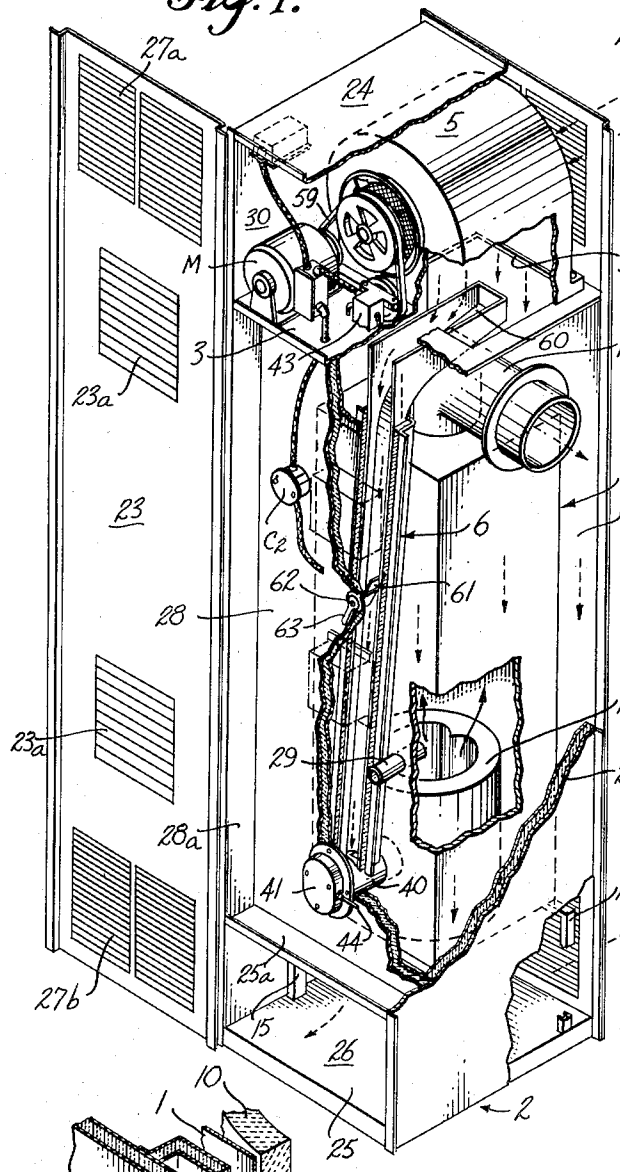
Dec. 23, 1958 H. J. CUTLER 2,865,364

UPRIGHT FURNACE ASSEMBLY

Filed July 23, 1956 3 Sheets-Sheet 1

Fig. 1.



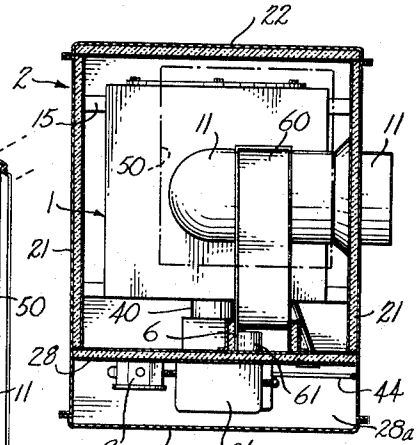




Fig. 4.

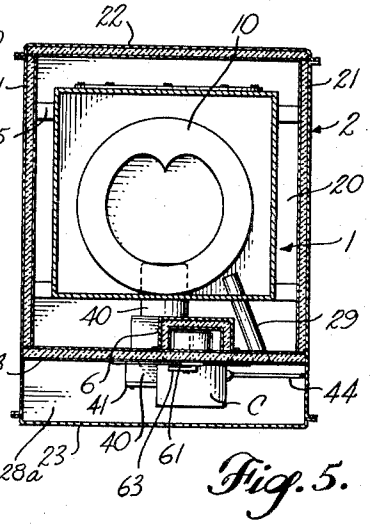



Fig. 5.

