

Jan. 12, 1937.

J. GOOD

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BURNER CONTROL

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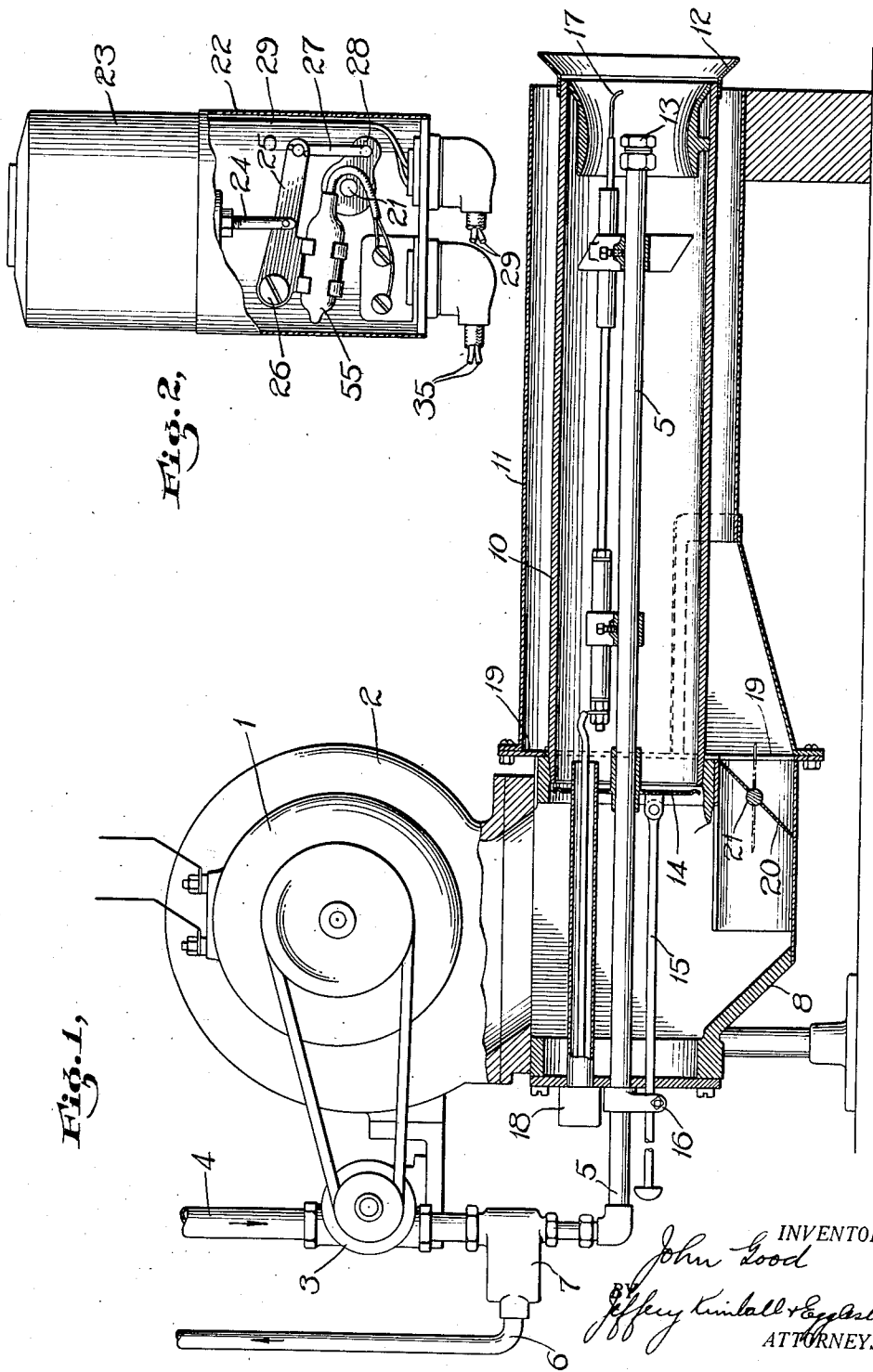


