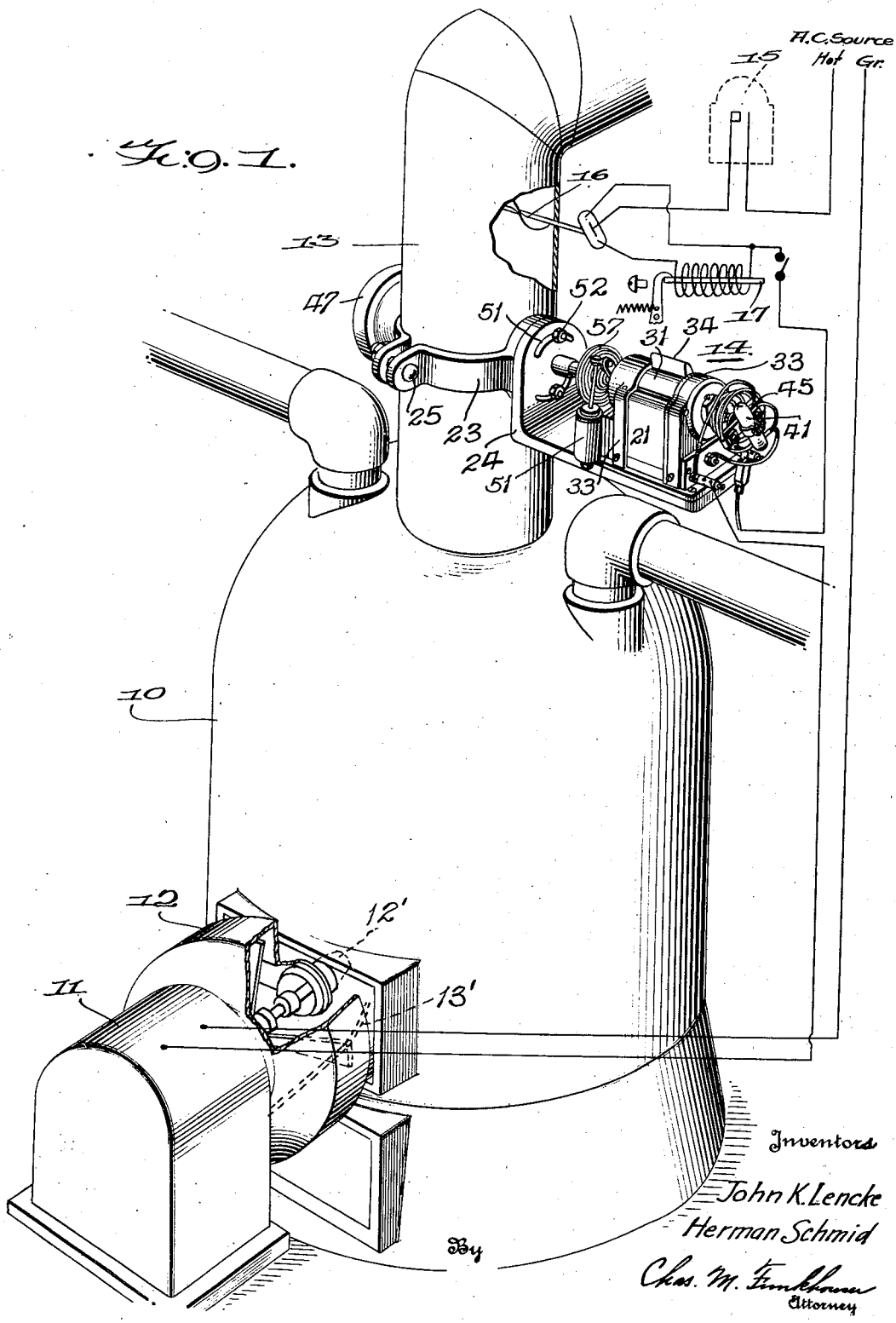
July 6, 1937. J. K. LENCKE ET AL 2,085,912

CONTROL DEVICE FOR HEATING SYSTEMS

Original Filed Aug. 24, 1931 3 Sheets-Sheet 1

Fig. 1.




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Fig. 2.

