Feb. 13, 1940.

V. O. BEAM

2,190,349

HEATER

Filed Jan. 5, 1937

5 Sheets-Sheet 1

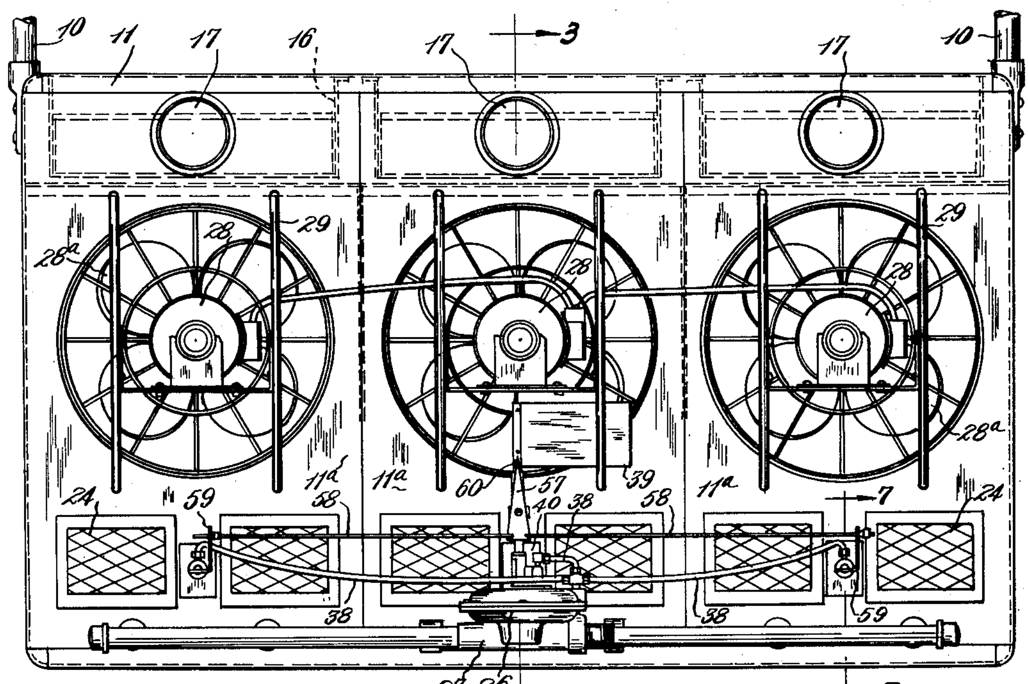

FIG. 2

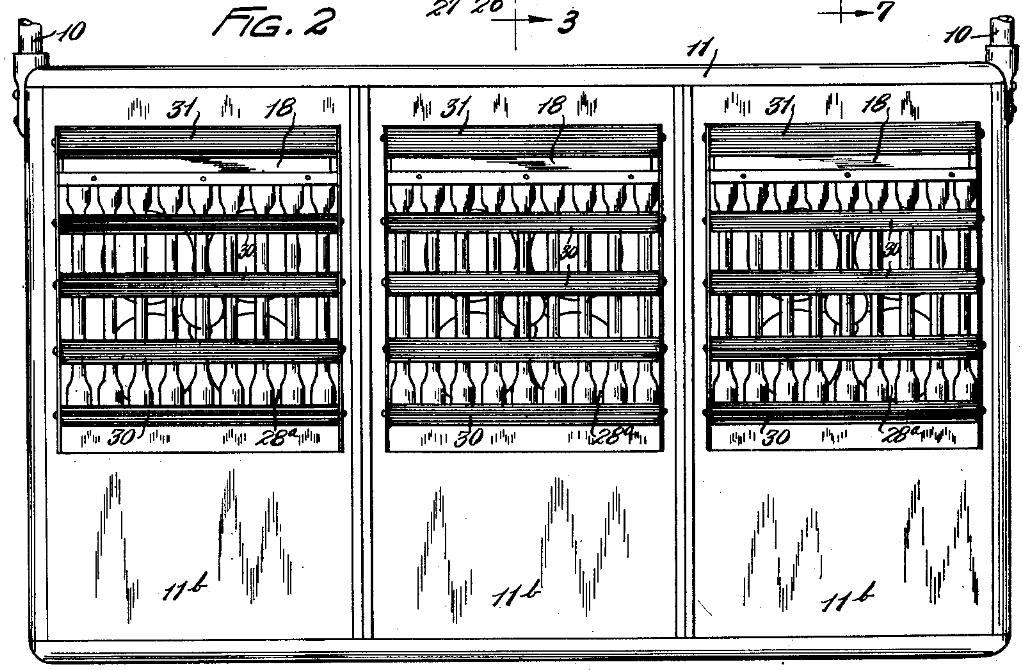

FIG. 1

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HEATER

