# United States Patent [19]

**Beavers**

[11] **3,916,870**

[45] **Nov. 4, 1975**


[54] **HEATER-BLOWER ASSEMBLY**


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[73] Assignee: **T. A. Pelsue Company,** Englewood, Colo.



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[52] **U.S. Cl.** ..... **126/110 B;** 126/116 R; 431/153

[51] **Int. Cl.²** ..... **F24H 3/10**

[58] **Field of Search** ..... 126/110 R, 110 B, 110 D, 126/116 R, 116 A, 116 B; 431/153; 339/153, 339/154 R, 28, 29 R; 219/201



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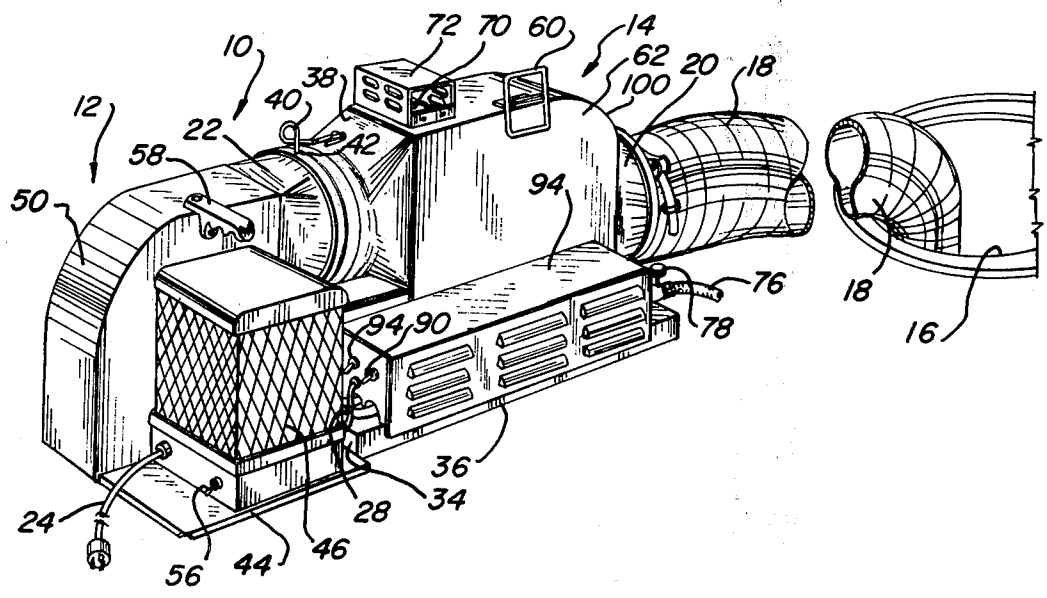
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*Attorney, Agent, or Firm*—Edwin L. Spangler, Jr.



[57] **ABSTRACT**

This invention relates to a heater-blower assembly for supplying warm air to subsurface installations that is characterized by a self-contained master blower subassembly which can be used by itself as a source of cool air and a slave heater subassembly which will only operate when connected to the blower. The subassemblies in assembled relation cooperate to shield and keep the power connection therebetween connected. The heater subassembly has a master burner and a slave burner, the master being independently operative while the slave can only operate when the master is actuated.


