

May 15, 1945.

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2,376,170

HEATING APPARATUS

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2 Sheets-Sheet 1

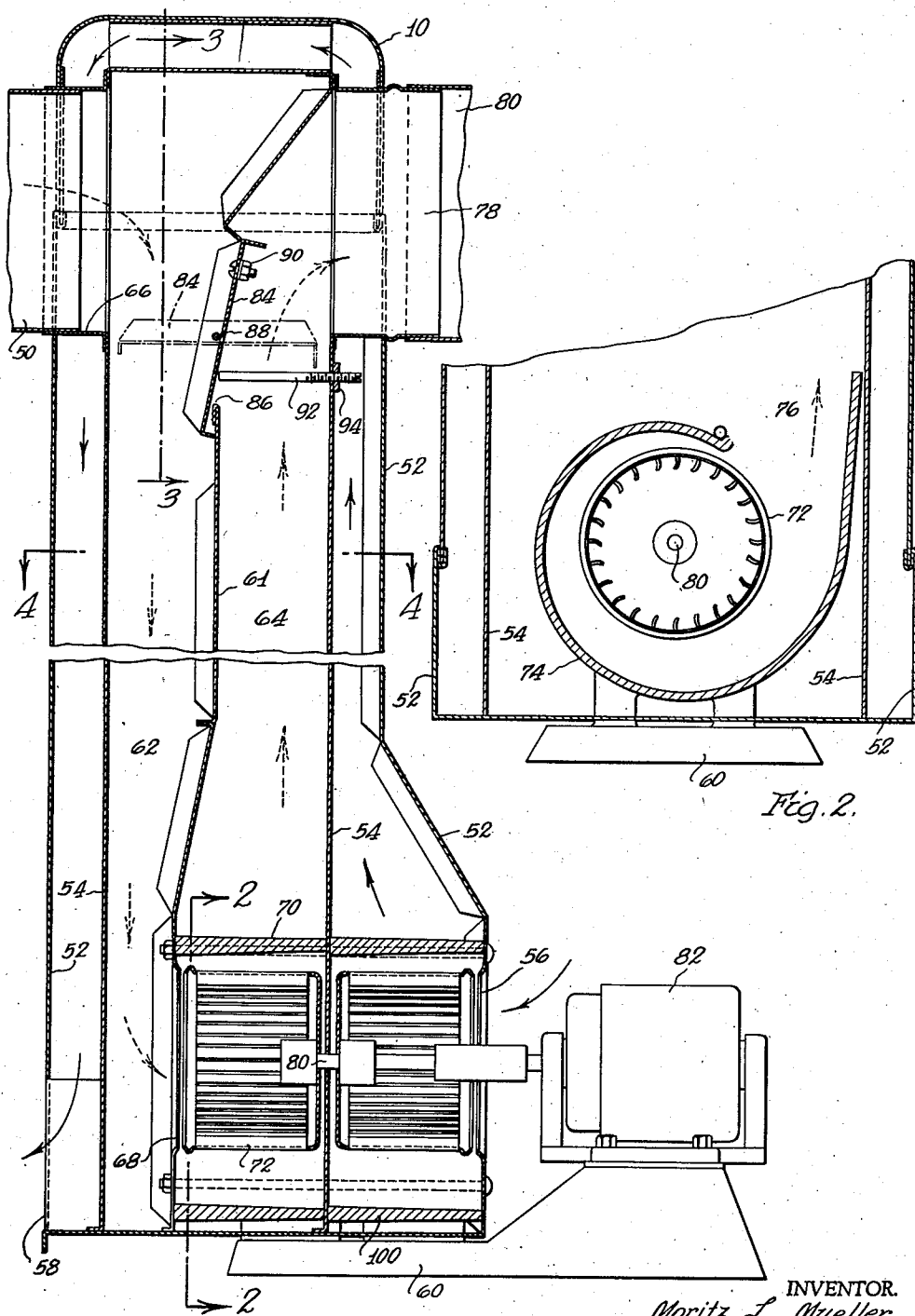


Fig. 1.

Fig. 2.