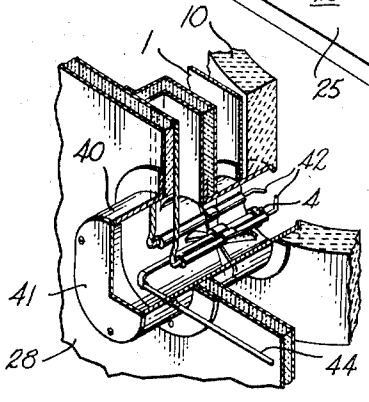



Fig. 6.

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UPRIGHT FURNACE ASSEMBLY

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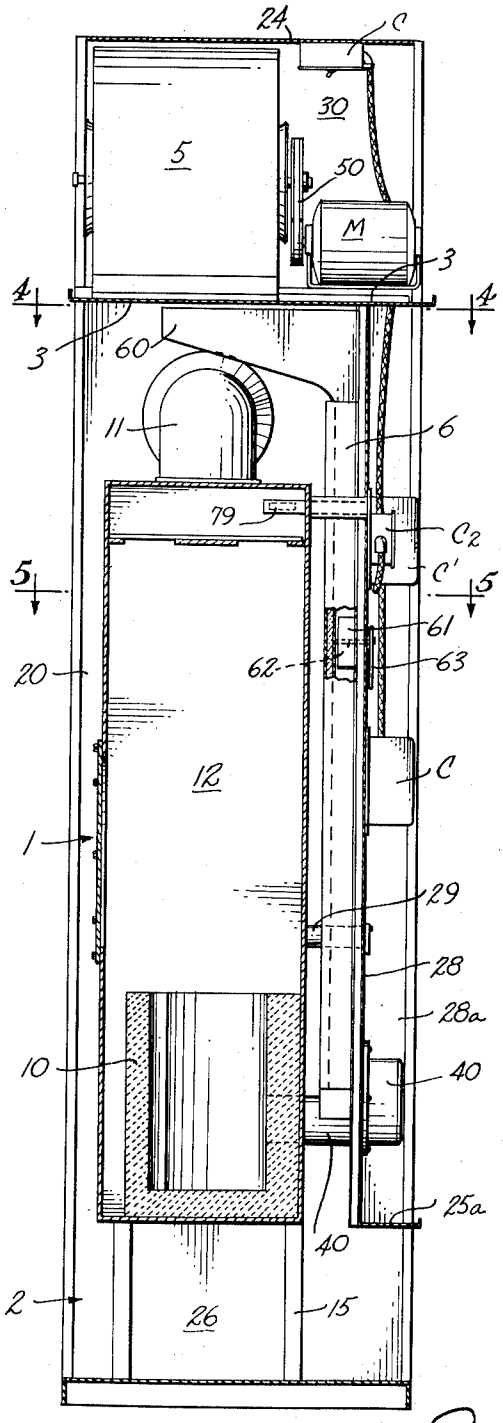


Fig. 2.