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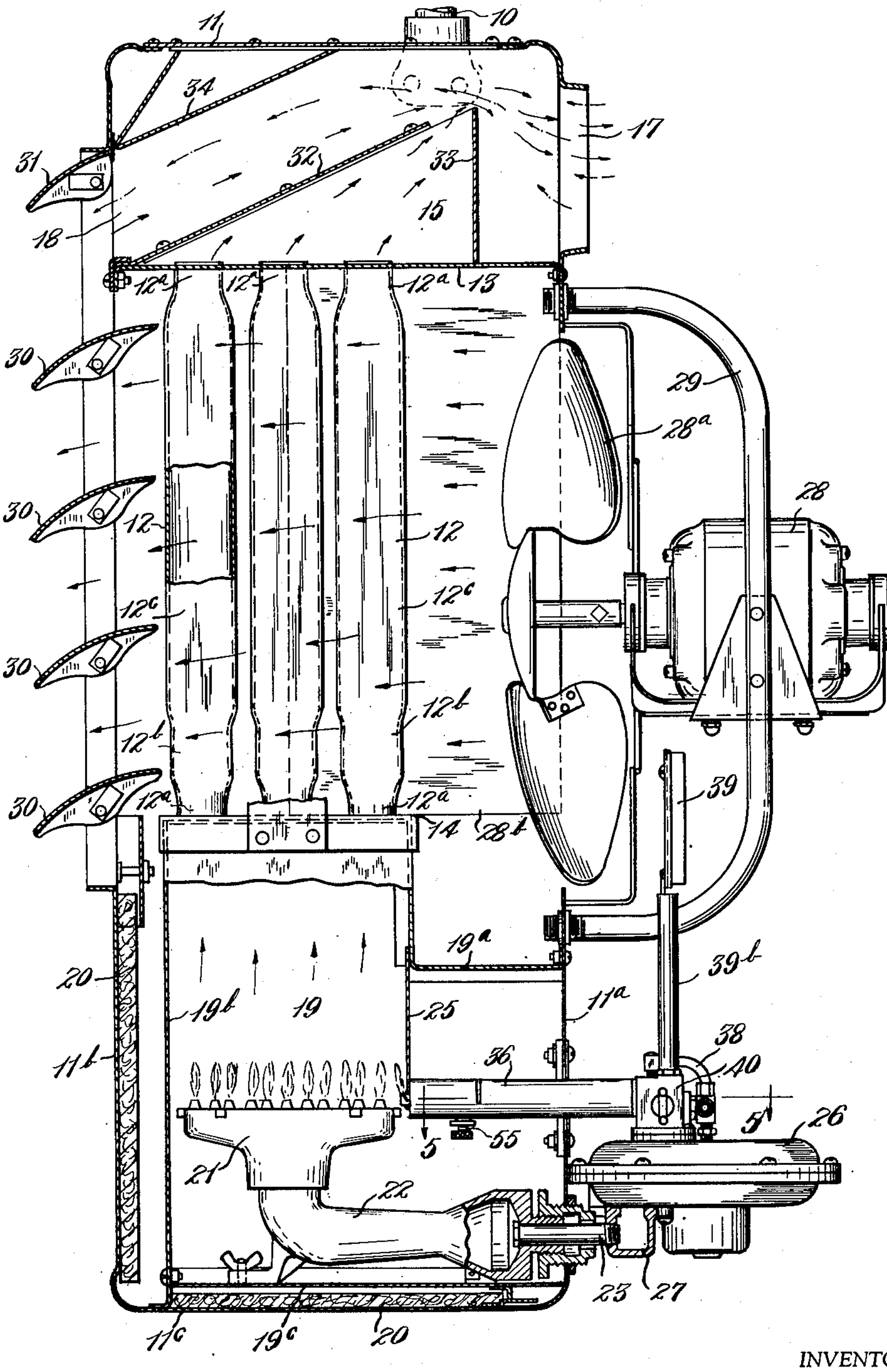

FIG. 3

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HEATER

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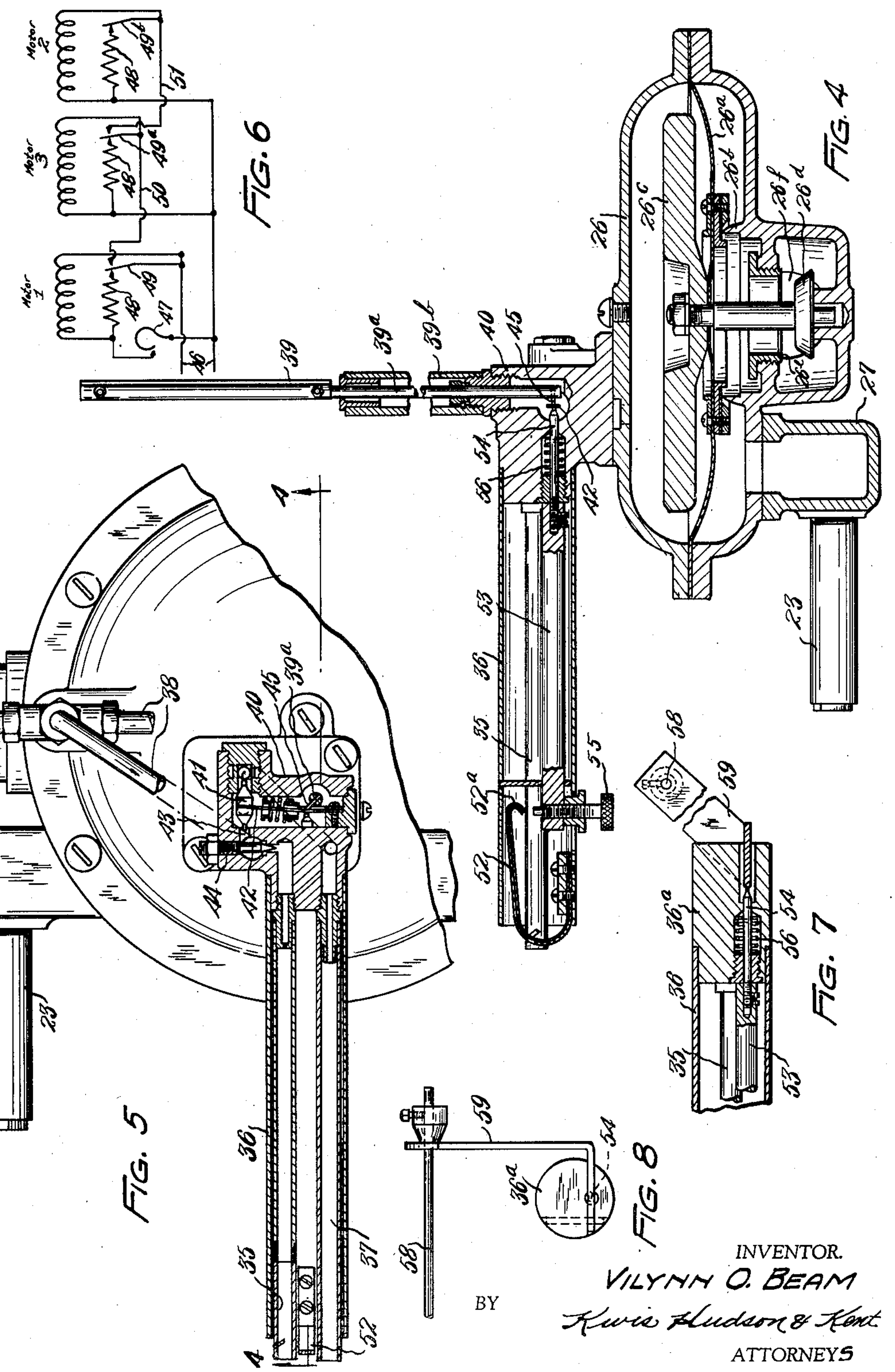