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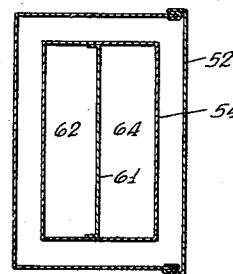
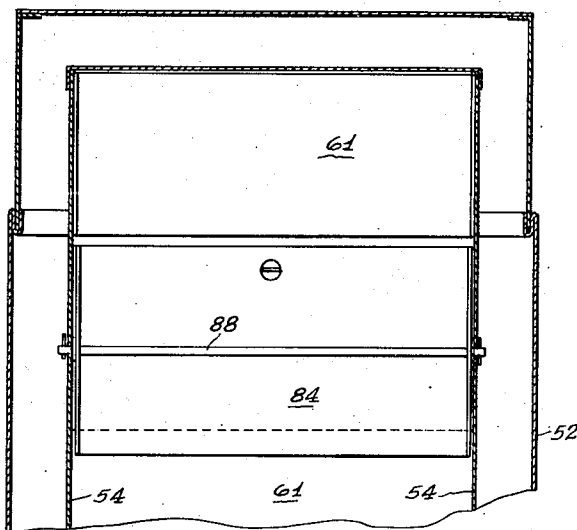
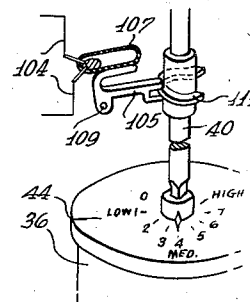
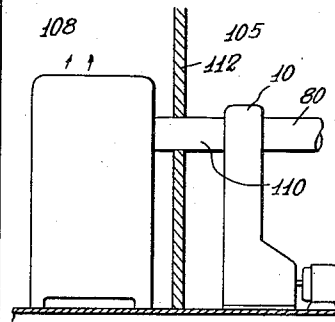
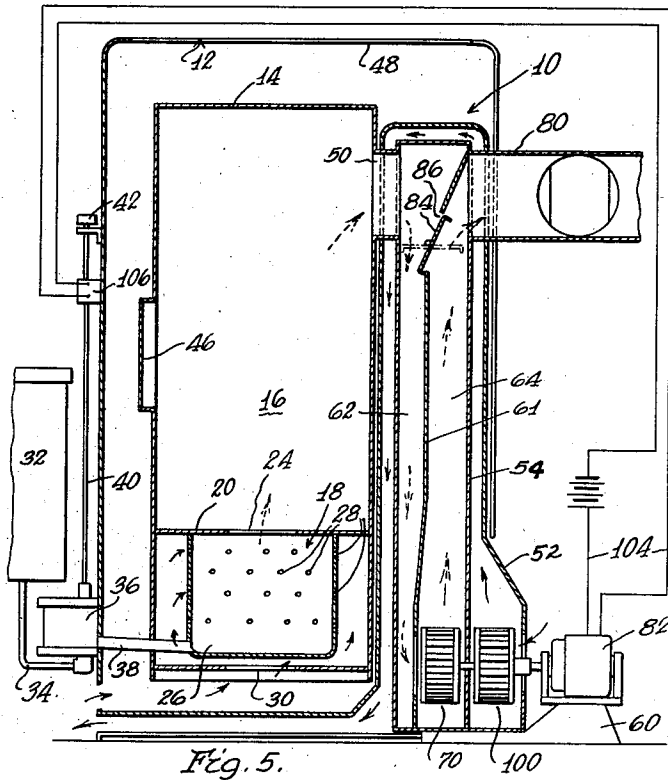
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2 Sheets-Sheet 2



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HEATING APPARATUS

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Application January 15, 1941, Serial No. 374,522

25 Claims. (Cl. 126—110)

This invention in general relates to heating apparatus and has particular reference to a novel and improved apparatus for efficiently burning fuel and recovering heat from the flue gases.

As illustrated in the embodiment of the invention selected for purposes of illustration, one form of device embodying my invention is particularly adapted, although not limited, for use in combination with a space heater having an atmospheric or heat vaporizing oil burner, manually regulatable means for supplying oil thereto, a fixed air intake and an outlet for the flue gases or products of combustion, and comprises in general a radiator, economizer or heat exchange device having a passageway for flue gases therethrough, one end of said passageway being connected to the flue gas outlet from said space heater and the other end of said passageway being connected to a conduit leading to a vent, stack or chimney, a damper controlled by-pass between said outlet and said conduit and adapted when open for shunting said radiator out of the path of travel of said flue gases and so as to permit natural draft of the gases of combustion through said space heater, outlet therefrom and conduit to said vent, forced draft effecting means in said passageway operable for closing said by-pass and for effecting a forced draft through the space heater, burner, burner outlet and the radiator of the flue gases to the vent, means associated with the manually regulatable oil supplying means for rendering said forced draft effecting means operative and inoperative and means associated with said forced draft effecting means and operative therewith for circulating a medium to be heated in heat exchange relationship with said radiator.

Principal objects of the invention are:

To provide in combination with a heating element, an economizer which can be rendered operative and inoperative in accordance with variations in the heat output of and/or the fuel input to said heating element;

To provide in combination with a forced draft effecting means for a combustion burner, a means to provide natural draft operation of the burner when the forced draft effecting means are inoperative;

To provide an accessory device in the nature of an economizer and forced draft creating and air circulating means for use in connection with space heaters and other forms of heating appliances now already in use for materially increasing the utility and efficiency thereof;

To provide a novel and improved form of heating apparatus for efficiently burning fuel and recovering heat from the flue gases therefrom;

To provide a so-called "space heater" construction which is more efficient and dependable in operation and more useful than heaters of this kind which are now available;

To provide in combination with an atmospheric oil burner, a means for aiding combustion and recovering a higher percentage of the heat from the combustion gases therefrom;

To provide a heating device having a combustion burner with a plurality of heat exchange elements through which the flue gases of combustion circulate, with means for rendering one of said elements operative and inoperative by bypassing the flue gases therearound and in accordance with the heat output of the burner.

Other objects and advantages of the invention will be apparent from a consideration of the following specification taken in conjunction with the accompanying drawings, of which there are two sheets, and wherein:

Fig. 1 is a vertical sectional view through an economizer unit embodying a part of my invention;

Fig. 2 is a section taken along the line 2—2 of Fig. 1, looking in the direction of the arrows and showing the construction of the flue gas blower;

Fig. 3 is a section taken in the plane along line 3—3 of Fig. 1, looking in the direction of the arrows and showing further details of construction of the damper controlled by-pass;

Fig. 4 is a horizontal section taken along the line 4—4 of Fig. 1;

Fig. 5 is a somewhat diagrammatic view illustrating, partly in section, the combination of an economizer embodying my invention with a space heater having an atmospheric or heat vaporizing type oil burner;

Fig. 6 is a view illustrating diagrammatically another type of arrangement of an economizer embodying my invention in combination with a space heater; and

Fig. 7 is an enlarged view illustrating one form of means which might be employed for controlling the motor circuit.