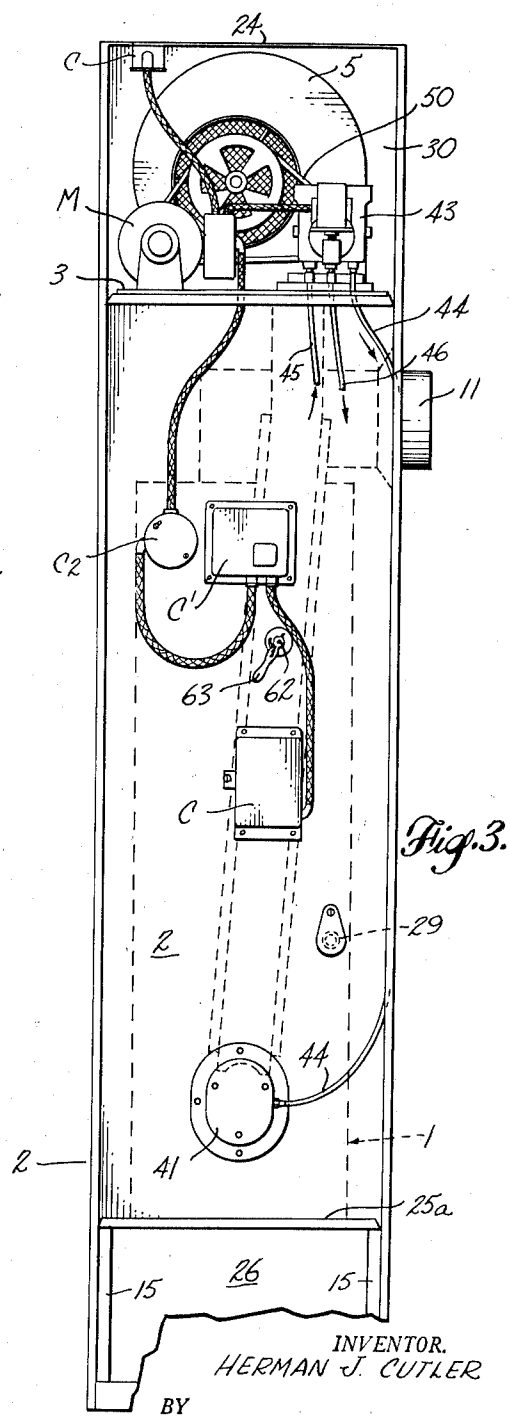


Fig. 3.