Fig. 1,

Fig. 2,

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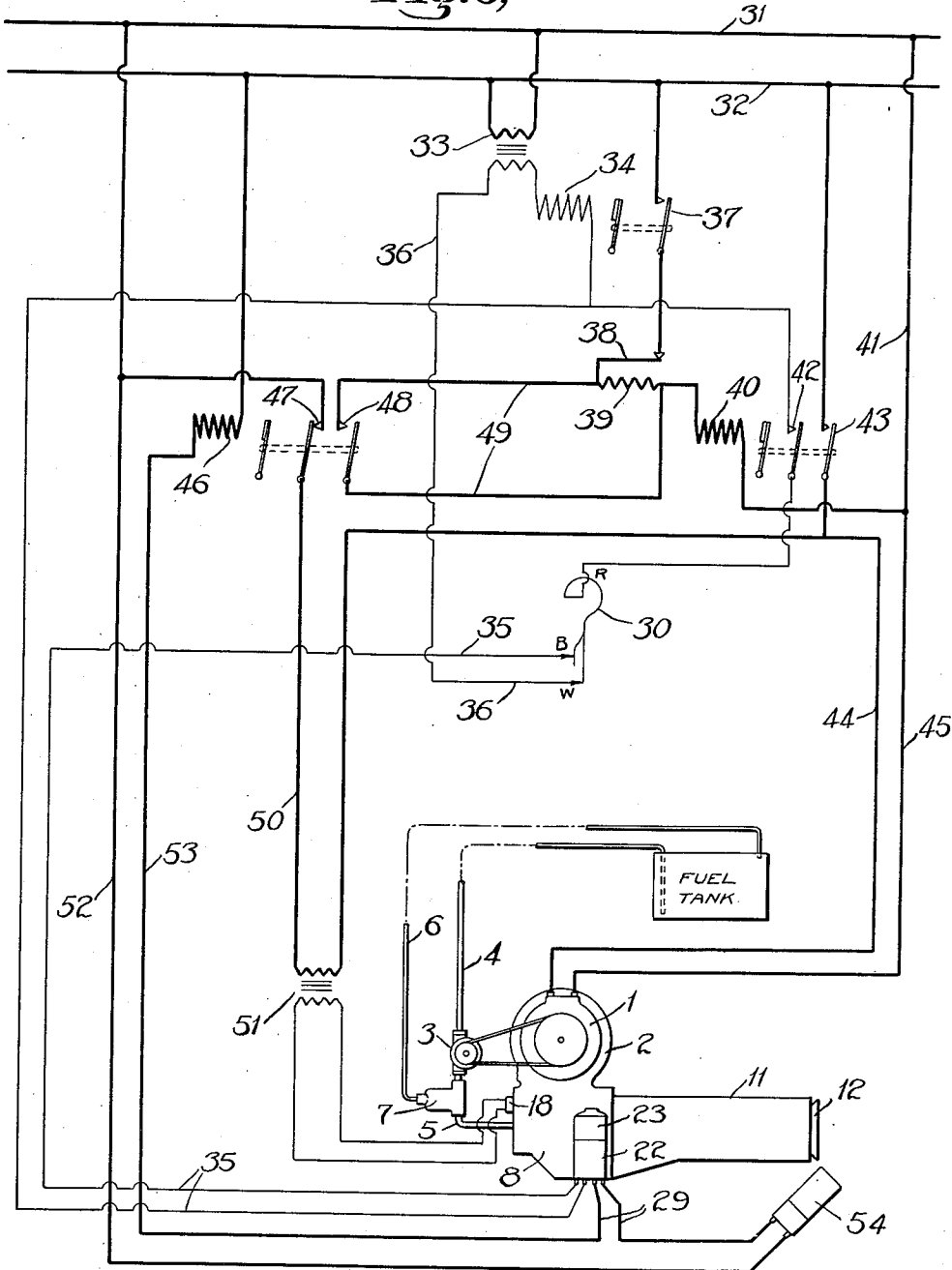
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Fig. 3,