Referring now to Fig. 5, there is illustrated an economizer unit indicated generally at 10 embodying my invention in combination with a space heater indicated generally at 12. As illustrated, the space heater comprises a heater body 14 forming a heat exchange element or drum and providing therein a combustion chamber 16 for an atmospheric or heat vaporizing type oil burn-

er indicated generally at 18. The burner 18 comprises a baffle 20 arranged transversely of the drum 14 and provided with a central opening 24. A pot 26 having a series of air intake openings 28 provided in the walls thereof is arranged below the baffle 20 and communicates with combustion chamber 16 through the opening 24 therein. Air to support combustion in the pot 26 at low fire and in the pot 26 and combustion chamber 16 at high fire is admitted into the drum 14 through a fixed opening 30 therein. Oil is supplied to the bottom of the pot 26 from a fuel supplying and regulating means which comprises an oil reservoir 32, a conduit 34 leading from the reservoir to a regulatable flow controlling device 36 and a conduit 38 communicating at one end thereof with the device 36 and at the other end thereof with the bottom of the burner pot 26 supplies regulated quantities of oil to the burner.

The device 36 includes a manual control comprising a rod 40, a dial 42 and an indicator 44 (Fig. 7) by means of which the device 36 may be set to supply oil in desired quantities to the burner 18 so as to obtain either low, intermediate, or high fire within the combustion chamber 16.

The oil in the bottom of the pot 26 may be ignited by manually applying a light or flame thereto through the door 46. The heater body 14 may be arranged within a casing 48, and air to be heated will circulate by gravity over the outside surface of the heater body 14 and absorb heat from the body 14 which in turn is heated by the gases of combustion or flue gases in the combustion chamber 16.

The casing 48 may be open at the top, sides, and bottom so as to expedite the circulation of air in heat exchange relationship therewith. The heater body 14 is provided with a flue gas outlet 50 which is connected with the economizer 10 in such a way as to supply flue gases to the intake side thereof. While the construction of the economizer and the arrangement thereof in relationship to the body 14 of the space heater is illustrated in Fig. 5, reference may now be had to Fig. 1 for a more complete illustration of the construction of the economizer 10 which, as illustrated, consists of an outer casing 52 having an inner casing 54 arranged therein and in spaced relationship with respect to the outer casing 52. The outer casing 52 as illustrated is rectangular in cross-section and is provided with an air intake 56 at the bottom on one side thereof and with a hot air discharge 58 at the bottom on the opposite side thereof. The outer casing 52 may be mounted upon a base 60 in such a manner as to permit vertical adjustment of the casing 52 with respect to the base 60.

The inner casing 54 which comprises a radiator or heat exchange element may be of rectangular shape, as illustrated in Fig. 4, and is supported within the casing 52 in such a manner as to permit circulation of air within the casing 52 over substantially all of the outside surface of the casing 54 as is explained more fully hereafter. The inside of the casing or radiator 54 is divided by a vertically arranged partition 61 extending transversely of the casing 54 so as to provide a duct or passageway 62 thereof on one side and another duct or passageway 64 on the other.

The passageway 62 at its upper end is adapted to be connected by a sleeve 66 to the outlet 50 of the combustion chamber 16, and the lower end of the passageway 62 terminates in a flue gas intake opening 68 to a flue gas blower indicated at

70. The flue gas blower may, as illustrated (Fig. 2), be of the blower wheel type of pressure fan and comprises a blower wheel 72 arranged for rotation within a scroll 74 and adapted upon rotation to draw flue gases through the intake 68 and to discharge the same upwardly through the discharge 76 from the scroll. The flue gas blower is arranged in the lower end of the passageway 64 and is adapted to force flue gases upwardly through the passageway 64. The upper end of the passageway 64 is connected by a sleeve 78 to a conduit means 80 which leads to a chimney or vent for the flue gases, the same being forced through the chimney or vent by the blower 70.

To facilitate following the path of travel of the flue gases through the economizer, such path has been indicated by dotted arrows while the path of the air to be heated and which circulates over the outside of the radiator 54 has been indicated by full line arrows.

The blower wheel 72 is mounted on a shaft 80 so as to be driven thereby and this shaft may form a continuation of the main shaft of an electric motor 82 mounted upon the base 60. It will be observed that the flue gases are drawn downwardly through the passageway 62 from the intake 66 of the economizer and are then forced upwardly through the passageway 64 to the discharge side 78 of the economizer and that the radiator 54 is arranged below the level of the outlet 50 from the heater body.

The partition 61 which divides the intake passageway 62 of the economizer from the discharge passageway 64 thereof includes a movable damper 84 which, when the blower is operating, is arranged as illustrated in full lines in Fig. 1 to close a by-pass or opening 86 between the intake 66 of the economizer and the discharge 78 thereof. The damper 84 (Fig. 3) comprises a plate pivotally mounted upon a rod 88 supported in the side walls of the casing 54 and the damper 84 is weighted as at 90 so that when the blower 70 is not operating the damper 84 will assume the position shown in dotted lines in Fig. 1. In this position it will be observed that the intake to the passageway 62 and the discharge from the passageway 64 are closed and that the opening 86 provides a by-pass directly between the outlet 50 of the heater body and the conduit 80 leading to the vent or stack. When the blower 70 begins to operate the suction effect on that portion of the damper 84 exposed to the intake passageway 62 and the pressure effect of the flue gases discharged by the blower 70 on that portion of the damper 84 exposed to the discharge passageway 64 will move the damper 84 from the position shown in dotted lines to the full line position shown in Fig. 1 and will hold the damper in such position as long as the blower 70 is operating.

A screw 92 threadedly supported in a nut 94 carried by the wall of casing 54 is adapted to be advanced or retracted and is engageable with the damper 84 for limiting its counterclockwise movement so as to bleed flue gases, if desired, from the discharge passageway 64 to the intake passageway 62 for the purpose of controlling or setting the maximum forced draft provided by the blower 70.