**10 Claims, 13 Drawing Figures**



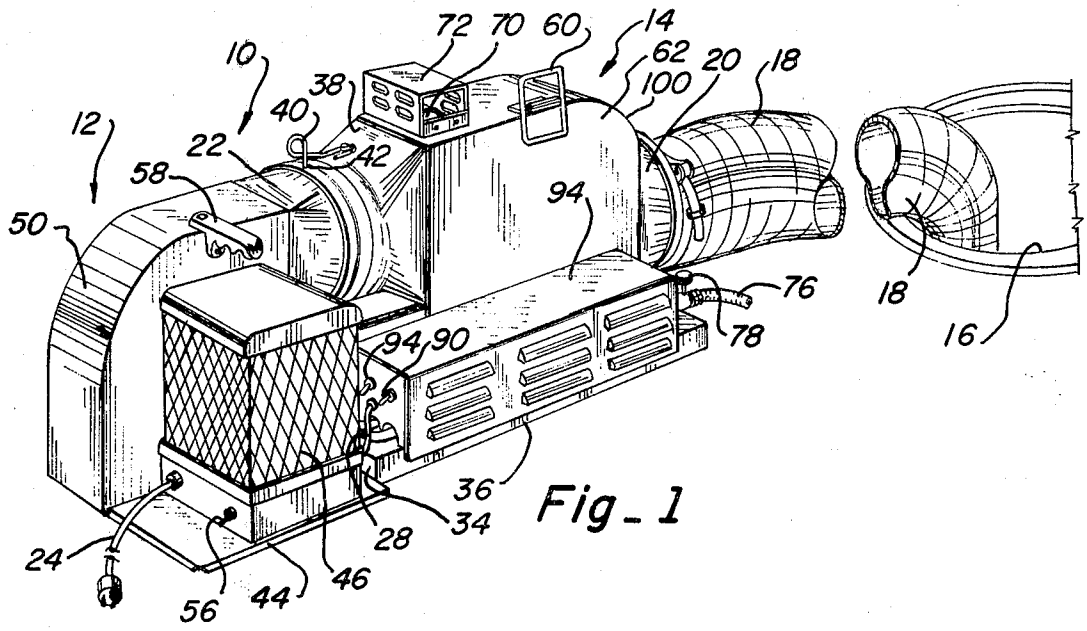



Fig_1

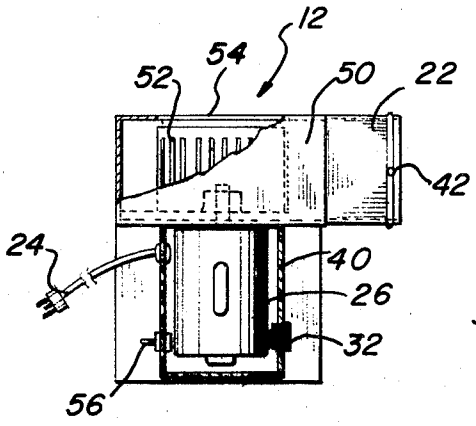



Fig_2

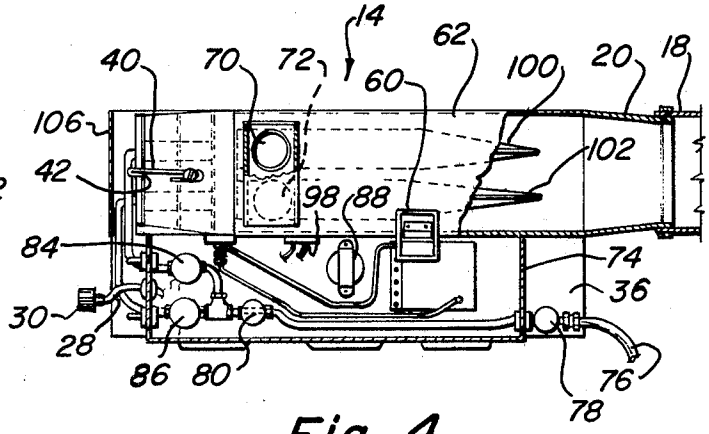



Fig_4

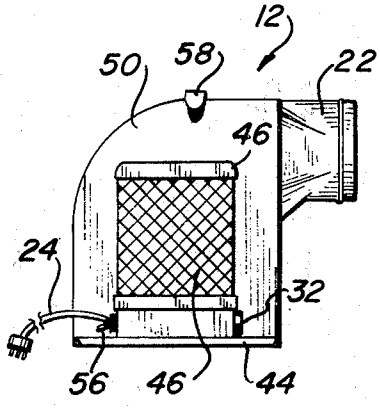



Fig_3

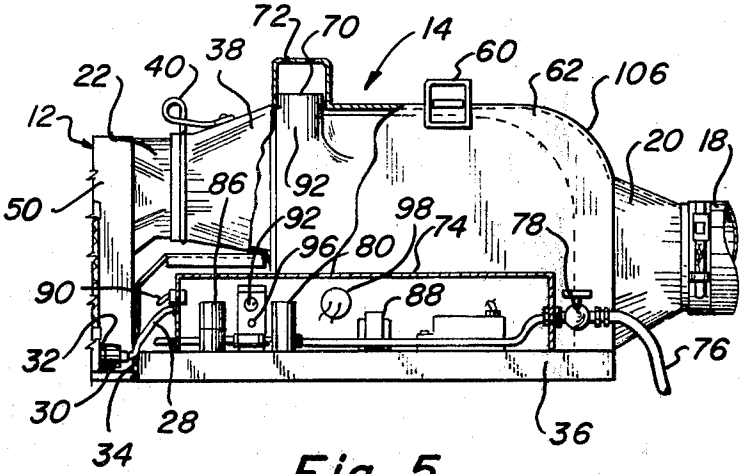



Fig_5

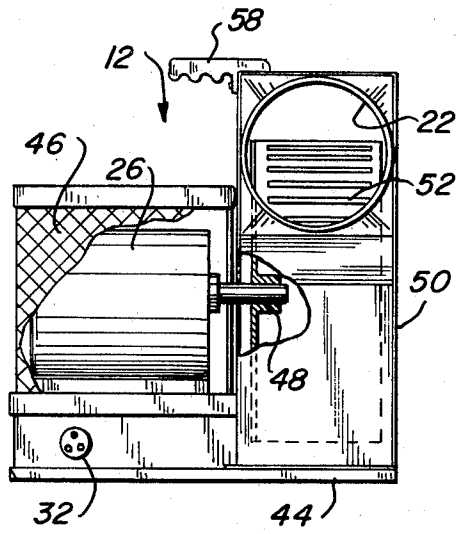



Fig_6

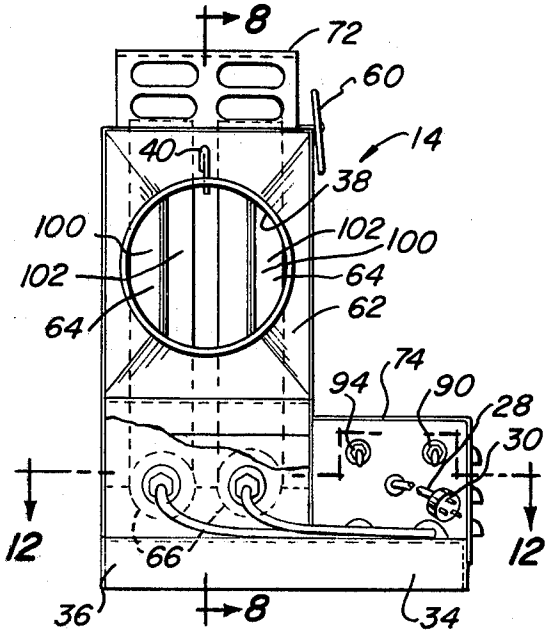



Fig_7

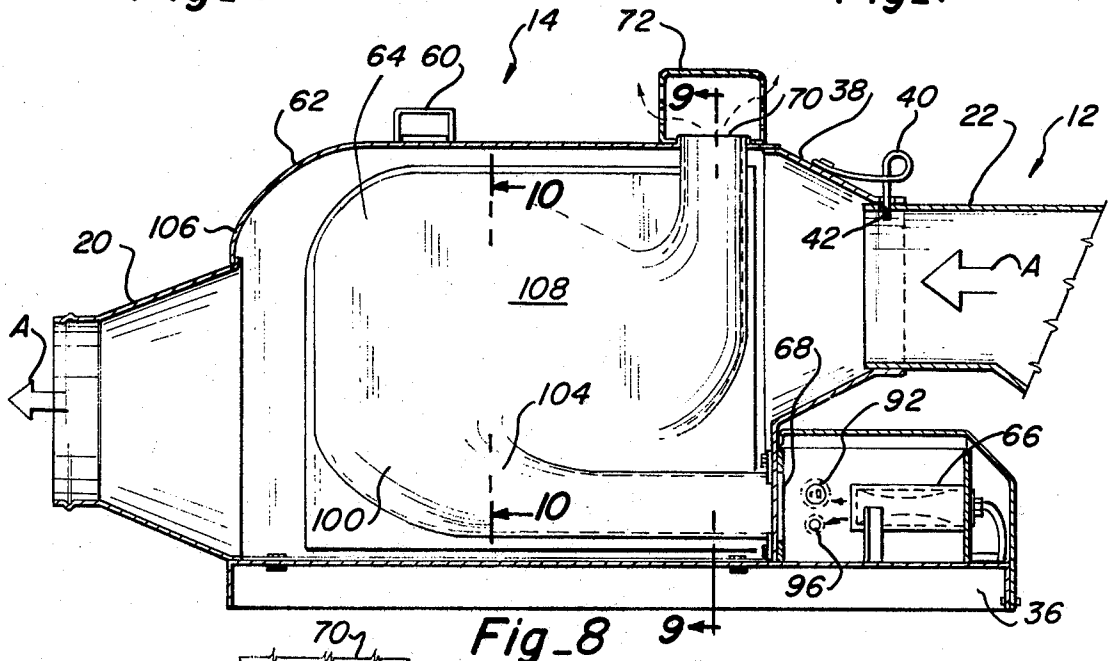



Fig_8

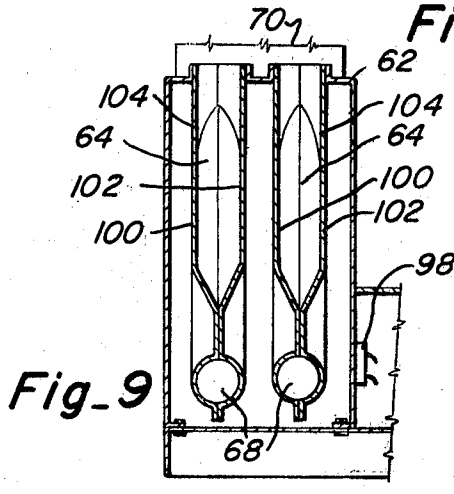



Fig_9

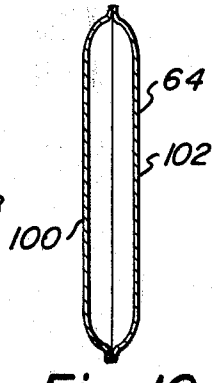



Fig_10

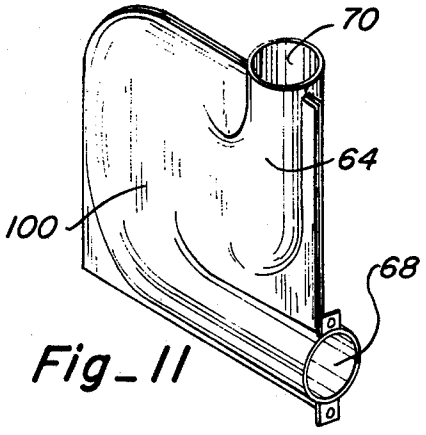



Fig_11

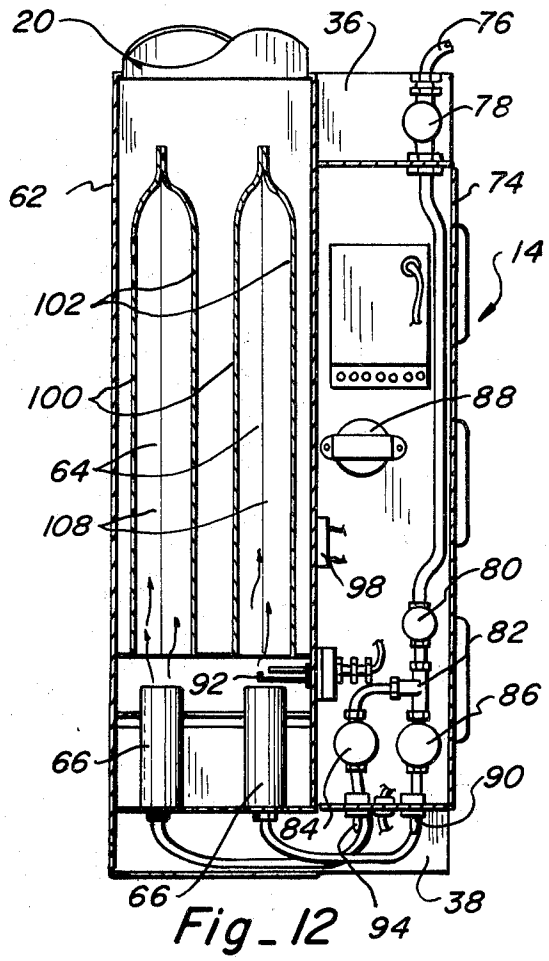

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Fig_12

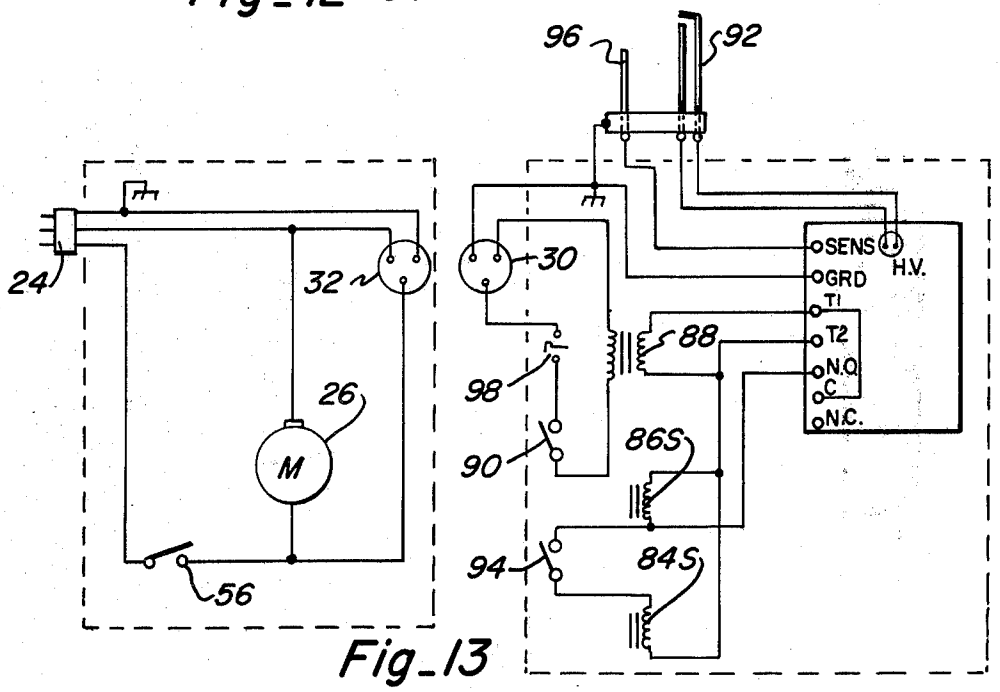

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N.O.
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90
86S
94
84S
56

Fig_13