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HEATER

Filed Jan. 5, 1937 5 Sheets-Sheet 4

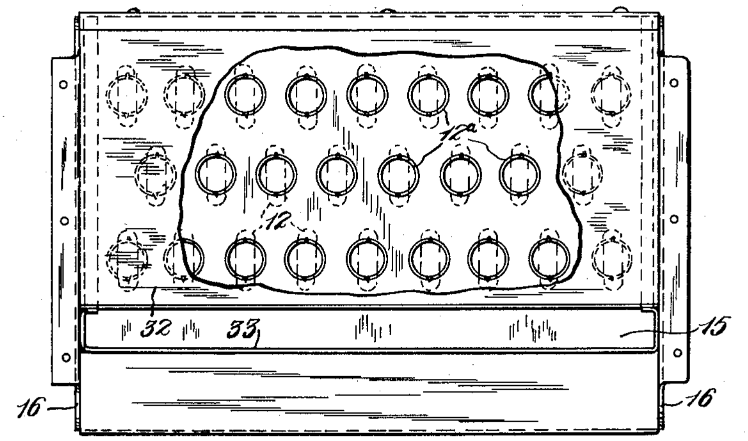

FIG. 10

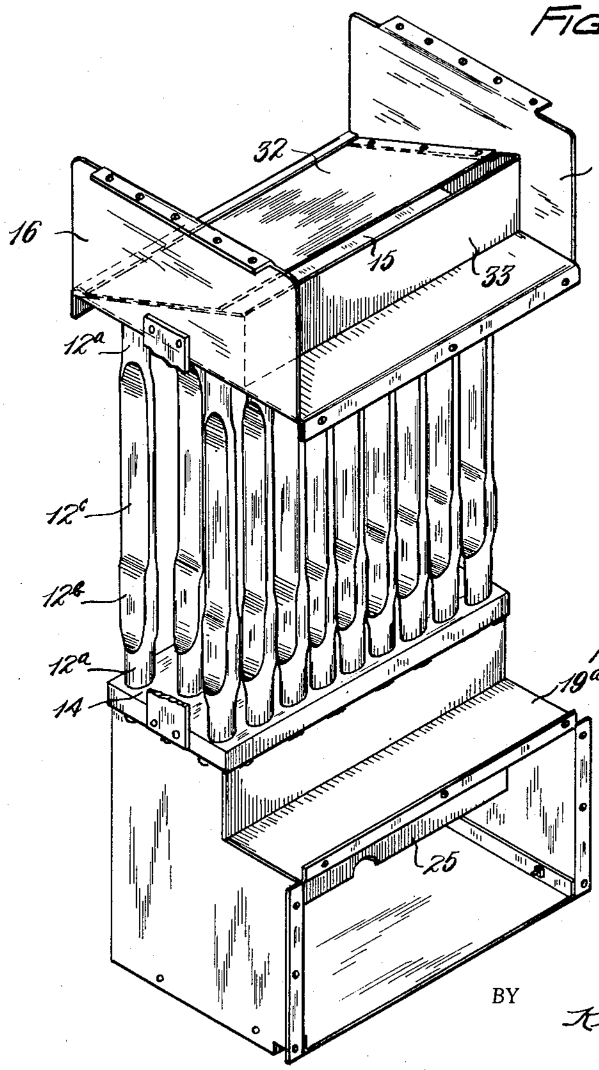

FIG. 9

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HEATER

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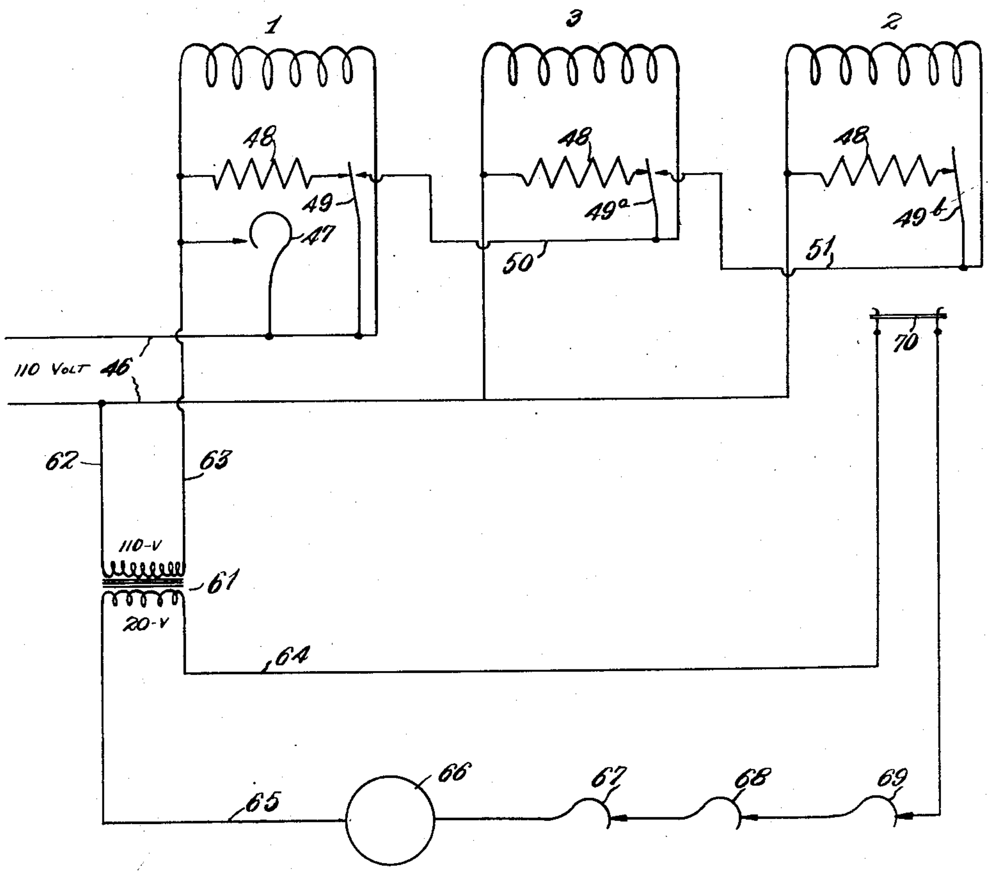

