Dec. 3, 1946. H. B. HOLTHOUSE 2,412,088

UNIT HEATER

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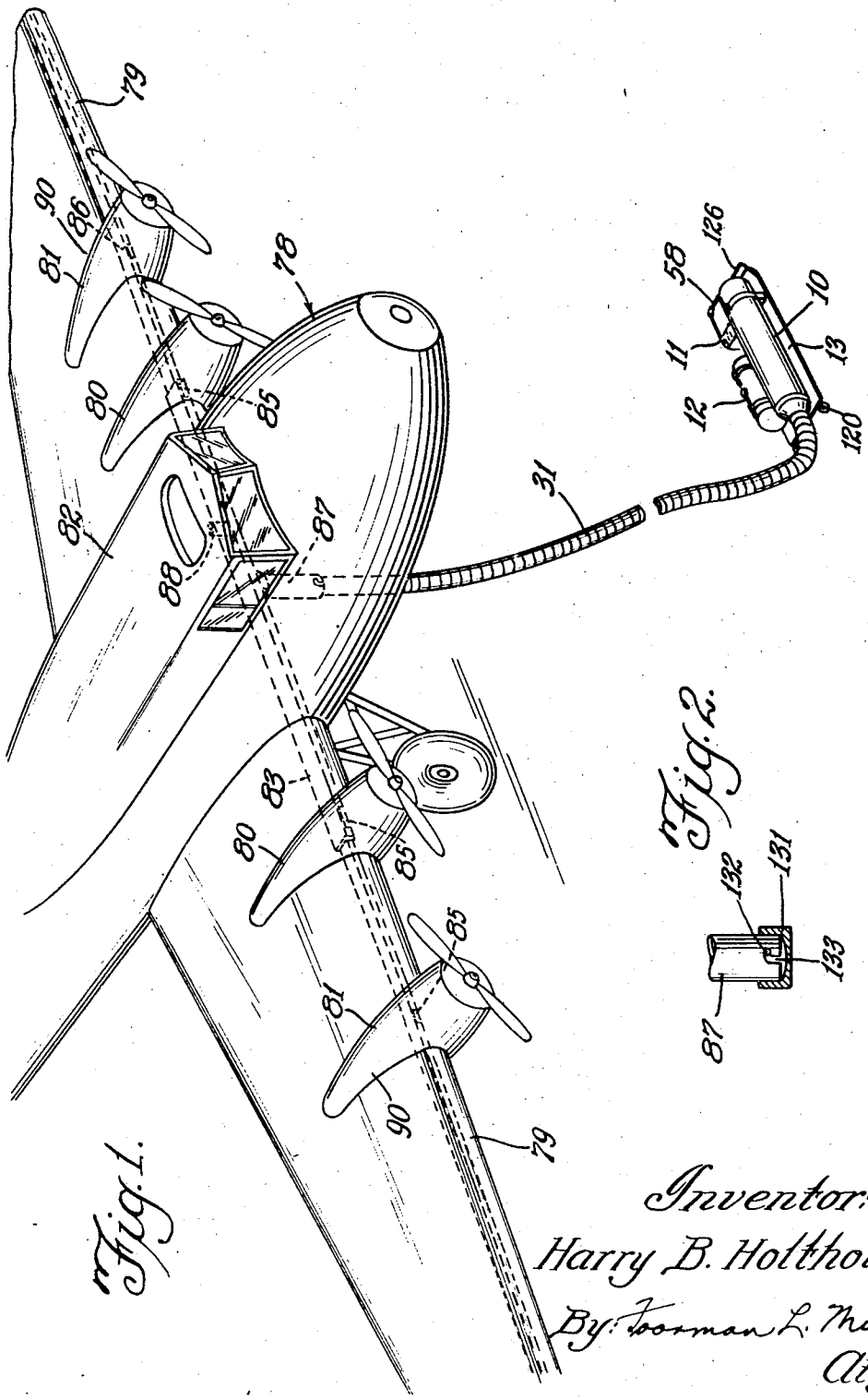


Fig. 1.

Fig. 2.