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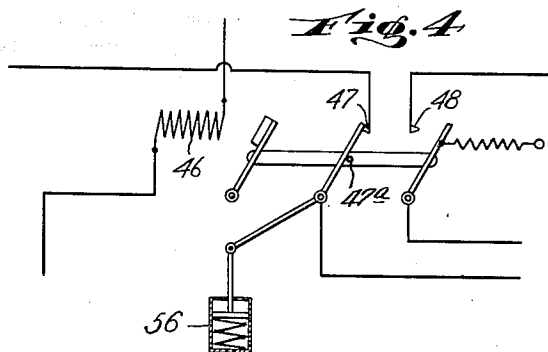
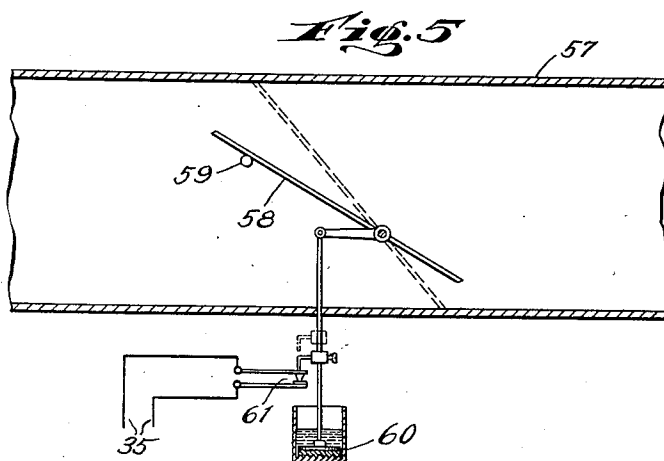
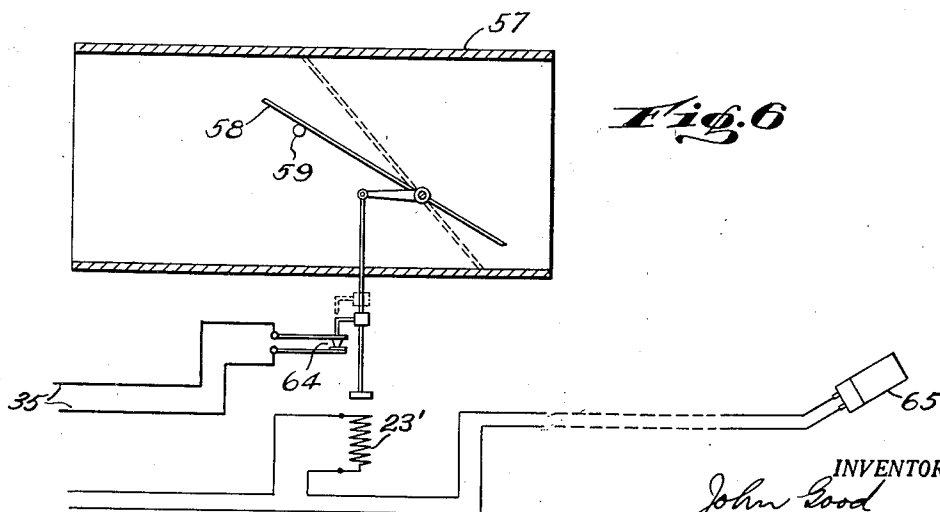
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BURNER CONTROL

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3 Sheets-Sheet 3



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BURNER CONTROL

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Application February 20, 1933, Serial No. 657,496

5 Claims. (Cl. 158—28)

The invention relates to burners and has for its object the provision of a burner suited to domestic heating, using oil as fuel, although not limited thereto, and characterized by its simplicity and its safety under all conditions of operation. More particularly the invention contemplates the automatic control of the air supply whereby the fuel and air mixture will be appropriate to combustion requirements during normal burning but will be rendered unduly lean, and hence non-explosive, whenever a dangerous condition would otherwise be present.

The invention consists in the means for accomplishing this purpose and in the general assembly and organization of parts all as herein described, and its principles are exemplified in the accompanying drawings, in which

Fig. 1 is a part sectional view of an oil burner embodying those principles,

Fig. 2 a large scale elevation of part of the controlling mechanism,

Fig. 3 a smaller scale elevation of the burner and an appropriate controlling system,

Fig. 4 a detail of an addition to the control system of Fig. 3, and

Figs. 5 and 6 diagrammatic views of two modified forms of the invention.