# HEATER-BLOWER ASSEMBLY

Safety regulations governing working conditions in underground utility installations require that they be ventilated for the safety of the personnel. Surface-mounted blowers have been used for years to supply cool air to such installations by means of large diameter flexible ducts passing down through manholes. In fact, combination heater-blower units have been developed for this same purpose, one of which forms the subject matter of U.S. Pat. No. **2,811,962,** of which I am a co-inventor.

Building both the heater and blower into the same unit has certain advantages as well as disadvantages. Among the latter is the problem of keeping the unit light and compact enough to be easily portable while, at the same time, providing adequate heating and ventilating capacity. Also, even in the cold climates, the heater is only needed a few months out of the year and it becomes excess baggage the rest of the time.

It has now been found in accordance with the teaching of the present invention that these and other deficiencies inherent in the prior art combination heater-blower units including my own can, in large measure, be eliminated by the simple, yet unobvious, expedient of making a master self-contained blower unit that is independently operative and of larger capacity while remaining fully portable and adding thereto an equally portable slave heater operable only when connected to the blower. The blower is so designed and constructed that it provides maximum utility and output when used alone as it usually is. The heater, on the other hand, can provide a significantly greater heat output and still remain fully portable due to the fact that the blower motor which is the single heaviest component no longer forms a part thereof.

With the advantages of separability, however, come certain problems such as, for example, the inherent danger of overheating in case the blower becomes disconnected or otherwise inoperative. Thus, a temperature-responsive control circuit is included in the plenum and automatically operative to shut down the burners whenever the air flow stops or is obstructed to a point where the temperature exceeds a predetermined maximum. While temperature-responsive shut-off mechanisms are common in various types of furnaces and the like, the construction which prevents the power failure from taking place that is most often responsible for overheating is not. Not only is the plug and socket of the interlocking type but, in addition, the blower housing and heater housing cooperate in assembled relation to shield the plug and prevent its accidental or even intentional removal.

Electrically, the main blower control switch must be closed before any power is supplied to the heater for igniting the electrically-actuated burners. Also, the heater has a master burner and a slave burner, the latter being ignitable only after the former has been lighted. With both burners lighted, the heat output is effectively doubled over using the master alone.

Accordingly, it is the principal object of the present invention to provide a novel and improved heater-blower assembly.