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UNIT HEATER

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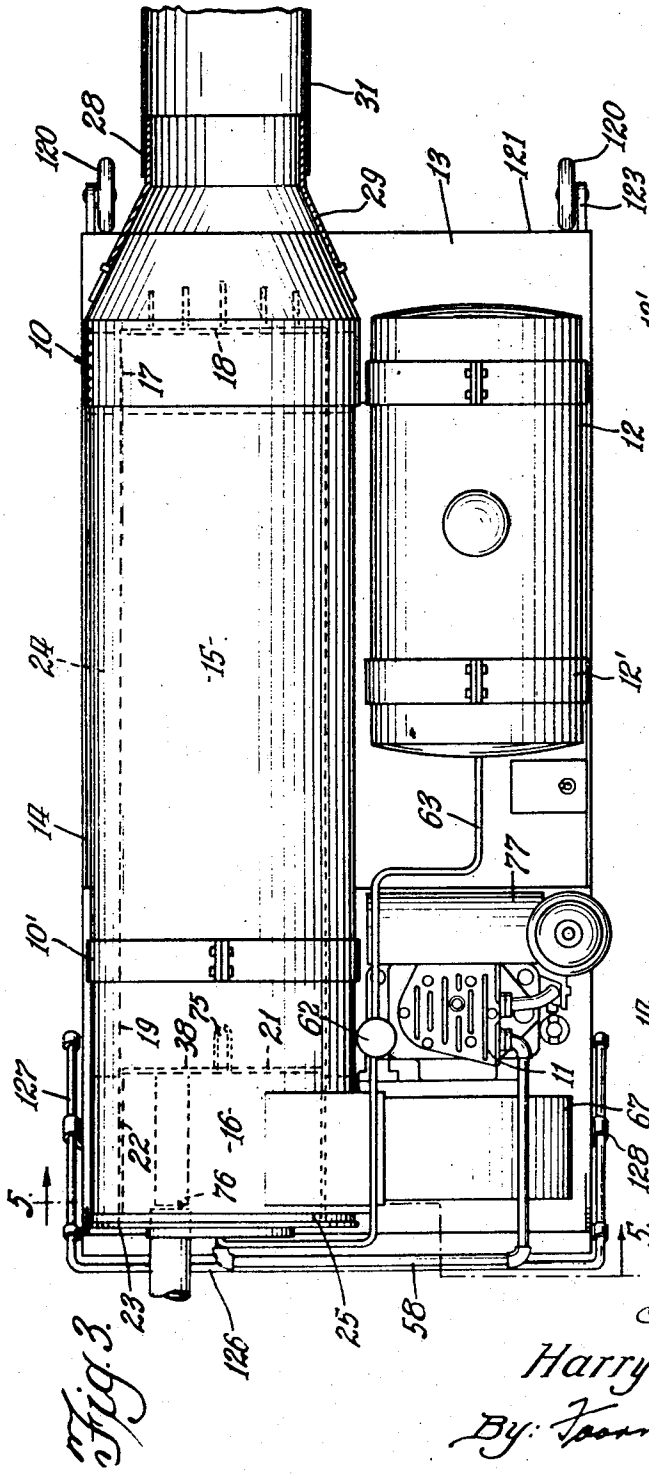


Fig. 3.

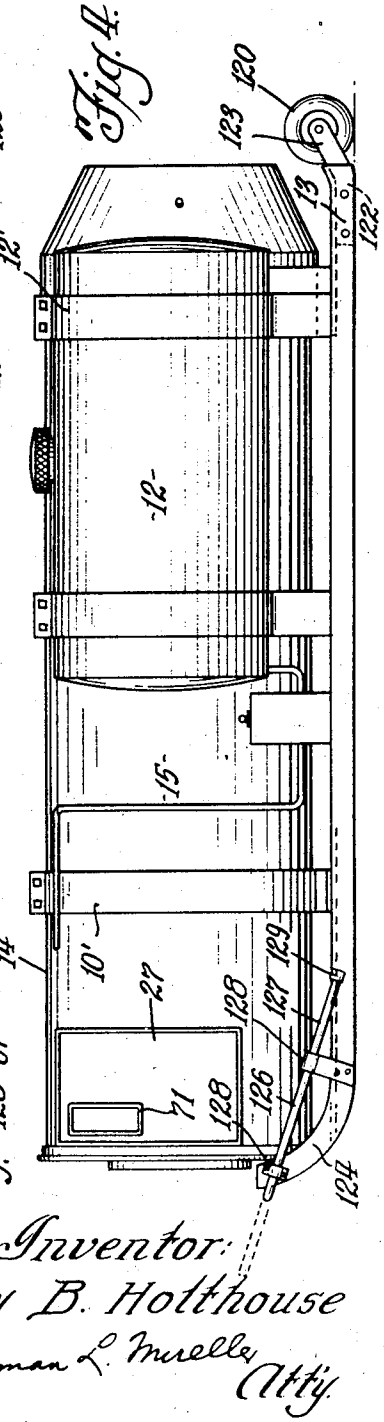


Fig. 4.