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UPRIGHT FURNACE ASSEMBLY

Filed July 23, 1956 3 Sheets-Sheet 3

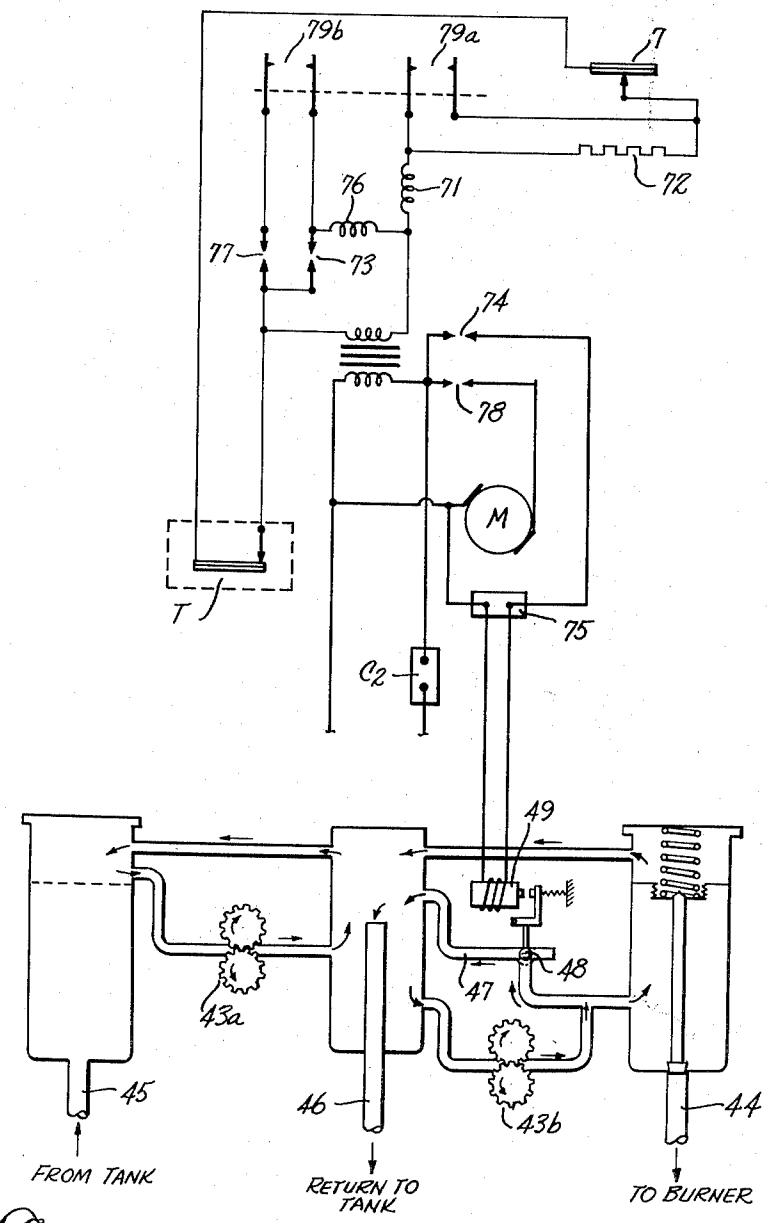


Fig. 7.

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2,865,364

# UPRIGHT FURNACE ASSEMBLY

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Application July 23, 1956, Serial No. 599,573

3 Claims. (Cl. 126—110)

This invention relates to an automatic oil-fired circulating-air furnace for heating of residences and similar small and compact spaces, especially where the floor space available for its installation is small. Each such furnace must have its functioning parts and controls conveniently accessible for inspection, adjustment and replacement, notwithstanding the compactness of the whole, yet the controls, in general, and all surrounding building structure, must be adequately insulated from overheating. The furnace assembly must be simple and inexpensive, yet reliable over long periods of continuous operation.

The furnace assembly of this invention is of a nature somewhat similar to that disclosed in the patent to W. L. Steele, No. 2,144,129 of January 17, 1939, in that it is a simplified and compact installation, and like Steele employs but one motor that drives both a blower and the oil pump, which blower circulates the air and supplies bled-off air for combustion. It differs from the Steele assembly in that the present furnace assembly is arranged with the blower, motor, and oil pump above the furnace body rather than alongside the same, whereby the whole assembly is better suited for unit installation in houses which lack any basement or furnace room, and wherein the furnace must occupy the very minimum of floor space, and no more vertical space than that between the floor and the ceiling, so that it is frequently installed in a small closet and upon the general floor slab that serves as the foundation and floor of the building.

The present invention, then, aims at the provision of a furnace assembly having a minimum area in plan and of dimensions to fit into a wall between two studs of the building wall, but of a height not exceeding the normal wall height of such a building, within which limitations must be located and installed, for easy access, all functioning elements of the furnace, of the oil burner, of the circulating blower, and of the automatic controls. Furthermore, such a furnace assembly must have its several parts adequately separated during operation, and properly heat-insulated but freely accessible for adjustment and servicing when necessary.

Furnaces of the type indicated frequently do not employ duct work, but take in air from the general space within the building and discharge it into the same space. Most usually, because convection currents rise, such furnaces are arranged to take in cold air from the floor level and to discharge the hot air near the ceiling, but this has proven to be inefficient in heating, since the hot air tends to collect and stagnate near the ceiling, and the floors are always cool, and so in an effort to heat the room down to a comfortable level near the floor, the upper part of the room is considerably overheated. By the present invention this is reversed, and the cooler air is intaken near the ceiling level and is discharged after heating near the floor level, wherefore it may rise after it has been blown into and distributed within the interior space, and so there will tend to be more nearly uniform distribution of heat at the various levels.

By reason of the driving of the circulating blower by the same motor that drives the oil pump, it might be supposed that the blower would cease operation upon opening of the room thermostat, and would not resume operation until the thermostat recloses, calling for more heat. Actually, it is necessary that the blower resume operation to dissipate residual heat in the furnace body, and that the oil burner at such time by-pass all oil pumped back to the fuel tank, and that none be delivered to the burner tip. These ends are attained by known controls, rearranged to accomplish such ends. The controls, and their rearrangement, are not part of my invention, but the same are shown and will be described hereinafter, to enable full understanding of the invention.