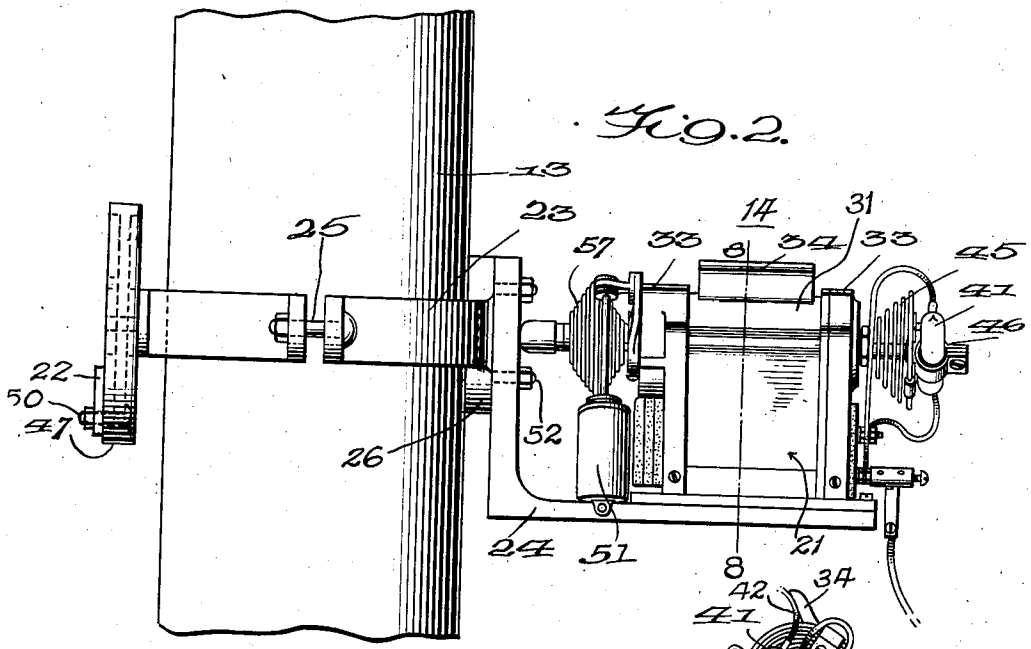



Fig. 4.

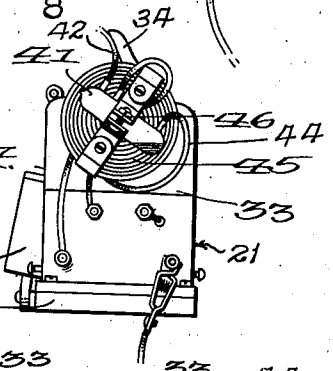
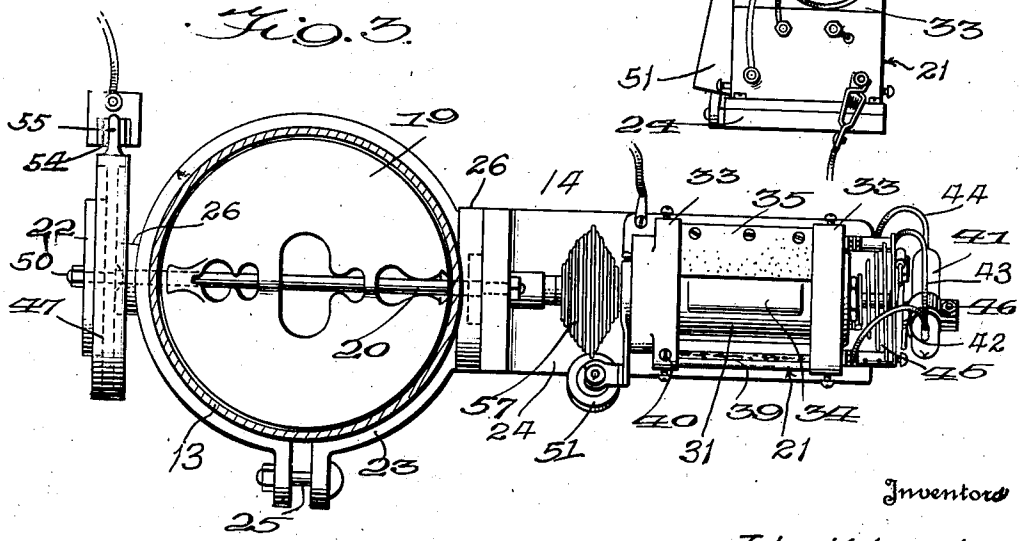



Fig. 3.