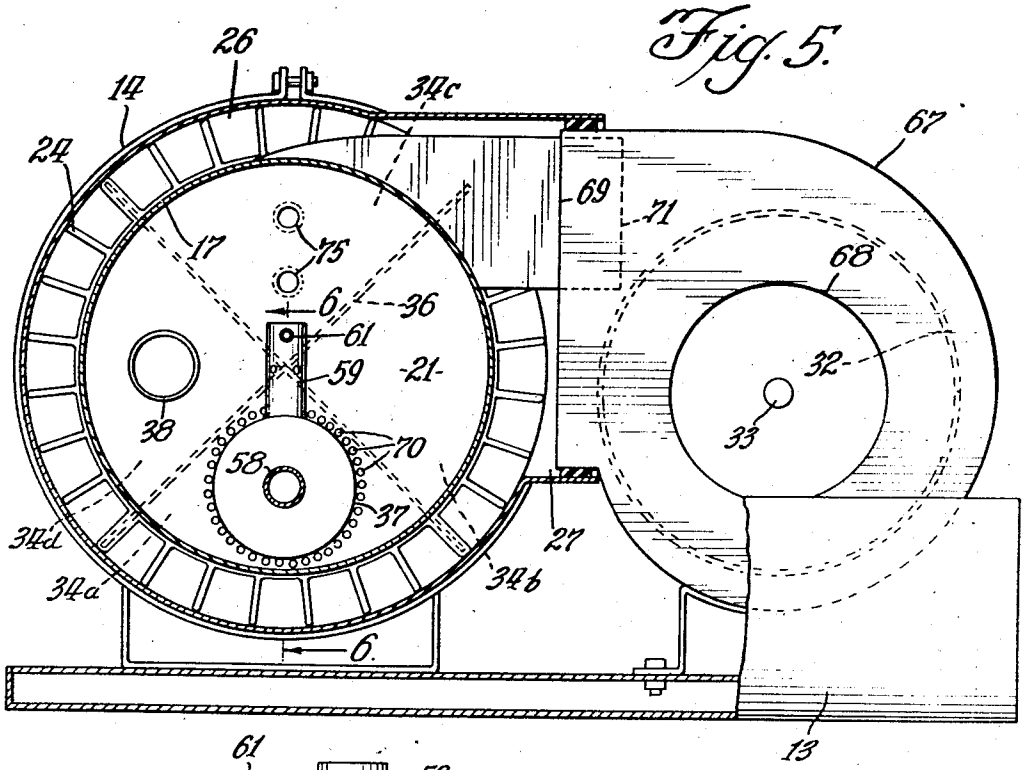
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Dec. 3, 1946. H. B. HOLTHOUSE 2,412,088

UNIT HEATER

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Fig. 5.



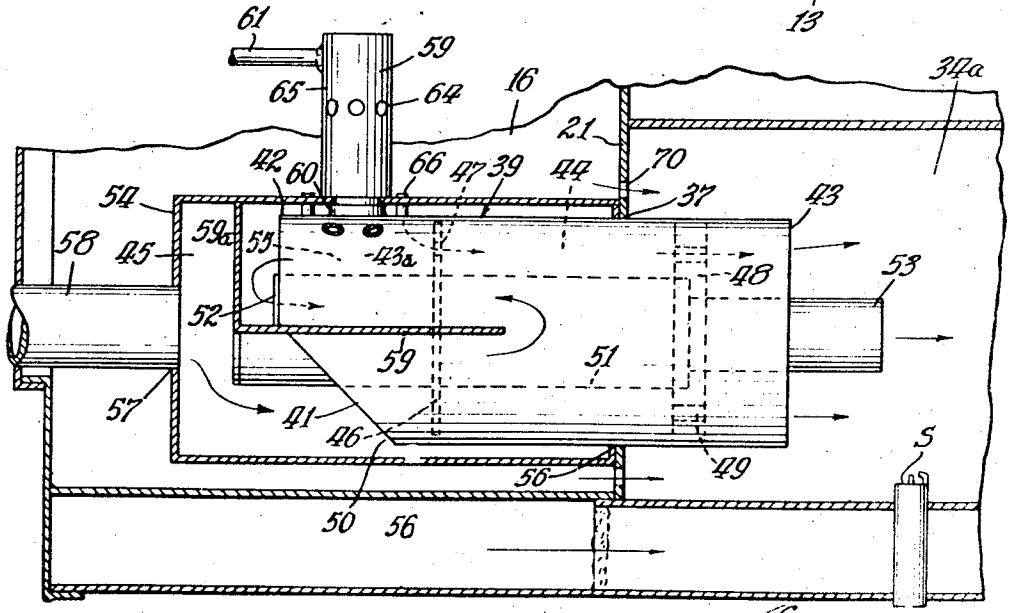


Fig. 6.