A second objective of the invention is to provide a two-element assembly of the type described wherein the blower unit is a self-contained subassembly having utility independent of the heater subassembly.



Another objective of the within described invention is to provide a heater subassembly which is functionally dependent in all respects upon the blower subassembly.

Still another objective is to provide a mechanical power interlock rendered disconnectable by the juxtaposed relation of the subassembly housings when in assembled relation.

An additional object of the invention forming the subject matter hereof is to provide an assembly with maximized utility as well as output achieved through separability of its components and all without sacrificing portability.

Further objects are to provide a heater-blower assembly for underground installations which is safe, efficient, versatile, easy to use, compact, rugged, reliable and even decorative in appearance.

Other objects will be in part apparent and in part pointed out specifically hereinafter in connection with the description of the drawings that follows, and in which:

FIG. **1** is a perspective view looking down and to the right upon the heater-blower assembly of the present invention as it delivers heated air into a subsurface installation through an open manhole, portions of the air duct having been broken away and shown in section to conserve space;

FIG. **2** is a top plan view of the blower subassembly alone, portions of the housing having been broken away to expose the fan;

FIG. **3** is a top plan view of the heater subassembly showing the corner removed from a portion of the housing to expose the elements contained therein and part of the plenum broken away to reveal the heat exchangers;

FIG. **4** is a side elevation of the blower subassembly;

FIG. **5** is a fragmentary side elevation of the heater-blower assembly, again having portions of the housing broken away to reveal the interior construction;

FIG. **6** is a front elevation of the blower with parts of the housing broken away to reveal the blower motor and squirrel-cage fan;

FIG. **7** is a rear elevation of the heater subassembly by having parts of the plenum broken away to expose the gas lines to the burners;

FIG. **8** is a fragmentary section taken alone line **8—8** of FIG. **7**;

FIG. **9** is a fragmentary section taken along line **9—9** of FIG. **8**;

FIG. **10** is a section of the heat exchanger alone taken along line **10—10** of FIG. **8**;

FIG. **11** is a perspective view of one of the heat exchangers;

FIG. **12** is a section taken along line **12—12** of FIG. **7**; and,

FIG. **13** is an electrical diagram of the assembly.

Referring next to the drawings for a detailed description of the present invention and, initially, to FIG. **1** for this purpose, reference numeral **10** has been selected to broadly designate the heater-blower assembly while numerals **12** and **14** have been similarly employed to denominate the blower and heater subassemblies, respectively. Reference numeral **16** is the manhole entering into an underground installation requiring ventilation, the manhole cover (not shown) having been removed therefrom. A flexible air duct **18** of conventional design has been shown detachably connected to the heater outlet **20.** This duct **18** is connectable di-

rectly to the blower outlet **22** in those instances where the blower subassembly **12** is used separately and no heater is required.

Power cord **24** on the blower is connectable to any **115V** AC power source which runs the blower motor **26.** Power cord **28** on the blower subassembly **14,** on the other hand, is not intended at least for direct connection to a source of electrical power, but instead, is preferably fitted with a special bayonet-type rotatable locking plug **30** that interlocks into socket **32** therefor (FIGS. **2, 3, 6** and **13**). While the more common variety of 3-wire plug like that found on the blower can, of course, be used in place of the special interlocking type, the latter has the advantage of requiring a special socket adapted to mate therewith which is far less common, thus virtually eliminating the possibility that the heater will be accidently connected directly to a power source. Accordingly, when used as intended, the heater subassembly is always a slave unit to the blower subassembly upon which it depends for its electrical power.

While on the subject of the electrical connection between the blower and heater subassemblies, reference will be made briefly to FIG. **5** where it will be seen that once the heater and blower units are detachably connected together in assembled relation as shown, the space left behind plug **30** over to the step **34** in the base **36** is insufficient to permit removal of the plug from its socket. Thus, one must disconnect the blower outlet **22** from the heater inlet **38** and separate the two subassemblies before the electrical connection therebetween can be disconnected. Conversely, plug **30** must be inserted into its socket **32** before the connection is made between the blower outlet and heater inlet. Thus, in order to disconnect the aforementioned electrical connection, one must first disengage the spring latch **40** atop the heater inlet and separate the two subassemblies.