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Fig. 5.

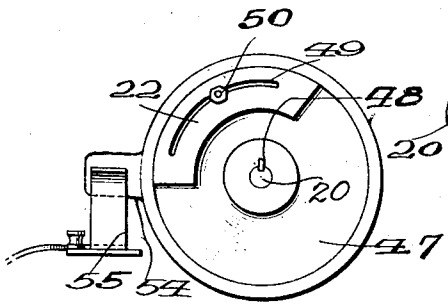



Fig. 6.

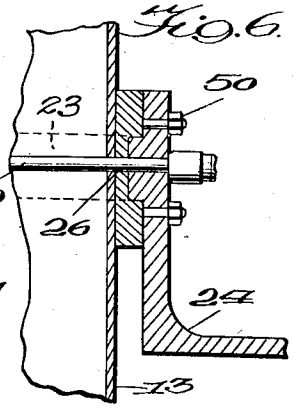



Fig. 7.

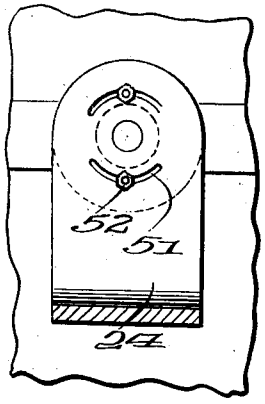



Fig. 8.

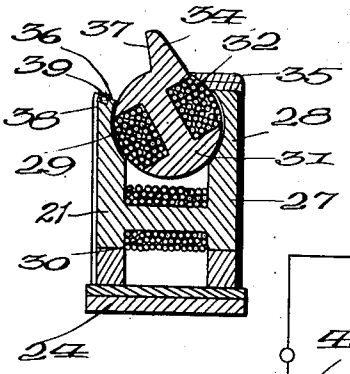



Fig. 9.




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# UNITED STATES PATENT OFFICE

2,085,912

## CONTROL DEVICE FOR HEATING SYSTEMS

John K. Lencke and Herman Schmid, Kingston, N. Y.

Application August 24, 1931, Serial No. 559,076
Renewed June 8, 1936

6 Claims. (Cl. 236—1)

This invention relates to heating devices and more particularly to heat conservation apparatus for heaters employing gas, oil or electricity as the heat generating medium.

An apparatus embodying the present invention is particularly desirable for use in conjunction with intermittently operated oil or gas fired furnaces wherein the combustion chamber is supplied with a liquid or gaseous fuel and an outside source of air. The supply of fuel may be automatically regulated by a motor operated pump or blower device, and the outside source of air necessary for combustion may be supplied through the furnace stack, ash pit, or a separate flue leading to the combustion chamber, as well understood in the art. Regardless of the type of heater employed, one of the objects of the present invention is to provide heat conservation apparatus which shall be operated in connection with the fuel feeding auxiliaries to interrupt the supply of air to the combustion chamber, whenever combustion ceases for any reason.

Another object of the invention is to provide an automatic damper which shall be located in an exhaust pipe passage leading from the furnace combustion chamber and connected with intermittently operated fuel feeding auxiliaries to interrupt the air supply during the intermittent periods and thereby conserve a maximum amount of heat when combustion ceases.

Another object of the invention is to provide a damper of the character designated which shall be intermittently operated in conjunction with the fuel feeding motor to interrupt the air supply after combustion ceases and opened prior to the time the fuel is again ignited.

Another object of the invention is to provide a damper operating unit having safety devices which shall prevent the operation of the fuel feeding device while the damper is in closed position.

Another object of the invention is to provide a damper control unit of the character designated which may be readily attached to the chimney, stack or flue of a household heating plant.

Another object of the invention is to provide an improved motor for operating the damper.

Another object of the invention is to provide a novel switch mechanism for controlling the operation of the damper motor.

Another object of the invention is to provide novel coupling mechanism between the damper, motor and switch connections assembled in the unit.

A further object of the inventien is to provide a damper unit of the character designated which shall be durable and rugged in construction and more efficient in operation than similar devices heretofore employed.

These and other objects of the invention will be more manifest from the following specification and drawings and particularly set forth in the claims.