The present invention aims also to produce a furnace assembly of the character indicated which shall be simple and relatively inexpensive, and thus especially suited for the requirements of low-cost housing.

With such objects in mind, and others as will appear hereinafter, the present invention comprises the novel furnace assembly as a whole, and the novel combination and arrangement of the individual parts thereof with relation to one another, all as shown in a preferred form in the accompanying drawings, and as will be explained in greater detail in this specification, and the novel features whereof will be defined in the appended claims.

Figure 1 is an isometric view broken away to illustrate the complete assembly in condition for operation.

Figure 2 is, in general, an axial sectional view through the assembly on a vertical plane from front to rear, with front and rear walls removed.

Figure 3 is an elevational view of the assembly looking from the front, but with the front wall of the housing removed.

Figures 4 and 5 are transverse sectional views at the respective lines 4—4 and 5—5 of Figure 2.

Figure 6 is a detail isometric view showing the blast tube and associated parts in section, to illustrate the location and arrangement of the burner tip and its igniting means.

Figure 7 is a diagram of the oil pump and of the controls for the same and for the blower, and for the motor common to and driving both pump and blower.

The furnace assembly of this invention comprises, in general, a furnace body of appreciable vertical height but of slight cross-sectional area, having a ceramic fire pot at its bottom and a smoke stack leading laterally from its top, supported within but spaced from the walls and bottom of a sheet metal cabinet or housing; a blast tube entering from the front surrounds a burner nozzle, and conveys to the fire pot air bled off from the circulating air and conducted by an upright duct from the bleed-off point above the furnace body. Air is circulated by a blower positioned above the furnace body and directing the circulating air, intaken at the top of the housing, downwardly about the furnace body, to exit at the bottom of the housing. The air for combustion is bled off by means of an air scoop leading to the upright duct previously mentioned, and positioned at the outlet from the blower. An electric motor is located adjacent the blower, above the furnace body, to drive the blower and also to drive the oil pump, and is kept cool by the downward movement of air within the housing. Various controls are located within the housing and arranged in a special manner, all as will be described in detail hereinafter, and the housing is formed with an insulated vertical panel intermediate the furnace body and a removable front wall, whereby by locating the controls and electrical apparatus in the insulated space, they are protected from direct heat, yet are readily accessible.

The closed furnace body is indicated in general by the numeral 1, and includes a ceramic fire pot 10 of conventional shape, located at its lowermost point and open-

ing upwardly, and a smoke stack **11** leads from its upper portion and laterally for connection to a flue. Intermediate the fire pot **10** and the smoke stack **11** is the combustion space, designated in Figure 2 by the numeral **12**. All this is preferably a self-contained subassembly ready for mounting within an enclosing housing. The furnace body **1** may conveniently be of rectangular cross-section as shown, although this is not material.

Surrounding the furnace body **1** is a housing, generally indicated by the numeral **2**. This too may be of upright, rectangular cross-sectional form and is spaced at all points from the furnace body housed within it to define a heat exchange space **20**. The housing preferably consists of two opposite side walls **21**, a rear wall **22**, and a removable front wall **23**. It is, of course, closed at its top by a top plate **24**, and it should also have a bottom plate **25**. Certain of these walls, as required, are insulated to lessen the conduction of heat through the wall to closely surrounding structure.

The furnace body **1** is supported within the housing **2** in a manner such that the fire pot **10**, being the lowest part of the furnace body, is elevated appreciably above the floor level, or above the bottom **25** of the housing, to define a hot air chamber **26** at floor level. A horizontal partition **3**, constituting a platform is supported within the housing **2** above the top of the furnace body **1**, and sufficiently below the top **24** of the housing **2** to define a cold air chamber **30**. One of the walls of the housing **2**, preferably the removable front wall **23**, and, preferably in addition, the rear wall **22**, is provided with registers or louvers **27***a* and **27***b*, respectively admitting to the cold air chamber **30** and affording means for discharge from the hot air chamber **26**.