FIG. 11

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Patented Feb. 13, 1940

2,190,349

UNITED STATES PATENT OFFICE

2,190,349

HEATER

Vilynn O. Beam, Cleveland Heights, Ohio, assignor to The Bryant Heater Company, Cleveland, Ohio, a corporation of Ohio

Application January 5, 1937, Serial No. 119,119

8 Claims. (Cl. 126—110)

This invention relates to heating apparatus supplied with fluid fuel, such as gas, and has particular reference to a type of heater commonly called a unit heater utilized for heating garages and the like which are not usually provided with furnace heat, and generally include burner equipment associated with a heat exchanger and a motor for blowing air past the tubes of the exchanger and into the room to be heated.

One of the objects of the present invention is to provide a unit heater of this class which can be economically manufactured in different sizes by utilizing a single section or unit or a plurality thereof each of which in its main essentials, including the heat exchanger, combustion chamber, and motor driven fan or blower, being a duplicate of the other section or sections. Thus, instead of following the usual procedure of manufacturing heaters of a plurality of different sizes, each separately constructed, I am able to effect important economies of manufacture in utilizing the multiple section or unit idea by constructing the unit in quantities and by combining into a single casing any desired number of them to meet different capacity demands.

A further object is to provide a multiple section heater of this kind with a separate motor-fan unit for each section, with a single gas control and with the motors connected and operated in a manner such that the stopping of any one of them will stop the remainder and shut off the supply of gas, and in a manner such that the gas valve cannot be opened unless the motors of all the units are operating.

A further object is to provide a heater with a novel form of draft diverter which, in this instance, I arrange immediately above the heat exchanger or one immediately above each heat exchanger, depending upon the number of sections employed, the diverter including suitable baffles in proper relation to a flue opening for the products of combustion and also in proper relation to a down draft relief opening which is at the front of the heater and concealed by a false louver which matches the air louvers beneath it.

A further object is to provide a heat exchanger with streamlined tubes so shaped as to be highly efficient in the exchange or transmission of heat from the walls of the tubes to the fan-impelled air passing around the tubes which tubes are additionally shaped to facilitate their assembly in the headers of the heat exchanger.

A still further object is to provide a heater of this kind with the main gas valve controlled by a so-called sail actuated by the stream of air impelled by one of the motor-driven blowers regardless of whether there is a single section or a plurality of sections in the heater, together with novel means, preferably mechanically actuated, for preventing the opening of the main valve and also for causing the sail to be moved to "off" position resulting in the closure of the valve should the pilot flame of the heater or of any section thereof (if the heater is of the multiple section type) be extinguished so as to cool the thermal element associated therewith.

The invention may be briefly summarized as consisting in certain novel combinations and arrangements of parts and details of construction which will be described in the specification and set forth in the appended claims.

In the accompanying sheets of drawings,

Fig. 1 is a front view of a three-section heater constructed in accordance with my invention;

Fig. 2 is a rear view of the same;

Fig. 3 is a vertical sectional view on an enlarged scale substantially along the line 3—3 of Fig. 2 with the valve and associated parts in elevation;

Fig. 4 is a sectional view through the valve and associated parts including the pilot and sail, the section being taken substantially along the line 4—4 of Fig. 5;

Fig. 5 is a fragmentary sectional plan view substantially along the line 5—5 of Fig. 3;

Fig. 6 is a diagrammatic view showing the three motors of a three-section heater serially connected to the current supplying line which motors are, upon the closure of the circuit through the action of the thermostat, successively started by means of centrifugally operated switches which normally are utilized to cut out the starting windings of the motor when they get up to speed;

Fig. 7 is a fragmentary sectional view substantially along the line 7—7 of Fig. 2;

Fig. 8 is an end view looking toward the left of Fig. 7;

Fig. 9 is a perspective view of one of the heat exchangers;

Fig. 10 is a top plan view of the same with a portion of one of the baffles broken away; and

Fig. 11 is a diagrammatic view of a different system of control for the main valve and motors.

Referring now to the drawings, it will be observed from the front view shown in Fig. 1 and the rear view shown in Fig. 2 that I have illustrated a three-section heater, but I wish it to be understood that while the multiplication of similar units for the production of a multiple section heater is an important feature of the invention, so far as certain features of the invention are concerned, the heater may consist of a single section and that the multiple section heaters may be composed of two sections, three sections as herein illustrated, or more if desired. At the present time, however, I find that the capacity requirements are answered by heaters composed of a single section, two sections, and three sections. Unit heaters of this kind are generally (but not necessarily) suspended from the ceiling or from some other overhead support, and in this instance the suspension rods 10 are shown attached to the upper ends of the sheet metal casing 11 which casing, though enclosing the multiple sections, may in part at least be composed of the casing walls of the individual sections.

A multiple section heater of two or more sections includes heat exchangers which are the same for all the sections, each of these heat exchangers being provided at the top with my improved draft diverter and at the bottom with a combustion chamber, as will be seen by reference to Figs. 3 and 9. These parts of the heat exchanger form a self-contained unit two or more of which are arranged side by side in the multiple section heater.