An air circulating means comprising a blower 100 similar in construction and operation to the blower 70 and also mounted upon the shaft 80 and arranged to be driven thereby is arranged in the lower part of the casing 52 and externally of the casing 54. The blower 100 is arranged to draw air through the air intake 56 and to dis-

charge such air upwardly on the air intake 56 side into the space between the casings 52 and 54 and downwardly on the discharge 58 side thereof and to discharge a stream of heated air laterally through the air discharge 53 of the economizer as illustrated in Figs. 1 and 5. The air discharged from the economizer may pass along the floor below the heater 14 and outwardly into the room in which the space heater 12 is arranged or be directed in any other direction. The heated air discharged from the economizer preferably is arranged so as not to interfere with the gravity circulation of air over the heater body 14. In passing through the space between the casings 52 and 54 the air passes over the heated outside surfaces of the casing 54 and absorbs heat therefrom, the casing 54 being heated by the flue gases which pass through the passageways 62 and 64 thereof.

As the blowers 70 and 100 are driven by the same shaft, it is evident that when the blower 70 is operating to provide a circulation of flue gases through the radiator 54, that the blower 100 will operate to provide a forced circulation of air over the outside surface of the radiator 54 in heat exchange relationship therewith and conversely, when the blower 70 is stopped, the blower 100 will be stopped as when the blower 70 is stopped the outside surface of the casing 54 will not be heated due to the fact that the flue gases will by-pass the radiator 54 and will pass directly from the outlet 50 of the heater body to the pipe or conduit 80 leading to the stack.

In addition to setting up a circulation of flue gases through the radiator 54 of the economizer the blower 70 also induces a forced draft through the air intake openings of the burner 18 and the combustion chamber 16 and thereby provides a forced draft and an increased air supply for the burner 18 thus insuring an efficient combustion of the oil vapors in the combustion chamber 16.

The motor 82 is adapted to be supplied with electric energy through a circuit 104 which includes a switch indicated generally at 106 in Fig. 5, the construction of which is shown in Fig. 7. The switch 106 is associated with the means 36 for regulating the supply of oil to the pot burner 18 and preferably is arranged so that the switch is open and the circuit 104 is open when a comparatively small amount of oil is supplied to the pot burner 18. Thus at such time that the motor circuit 104 is open the burner 18 is arranged to operate on a natural draft due to the stack or chimney and the products of combustion will pass from the outlet 50 of the combustion chamber 16 through the by-pass 86 directly to the pipe 80 leading to the chimney. As the dial 42 is turned to increase the supply of oil to the pot burner 18 the switch 106 may be arranged so as to be closed thereby energizing the motor circuit 104 and starting the flue gas blower 70 and air circulating blower 100, thereby increasing the air supply to the burner along with the increase in the fuel supply so as to provide a good combustible mixture of fuel vapors and air. The switch 106 may remain closed until the supply of oil to the pot burner 18 is reduced to provide a low fire whereby the air supply to the burner is cut down along with the decreased oil supply.

As shown in Fig. 7, the switch 106 may comprise a tiltable mercury switch 107 having contacts therein connected to the circuit 104 and adapted to be closed by a body of mercury as is well-known in regard to switches of this kind. The mercury switch 107 is supported upon a

bracket 105 pivotally mounted at 109, the end of the bracket comprising a follower shaped so as to engage a cam track 111 arranged on rod 40 so as to rotate therewith. As illustrated in Fig. 7, the oil flow regulating device 36 is set on No. 4 position to supply oil for a medium fire and the mercury switch 107 is tilted so that the mercury therein has closed the circuit 104. Turning the dial 42 from the position illustrated in Fig. 7 so as to increase the oil flow will not open the contacts of the mercury switch 107, but turning of the dial 42 so as to decrease the oil flow from that indicated in Fig. 7 will cause the mercury switch 107 to tilt in a clockwise direction and open the contacts. Thus it will be observed that the motor circuit is closed and opened as the fuel input to the burner is increased and decreased. As the heat output of the burner will vary in accordance with the fuel input, it will be appreciated that the economizer will be rendered operative and inoperative in accordance with the variation in the heat output of the burner.

When the flue gas blower 70 is operating, the forced draft through the air intake to the pot burner and combustion chamber will assure an adequate supply of air to support combustion and the increased heat output of the burner will be absorbed at least in part by the forced circulation of air to be heated over the radiator 54 of the economizer.

In the construction illustrated in Fig. 5 the economizer 10 is illustrated as being built into the space heater 12 and is arranged inside the cabinet 48 thereof, while in Fig. 6 a modified form of arrangement is illustrated in which the economizer 10 may be arranged in a room 108 other than the room 108 in which the space heater 12 without the economizer therein is arranged. The hook-up of the economizer 10 in the modification illustrated in Fig. 6 to the space heater 12 is the same as that illustrated in Fig. 5 except that a length of pipe 110 is arranged between the outlet of the space heater 12 and the intake of the economizer 10 so as to permit their arrangement in separate rooms, the pipe passing through an aperture in a partition 112. In this modification the air circulated over the radiator of the economizer will heat the air in the room 105 while the air passing over the heater or heat exchange element of the space heater 12 will heat the air in the room 108. Other modifications of the arrangement of the economizer 10 with respect to the space heater 12 may be provided, and also other types of combustion burners and heating appliances may be used in connection with the economizer 10.

It will be appreciated that the switch 106 may be set so as to close the motor circuit 104 at any desired setting of the dial 42 so as to cut the economizer in and out of operation at any desired position of setting for the oil flow regulating device 36.