In FIGS. **1, 2, 4** and **8** to which brief reference will be made while on the subject of spring latch **40,** it will be seen to extend down through vertically-aligned apertures **42** in the blower outlet and heater inlet when in assembled relation as shown. Other types of latches could, of course, be substituted for the one shown, but it has the advantage of being simple, inexpensive and easy to operate.

The blower subassembly **12** is best revealed in FIGS. **1, 2, 3** and **6** where it will be seen to have a base **44** upon which is mounted a conventional electric motor **26** protected inside a ventilated housing **46.** The motor shaft **48** extends into a fan housing **50** mounted alongside thereof that houses the squirrel-cage-type fan **52.** Air enters opening **54** (FIG. **2**) in the side of the blower housing **50** opposite the side where the motor shaft is located and is propelled by fan **52** out through outlet **22** in the well-known manner. Switch **56** on the motor housing is used to turn the motor on and off. A handle **58** facilitates transportation of the blower subassembly by itself and also cooperates with handle **60** on the heater subassembly to enable both subassemblies to be lifted together when in the assembled relation shown in FIGS. **1** and **5.** While the assembly can be moved a short distance in this manner, the subassemblies are preferably moved separately and connected together at their point of use as this enables both units to be made larger and with a capacity more nearly answering the heating and ventilating requirements of the usual subsurface installation.

So far as the novelty of the blower subassembly is concerned, it has none apart from the heater subassembly **14** with which it cooperates in a unique manner in assembled relation. Saying this another way, with the exception of latch aperture **42** in the outlet **22,** hot socket **32** and the location of the latter relative to the heater housing, the remaining elements of the blower subassembly are conventional both from the standpoint of their function and their construction. Even the aforementioned additions to the blower subassembly have no function apart from the assembly that includes the heater and they are, therefore, surplusage when the blower is used alone.

Now, the heater subassembly **14** is most clearly revealed in FIGS. **1, 4, 5, 7, 9** and **12** to which detailed reference will now be made. Mounted along one side of the base **36** is the plenum **62** within which the heat exchangers **64** are mounted in side-by-side relation. Air from the blower subassembly **12** enters the plenum through inlet **38,** passes over the heat exchangers **64** and exits through the outlet **20** in the usual manner, such flow having been indicated by the arrows "A" in FIG. **8.** The hot gaseous products of combustion from the burners **66** enter the intake ends **68** of the heat exchangers, migrate therethrough in heat-exchange relation with the cold air moving through the plenum, and are exhausted out the chimney **70** beneath protective cover **72.**

Fastened to the other side of the base **36** alongside the plenum is a louvered housing **74** containing the burner controls. Gas under pressure enters the housing through gas line **76** containing shut-off valve **78.** Inside the housing the gas passes through a pressure regulator **80** and into a T-connection **82** that splits the stream and sends one branch to a first solenoid-actuated valve **84** and the other to a second solenoid-actuated valve **86.**

In FIG. **13** it can be seen that solenoids **84S** and **86S** of these valves **84** and **86,** respectively, are wired to the low side of transformer **88** which is, in turn, energized by closing master power switch **90** on the front of the housing. With switch **90** closed, the transformer will energize the solenoid **86S** of valve **86** and open it to admit gas to one of the two burners **66.** Closing of switch **90** also completes a high voltage circuit to electric ignitor **92** which ignites the gas issuing from the burner. A slave switch **94** is wired to the low side of transformer **88** and, in closed position, it will energize solenoid **84S** to open valve **84** and admit gas to the second burner **66** provided that main switch **90** is also closed to energize the transformer. Thus, the second burner fed by valve **84** cannot be lit unless the first burner is lit or at least simultaneously actuated. Ignitor **92** and flame sensor **96** actually comprise components of a standard direct spark ignition (D.S.I.) control system which is well known in the art and widely available commercially. When switch **90** is actuated, for example, ignitor **92** generates **19,000** volt spark which will light one or both burners **66.** The flame sensor continuously "proves" the flame and is automatically operative to shut down the system in the event of either an electric power failure or a lack of gas. Once off, the system cannot be restarted until switch **90** is turned off and then closed again.