In accordance with the well understood operation of burners of the type to which the invention is herein applied, an electric motor 1 operates a blower 2, for supplying combustion air and also drives an oil pump 3 having its intake and discharge connected by pipes 4 and 5, respectively, with a source of supply, such as the fuel tank shown in Fig. 3, and with the burner. A return pipe 6 serves to maintain a constant oil delivery pressure under the control of a spring loaded relief valve 7 in the usual manner. These parts form no part of the invention and accordingly may be substituted by any other suitable means or organization designed to supply the air and oil requirements of the burner.

The blower is mounted upon and has its discharge open to the interior of a casing 8 which serves as a distributing chamber, which is connected with the combustion space by a suitable air passage or passages herein conveniently constituted by the coaxial pipes 10 and 11. The inner pipe 10 is shown as provided with a flared outlet 12 extending somewhat beyond the end of the outer pipe whereby the discharge from the outer pipe is directed away from that of the inner one so that they mingle only as they progress into the combustion space and not immediately at the pipe outlets.

The oil line 5 passes through the distributing chamber and is arranged centrally of the inner pipe 10, terminating adjacent the end of the latter in a nozzle 13 which in this type of burner serves to spray the oil. Slidably mounted on the oil pipe is a baffle 14, which can be moved forward or backward to decrease or increase the air flow from the distributing chamber to the inner pipe. This is accomplished by a control rod 15 which extends through to the outside of the rear wall of casing 8 where a clamp 16 serves to hold the rod and baffle in any desired position of adjustment. This adjustment is determined so that the air delivered by way of pipe 10 satisfies the normal combustion requirements of the oil discharged by nozzle 13. The fuel is ignited by any suitable means, such as the spark igniter of which one electrode is shown at 17, and which is located in the path of the oil spray, the high tension leads being supported on the oil pipe 5 and passing out through casing 8 to the box 18. Although not shown it will be understood that the other electrode is complementary to the one illustrated. It will be apparent that the pipe 10 encloses a complete burner unit, including air and oil supply means and an igniter, which may be arranged or organized in any desired manner. The air and oil thus delivered to the combustion space are, as usual, in explosive proportions, which is a condition incident to clean and efficient burning, and accordingly the mixture is a source of danger under such conditions as the failure of the ignition means, or the inadvertent extinguishment of the flame while the igniter is not active. In this event the combustion space rapidly fills with air and oil in explosive proportions and if the igniter subsequently becomes active, or if the walls of the combustion chamber are sufficiently hot, an explosion results. The invention avoids this danger in the following manner:

A plate 19 closes the inner end of pipe 11 except at the lower part of casing 8 where the latter opens into the pipe. This opening is of large size and accordingly capable of passing a considerable volume of air. It is controlled by a damper 20, the shaft 21 of which extends out through the wall of casing 8.

When the damper is closed oil is fed through pipe 5 to be sprayed at nozzle 13, the combustion air passes around the edge of baffle 14 and through pipe 10, this being the normal combustion condition, but when the damper is open additional air flows from the distributing chamber to the combustion space by way of pipe 11 and the capacity of the blower and the size of pipe 11

are so designed and related that the volume of air thus passed to the combustion space dilutes the fuel and air mixture sufficiently to render it non-explosive. If the burner is already operating when the damper is opened the only effect of the additional air is to lower the temperature of the combustion space. If on the other hand the mixture flowing from the inner tube is not burning, the additional air mingles with it and renders it sufficiently lean as to be non-explosive so that there is no danger even though the fire box walls are at a fuel igniting temperature as a result of prior combustion. Similarly, there can be no explosion as a result of delayed igniter operation, provided the damper is open, since ignition can only occur at or in the neighborhood of the end of pipe 10 and then only to start the normal burner flame as the flowing mixture emerges from the inner pipe, the mixture accumulated beyond this region and throughout the fire box and in the flues being non-explosive, as above explained. The coaxial arrangement of the air supply pipes is not essential but provides a compact construction and a simple arrangement which readily lends itself to the use of a single air source, such as the blower, for supplying both the combustion and the additional air, which is preferred.