While the invention has been described with some detail, it is to be understood that the description is for the purpose of illustration only and is not definitive of the limits of the inventive idea. The right is reserved to make such changes in the details of construction and arrangement of parts as will fall within the purview of the attached claims.

I claim:

1. In combination with a space heater comprising a heat exchange element having a combustion burner which is constructed and arranged to operate under natural draft for supply-

ing heated flue gases thereto and an outlet for flue gases, air intake means for admitting air to said burner to support combustion, said heat exchange element being exposed to the gravity circulation of a medium to be heated thereover, an economizer comprising a radiator having a passageway for flue gases therethrough, a connection between one end of said passageway and said outlet, a conduit connected to the other end of said passageway and leading to a vent, a damper controlled by-pass between said connection and said conduit and arranged so as to be open to permit natural draft of the flue gases from said combustion burner to said vent, means for effecting a forced draft through said combustion burner, connection, radiator and conduit to said vent and operative for closing said by-pass, and means for circulating a medium to be heated, other than that which is brought into heat exchange relationship with said heat exchange element, over said radiator when said forced draft effecting means are operative.

2. In combination with a heat exchange element having a combustion burner which is constructed and arranged to supply heated flue gases thereto under natural draft conditions for heating the same and an outlet for the flue gases, air intake means for admitting air to said burner to support combustion, a radiator arranged below the level of said outlet and having a passageway for flue gases therethrough, one end of said passageway being connected to said outlet and the other end of said passageway terminating at a level adjacent said outlet and being connected to a conduit leading to a vent, a damper controlled by-pass between said outlet and conduit and adapted to be open so as to permit natural draft operation of said combustion burner and the flow of flue gases through said outlet and by-pass to said vent and power driven means in said passageway for closing said by-pass and effecting a forced draft through said combustion burner, outlet and conduit to said vent, means for supplying fuel to said combustion burner and means associated with said fuel supply means for rendering said power driven means operative and inoperative.

3. In combination with a space heater having a heater body with an oil burning combustion burner constructed and arranged to operate under natural draft therein and an outlet for the flue gases, air intake means for admitting air to said burner to support combustion, an economizer having a passageway for said flue gases therethrough, one end of said passageway being connected to said outlet and the other end of said passageway being connected to a vent, means in said passageway for effecting a forced draft of said flue gases from said combustion burner and through said passageway, a damper controlled by-pass around said forced draft effecting means arranged to be open when said forced draft effecting means are inoperative and to be closed when said draft effecting means are operative, means for regulating the supply of fuel to said combustion burner, means actuated by said regulating means for rendering said forced draft effecting means operative and inoperative, and means for circulating a medium to be heated over said economizer when said forced draft effecting means are operative, said economizer being arranged so as to be exposed to the medium to be heated on the discharge side of said circulating means.

4. In combination with a combustion burner

constructed and arranged to operate under natural draft and having air intake means for admitting air to said burner to support combustion, a pair of heat exchange elements connected in series to said combustion burner so as to receive the heated flue gases therefrom, conduit means for conducting said flue gases from said heat exchange elements to a vent and by-pass means for the flue gases between one of said heat exchange elements and a part of said conduit and arranged to be opened and closed in accordance with variations in draft pressure in said conduit during the operation of said burner, means arranged out of the path of flow of the flue gases during the operation of said burner under natural draft for effecting a forced draft through said combustion burner, heat exchange elements and conduit means when said by-pass is closed, means for circulating a medium to be heated over the one of said heat exchange elements remote from said burner when said forced draft effecting means are operative, said one of said heat exchange elements being arranged in the path of flow of the medium to be heated on the discharge side of said circulating means, and a single motor operatively connected to said forced draft effecting means and said circulating means for simultaneously operating the same.

5. In combination with a space heater having a heater body with an atmospheric type of oil burning combustion burner constructed and arranged to operate on natural draft therein, air intake means for admitting air to said burner to support combustion, and an outlet for flue gases therefrom, an economizer having a passageway for flue gases therethrough, said space heater being arranged to deliver heat recovered from the flue gases independently of said economizer, means for effecting a forced draft of said flue gases from said combustion burner and through said passageway, a damper controlled by-pass around said forced draft effecting means arranged to be open when said forced draft effecting means are inoperative during operation of said burner and to be closed when said forced draft effecting means are operative, said forced draft effecting means comprising a blower, a motor for driving said blower and another blower driven by said motor simultaneously with said first-mentioned blower and operative for circulating a medium to be heated over said economizer, said economizer being arranged in the path of flow of said medium to be heated on the discharge side of said other blower, and means for starting said motor when the fuel supply to said burner is increased.

6. An economizer unit adapted to be operatively arranged between the flue outlet of a combustion burner of a space heater, furnace or the like, which is constructed and arranged to burn fuel under natural draft and an atmospheric vent for the flue gases therefrom, said economizer being arranged out of the path of flow of the air to be heated by said space heater, furnace or the like and comprising a radiator having a passageway for flue gases therethrough, one end of said passageway being adapted for connection to the flue outlet of said combustion burner and the other end of said passageway being connected to said vent, a by-pass short-circuiting a part of said passageway and arranged to be opened and closed in accordance with variations in draft pressure in said part of said passageway, and means operative when said by-pass is closed for effecting a forced circulation of air to be heated in heat exchange relationship with said radiator, said

radiator being arranged in the path of flow of air on the discharge side of said forced air circulating means.

