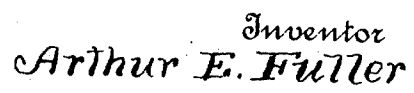


1,372,416.

3 SHEETS—SHEET 1.

Fig. 1.



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A. E. FULLER.
AUTOMATIC HEAT REGULATOR.
APPLICATION FILED DEC. 3, 1919.

1,372,416.

Patented Mar. 22, 1921.

3 SHEETS—SHEET 2.

Fig. 3.

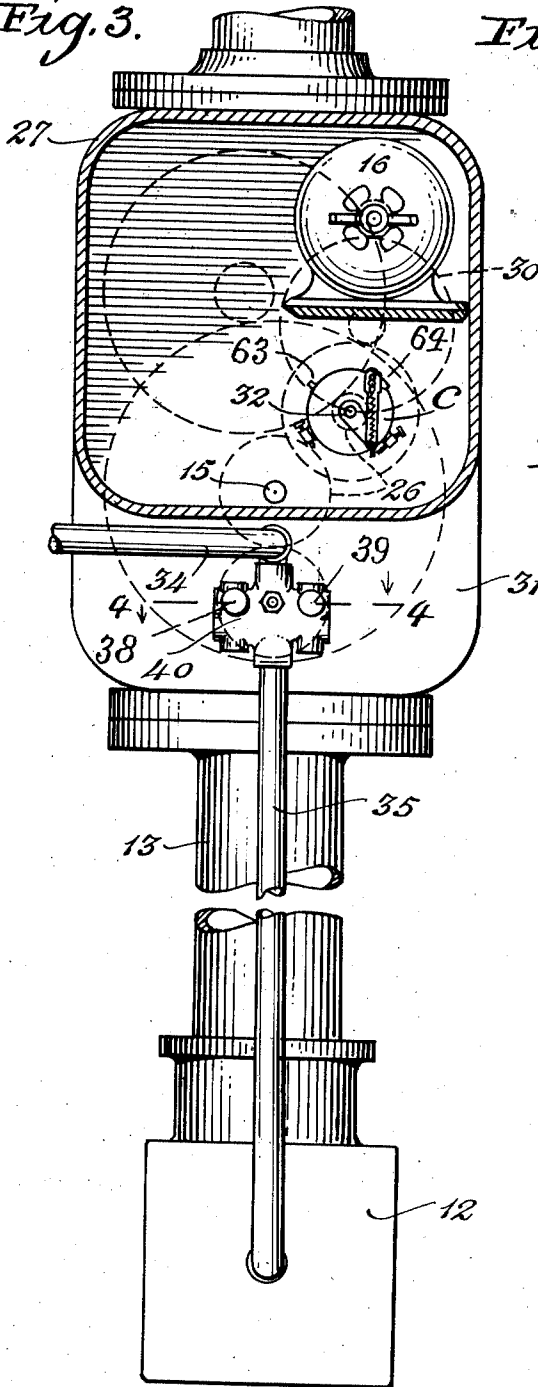


Fig. 4.

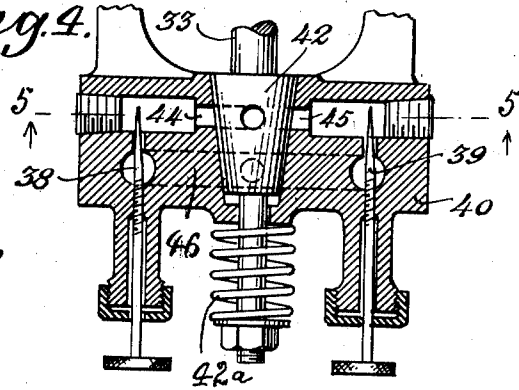


Fig. 5.