The burner tip **4** is mounted in an aperture through the furnace body **1** and its ceramic fire pot **10** to discharge into the latter, and it is surrounded at its projecting outer end by a blast tube **40**, which projects into the space between the furnace body and the removable front wall **23**. Preferably an extra panel **28**, which also may be and preferably is insulated, is installed in an upright position between and spaced from each of the front wall **23** and the furnace body, and extending from the partition **3** downwardly to about the lowermost level of the furnace body. The space **28***a* between this panel **28** and the removable front wall **23** may be completely sealed off from the air circulation space by a shelf **25***a*. This shelf may, itself, constitute the support for the furnace body **1**, or the latter may and preferably is supported by U-shaped supports or brackets **15**, from the floor directly. The outer end of the blast tube **40**, within the space **28***a*, is closed by a removable cap **41**, whereby access may be had to the burner tip **4** and to the igniting spark means therein, indicated at **42** (see Figure 6).

A blower **5** is provided for forced circulation of air through the housing, for the air movement is counter to convection currents. This blower is mounted or supported from the partition **3**, preferably being located in the cold air chamber **30**. Its inlet, being open to that chamber, takes in air admitted through the upper register **27***a*, and the blower outlet communicates (by way of an opening **50** in the partition **3**) with the heat exchange space **20** between the furnace body **1** and the housing **2**. A motor M is provided for driving the blower **5**, and this too can be supported upon the partition **3**. There must also be an oil pump, which is indicated generally at **43**, and which in practice may include (Figure 7) a suction pump **43***a* and a pressure pump **43***b*. This also can be supported upon the partition **3**, in such manner that the motor M drives both the blower **5** and the oil pump **43** by means of a common belt **59**. An oil pressure line **44** extends from the output of the oil pump **43** (or **43***b*) to the blast tube **40** and thence to the burner tip **4**. An oil feedline **45**, as is customary, will also extend to the oil pump **43** (or **43***a*), and a return line **46**, also customary, will return to the tank (not shown) all oil not delivered to the burner tip or to the pressure pump **43***b* for delivery to such burner tip **4**.

As in the Steele patent mentioned above, no separate blower is provided for supplying combustion air to the burner tip. Instead, a portion of the air is bled off from the circulating air supply and is conveyed by a suitable duct to the blast tube **40**, and thence past the burner tip into the fire pot. In the present arrangement however, differing from the Steele arrangement, it is necessary to provide a fairly extensive and lengthy duct, and one that is conveniently accessible when this is necessary. Such a duct is indicated in general by the numeral **6**, and comprises, in effect, an air scoop **60** for interposition within the air discharge aperture **50** from the blower **5**, and a channel-shaped duct **6** extending downwardly from the scoop for connection to the blast tube **40** whence air is directed around the burner tip **4** and into the fire pot **10**. The channel of the duct **6** is open to the front, and the channel-shaped form of the scoop **60** is open to the top, these open sides being closed respectively and to the extent necessary, by the panel **28** and by the partition **3**. Thus, upon removal of the panel or partition **28**, the air duct is freely opened and accessible, yet is adequately closed when the panel **28** is in place. The duct **6** may be insulated if desired, since it extends downwardly alongside, but not in contact with, the furnace body **1**.

It being desirable to regulate the volume of air admitted through the blast tube, in correct ratio to the volumetric rate of the oil supplied to the burner tip, this is conveniently done by providing a damper **61** in the duct **6**, mounted upon a spindle **62** pivoted in the panel **28** and provided with a handle **63** within the space **28***a*, by means of which the position of the damper **61** in its duct may be regulated.

Such a burner is provided with various automatic controls, a transformer, condenser, junction boxes, etc., and all these, to the greatest extent possible, should be so located that they are readily accessible, and so that they are not harmfully affected by the heat of the furnace body. By locating them so far as possible in the space **28***a* between the removable front wall **23** and the insulated upright panel **28**, such controls, etc., may be readily accessible and yet are protected by the insulated panel **28** from the heat. Various such controls are shown and indicated generally by the letter C, but they may be largely of known character and arrangement, and it is not necessary to describe them in detail, with certain exceptions hereinafter explained. An inspection pipe **29** permits inspection of the character of the flame within the fire pot.