The invention also contemplates automatic means for operating the damper so as to ensure an adjustment appropriate to existing conditions, a simple mechanism for moving the damper being illustrated in Fig. 2.

The damper shaft 21 extends into a control box 22 which is secured to the outside of casing 8, and on top of the box is mounted a solenoid 23 which has an armature extension 24 connected with an arm 25 pivoted at 26 to the wall of the box. Arm 25 is connected by link 27 with a crank arm 28 which is secured to the damper shaft 21. The leads to the solenoid are designated 29.

When the parts are in the position shown in Fig. 2 the solenoid is de-energized and the damper is open, so that whenever the solenoid circuit is opened, either intentionally or by the failure of the current, the burner is in a condition of safety. When the solenoid circuit is closed, the armature lifts, raises arm 25 and the latter turns crank arm 26 to close the damper.

The solenoid can be controlled in a variety of ways but is preferably arranged to operate coincidentally with some suitable control which responds to the initiation and cessation of combustion operation, controls of this nature, electrical and mechanical, being in common use for opening and closing igniter circuits, operating oil valves and for other purposes. A preferred application of the invention is illustrated by means of the control system shown in Fig. 3 which embodies such a control and which will now be briefly described.

The primary control is in room thermostat 30, the letters R, B and W indicating the so-called red, white and blue lines. For the sake of clearness the mains 31, 32 and all high voltage circuits are indicated by heavy lines.

A transformer 33 supplies energy to a low voltage pilot relay 34 the circuit of which is directly controlled, when the apparatus is at rest, by the blue line 35, white line 36 and room thermostat 30. The pilot relay operates a switch 37 in a high voltage circuit through thermostatic timing element 38, element heater 39, main relay 40 and line 41 back to main 31. Relay 40 operates a

switch 42 in the red line and a switch 43 which controls the circuit 44, 45 of burner motor 1.

A second main relay 46 controls switches 47 and 48, the former being closed when the apparatus is at rest and hence opened by the relay. Switch 47 represents the ignition control and according to the system here contemplated controls the primary circuit 50 of spark coil 51. Switch 48 controls a shunt circuit 49 around heater 39.

The circuit 52, 53 of relay 46 is controlled in this case by a so-called protectostat 54 which is a thermostatic switch device operated by radiant heat. It is so located as to be operated by the burner flame and to move its switch element to closed position under the influence of heat.

Solenoid 23 which operates damper 20, is arranged in series with the protectostat and its leads 29 are shown so connected.

Referring to Fig. 2 it will be seen that arm 25 carries a mercury switch 55. It is so arranged that when the arm is lifted, which corresponds to the closed position of the damper, the switch is opened. The switch is connected in the blue line circuit 35, as appears from Fig. 3.

When the room thermostat moves to the position shown, which represents a surrounding temperature condition lower than that desired, pilot relay 34 is energized through the blue and white lines 35 and 36, mercury switch 55 being closed and the damper in its open position. This relay closes switch 37 to complete the circuit of relay 40 which also includes element 38 and heater 39. These operate in the usual manner to cause this circuit to be opened if the burner fails to function after a predetermined safety period has elapsed, the time switch 38—39 preferably being of the type requiring to be re-set after operating to shut down the system.

Relay 40 closes red line switch 42 and a switch 43, the latter causing the motor to start and rendering active the igniter.

Were it not for the present invention, the safety of the burner at this juncture would depend solely on prompt ignition, since the blower and oil pump, or whatever supply means are used deliver an explosive mixture, as above pointed out and any appreciable delay in the activity of the igniter is liable to result in a serious explosion. As it is however, the damper is open and an additional quantity of air is delivered to the combustion space by way of pipe 11 in the manner above described. If the igniter fails to operate for any reason this non-explosive mixture continues to pass through the combustion space until element 38 flexes under the influence of heater 39, to break the circuit of relay 40 and so bring the apparatus to rest.

