound screens, faster operation can be secured for the closing of the draft than for the opening thereof if desired, or the effect may be reversed. Furthermore by reversing the positions of the fixed and wound screens or by changing the number of steps of gear reduction, the direction of rotation also, the speed and torque of sprocket **21** can be varied as desired.

In this manner the motor may be caused to rotate much faster to close a valve or a damper, or close a draft damper and open a check faster when the demand is for less heat as compared to when the demand is for more heat. By operating the motor twice as fast in one direction, much fuel can be saved.

The limit switch is attached to the furnace wall by means of the screw **66** and spring **67** which allows for adjustment of the switch to or from the wall of the furnace **35**.

The elements disclosed in Figs. 4 to 7, also such as shown in Fig. 9 and at **59** in Fig. 8, together with the description thereof, all relate to thermostat means arranged to cause the damper **36** to either open or to close under predetermined temperature conditions. Of course, our improvements in this art include means for operating valves, doors, windows, switches or the like including devices and method of operations which may be advantageously used in connection with our improved motors. From the above it will be clear that other modifications are possible without departing from the broad scope and spirit of our invention, and all of the above including means disclosed in this application and the subject matter shown and described with respect to Figs. 1, 2, and 3, are all related to similar subject matter of invention relative to this art and to the subject matter of our first filed application for patent Serial No. 652,528, filed January 19, 1933.

When desired any or all of the safety devices shown in Figures 1 and 8 may be omitted or for other purposes, the thermostat **34** shown in Figure 9 may be omitted, operating the heating system under the sole control of the compensating surface limit switch **59**.

What we claim is:

1. In an electric power device of the character described, an alternating current motor having an armature and a shading coil adapted to be energized for causing rotation of the armature, a circuit for said coil including a control switch, a train of cooperating gears connected with said armature to be driven thereby, and means for stopping the motor comprising pins projecting from at least two gears of said train and adapted to engage each other after predetermined rotation of the armature.

2. In an electric power device of the character described, a motor having an armature and a main coil adapted to be continuously energized by alternating current, a shading coil adapted to be energized for causing rotation of the armature, a circuit for the shading coil including a control switch, a train of cooperating gears connected with said armature to be driven thereby, and means for stopping the motor without deenergizing said main coil or opening the shading coil circuit comprising pins projecting from at least two gears of said train and adapted to engage each other after predetermined rotation of the armature.

3. In an electric power device of the character described, a reversible shaded pole induction motor having a stator with a primary winding thereon, a rotor, and two shading coils respectively tending when energized to cause rotation of the rotor in opposite directions, a shading coil circuit having a switch therein, one of said shading coils being effective upon closing of said switch to exert a sufficiently greater shading effect than the other shading coil to cause rotation of the rotor in the corresponding direction, a train of cooperating gears connected with said armature to be driven thereby, and means for stopping the motor without deenergizing said primary winding or opening the shading coil circuit comprising projections on at least two gears of said train adapted to engage each other after predetermined rotation of the armature.

4. An electric power device of the character described, comprising an electric motor, a circuit for energizing the motor, a train of gears connecting the motor with a shaft to be driven and including two gears having different rotative speeds, and pins carried by said two gears and located thereon to engage each other after predetermined rotation of the gears to thereby stop the motor while the latter remains energized.

GEORGE W. CRISE.
WILFORD P. CRISE.