7. An economizer unit adapted to be operatively arranged between a heating element and a vent for the flue gases therefrom comprising a radiator having a passageway for flue gases therethrough, one end of said passageway being adapted for connection to the flue outlet of a combustion burner of said heating element and the other end of said passageway being adapted for connection to a conduit leading to said vent, a by-pass short-circuiting a part of said passageway and arranged to be opened and closed in accordance with variations in draft pressure in said part of said passageway, means for effecting a forced circulation of air to be heated in heat exchange relationship with said radiator when said by-pass is closed, means in said part of said passageway adapted for effecting the forced flow of flue gases therethrough and from said burner to said vent when said by-pass is closed, said by-pass including a pivoted damper having a part thereof on one side of said pivot exposed to the suction effect of said means for effecting the forced flow of flue gases through said passageway and having another part thereof on the other side of said damper exposed to the discharge side of said means for effecting the flow of flue gases through said passageway, and a single motor operatively connected to both of said means for simultaneously operating the same.

8. In combination with a heat exchange element having a combustion burner which is constructed and arranged to operate under natural draft conditions for supplying heated gases of combustion to said element, air intake means for admitting air to said burner to support combustion, said element being arranged to deliver heat recovered from the gases of combustion by the gravity circulation of air thereover, an outlet from said element for the gases of combustion, a conduit for conducting the gases from said outlet of said heat exchange element to an atmospheric vent and including a radiator through which gases of combustion may flow, said radiator being out of the path of gravity flow of air over said heat exchange element, electric power operated means for effecting a forced draft of the gases of combustion through said combustion burner, heat exchange element and outlet therefrom, conduit and radiator, and means operable in response to failure of the electric power for said draft effecting means for shunting said radiator out of said conduit, without stopping the flow of combustion gases under natural draft from said burner through said heat exchange element to said vent.

9. In combination with a heat exchange element having a combustion burner which is constructed and arranged to supply heated flue gases thereto under natural draft conditions and a conduit for the flue gases between the outlet from said element and an atmospheric vent, air intake means for admitting air to said burner to support combustion, electric power operated means for effecting a forced draft through said combustion burner and conduit to said vent, a by-pass around said means arranged to be open when said means are inoperative due to power failure, to permit operation of said burner under natural draft conditions, means for supplying fuel to said combustion burner and means actuated by an adjustment of said fuel supplying means for rendering said forced draft effecting

means operative and inoperative during operation of said burner.

10. Heating apparatus adapted to be operatively arranged between the flue outlet of a combustion burner, which is constructed and arranged to operate under natural draft, and an atmospheric vent, said burner being provided with air intake means for admitting air to said burner to support combustion, said heating apparatus comprising a heat exchange element, means including said element providing a flue gas passageway between said outlet and said vent, a by-pass short-circuiting a part of said passageway, blower means operable for effecting a forced circulation of air to be heated in heat exchange relationship with said element only when said by-pass is closed, blower means in said part of said passageway operable for effecting the forced flow of flue gases through said passageway and from said burner outlet to said vent when said by-pass is closed, said by-pass including a damper, means automatically positioning said damper to open said by-pass upon stoppage of said flue gas blower means, and a single electric motor having a shaft, said blower means having co-axially arranged fans directly connected to said motor shaft to be simultaneously driven thereby.

11. Heating apparatus adapted to be operatively arranged between the flue outlet of a combustion burner, which is constructed and arranged to operate under natural draft, and an atmospheric vent, said burner being provided with air intake means for admitting air to said burner to support combustion, said heating apparatus comprising a heat exchange element, means including said element providing a flue gas passageway between said outlet and said vent, a by-pass short-circuiting a part of said passageway, blower means operable for effecting a forced circulation of air to be heated in heat exchange relationship with said element only when said by-pass is closed, blower means in said part of said passageway operable for effecting the forced flow of flue gases through said passageway and from said burner outlet to said vent when said by-pass is closed, said by-pass including a damper, means automatically positioning said damper to open said by-pass upon stoppage of said flue gas blower means, and electric motor means operatively connected to said blower means for operating the same, the supply of fuel to said combustion burner being independent of the current supply for said motor means so that in the event of failure of the current supply, said burner will continue to operate and said by-pass will be opened to permit natural draft operation of said burner.

12. Heating apparatus comprising a hollow member provided with a gas inlet opening and a gas outlet opening, partition means defining a path between said inlet and outlet openings, said partition means having a damper-controlled opening therein providing a by-pass around part of said path, and a blower arranged in said part of said path and operative for effecting the forced flow of gas through said member when said by-pass is closed, a combustion burner adapted to burn fuel under natural draft operation and provided with an air intake opening and a combustion products outlet opening, said gas inlet opening of said hollow member being connected to said combustion products outlet opening of said burner so as to effect forced draft operation of said burner when said by-pass is closed and to permit natural draft operation of said burner

when said by-pass is open, and means operable with said blower for circulating air to be heated over said hollow member.

13. Heating apparatus comprising a hollow member provided with a gas inlet opening and a gas outlet opening, partition means defining a path between said inlet and outlet openings, said partition means having a damper-controlled opening therein providing a by-pass around part of said path, and a blower arranged in said part of said path and operative for effecting the forced flow of gas through said member when said by-pass is closed, a combustion burner adapted to burn fuel under natural draft operation and provided with an air intake opening and a combustion products outlet opening, said gas inlet opening of said hollow member being connected to said combustion products outlet opening of said burner so as to effect forced draft operation of said burner when said by-pass is closed and to permit natural draft operation of said burner when said by-pass is open, and means operable with said blower for circulating air to be heated over said hollow member, said blower and air circulating means being driven by an electric motor, means for supplying fuel to said burner and including a manually operable device for adjusting the rate of fuel feed and a circuit for supplying current to said motor for operating the same and including a switch which is open and closed by operation of said device.