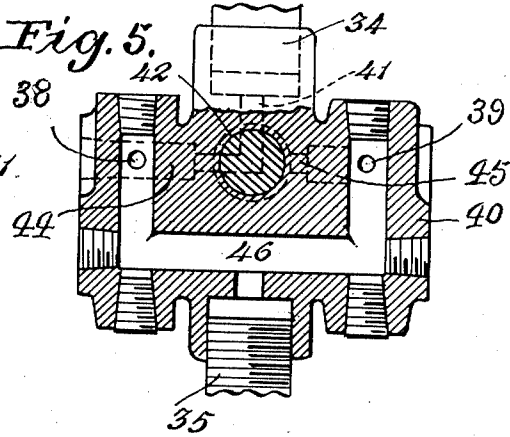
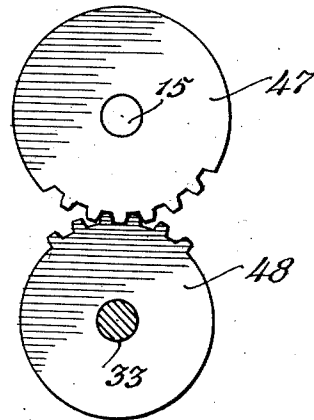


Fig. 10.



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3 SHEETS—SHEET 3.

Fig. 6.

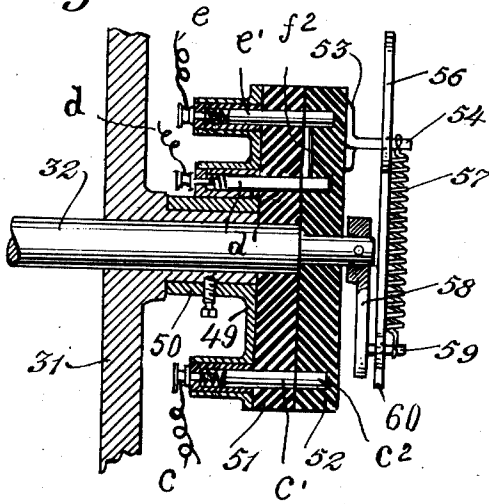


Fig. 7.

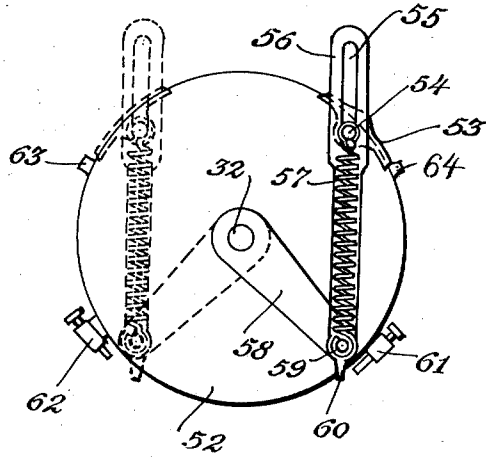


Fig. 8.

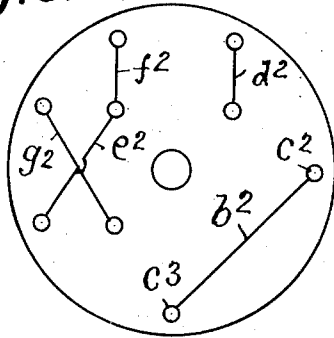


Fig. 9.

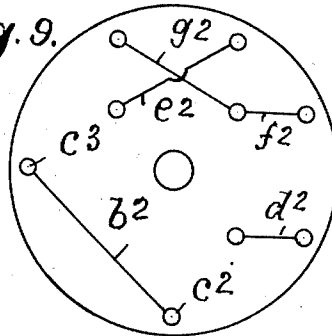
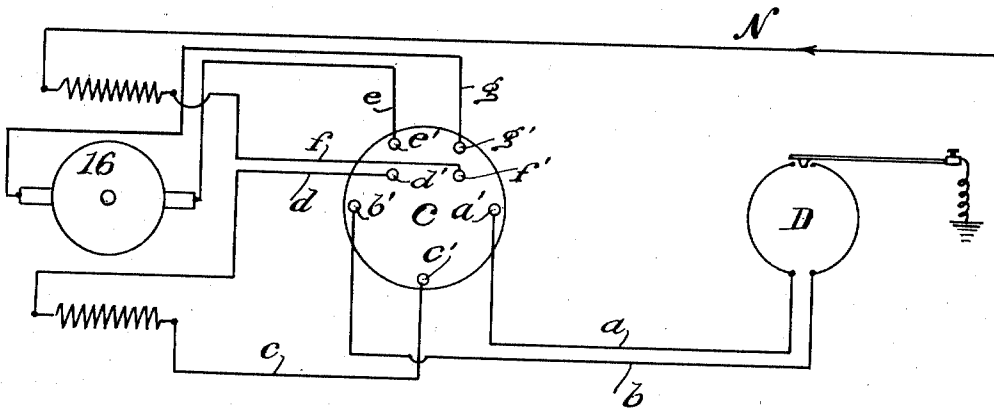


Fig. 11.