As far as the circuit diagram of FIG. **13** is concerned, the only remaining element that has not been described is thermal switch **98.** This switch is connected into the

side of the plenum **62** as shown most clearly in FIGS. **4, 5** and **9** in the path of the air moving therethrough. It is a normally-closed temperature-sensitive switch automatically operative to de-energize the D.S.I. system whenever the plenum temperature exceeds a predetermined maximum. So long as the blower subassembly is operative and nothing is plugged or kinked to prevent free movement of the air through the plenum, the thermal switch will remain closed and inoperative to shut down the D.S.I. system.

Finally, with brief reference to FIGS. **10** and **11**, the heat exchangers **64** will be seen to each comprise a pair of mating preformed half-sections **100** and **102** that are mirror images of one another and are joined together along their outer marginal edges to produce a circuitous gas-circulating tunnel **104** therein. Tunnel **104** extends along the bottom of the plenum from the intake **68** adjacent the burners and then curves up along the rear wall **106** of the plenum near its outlet **20.** From this point, the tunnel opens into a large central chamber **108** which, in turn, communicates with the chimney **70.** The hot products of combustion, therefore, flow along the bottom of the heat exchanger in concurrent flow relation to the blower air, up along the rear wall, forwardly in countercurrent flow relation along the top, down into the entrance to the chimney and back up again where it is exhausted out the latter. Thus, the blower air has ample opportunity to pick up heat from one or both heat exchangers as it is force-fed through the plenum.

What is claimed is:

**1.** A portable heater-blower assembly comprising in combination: a blower subassembly including an electric-motor driven forced air fan, a blower housing enclosing said fan having an outlet connectable to an air duct, and an electrical outlet within said housing alongside said air outlet facing in the same direction as the latter; a heater subassembly including at least one gas-fired burner connectable to a source of gaseous fuel, electric ignition means positioned adjacent said burner operative upon actuation to ignite same, first electrically-actuated valve means connected to control the supply of fuel to said burner; a heater housing including a plenum having an air inlet detachably connectable to the forced air outlet of the blower subassembly, a heat exchanger within said plenum positioned to receive the hot gaseous products of combustion from the burner and pass same in heat-exchange relation to the air from the blower subassembly, an electrical circuit including the electric ignition means and first electrically-actuated valve means having a plug detachably connectable to the electrical outlet of the blower subassembly, and means carried by said heater housing in opposed relation to the electrical outlet in said blower housing cooperating therewith to maintain said plug operatively connected thereto when the heater plenum inlet is connected to receive air from the forced air outlet of the blower subassembly.

**2.** The combination as set forth in claim **1** in which: the means carried by said heater housing in opposed relation to said blower housing electrical outlet comprises an abutment-forming step.

**3.** The combination as set forth in claim **1** in which: the electrical circuit includes a length of conductor terminating in the plug, said conductor length being selected such that said plug will only reach the electrical outlet in the blower housing when the forced air outlet is positioned to deliver air into the heater inlet.

**4.** The combination as set forth in claim **1** in which: the blower subassembly includes switch means connected to the electrical outlet operative upon actuation to energize the electrical circuit of the heater subassembly.

**5.** The combination as set forth in claim **1** in which: the electrical circuit of the heater subassembly includes a normally-closed temperature sensitive switch, said switch being located in the plenum in the path of the air moving therethrough from the blower subassembly, and said switch being automatically operative to de-energize said electrical circuit whenever the air temperature in said plenum exceeds a predetermined value.

**6.** The combination as set forth in claim **1** in which: the heater subassembly includes a second burner in position to be fired by the electric ignition means; and, in which the electrical circuit includes a second electrically-actuated valve means connected to control the supply of gas to the second burner and a first switch operative upon actuation to open said second valve means, said second valve means being located downstream of the first electrically-actuated valve means in series therewith and with said second burner.

**7.** The combination as set forth in claim **1** in which: the forced air outlet of the blower subassembly and the air inlet of the heater subassembly telescope one inside the other to define a continuous duct; and, in which latch means releasably maintains said inlet and outlet in telescoped relation.

**8.** The combination as set forth in claim **1** in which: the electrical circuit includes a second switch operative upon actuation to open said first valve means and simultaneously fire said electric ignition means.

**9.** The combination as set forth in claim **6** in which: the electrical circuit includes a second switch operative upon actuation to open said first valve means and simultaneously fire said electric ignition means.

**10.** The combination as set forth in claim **6** in which: a second heat-exchanger is mounted inside the plenum in position to receive the hot gaseous products of combustion from the second burner and pass same in heat-exchanger relation to the air from the blower subassembly.

* * * * *