Each heat exchanger includes a plurality of rows of similar streamlined tubes 12 of novel form. These tubes are streamlined by being flattened, but they are flattened between their ends only, their ends being round as shown at 12a and being fitted into and secured in round holes in the upper header 13 and the lower header 14, thus greatly facilitating assembly. Furthermore, they are preferably not uniformly flattened, but the flattening is done so as to obtain diminishing interior cross-section. The flattening is preferably in two or more stages, the two-stage flattening being shown at 12b and 12c, the portion 12c being flattened and therefore having its interior cross-section decreased with respect to the lower flattened portion 12b. In other words, as the temperature of the products of combustion decreases in their upward flow through the tubes, the internal cross-section of the tubes is decreased by the increased flattening, increasing the so-called scrubbing action within the tubes and at the same time providing a form which exteriorly obtains the most effective wiping action of the cooling air currents passing around the flattened surfaces of the tubes and therefore maximum heat transference from the heated products of combustion to the tubes and from the tubes to the air which is blown by the fan or blower at the rear of the casing forwardly across the surfaces of the tubes. It might be stated that the tubes of the several rows are preferably staggered so as to further increase the efficiency of the heat transference.

The upper header 13 forms the bottom wall of a flue header or collector 15 constituting an outlet chamber for the products of combustion flowing upwardly through the tubes 12 and also forming, with baffles to be referred to presently, a draft diverter which, as previously pointed out, forms a part of the heat exchanger unit. The ends 16 of the chamber 15 are preferably formed by bending upwardly the ends of the sheet metal plate forming the upper header 13, and the top, front, and rear walls of the chamber 15 are formed by portions of the outer casing 11, the rear wall being provided with an outlet or flue opening 17 for the products of combustion, this opening being generally round, as shown in Fig. 2, and the front wall of the chamber 15 being provided with a relief opening for the draft diverter, this opening being shown at 18 and being horizontally elongated and extending substantially entirely across the front of the section.

At the bottom of the heat exchanger is a combustion chamber 19 which also, as previously stated, is formed as a unit with the heat exchanger, the lower header 14 forming the top of the combustion chamber. This combustion chamber, when viewed from the side, is L-shaped in cross-section, the same being provided with a rearward extension 19a which is attached to the rear wall of the casing which wall is preferably composed of a series of plates 11a, one for each section. The front wall 19b of the combustion chamber is spaced from the front 11b of the casing 11 and may be separated therefrom by insulation 20. Likewise, the bottom wall 19c of the chamber 19 is spaced from the bottom 11c of the casing and may be separated therefrom by insulation.

In the lower part of each combustion chamber there are one or more main burners 21 to each of which is connected a mixing tube 22 to which gas is supplied by a spud 23, the primary air being supplied to the tube in the usual manner. Secondary air is supplied through suitable grills 24 fitted into the rear wall of the casing, there being a vertical baffle 25 extending downwardly from the upper part of the combustion chamber across the same so as to direct the secondary air downwardly to a level beneath the burner openings.

A single valve preferably in the form of a diaphragm valve 26 controls the flow of gas to all the burners 21. This valve, which is supported at the lower rear central part of the heater as shown in Fig. 2, discharges gas into a manifold 27 to which the spuds 23 are connected, as shown in Fig. 3, this manifold extending across the lower rear part of the heater, as shown in Fig. 2. Though the present invention is not limited to any particular gas control valve, in Fig. 4 the valve 26 is shown as a combined diaphragm valve and pressure regulator, the diaphragm 26a having a seating portion which engages an annular seat 26b when the valve is closed and being provided in the upper chamber of the valve with a weight 26c and having a downwardly extending stem carrying a movable valve member 26d of the throttling valve, this valve member being adapted to move toward but not to entirely engage a stationary valve member 26e which is below and concentric with the annular valve seat 26b. When the valve is open, the gas flows from the inlet partially shown at 26f in this figure up through the stationary member 26e of the throttle valve into the chamber beneath the diaphragm and then out of the valve into the manifold 27 and to the main burners. A combined diaphragm valve and throttling valve of the type here shown is not claimed herein but in a prior pending application, and as it forms no part of the present invention it need not be further referred to.

Each section of the heater has its own fan or blower and motor for driving the same, as clearly shown in Fig. 2. The motors, which are designated 28, are individually supported by brackets 29 on each rear plate 11a of the casing 11, and on the forward end of each motor shaft is a fan or blower 28a which is adapted to rotate in a circular opening provided in the corresponding rear casing plate 11a directly behind the tubes of the heat exchanger unit so that the air will be blown across the same and will be heated in the manner already explained and driven out through a large rectangular opening at the front of the section. This opening is traversed by a plurality of adjustable curved louvers 30 which are pivoted at their ends so that the direction in which the heated air is sent into the room to be heated can be varied. In order that cross currents may not occur inside the casing and so that each blower will impel the air forwardly across the tubes of the particular heat exchanger with which the blower is associated, the heat exchanging tubes of the different sections are separated by vertical partitions 28*b* which extend the full length of the tubes and from the rear wall of the casing forwardly toward the front of the casing but preferably they terminate a short distance from the front of the casing.

Directly above the louvers 30 of each section and immediately above the relief opening 18 of the draft diverter of the corresponding heat exchanger there is a fixed or false louver 31 which matches the louvers 30, thus substantially concealing the relief opening 18 for the draft diverter at the front of the heater.