14. In combination with a space heater having a heater body with an oil burning combustion burner constructed and arranged to operate under natural draft therein and an outlet for the flue gases, air intake means for admitting air to said burner to support combustion, a path for flow of air in heat exchange relationship with said heater body, an economizer having a passageway for said flue gases therethrough, one end of said passageway being connected to said outlet and the other end of said passageway being connected to an atmospheric vent, means in said passageway for effecting a forced draft of said flue gases through said combustion burner and passageway, a damper controlled by-pass around said forced draft effecting means, means automatically positioning the damper of said by-pass in by-pass-open position upon the stoppage of said forced draft effecting means and in by-pass-closed position during the operation of said forced draft effecting means so that during operation of said burner said by-pass is open when said forced draft means are inoperative and closed when said draft effecting means are operative, said economizer being arranged out of the path of flow of air over said heater body.

15. In combination with a space heater having a heater body with an oil burning combustion burner constructed and arranged to operate under natural draft therein and an outlet for the flue gases, air intake means for admitting air to said burner to support combustion, a path for flow of air in heat exchange relationship with said heater body, an economizer having a passageway for said flue gases therethrough, one end of said passageway being connected to said outlet and the other end of said passageway being connected to a vent, means in said passageway for effecting a forced draft of said flue gases from said combustion burner and through said passageway, a damper controlled by-pass around said forced draft effecting means, means automatically positioning the damper of said by-pass in by-pass-open position upon the stoppage of

said forced draft effecting means and in by-pass-closed position during the operation of said forced draft effecting means so that during operation of said burner said by-pass is open when said forced draft means are inoperative and closed when said draft effecting means are operative, manually operable means for regulating the supply of fuel to said combustion burner and means actuated by said regulating means for rendering said forced draft effecting means operative and inoperative, said economizer being arranged out of the path of flow of air over said heater body.

16. In combination with a combustion burner constructed and arranged to operate under natural draft, air intake means for admitting air to said burner to support combustion, control means for regulating the operation of said combustion burner to provide for high or low fire operation thereof, a pair of heat exchange elements connected to said combustion burner so as to receive the heated flue gases therefrom, conduit means for conducting said flue gases from said heat exchange elements to a vent, means for preventing the flow of said heated flue gases through one of said heat exchange elements during operation of said burner without interfering with the flow under natural draft of the flue gases from said combustion burner and through said other one of said heat exchange elements and said conduit means to said vent, and blower means for effecting a forced draft from said combustion burner and through said heat exchange elements and conduit means and operative for rendering said preventing means inoperative, and blower control means operative, upon regulating the operation by said control means of said burner to provide for low fire operation thereof, to concurrently discontinue operation of said blower means.

17. In combination with a heat exchange element having a combustion burner constructed and arranged to operate under natural draft operatively associated therewith and an outlet for the flue gases, air intake means for admitting air to said burner to support combustion, control means for regulating the operation of said combustion burner to provide for high or low fire operation thereof, a conduit connected to said outlet and leading to a vent for said flue gases, blower means for effecting a forced draft through said combustion burner and conduit and a damper controlled by-pass around said forced draft effecting means, blower means automatically positioning the damper of said by-pass in by-pass-open position upon the stoppage of said blower means and in by-pass-closed position during the operation of said blower means so that during operation of said burner said by-pass is open when said blower means are inoperative so as to permit natural draft operation of said burner and flow of flue gases through said heat exchange element and conduit at such time, and blower control means operative, upon regulating the operation by said control means of said burner to provide for low fire operation thereof, to concurrently discontinue operation of said blower means.

18. In combination with a heat exchange element having a combustion burner operatively associated therewith which is constructed and arranged to supply heated flue gases thereto under natural draft conditions for heating the same and an outlet for the flue gases, said burner being provided with air intake means for admitting

air to said burner to support combustion, regulatable means for supplying fuel to said combustion burner to provide for high or low fire operation thereof, a radiator having a passageway for flue gases therethrough, power driven blower means for effecting a forced draft through said combustion burner, outlet, passageway and conduit to said vent, a damper controlled by-pass around said forced draft effecting means, means automatically positioning the damper of said by-pass in by-pass-open position upon the stoppage of said forced draft effecting means and in by-pass-closed position during the operation of said forced draft effecting means so that during operation of said burner said by-pass is open when said means are inoperative, blower control means operative, upon regulating the fuel supplied by said fuel supplying means to said combustion burner to provide for low fire operation thereof, to concurrently discontinue operation of said blower means, and means associated with said power driven means for circulating a medium to be heated in heat exchange relationship with said radiator when said power driven means are operative.

19. An economizer unit adapted to be operatively arranged between the flue outlet of a combustion burner of a heating element which is constructed and arranged to burn fuel under natural draft and an atmospheric vent for the flue gases therefrom, a path for flow of air in heat exchange relationship with said heating element, said economizer being arranged out of the path of flow of the air to be heated by said heating element and comprising a radiator having a passageway for flue gases therethrough, one end of said passageway being adapted for connection to the flue outlet of said combustion burner and the other end of said passageway being connected to said vent, a by-pass short-circuiting a part of said passageway and arranged to be opened and closed during operation of said combustion burner, means in said part of said passageway adapted for effecting the forced flow of flue gases therethrough and from said burner to said vent when said by-pass is closed, means for automatically opening said by-pass upon stoppage of said forced draft effecting means and for automatically closing said by-pass during operation of said forced draft effecting means, means for circulating air to be heated in heat exchange relationship with said radiator when said forced draft effecting means are operating, and a single motor operatively connected to both of said means for simultaneously operating the same, said radiator being arranged in the path of flow of air on the discharge side of said air circulating means.