Because the space **28***a*, if closed over long periods of operation, might tend to heat up to an undesirable temperature despite the insulation of the panel **28**, louvered apertures **23***a* in the removable front wall **23** are provided at top and bottom respectively of this space, for passage of convection currents through the space **28***a* to cool it and the installations therein.

It has been explained that the blower must operate after cut-off of oil to the burner tip, in order to dissipate residual heat in the furnace body, yet when the thermostat calls for heat, the oil pump must commence to operate normally, as the blower commences its operation. All this must occur notwithstanding the driving of the single blower **5** and the oil pump **43** by the common driving motor M. Such operation is accomplished by certain controls which in essence are normal controls in such an installation, but slightly rearranged. None of this is part of my invention, and is not claimed by me.

The oil pump is provided with an internal by-pass passage **47**, having a solenoid valve **48** biased to remain open, for return of all oil pumped to the tank via pipe **46**, but movable to closed position when its solenoid **49** is energized, for delivery of pumped oil to the burner tip. Such a by-pass valve is normal, except that nor-

mally it is biased to close, and is opened only by energization of the solenoid. The electrical control circuit is substantially normal, with the exception just noted, and will be best understood by describing its operation.

When the room thermostat T calls for heat, the starting circuit is established through relay coil **71**, safety switch heater **72**, safety switch **7**, and back to the thermostat T. Relay coil **71**, thus energized, closes its low-voltage contacts **73** and line-voltage contacts **74**. When **73** and **74** close, the ignition at **75** comes on, the oil valve **48** closes, and the low-voltage circuit is established through relay coil **76** and contacts **74**. Relay coil **76**, thus energized, closes its contacts **77** and **78**. When **78** closes, the line-voltage circuit is completed to motor M, which then starts. The oil valve **48** having previously been closed, delivery of oil to the burner tip commences with energization of motor M.

If flame is not established, the stack temperature will not rise enough to close Pyrostat hot contacts **79***a* (the Pyrostat **79** being projected into the furnace body) before the end of the safety switch timing period. The current through the safety switch heater **72** will therefore cause the safety switch **7** to lock out, or open. Normally, however, the furnace temperature will rise, first closing Pyrostat hot contacts **79***a* and then **79***b*. When **79***a* closes, the safety switch heater **72** is shunted out, and the running circuits are completed.

When the thermostat T is satisfied, its contacts open, breaking the low-voltage circuit through relay coil **71**, hot contact **79***a*, safety switch **7**, and thermostat. Deenergizing the relay coil **71** causes contacts **73** and **74** to open. When **74** opens, the line-voltage circuit is broken to ignition at **75** and to the oil valve solenoid at **49**. The oil valve will open, thereafter by-passing all oil back to the tank, and the ignition will cut off.

The motor M continues to operate, to provide a post-cycle purge, for the purpose of dissipating residual heat, because the motor-relay holding circuit is maintained through relay coil **76**, hot contact **79***b*, and relay contacts **77**. The motor will continue to run until the combustion chamber temperature drops to a given low value, enough to cause the Pyrostat hot contact **79***b* to open, breaking the motor-relay holding circuit. During none of this time is there any delivery of oil, although the blower is running.

A high limit control switch at C2 in the line closes at a given low value and opens at a given higher value, so that whenever air in the space **28***a*, wherein the control C2 is installed, reaches the upper limit of temperature, this limit control C2 opens and shuts off everything.

By the construction described, there is provided a compact upright furnace of good efficiency, with forced circulation in a direction which affords the best heating efficiency for the space to be heated, with all parts accessible when necessary, and protected against undue heat. The furnace assembly, notwithstanding its close proximity to the wall structure, will not heat the latter beyond an acceptable temperature, even during prolonged operation. Operating parts are reduced to a minimum, and the installation is of reasonable cost, yet is reliable over long periods of time.