At this point further reference will be had to the flue header or collector and draft diverter. It will be seen particularly from Fig. 3 that, extending across the chamber 15 above the outlet openings of the tubes 12 of each heat exchanger, there is an inclined baffle 32 which extends upwardly and rearwardly from the lower front part of the chamber 15. Likewise, it will be seen that rearwardly of the outlet openings of the tubes 12 is an upright baffle 33 the upper end terminating slightly rearwardly of and slightly above the upper rear edge of the baffle 32, leaving at the top an outlet opening for the products of combustion which normally flow out through the outlet or flue opening 17, and at the same time the draft is relieved by air flowing into the front opening 18 over the baffle 32, the flow of air from the opening 18 and the flow of the products of combustion being indicated by the solid arrows of Fig. 3. However, should a down draft occur, it will be relieved, so far as any effect on the burners is concerned, by passing downwardly and forwardly in the direction of the dotted arrows of Fig. 3 and out through the relief opening 18 at the upper front part of the heater. There is preferably provided at the upper front corner of the chamber 15 an inclined guide 34 to guide the air out through the relief opening 18, this in effect forming a continuation of the false louver 31 and being parallel to the baffle 32 so as to form an unobstructed downwardly and forwardly extending passageway for the relief of the down draft.

Each heater section of the multiple section heater includes not only the heat exchanger with its associated draft diverter and flue collector chamber at the top and the combustion chamber at the bottom, the fan and motor unit, and the main burner or burners, but also a pilot burner supported in suitable igniting relation with the main burner or burners of the section.

In Figs. 3, 4, and 5 I have shown the pilot burner for the middle section at 35, this pilot burner being in a tube 36 alongside a pipe 37 constituting the escapement burner which functions in the usual manner to dispose of the gas which passes from the upper chamber of the diaphragm valve each time the pressure above the diaphragm is relieved and the valve is opened. The two end sections of the heater are provided with similarly positioned pilot burners, the gas being supplied to the pilot burners from the inlet side of the valve 26 by tubes or pipes 38 shown in Fig. 2 and portions in Figs. 3 and 5.

In my improved heater, I provide a simple but reliable control for the main gas valve such that the valve is not opened if any one of the motors fails to start or if the flame of any one of the pilot burners is extinguished at the time the thermostat calls for heat or if when the heater is in operation any of the motors stop or if a pilot flame should become extinguished. In this instance, though not necessarily, the valve is controlled by a so-called sail 39 mounted on a vertical spindle 39*a* journaled in a tube 39*b* extending upwardly from the valve casing which sail functions for all motors regardless of their number and in the three-section heater herein illustrated is associated with the middle motor and blower, as best shown in Fig. 2. In this figure the sail is shown in its "off" position and it is swung to "on" position so as to cause the opening of the main valve, in a manner to be explained presently, by the air currents induced by this particular blower.

To bring about the actuation of the main valve by this movement of the sail, I provide in the casting 40 at the top of the casing of the valve 26 a double-throw valve member 41 (see Fig. 5) supported on a flexible metallic strip 42 associated with a snap acting mechanism of well known form. In the position of the valve member shown in Fig. 5, the main valve 26 is closed, gas then passing freely from the pilot burner pipe 38 through a port 43 into a chamber which houses the valve member 41 and its spring support 42 and through a port leading to the upper chamber of the diaphragm valve. At the same time and, in fact, regardless of the position of the valve member 41, gas flows into the pilot burner pipes 35, the rate of flow being controlled by a needle valve.

The lower end of the stem 39*a* supporting the sail is located adjacent the spring 42 which supports and actuates the valve member 41. The lower end of this stem carries a pin or equivalent device 45 which, when the sail is moved to "on" position by the starting of the central motor, engages and moves the spring 42 from the position shown in Fig. 5 so that the valve member 41 is moved to its left-hand position, and this shuts off the supply of gas to the port leading to the upper chamber of the diaphragm valve and allows the gas to bleed from the upper chamber into the escapement burner tube 37 and thence into the combustion chamber adjacent the burners where it is consumed. Thus when the motors, including the central motor, are started, the sail is swung to "on" position, causing the opening of the diaphragm valve and the supply of gas to the main burners of all sections. When the motors are stopped, as hereinafter explained, the air currents of course no longer hold the sail 39 in its "on" position and the pressure of the pin 45 on the spring 42 is relieved, whereupon the latter restores the valve 41 to the position shown in Fig. 5, resulting in the closure of the main valve 26.

An accordance with the present invention, starting and stopping of the motor of the single section heater or the starting and stopping of the two or more motors of the multi-section heater are controlled by a thermostat located in the room which is being heated, the motors in the latter event being serially connected so that the thermostat will be effective to start and stop all the motors. In accordance with another important feature of the invention, the motors are not only serially connected, as just explained, but they are connected so that they will be started and stopped in sequence, the last motor to start being that which controls the sail. This is accomplished by using alternating current motors each having a starting winding which is cut out of the circuit when the motor is up to speed by a centrifugal switch and by providing a back contact or an extra set of contacts which are closed when the switch is operated to cut out the starting winding and at the same time to close the circuit for the next motor to start, the last motor to start in this instance being the middle motor which controls the sail. This is illustrated in the diagrammatic view of Fig. 6 wherein the motors are designated motor No. 1, motor No. 3, and motor No. 2 in the order shown, motor No. 2 however being the middle motor of the three unit heater or the motor which controls the sail whether the heater has two or more sections. In this view the current supplying conductors are shown at 46 and the thermostat which controls the starting and stopping of the motor is shown at 47. Of course the thermostat will not be directly in the circuit of the motors but normally will function to operate a switch in the motor circuit, but the direct application of the thermostat is shown for convenience of illustration.