20. In combination with a combustion burner constructed and arranged to operate under natural draft and having air intake means for admitting air to said burner to support combustion, a conduit for the flue gases between the outlet from said burner and the vent, electric motor driven means operable for effecting a forced draft of flue gases from said burner through said conduit to said vent, and a by-pass around said means adapted to be open during operation of said burner when said means are inoperative and in event of failure of said means to operate due to current failure or otherwise so as to permit continued operation of said burner under natural draft, means for automatically opening said by-pass upon stoppage of said forced draft effecting means and for automatically closing said by-pass during operation of said forced draft

effecting means, means operable without regard to the operativeness of said electric motor driven means or the current supply therefor for controlling the heat output of said combustion burner.

21. In combination with a space heater having a heater body with an atmospheric type of oil burning combustion burner constructed and arranged to operate on natural draft therein and air intake means for admitting air to said burner to support combustion, and an outlet for flue gases therefrom, an economizer having a passageway for flue gases therethrough, said space heater being arranged to deliver heat recovered from the flue gases independently of said economizer, means for effecting a forced draft of said flue gases through said combustion burner and passageway, a damper controlled by-pass around said forced draft effecting means adapted to be open when said forced draft effecting means are inoperative during operation of said burner and to be closed when said forced draft effecting means are operative, means for automatically opening said by-pass upon stoppage of said forced draft effecting means and for automatically closing said by-pass during operation of said forced draft effecting means, said forced draft effecting means comprising a blower, a motor for driving said blower and another blower driven by said motor simultaneously with said first-mentioned blower and operative for circulating a medium to be heated over said economizer, said economizer being arranged in the path of flow of said medium to be heated on the discharge side of said other blower.

22. In combination with a space heater comprising a heat exchange element having a combustion burner which is constructed and arranged to operate under natural draft for supplying heated flue gases thereto and an outlet for flue gases, air intake means for admitting air to said burner to support combustion, regulatable means for supplying fuel to said combustion burner to provide for high or low fire operation thereof, said heat exchange element being exposed to a heat transfer medium which is free to circulate thereover due to gravity circulation, an economizer comprising a radiator having a passageway for flue gases therethrough, a connection between one end of said passageway and said outlet, a conduit connected to the other end of said passageway and leading to a vent, a damper controlled by-pass between said connection and said conduit and arranged so as to be open to permit natural draft operation of said burner and the flow of the flue gases from said combustion burner to said vent, blower means for effecting a forced draft through said combustion burner, connection, radiator and conduit to said vent and operative for closing said by-pass during high fire operation of said combustion burner, and blower control means operative, upon regulating the fuel supplied by said fuel supplying means to said combustion burner to provide for low fire operation thereof, to concurrently discontinue operation of said blower means.

23. In combination with a heat exchange element having a combustion burner which is constructed and arranged to supply heated flue gases thereto under natural draft conditions for heating the same and an outlet for the flue gases, air intake means for admitting air to said burner to support combustion, regulatable means for supplying fuel to said combustion burner to provide for high or low fire operation thereof, a radiator

arranged below the level of said outlet and having a passageway for flue gases therethrough, one end of said passageway being connected to said outlet and the other end of said passageway terminating at a level adjacent said outlet and being connected to a conduit leading to a vent, a damper controlled by-pass between said outlet and conduit and adapted to be open so as to permit natural draft operation of said combustion burner, and the flow of flue gases through said outlet and by-pass to said vent, power driven means for closing said by-pass and including a blower for effecting a forced draft through said combustion burner, outlet and conduit to said vent during high fire operation of said combustion burner, and blower control means operative, upon regulating the fuel supplied by said fuel supplying means to said combustion burner to provide for low fire operation thereof, to concurrently discontinue operation of said blower means.

24. In combination with a heat exchange element having a combustion burner which is constructed and arranged to operate under natural draft operatively associated therewith and through which the hot gases of combustion from said burner pass, said burner being provided with air intake means for admitting air to said burner to support combustion, regulatable means for supplying fuel to said combustion burner to provide for high or low fire operation thereof, a conduit for conducting the hot gases of combustion from said heat exchange element to a vent, a radiator having a passageway therethrough and operatively connected to said conduit, blower means for effecting a forced draft through said combustion burner, heat exchange element, conduit, and radiator during high fire operation of said combustion burner, a valve controlled by-

pass around said blower means, said valve controlled by-pass being constructed and arranged so as to be closed when said blower means are operative and to be open during operation of said burner when said blower means are inoperative so as to permit operation of said burner under natural draft, means operable simultaneously with said blower means for utilizing the heat exchange surface of said radiator for effecting the transfer of heat to a medium to be heated, and blower control means operative, upon regulating the fuel supplied by said fuel supplying means to said combustion burner to provide for low fire operation thereof, to concurrently discontinue operation of said blower means.

25. In combination with a combustion burner constructed and arranged to operate under natural draft and having air intake means for admitting air to said burner to support combustion, control means for regulating the operation of said combustion burner to provide for high or low fire operation thereof, a conduit for the flue gases between the outlet from said combustion burner and an atmospheric vent, electric power driven blower means for effecting a forced draft through said combustion burner and conduit during high fire operation of said burner, a by-pass around said blower means adapted to be opened when said blower means are inoperative so as to permit natural draft operation of said burner in the event of power failure, means for automatically opening said by-pass upon stoppage of said electric power driven means, and blower control means operative, upon regulating the operation by said control means of said burner to provide for low fire operation thereof, to concurrently discontinue operation of said blower means.

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