If the igniter functions as intended protectostat 54 responds to the radiant heat of the igniter mixture whereupon its switch element closes the circuit of solenoid 23 and relay 46. The energization of the solenoid results in the closure of the damper, as above explained, and since relay 46 operates simultaneously to open switch 47 and so render the igniter inactive, the normal operating condition of the burner is achieved. Switch 48 is also closed by relay 46 to shunt heater 39.

When the solenoid operates to close the damper, it also serves to open mercury switch 55 thereby breaking the blue line and rendering the circuit of pilot relay 34 subject to direct control by red line switch 42, which of course is held closed by relay 40. This latter arrangement in one form or another, is customary in control systems of this type and serves to guard against accident as a

result of tampering with the room thermostat. As will be apparent, as soon as the white line contacts are separated, the pilot relay circuit is broken, relay 40 de-energized and red line switch 42 opened, so that even though the white line circuit is broken momentarily a complete re-cycle with its attendant safeguards is necessary before the burner will re-start. The safety condition produced by the additional air supply and its associated controlling mechanism will be present whenever the burner ceases to operate on its normal combustion cycle. For example, when the burner flame is extinguished, either by stoppage of the motor or otherwise, the protectostat switch breaks the circuit of solenoid 23, permitting its armature to drop and the damper to open. In the system illustrated relay 46 coincidentally releases switches 47 and 48 which return to their initial positions respectively to render active the igniter and the time element device 38-39. This will be recognized as the normal and safe condition which the burner assumes at each starting. Accordingly the circuit connection 35 to the thermostat, above referred to as the blue line, would remain broken and since the blue line is a part of the starting circuit through which pilot relay 34 is energized (as heretofore described) the burner could not automatically re-cycle. In other words the burner cannot start up as long as the damper is in its flow-restricting position. This feature will be recognized as a further step in the direction of safety.

In the particular type of control system illustrated in Fig. 3 the protectostat does not directly control the motor circuit and since the burner mechanism continues in operation after the flame has been extinguished and until brought to rest by the timing element 39, it is desirable to delay the closure of ignition switch 47 until the extra air admitted upon the opening of the damper has had an opportunity to dilute the mixture in the combustion space to a safe condition. Accordingly, with such a system, it is preferred to interpose a delay, which need not be more than a few seconds, between the opening of the damper and the closure of the ignition switch, which may be accomplished, for example, by a dash-pot arrangement such as is diagrammatically illustrated in Fig. 4. As in Fig. 3, when main relay 46 is de-energized the damper is opened and switches 47 and 48 tend respectively to close and open. The latter acts promptly, to cut in the heater 39, whereas the ignition switch, delayed by dash-pot 56, does not close until some five seconds later, during which interval the extra air passed by the damper will render safe the mixture in the combustion space and in such condition that it cannot explode upon the coming on of the ignition. When, on the other hand, main relay 46 is energized, pin 47^a insures that switches 47 and 48 are operated simultaneously.

Subject only to the limitations of the following claims the principles above exemplified can be variously applied to existing installations or otherwise and the burner elements and their controls organized and arranged to suit the conditions in mind.

In the modified forms of the invention diagrammatically illustrated in Figs. 5 and 6, 57 indicates any appropriate air conduit leading to the combustion space and subject to control by a damper 58 which in one position (that shown in dotted lines) restricts the air flow, so that the combustion space mixture conforms to normal combustion requirements (air and oil being furnished for

that purpose by such means as above described or otherwise) and in its other (full line) position, passes the excess air necessary to render the combustion space mixture non-explosive. As indicated, the damper is unbalanced and is adapted to be moved from its open position, established by a stop 59, to its closed position by the air flow through the conduit, being restrained however and permitted to close only when the conditions favorable to an explosion no longer obtain.