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UNITED STATES PATENT OFFICE.

ARTHUR E. FULLER, OF STRATFORD, CONNECTICUT.

AUTOMATIC HEAT-REGULATOR.

1,372,416.

Specification of Letters Patent. Patented Mar. 22, 1921.

Application filed December 3, 1919. Serial No. 342,260.

To all whom it may concern:

Be it known that I, ARTHUR E. FULLER, a citizen of the United States, and resident of Stratford, in the county of Fairfield and State of Connecticut, have invented certain new and useful Improvements in Automatic Heat-Regulators, of which the following is a specification.

This invention relates to new and useful improvements in automatic heat regulating devices such as are used in connection with heat furnaces, such as heat treating and boiler furnaces, and in connection with any kind of fuel mixture, for the purpose of maintaining a predetermined temperature therein.

The object of the invention is to provide a device for regulating the temperature of furnaces as may be required to keep within a certain specified degree of heat and whereby crude petroleum may be used in a perfectly satisfactory manner and to improve upon this class of devices by providing an automatic means for regulating the supply of fuel mixture, such as oil and air, by including two separate adjustable passages through which the oil may alternately be fed, one of said passages being larger than the other, and by providing valves for automatically controlling the oil and air supply in proper proportions; also to include an electric motor for operating both the oil supply valve and the air intake valve; further to include an automatic electric limit switch for cutting off the current when the valves register and at the same time to reverse the circuit between the fields and armature in the motor causing the motor to run in the reverse direction when the circuit is again closed by the recording machine.

With these and other objects in view the invention resides and consists in the construction and novel combination and arrangements of parts hereinafter more fully described, illustrated in the accompanying drawings, and pointed out in the claims hereto appended, it being understood that various changes in the form, proportion, size and minor details of construction within the scope of the claims may be resorted to without departure from the spirit or sacrificing any of the advantages of the invention.

Figure 1 shows a central vertical sectional elevation through my improved device, including a furnace, an oil burner therefor

connected with both the oil supply pipe and the air supply pipe, each having automatically operated valves.

Fig. 2 is a detached cross section of the shut-off valve contained in the air supply pipe, and taken on line 2—2 of Fig. 1.

Fig. 3 shows a front sectional elevation of the device as seen from the right of Fig. 1.

Fig. 4 shows a horizontal sectional view of the oil valves taken on line 4—4 of Fig. 3.

Fig. 5 shows a vertical section of the oil valves taken on line 5—5 of Fig. 4.

Fig. 6 shows a central vertical section of a limit switch, which is operated by the electric motor and which controls the current to the motor.

Fig. 7 shows a front elevation of the limit switch shown in Fig. 6.

Fig. 8 shows a detached side view of the front or commutator member of the limit switch.

Fig. 9 is a further side elevation of the same commutator differently positioned.

Fig. 10 is a detailed side view of the gears shown in Fig. 1 for operating the fuel valve, and

Fig. 11 shows a diagram of the motor, limit switch, recording instrument, and electrical connections whereby the device may be electrically controlled and operated as will later be more fully described.

Referring in detail to the characters of reference marked upon the drawings, A represents a furnace and B a small opening through which fuel is introduced from the burner 12 positioned adjacent thereto. The burner in question is designed to produce a combustible mixture from the crude oil and air which are brought together in the burner and forced out therefrom and into the hole of the furnace by the force of the air that is conducted to the furnace through a supply pipe 13 that would be provided with a blower, not shown.

The air pipe is provided with a cylindrical valve 14 that is loosely mounted on a shaft 15 and adapted to be operated at suitable intervals by a motor 16.