In the drawings:

Fig. 1 is a perspective view of a furnace employing an automatic damper constructed in accordance with the present invention,

Fig. 2 is a view in elevation of the apparatus shown in Fig. 1,

Fig. 3 is a top view of the damper apparatus shown in Fig. 2,

Fig. 4 is a front end view of the apparatus in Figs. 2 and 3,

Fig. 5 is a detail view of the damper weight and switch mechanism associated therewith,

Fig. 6 is a detail view of the rotary mounting for the damper motor support,

Fig. 7 is an end view of the mechanism for adjusting the support shown in Fig. 6,

Fig. 8 is a sectional view on line 8—8 of Fig. 2, showing the motor construction, and

Fig. 9 is a circuit diagram of the operating mechanism.

Referring to Fig. 1 of the drawings, there is shown a preferred embodiment of apparatus constructed and arranged in accordance with the present invention as applied to the usual type of household furnace indicated by the numeral 10. In this illustrative embodiment of the invention, the furnace 10 is heated by fuel supplied to the combustion chamber by a motor-driven fuel feeding unit comprising a motor 11 and a fuel feeding device 12 connected thereto for atomizing the fuel for proper combustion in the furnace combustion chamber as well understood in the art. The fuel feeder 12 includes the usual atomizer 12' and a pilot ignition device 13'. Associated with the furnace 10 is a stack or flue 13 which provides the usual escape of furnace gases after combustion and a novel form of automatic damper 14 for interrupting the flow of air to the combustion chamber is preferably located in this exhaust passage. While this damper is shown applied to the stack, it is obvious that it may work with equal facility in any passage or flue communicating with the furnace combustion chamber to interrupt the flow of air through the same when the combustion ceases.

A heating installation of the character illustrated is usually automatically controlled and intermittently operated to produce a uniform temperature within certain narrow limits. The operation of such a fuel feeding unit is controlled by a thermostat 15 located in a chamber or compartment to be maintained at a predetermined temperature, as well understood in the art. Also connected with the fuel motor 11 and thermostat 15 is a heat responsive safety device 16 and switch 17 which are affected directly by the heat of combustion to stop the motor in case the fuel is not ignited when supplied to the furnace combustion chamber. These auxiliary furnace controls are well understood in the art, and are merely illustrated in diagrammatic form to show the cooperation of these devices with the improved automatic damper embodying our invention. In the present type of furnace, the fuel feeding apparatus is intermittently operated in response to certain predetermined temperature changes and one of the disadvantages of present day devices is that each time the heating apparatus is stopped there is a considerable loss of heat due to the rapid cooling effect of the continued flow of air through the combustion chamber and furnace.

Apparatus embodying our invention contemplates conserving the heat in the furnace and thereby increase efficiency thereof by providing a damper or interruptor mechanism which shall close and stop the flow of air through the combustion chamber as soon as combustion ceases for any reason. One novel feature of our automatic damper mechanism is that of safety. Provision is made for positively preventing the operation of the fuel motor 11 when the damper 14 is closed and likewise, positive means is provided for opening the damper 14, before the motor 11 can be started. The desired control of the damper is accomplished by connecting the apparatus in the live or hot side of a source of electric current whereby the damper shall exercise full control over the fuel feeding motor 11 under all conditions of operation.

The damper unit 14 includes a damper vane 19 mounted on a shaft 20 so that it may be conveniently operated in the stack 13. The mechanism for operating the damper vane 19 comprises a novel form of electric motor 21 shown in Figs. 2, 3 and 4 and a gravity weight 22, Fig. 5, both of which are directly connected to the shaft 20 as hereinafter described. The motor 21 and the vane 19 are mounted directly on the stack 13 by means of a band or collar 23 and an angularly adjustable bracket 24. The collar 23 is secured in place by a clamp bolt 25, and is also provided with bearing supports 26—26 for the damper shaft 20 as shown in Fig. 6.

The motor 21 for operating the damper vane 19 is mounted on the bracket 24 and in axial alignment with the damper so that the same may be adjusted as hereinafter described. This motor includes a stator 27 composed of a plurality of thin ferro silicon iron laminations which form pole pieces 28—29 as shown in Fig. 8. The lower connecting portion of the stator is provided with a field coil 30 for energizing the pole pieces 28—29 as well understood in the art. Rotatably mounted between the pole pieces is a rotor 31 of the shuttle type also composed of soft iron laminations and including an armature coil 32 wound lengthwise thereof. The rotor is mounted in end frame members 33—33 which also provide a suitable frame for the stator section and thus form a compact unit. One pole of the rotor 31 is provided with an angularly disposed projection 34 which moves between a stop 35 mounted on pole 28 of the stator frame and a top surface portion 36 of pole 29. The face of the angular projection 34 is provided with a plane surface 37 projected radially from the axis of the rotor and in a like manner the pole surface 36 is preferably an inclined plane surface also projected from the axis of the rotor. The surface 36 is provided with a longitudinal groove 38 arranged to accommodate a fibre wick 39 which is supplied with a lubricant in any suitable manner as for example by the cup 40. The wick is of particular advantage in minimizing any tendency of the armature to stick due to residual magnetism.