In Fig. 5 the damper is coupled to a suitable mechanical timing device 60 which may be of any preferred construction capable of holding the damper in its open position for a predetermined interval, which is selected with reference to the setting of the customary safety trip, corresponding to element 38 and its heater 39 in Fig. 3. For example, if the safety trip is adjusted to bring the burner to rest after an interval of 90 seconds if ignition does not occur, the timer 60 will be set to release the damper after a somewhat longer interval, say 110 or 120 seconds. In the normal cycle and assuming ignition occurs the damper will thus be closed after the expiration of the said 110 or 120 seconds but if, on the other hand, the fuel fails to ignite for any reason the safety trip will act to stop the burner after 90 seconds and the damper will thus remain in its open or safe position, ready for the next cycle. As will be apparent, this type of air control is adapted for use with any of the well known or suitable burner system embodying a protectostat or equivalent device acting promptly to stop the burner in response to combustion failure. Switch 61 corresponds in function to switch 55 above described, being coupled to the damper control so as to open when the damper closes and vice versa, thereby rendering it impossible for the burner to re-cycle until the damper has opened.

In Fig. 6 the damper is held open by a solenoid 23' which is so controlled as to be energized during the ignition period and to be de-energized in response to combustion of the fuel. For the purpose of illustration the solenoid circuit is shown directly controlled by a heat sensitive device 65, which, as will be understood, includes a normally-closed switch adapted to be opened by the heat of the burner flame, whereupon the solenoid is de-energized and the damper is released and moved to its closed position by the force of the air blown or sucked through conduit 57. As with the forms of the invention already described, switch 64 constitutes a starting control for the burner and must be closed (and hence the damper open) before the burner can start up.

I claim:

1. In a burner, the combination of two air conduits and means for feeding air therethrough, means for feeding fuel to initially mix with the air delivered through one of said conduits, said one conduit furnishing a supply of air appropriate for normal combustion requirements and the other conduit together with said one conduit furnishing sufficient air to render the combustion space mixture non-explosive, ignition means positioned to ignite the initial mixture, a damper controlling the flow of air through said other conduit, and means rendered operative in response to the establishment of combustion to close said damper.

2. In a burner, the combination of two air conduits and means for feeding air therethrough, means for feeding fuel to initially mix with the air delivered through one of said conduits, said

one conduit furnishing a supply of air appropriate for normal combustion requirements and the other conduit together with said one conduit furnishing sufficient air to render the combustion space mixture non-explosive, ignition means positioned to ignite the initial mixture, a damper controlling the flow of air through said other conduit, and means rendered operative in response to the establishment of combustion to close said damper and in response to the cessation of combustion to open said damper, a control circuit for said ignition means, and means controlling a switch in said ignition circuit adapted to open the same to render the ignition means inactive during normal running of the burner and to close the switch in response to cessation of burner activity, including means for delaying the closure of said switch until after the said opening of the damper.

3. In a burner, the combination of air conduit means and a fan for feeding air therethrough, means for feeding fuel at a constant rate to mix with said air in the burner combustion space, a damper controlling the volume of air delivered through said conduit means to the combustion space, said damper having an open position of adjustment in which it permits the flow of excess fan air to the combustion space sufficient to render the mixture therein non-explosive, and a closed position of adjustment in which it reduces the air flow to the normal combustion requirements of said fuel, ignition means positioned to ignite said fuel prior to its dilution by said excess air, and means rendered operative subsequent to the establishment of combustion to cause said damper to move from its open to its closed position.

4. In a burner, the combination of means for feeding fuel at a substantially constant rate, means for feeding air sufficiently in excess of the combustion requirements to render the combustion space mixture non-explosive, means for igniting the fuel, a safety control device adapted to trip the burner after a pre-determined interval, combustion responsive means for rendering said device ineffective, and means operable after a predetermined interval following the starting up of the burner to reduce the air supply to normal combustion requirements, said second interval being longer than that for which said safety control device is set.

5. In a burner, the combination of means for feeding fuel at a substantially constant rate, means for feeding air sufficiently in excess of the combustion requirements to render the combustion space mixture non-explosive, means, including an igniter, for effecting ignition of said fuel prior to its dilution to non-explosive condition by said excess of air, damper means controlling the air delivered to the burner, said damper means adapted to be moved by the air to a restricting position such that the air supply conforms to normal combustion requirements of the fuel and means for delaying said movement of the damper means until after the establishment of combustion.

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