When the thermostat calls for heat, it closes the circuit to motor No. 1 which will be one of the end motors of the series of three (assuming that the heater has three sections), the circuit through the starting winding 48 of this motor being then closed by the centrifugal switch 49. When motor No. 1 gets up to speed and the switch 49 opens so as to cut out the starting winding 48, the switch engages a contact which connects motor No. 1 to motor No. 3 through a conductor 50, the starting winding 48 of this motor being then closed through the centrifugal switch 49*a* of motor No. 3. When this motor gets up to speed the centrifugal switch 49*a* cuts out its starting winding and cuts in motor No. 2 or the middle motor of the series by connecting motor No. 3 to motor No. 2 by means of a conductor 51, and when this motor is up to speed its centrifugal switch, here designated 49*b*, cuts out the starting winding but performs no other function. Accordingly, when the thermostat calls for heat, motor No. 1 (one of the end motors) is first started. Then motor No. 3 (the other end motor) is started, and then motor No. 2 (the middle motor) is started, all three motors being then connected in series. This results in the operation of the sail and in the opening of the gas control valve 26 and the consequent supply of gas to the main burners of all sections. However, if for any reason any one of the three motors fails to start, the gas valve 26 will not be opened, and if, while the heater is in operation, any one of the three motors stops, as, for example, by the burning out of one of its windings, the other motors will be stopped, resulting in the restoration of the sail to "off" position and the closing of the main gas supply valve 26. Thus each section is protected against destruction or injury from excessive heat by reason of the failure of its associated motor and fan or blower to operate.

As stated above, provision is made for preventing the starting of the heater by the opening of the gas valve 26 if any pilot flame is extinguished, and this is accomplished by simple mechanical means as follows: There is associated with each pilot burner a thermal element 52 (see particularly Fig. 4) which when cold is in substantially the position shown in Fig. 4, but when heated by the pilot flame the upper section of the thermal element is flexed downwardly. Each pilot has associated with it a plunger 53 which is slidably mounted alongside the pilot in the tube 36 which encloses the pilot. The plunger has at its outer or rear end a pin 54 the rear end of which is adjacent the spring support 42 for the snap valve member 41, and at the forward end of the plunger 53 there is a suitable latch which in this instance is in the form of a setscrew 55 whose upper end is adapted to be latched behind a hook 52*a* at the rear free end of the thermal element 52 when the latter is heated. The three plungers will be manually latched in their "on" position with the springs 56 compressed when the thermal elements associated with the three pilots are heated and therefore flexed to latching position. The arrangement is such that when the flame of any pilot burner is extinguished, the corresponding thermal element is cooled and releases or unlatches the plunger 53 associated therewith, whereupon the spring then throws the plunger to the position shown in Fig. 4, and when the plunger is in this position the spring support 42 for the valve 41 is retained in the position shown in Fig. 5 and the plunger will restrain its movement from that position by the action of the sail and will therefore prevent the main valve 26 from being opened even though the thermostat calls for heat. Furthermore, even while the heater is in operation and the sail is in "on" position, the strength of the spring 56 is such that if the plunger 53 is released it will restore the snap valve 41 to position to bring about the closure of the main valve 26 and will shift the sail to "off" position against the action of its associated fan or blower.

The construction and arrangement illustrated in Figs. 4 and 5 are utilized for the middle heater section, but the same results are obtained by the pilot and plunger of either end section, and are accomplished by the following means. I provide immediately behind the sail and its support a pivoted arm 57 which is connected by rods 58 to levers 59 which are pivotally supported adjacent the rear ends of similar plungers 53 associated with the pilots of the two end sections each of which pilots has a spring-pressed plunger which is adapted to be latched by the thermal element, as with the construction shown in Fig. 4. In Fig. 7 I have shown the plunger 53 for one of the end sections of the heater, this plunger being slidably arranged alongside the associated pilot pipe 35 in the tube 36 the latter being secured to a support 36*a* in which the rear end of the plunger 53 consisting of the pin 54 is slidably mounted and on which the lever 59 is pivoted, the support 36*a* having at its rear end a slot in which a portion of the lever 59 is mounted opposite the rear or reduced end 54 of the plunger 53. The arrangement is such that when either of these plungers is released by the extinguishment of the associated pilot flame it will rock one or the other of the levers 59 and shift the pivoted arm 57. This arm 57, when thus shifted, engages a pin or equivalent device 60 on the sail so as to shift the latter to "off" position or to prevent it from being moved to "on" position by the action of the fan or blower of the middle section.

The operation is as follows: When the thermostat calls for heat, the motors will be started successively in the manner already explained, the middle motor being started last, resulting in the movement of the sail to "on" position and the resultant opening of the diaphragm valve which supplies gas to the main burners, this occurring only when all pilot burners are functioning. As already pointed out, if any motor fails to start, the valve 26 is not opened, or, if the circuit of any motor is opened, all three motors will be stopped, resulting in the closure of the valve 26. On the other hand, if any pilot burner is extinguished, the main valve 26 will not be opened, it being necessary that all three spring-pressed plungers associated with the pilots be held in latched position by the thermal elements to permit the main valve 26 to be opened or to permit the continuance of the operation of the heater.

I have heretofore stated that it was unnecessary that the main valve be controlled by a sail which is operated by the air currents induced by a motor-fan unit. On the other hand, the valve may be controlled electrically by any of the well known electric means, such as a motor or a solenoid valve, the circuit of the motor or the circuit of the solenoid being controlled, as is customary, by the thermostat. In such case the thermal elements associated with the pilot burners of the different sections (assuming that the heater is of the multiple-section type) will also exert a control on the circuit of the motor or solenoid so as to prevent the main gas valve being opened in the event the flame of any pilot burner is extinguished, by opening a switch in the circuit of the motor or solenoid so as to prevent the closing of the circuit by the thermostat. In a system of this kind, it is desirable, as with the system of control first described, that the heater be protected against injury or destruction due to excessive heat in case the motors fail to start or for any reason are stopped while the heater is in operation. This can be very easily taken care of in an electrical control system such as now under consideration by providing a fusible link in the circuit of the motor or solenoid which link will be suitably located with respect to the heater so as to be melted or blown in case the heater is being operated without the cooling effect of the motor-driven fan or fans.