The power for operating both the oil valve and the air valve is taken from the motor which is alternately driven forward and backward and thus serves to not only regulate the oil supply, but likewise the air supply. This air supply valve as before stated is mounted upon the shaft 15 and is journaled to rotate in suitable bearings 17 and

18 of the air pipe, and is provided with a rigidly attached disk 19 having a friction member 20 positioned between it and the outer disk 21 slidably keyed to the shaft 15, and against which the first mentioned disk and its friction member are frictionally engaged by reason of a spring 22. This disk 19 is provided with an extended arm 23 that serves to engage the adjustable stops 24 and 25 extended from the removable bearings 18 of the cylindrical valve.

The purpose of this construction is to limit the rotary movement of the cylindrical air valve 14 in its opening and closing movements when operated by the motor through a train of reducing gears 26. This valve shaft 15 is likely, of course, to be turned more than the quarter turn necessary, thus the friction is provided so that when the valve is turned sufficiently to open or close, the arm 23 will strike one of the stops on the bearing, and the friction connection will permit the shaft to continue in its rotation against the resistance of the said friction until such time as the motor stops.

The motor, as will be seen, may be located in a suitable housing 27 and is provided with a coupling 28 for its connection to the upper shaft 29 of the gear train 30. This gear train is inclosed in a casing 31 and serves to reduce the speed of the power for the several purposes for which the motor is employed. The shaft 32 upon which some of the gears of this train are mounted serves to operate what I term a novel form of limit switch C and by means of which the electric current for the motor is automatically cut off and reversed, as will later again be referred to. The shaft 33 journaled in the lower end of the casing connects the power for operating the valve which controls the oil supply.

In this connection it will be seen that 34 represents an oil supply pipe, that is connected to the body for the oil valve 42, and is in turn further connected by a feed pipe 35 with the fuel burner 12 and is positioned in alinement with its inner hub 36. A nozzle 37 through which the jet of oil is fed is detachably connected to this hub and alines with the opening to the furnace. The incoming current of air obviously encircles this nozzle and breaks up the supply of oil in the burner and carries the mixture through into the furnace where it is consumed.

The oil supply for the device is not controlled by automatically adjusting the passage through a supply valve, as is frequently the case in regulating apparatuses, but is obtained by employing a two-way valve and two adjustable passages through which the supply of oil from the two-way valve is alternately passed. These passages are preferably in the form of needle valves 38 and

39 which can be adjusted and set so that one is open much wider than the other, so that when the heat in the furnace rises above the required degree, the supply of oil will be cut off from one valve and turned through the other, thus reducing the oil supply, and when the temperature falls, the supply would again be shifted back through the larger valve. In this way a large or small supply of fuel is provided at all times and the fire is kept burning so that the temperature is maintained within the desired degrees.

This valve mechanism will probably be best understood from Figs. 3, 4 and 5, and includes a body portion 40 having an inlet port 41 which alines with the supply pipe 34. A rotatable two-way valve 42 that is mounted upon the before mentioned gear shaft 33 is operatively positioned in this body to aline with the inlet 41 and either one of the ports 44 or 45 leading to the respective needle valves 38 and 39. A common port 46 connects both of these needle valves with the before mentioned feed pipe 35.

This valve 42 is tapered and fitted in a tapered hole in the body and has a spring 42^a that is positioned between a nut on its stem and the body to operatively retain the valve in its seat and like the air valve is designed to be moved but a quarter turn. As this shaft is driven by power from the motor, I provide special segment gear connections as shown in Figs. 1 and 10 which includes an intermittent segment 48 on the valve shaft 33. As will be seen from this construction, the gear 47, in mesh, will cause gear 48 to rotate 90° and stop locked in correct position to register ports in the oil valve. The oil is thus alternately fed first through one needle valve and then through the other according to the position of the two-way valve.

In the drawings, D represents a contact switch of a commercial potentiometer recording machine, not shown. This switch is rotated right or left by mechanical means which is in turn controlled by a thermocouple, not shown, placed in the heating chamber of the furnace and connected to said potentiometer recorder by suitable wires making what is termed a thermo-couple circuit. The above being a well known recording machine for recording temperatures, we do not deem it necessary to describe it more fully herein.