I claim:

1. A unitary furnace assembly comprising an upright housing having a separate, closable and openable front wall for access to the space within the housing immediately behind said front wall, the housing being adapted to be supported from the floor, and an upright furnace body supported within the housing with its bottom above the floor level and its top below the upper end of the housing, the housing and furnace body being of relative sizes and relatively disposed to define a hot air chamber at floor level beneath the furnace body and a generally upright heat exchange space surrounding the furnace body and between the latter and the housing, said heat exchange space communicating at its bottom with the hot air chamber; an upright panel spaced intermediate the front wall of the housing and the furnace body to define an upright control space generally separate from the heat exchange space; a platform supported within the housing in spaced relation above the furnace body and below the top of the housing to define an uppermost cold air chamber, the housing having registers admitting air to the cold air chamber and for discharge of such air from the hot air chamber; the furnace body including a fire pot at its lower end, a smoke stack leading from its upper end, and an intermediate combustion space; an oil pump, a blower, and a motor connected to drive the pump and the blower, all supported from said platform, the blower inlet being open to the cold air chamber and its outlet opening discharging through said platform to the heat exchange space; a blast tube within but closed off from the heat exchange space, projecting at its outer end into said control space, and connected for discharge within the fire pot; a cap closing the outer end of the blast tube and accessible from within the control space; an oil burner tip within said blast tube; an oil line extending between the oil pump and said burner tip; an air duct generally of channel form located within the heat exchange space immediately behind and normally closed at its open side by said upright panel, said air duct including an air scoop disposed immediately below the platform at the blower outlet opening of a size and shape relative to such outlet opening to intercept a portion of the discharged air, said air duct extending downwardly from said scoop within the heat exchange space past the furnace body to said blast tube to supply air into the blast tube and past the burner tip for combustion; control devices operatively connected to the furnace assembly; and control means operatively connected to said control devices and located in and accessible from within the control space.

2. A unitary furnace assembly as in claim 1, including a control damper disposed in said air duct, a spindle journaled in the upright panel and mounting said control damper to vary the air volume moving through the air duct, and a handle carried upon said spindle for controlling said damper, located in said control space.

3. A unitary furnace assembly comprising an upright housing including a front wall closable and openable for access to the space immediately therewithin, the housing being adapted to be supported from the floor, and an upright furnace body supported within the housing with its bottom above the floor level and its top below the upper end of the housing, the housing and furnace body being of relative sizes and relatively disposed to define a hot air chamber at floor level beneath the furnace body and a generally upright heat exchange space surrounding the furnace body and between the latter and the housing, said heat exchange space communicating at its bottom with the hot air chamber; a platform supported within the housing in spaced relation above the furnace body and below the top of the housing to define an uppermost cold air chamber, the housing having registers admitting air to the cold air chamber and for emission of such air from the hot air chamber; the furnace body including a fire pot in its lower portion; a blast tube admitting to said fire pot and projecting from the furnace body into the heat exchange space; an oil pump, a blower, and a motor connected to drive the pump and the blower, all supported from said platform, the blower inlet being open to the cold air chamber and its outlet opening discharging through said platform to the heat exchange space; an oil burner tip within said blast tube and an oil line extending between the pump and the burner tip; an upright panel removably supported intermediate the front wall of the housing and the furnace body to define an upright space within but separate from the heat exchange space and accessible by opening the front wall, the blast tube pro-

jecting into said separate space; and an air duct generally of channel form disposed within the heat exchange space with its open side forwardly and located immediately behind said upright panel to be closed by the latter, said air duct including an air scoop disposed immediately below the platform at the blower outlet opening of a size and shape relative to such outlet opening to intercept a portion of the discharged air, said air duct extending downwardly to and connected for discharge within said blast tube to supply air for combustion.



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