It will be further noted that the armature projection 34 being to one side of the rotor pole, provides a magnetically unbalanced armature which is positive in action when the motor parts are energized with either A. C. or D. C. current. If A. C. current is used, the off center arrangement of the projection is of particular importance to effectively eliminate any tendency of the armature to flutter or chatter and thereby impair the operation of the mechanism for the purpose intended.

The switch mechanism necessary for effecting the desired operation of damper vane 19 is preferably a tiltable contactor 41 of the sealed-in type and comprises a plurality of terminals 42, 43, 44 and a globule of mercury movable between the terminals to form the necessary contacts. The tube is resiliently mounted on the rotor 31 by means of a helical spring member 45 so that its tilting axis shall coincide with the axis of the damper and the rotor. The tube is adjustably clamped on the resilient support by means of a bracket 46 engaging the outer coils of the spring and this construction permits a ready angular adjustment of the switch so that it shall conform with the angular operative position of the damper vane 19 in the stack 13, whether it be in a vertical or horizontal position. This particular mounting of this contactor tube 41 is an important feature in the successful operation of the automatic damper mechanism, in that any vibrations or shocks caused in the motor 21 or damper vane 19 for any reason, are not transmitted to the switch.

The damper is normally maintained in the closed position by the gravity weight 22 adjustably mounted on a disk 47 secured to the damper shaft 20 by a key 48. The weight 22 is adjusted circumferentially of the disk by bolt and slot connection 50 and 49 respectively. This construction permits the damper to be balanced with the force exerted by the pull of the rotor 31 and thereby insure smooth and uniform operation of the several connected parts, when the motor is intermittently energized. The smoothness of operation is facilitated by causing the weight 22 to move in an arc and increase the leverage of the rotor. This is illustrated diagrammatically in Fig. 9 wherein the weight 22 moves angularly to dotted line position when the damper is moved to its open position. It will be noted that when the motor 21 is first energized, the leverage of the weight 22 is at a minimum and increases as it is moved by the motor. In other words, the load on the motor increases as the damper is moved to open position.

To further aid in balancing the operation of the several operating parts, the rotor 31 of the motor is provided with a cushioning device such as a dash pot 51. This construction has the

further advantage that it serves to counteract the inertia of the damper vane 19 and weight 22 and thereby minimize any fluttering of the rotor or other disturbance which may affect the operation of the contactor switch 41.

The damper operating unit 14 is applied to a vertical stack but by arranging the damper vane 19, motor 21 and switch 41 on the same axis and providing individual adjusting devices, for these several mechanisms, each may be adjusted angularly so that the unit may be installed in an inclined or horizontally disposed air passage. The adjustment of the support 24 to suit the particular air passage is effected by bolt and slot connections 52 and 51, respectively.

To further aid in the positive action of the damper the motor 21 and damper shaft 20 are connected by a resilient helical spring coupling 57. This spring coupling minimizes any shocks due to the inertia of the moving parts during operation and effectively prevents the transmission of excess heat along the shaft 20 to the motor parts. It is important that the motor 21 be maintained in a relatively cool condition to insure the desired positive operation. By providing an open helical spring coupling, any injurious heat effects due to conduction are dissipated when traversing the open coils of the coupling.