As will be noted the body 49 of the limit switch is mounted upon a hub 50 of the casing 31 and is provided with seven binding posts to which wires *a, b, c, d, e, f, and g*, are connected. An insulative member 51 is secured to the face of the body and is provided with a series of seven holes in which brushes *a', b', c', d', e', f', and g'*, are mounted, the outer ends of each of said

brushes being yieldably connected to the respective binding posts before mentioned so that when the inner ends of either of said contact brushes are electrically connected one with another the current will pass through in the manner desired as will later be described.

Upon the outer end of the shaft 32 is secured an insulated commutator 52 that is loosely mounted on the shaft and is provided with nine contact buttons, shown in Figs. 8 and 9 and which connect with the ends of the brushes a' , b' , c' , d' , e' , f' , and g' , first in one order and then in another, for the purpose of first passing the current in one direction to drive the motor forward and then in a reverse direction to drive the motor in an opposite direction. An arm 53 is connected to the outer peripheral portion of the commutator in a manner to move therewith and includes an outwardly disposed pintle end 54 that passes through the slot 55 in a link 56 and also serves for the attachment of one end of a spring 57. A rock-arm 58 is secured to the outer end of the shaft 32 and is provided with a pivot 59 that extends through a hole in the lower end of the above mentioned link 56 and further serves for the attachment of the opposite end of the above mentioned spring 57. The lower end of the said link 56 bears a lug 60 that extends out beyond the periphery of the commutator 52 and is engaged by the stops 61 and 62 secured to the body 49. The commutator member is loosely mounted upon the shaft 32 and is free to be rocked backward and forward through the spring and link connections, by the movement of the arm 58 when swung backward and forward by the shaft 32. From the above it will be seen that, when the parts are positioned as shown in Fig. 7 and power applied through shaft 32 to rock the same and its arm 58, from the position indicated in full lines to those indicated in dotted lines, the lug 60 will strike the stop 62 thus causing the link to swing upon its pivot 59 in a way to slightly throw the upper end of the link together with the commutator to the left so that both the link and line of draft of the spring are moved past the axis of the commutator. This position of the arm and the link will obviously extend the spring and leave it free to quickly throw the upper end of the link and commutator over to the position shown in dotted lines against the stop 63. This breaks the electrical contacts and stops the motor and places a new set of contacts in operative position so that when power is again applied through the recording machine switch, the motor will be driven in an opposite direction until the switch is again operated and thrown back to its former position.

Referring to Fig. 11 it will be seen that wires a and b connect the potentiometer

switch D with the brushes a' and b' while the remaining brushes c' , d' , e' , f' , and g' , are connected by wires c , d and f with the field leads of the motor, and wires e and g with the armature of the motor.

The electrically connected buttons c^2 and c^3 of the commutator serve to alternately connect the brushes b' with c' and c' with a' , while the upper buttons carried by the commutator serve to connect the remaining brushes first in one order and then in another. In the first mentioned position of the commutator its buttons and wire d^2 connect the brush e' and d' and the buttons and wire f^2 connect the brush f' with g' . On the other hand, if the commutator is thrown to the other side so that the brushes c' and a' are connected by the wire b^2 , the brushes d' and g' are connected by the buttons and wire g^2 and the brushes e' and f' by the wire e^2 thereby passing the current first in one direction and then in another.

From the foregoing it will be seen that we obtain by this construction a quick acting form of limit switch including a rotary commutator that is operated by power and wherein the amount of movement is limited so as to properly make and break the required connections.

This switch being an important feature and well adapted for other uses than that herein shown and described, it is thought the same should be protected by a separate patent application which applicant reserves the right to file.

Having thus described my invention what I claim and desire to secure by Letters Patent is:—

1. In an automatic heat regulating device of the class described, the combination with a fuel burner, of a fuel supply including a large and a small fuel passage, means for alternately directing the flow of fuel first through one passage and then through the other, an air inlet having a valve for controlling the air to the burner, means for operating the said valves, and a limit device adapted to control the operating means.

2. In an automatic heat regulating device of the class described, the combination with a fuel burner, of a fuel supply including a large and a small fuel passage, means for alternately directing the flow of fuel first through one passage and then through the other, an air inlet having a valve for controlling the air to the burner, an electric motor for operating the said valves, and a limit switch adapted to cut off the current for the motor.