In Fig. 11 I have shown diagrammatically an electric control system of this type. In this figure, the main current supplying conductors, the thermostat, the motors, and the centrifugal switches are arranged as in Fig. 6, and the same reference characters as employed for these parts in Fig. 6 are applied also to the corresponding parts of Fig. 11. In addition to the parts shown in Fig. 6 I have shown in Fig. 11 a step-down transformer 61, the primary of this transformer being connected by conductor 62 directly to one side of the supply circuit and being connected to the other side by a conductor 63 through the thermostat 47. The secondary of the transformer has its circuit represented by the conductors 64 and 65, and in this circuit is the motor or solenoid, here designated 66, which operates or controls in the well known manner the main gas valve. Also in this circuit I have shown three switches 67, 68, and 69 which are controlled by the thermal elements associated with the pilots of the three heaters. Of course, there will be one for each heater section and the number will depend upon the number of sections of which the heater is composed. These switches are adapted to be closed by the thermal elements only when the latter are heated by the flames of the associated pilots, and they will be opened automatically when the pilot flames are extinguished. I have also shown in the circuit of the conductors 64 and 65 a fusible link 70 referred to above to protect the heater against injury due to the failure of the motor or motors to operate. In a multiple section heater this link will be in proper position with respect to the heat exchanger of that section of the heater whose motor is the last to start.

With the system here shown, when the thermostat 47 call for heat, it closes the circuit through the primary of the transformer 61, and at the same time causes the successive starting of the motors which drive the fans. Assuming that the pilot burners are in operation, the solenoid 66 or equivalent electric motive device will be energized so as to cause the main valve to be opened, allowing gas to pass to the main burners. However, if at the time the thermostat calls for heat, the flame at any pilot is extinguished, the circuit of the secondary of the transformer including the solenoid or valve controlling motive device 66 will not be energized, and therefore the gas valve will remain closed. Likewise, should the motors fail to start, the fusible link 70 will be melted before the heater is excessively heated, and this will result in the deenergization of the solenoid or other motive device which controls or operates the main valve, resulting in the valve being immediately closed. The main valve is preferably a diaphragm valve controlled by a solenoid valve which is associated therewith and forms a part thereof and which functions in the usual and well known manner to supply gas pressure to the upper chamber of the diaphragm valve and thus cause the closure of the valve when the solenoid is deenergized, and which permits the exhaust of gas pressure from the upper chamber of the diaphragm valve so as to cause it to open when the solenoid is energized.

The advantages of the multiple unit idea of my improved heater in the way of economies of manufacture, the advantages of my improved streamlined tubes, and the novelty and advantages of the flue collector and draft diverter arranged at the top and forming a part of the heat exchanger unit with a relief opening at the front of the casing have been explained and need not be here repeated.

While I have shown a three-section heater, it is to be understood, as previously pointed out, that a multiple section heater may be composed of two sections or more than three sections if desired, and that certain features of the invention have utility in connection with a heater of a single section. I therefore do not desire to be confined to the precise details or arrangements shown but aim in my claims to cover all modifications which do not involve a departure from the spirit and scope of the invention in its broadest aspects.

Having thus described my invention, I claim:

1. In a unit heater of the class described, a casing having heat exchange members therein, burners adjacent the bottom of the casing, a plurality of motor driven fans or blowers for directing air forwardly past the heat exchange members, control means for causing the same to be started successively, a valve for controlling the supply of fuel to the burners, and means whereby one of the blowers other than the first blower controls the valve.

2. In a unit heater of the class described, a

casing having heat exchange members therein, burners adjacent the bottom of the casing, a plurality of motors and fans or blowers for directing air forwardly past the heat exchange members, the motors having provision whereby they are controlled from a single point but start successively, a fuel valve, and means whereby one of the motors other than the first motor to start controls the valve.

3. In a unit heater of the class described, a casing having heat exchange members therein, burners adjacent the bottom of the casing, a plurality of motors and fans or blowers for directing air forwardly past the heat exchange members, the motors having provision whereby they are controlled from a single point but start successively, a single fuel valve, and means whereby the last motor to start controls said valve.

4. In a heater of the class described, a casing having a plurality of heat exchange members therein, combustion chambers at the lower part of the casing having burners, a single valve for controlling the supply of fuel to said burners, a plurality of fan and motor units arranged side by side for directing air forwardly across the heat exchange members, means for supplying current to said motors, means whereby the motors are started and brought up to speed successively, and motor operated means operatively connected with the valve and arranged to be operated by one of the fan and motor units other than the first unit to start.

5. In a heater of the class described, a casing having a plurality of heat exchange members therein, combustion chambers at the lower part of the casing having burners, a single valve for controlling the supply of fuel to said burners, a plurality of fan and motor units arranged side by side for directing air forwardly across the heat exchange members, means for supplying current to said motors, means whereby the motors are started and brought up to speed successively, and valve control means rendered effective by the last motor which is started.

6. In a heater of the class described, a heat exchanger including a plurality of tubes, a combustion chamber at the bottom and a flue collector chamber at the top, and a casing enclosing said heat exchanger and provided with a flue opening, said heat exchanger including the tubes and the two chambers at the top and bottom thereof being in the form of a self-contained unit independent of said casing and said flue collector chamber having draft diverting walls which cooperate with walls at the upper part of the casing to form a draft diverter.

7. In a heater of the class described, a casing having a plurality of similar heat exchangers arranged side by side therein, each heat exchanger being composed of a plurality of tubes, a chamber at the top constituting a flue collector for the products of combustion and a combustion chamber at the bottom, a burner in each combustion chamber, a blower at the rear of each unit, and a single control valve for the burners, said heat exchangers being in the form of similar self-contained units formed independently of said casing, the casing having a flue opening and a draft relief opening for each unit, and the flue collector of each heat exchanger having draft diverter walls which cooperate with walls at the upper part of the casing to form a draft diverter for each unit.

8. In a heater of the class described, a heat exchanger including a plurality of tubes, a combustion chamber at the bottom and a flue collector at the top, and a casing enclosing said heat exchanger, said casing having a flue opening and a back draft relief opening, the flue collector of the heat exchanger having a wall opposite the flue opening of the casing and a second wall extending toward the draft relief opening, and said walls cooperating with walls of the casing to form a draft diverter of which said relief opening is the outlet.

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