Having thus described apparatus constructed in accordance with the present invention, the operation is as follows:

Assuming the furnace is cold, and about to be started, the damper is held in normally closed position by the gravity weight 22. Referring to the circuit diagram in Fig. 9 the damper motor being connected on the hot side of the source of electric current, the stator and rotor coils 30 and 32 connected in series are energized causing the armature 31 to rotate about 45° and thus open the damper 19 in the stack 13. This circuit is completed through stator coil 30, rotor coil 32, terminal 43, mercury and terminal 44 and thence to the ground. Simultaneous with the rotation of the rotor and the resultant positive opening of the damper 19, the contactor tube 41 is tilted so that the mercury flows to the opposite end of the tube, thereby breaking the ground contact and making contact between terminals 43 and 42 and thus the current flows to the fuel motor 11 and energizes and starts the same. It will be observed that this arrangement provides that the damper shall be positively turned to open position before the current can be supplied to start the fuel motor. Assuming that the motor starts and combustion takes place in the normal manner, the damper is held open, against the gravity action of weight 22, by the constant energization of the stator and the armature parts of the motor 21. If for any reason the source of electric current to the motor 11 is cut off, by any of the associated auxiliary safety devices, the damper motor 21 is deenergized and the damper is closed by gravity and remains closed so long as there is no current flowing to the motor 21. This is a very desirable feature since it permits the damper to close whenever there is any improper or dangerous operation of the fuel feeding or combustion apparatus.

Another feature obtained by employing a combined gravity and motor operated damper constructed and arranged in the above manner, is, that it positively prevents the fuel motor 11 from being started when the damper is in closed position. This is accomplished by mounting the contactor switch tube 41 on the damper and motor so that these parts shall move with corresponding simultaneous angular movements and thereby insure a predetermined sequence of operations of the several parts.

If, for any reason, it is desired to cut out the action of the automatic damper from the system, a switch blade 54 is mounted on the disk 47 so as to engage a stationary contact 55 and thus short circuit the damper operating motor. This switch will be arranged to connect the supply line shown leading to the coil 30 in Fig. 10 directly to the motor M. This arrangement provides that the switch can only be closed when the damper vane is in a closed position, thus providing an additional safety feature.

Having thus described the preferred embodiment of our invention, it is obvious that various changes may be made therein without departing from the scope of the invention as set forth in the claims.

What we claim is:

1. The combination with a furnace including a combustion chamber, an air supply passage, and fuel feeding and ignition devices associated therewith, of automatically controlled means for interrupting the supply of air after the ignition of fuel ceases and means for permitting the air to again flow just before the fuel is again admitted to the combustion chamber and ignited, said means comprising a damper, a motor to control the damper, electrical connections and a switch for the motor movable with the damper, so arranged as to keep the motor energized and the damper held open when the air is flowing through the furnace.

2. The combination with a furnace including a combustion chamber, an air supply passage, and fuel feeding and ignition devices associated therewith, of a damper mechanism for interrupting the air supply and means for closing the damper after ignition of fuel ceases, together with a motor and parts to control the damper, a switch operable with the damper, and electrical connections so arranged as to energize the motor and hold the damper open when air and fuel enter said furnace.

3. The combination with a furnace including a combustion chamber, an air supply passage, and fuel feeding and ignition devices associated therewith, of a damper mechanism for interrupting the air supply, means for closing the damper after ignition of fuel ceases, and means for opening the damper just before the fuel is again admitted to the combustion chamber and ignited, said last-named means including a motor and parts to control the damper, a switch operable with the damper and connections so arranged as to keep the motor energized and the damper open when air and fuel are supplied to the furnace.

4. The combination with a furnace including a fuel feeding motor and an air supply passage, of a damper mechanism for interrupting the supply of air to the combustion chamber of said furnace, and means connected to the fuel feeding motor and the damper for positively opening said damper before the motor is started, said means comprising a motor device and parts to control said damper, a switch for same operable with the damper, and electrical connections so arranged as to put said motor and said device in series, and thereby cause the damper to be held open when the fuel feeding motor is operating.

5. The combination with a furnace including a

fuel feeding motor and an air supply passage, of a damper mechanism for interrupting the supply of air to the combustion chamber of said furnace, and a switch device movable with said damper and connected to the fuel feeding motor for causing the operation of said motor only when the damper is in open position, together with a motor device and parts associated with same to actuate the damper controlled by the switch, and connections associated with the said switch, all arranged to energize said device and keep the damper open when the fuel-feeding motor is working.

6. The combination with a furnace having an air supply passage for the combustion chamber thereof, of a fuel feeding device, a damper in said air passage, electric motors to cause operation of said device and said damper, and circuit connections between said motors including a switch movable with said damper for energizing the fuel feeding motor only after the damper is moved to its open position, said connections being arranged to supply energy to the motor for the damper, and parts to keep the damper open while the first motor is operating.

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