3. In an automatic heat regulating device of the class described, the combination with a fuel burner, of a fuel supply pipe having a large and a small oil passage, a valve for alternately directing the flow of fuel first through one passage and then through the

other, an air inlet having a valve for controlling the air to the burner, an electric motor for operating the said valves, and a limit switch connected to be mechanically operated by the motor and adapted to cut off the current for the motor.

4. In an automatic heat regulating device of the class described, the combination with a fuel burner, of two adjustable needle valves one forming a large and the other a small fuel passage, a two way valve for alternately directing the flow of fuel first through one needle valve and then through the other, an air inlet valve for controlling the air to the burner, an electric motor for operating the said two-way valve and the air valve, and a limit switch connected to be operated by the motor and adapted to cut off the current for the motor.

5. In an automatic heat regulating device of the class described, the combination with a fuel burner, of a fuel supply pipe having a large and a small fuel passage, a valve for alternately directing the flow of fuel first through one passage and then through the other, an air inlet having a valve for controlling the air to the burner, an electric motor for operating the said valves, a limit switch, and a train of gearing connecting the motor to operate the valves and switch.

6. In an automatic heat regulating device of the class described, the combination with a fuel burner, of a large and a small fuel passage, a valve for alternately directing the flow of fuel first through one of said passages and then through the other, an air inlet having a valve for controlling the air to the burner, an electric motor for operating the said valves, a limit switch connected to be mechanically operated by the motor and adapted to cut off the current for the motor, and a contact switch connected to start the motor at proper times.

7. The combination with a fuel burner of a fuel supply pipe and a large and a small fuel passage therefrom, a valve for alternately directing the flow of fuel first through one passage and then through the other, an air inlet having a valve for controlling the air to the burner, an electric motor, a train of gearing driven by the motor to operate the valves, a limit switch also connected to be operated through the gearing and adapted to cut off the current for the motor, and a contact switch connected to start the motor at proper times.

8. In an automatic heat regulating device, the combination with a fuel burner, of a fuel supply pipe, a valve for controlling the flow of fuel through said supply pipe an air inlet and a valve for controlling the air to the

burner, an electric motor for operating the said valves, and a limit switch connected to be mechanically operated by the motor and adapted to cut off the current for the motor.

9. In an automatic heat regulating device of the class described, the combination of a fuel burner, a fuel supply pipe and an air supply pipe leading thereto, valves in each of said pipes, and electrically operated means for regulating said valves, whereby different quantities of fuel can be automatically alternately delivered to said burner, and air in quantity conforming with the amount of fuel delivered can be supplied.

10. In an automatic heat regulating device of the class described, the combination of a fuel burner, a fuel supply pipe and an air supply pipe leading thereto, valves in each of said pipes, and a motor arranged and adapted to manipulate said valves so that different quantities of fuel can be automatically alternately delivered to said burner, and air in quantity conforming with the amount of fuel delivered can be supplied.

11. In an automatic heat regulating device of the class described, the combination of a fuel burner, a fuel supply including a large and a small fuel passage, and automatic means governed by the furnace which is to be supplied by the fuel, for alternately directing the flow through the large and the small fuel passages.

12. In an automatic heat regulating device of the class described, the combination of a fuel burner, a fuel supply including a large and small fuel passage, automatic means governed by the furnace which is to be supplied by the fuel, for alternately directing the flow of fuel through the large and the small fuel passages, and means for automatically supplying air to the burner to conform to the size of the passage.

13. In an automatic heat regulating device of the class described, the combination of a fuel burner, fuel supply means, mechanism for controlling the flow of fuel through the supply means to the burner, air supply means, mechanism for controlling the flow of air to the burner, an electric motor for operating the controlling mechanism, and a limit switch mechanically operated by the motor and having means to cut off the current to the motor.

Signed at Bridgeport, in the county of Fairfield and State of Connecticut this 29th day of November, A. D. 1919.

ARTHUR E. FULLER.

Witnesses:

C. M. NEWMAN,
LILLIAN M. ALLING.