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UNIT HEATER

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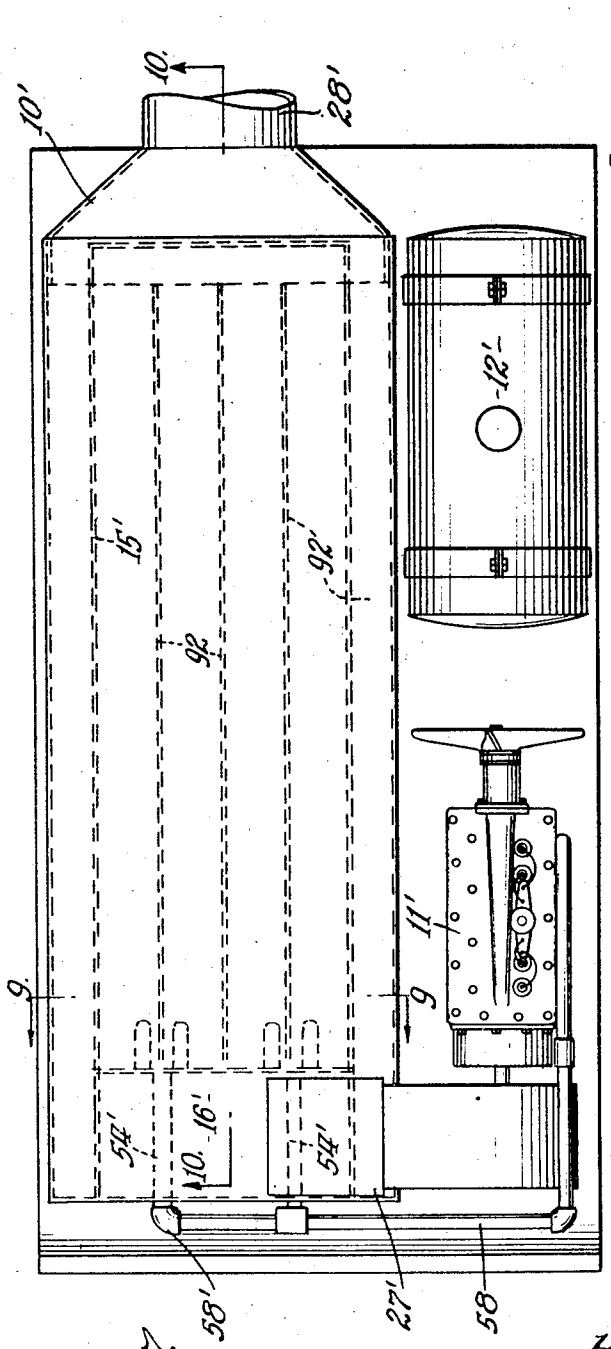


Fig. 7.

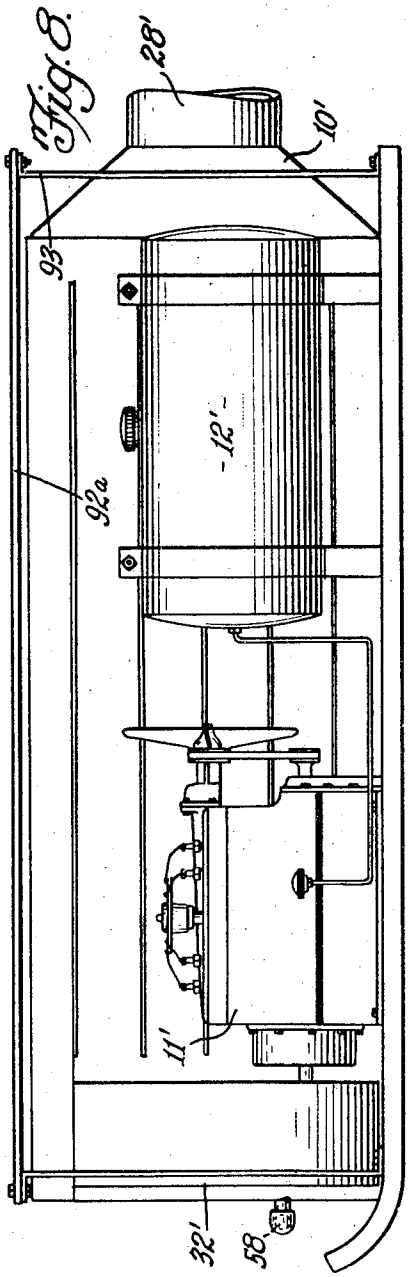


Fig. 8.

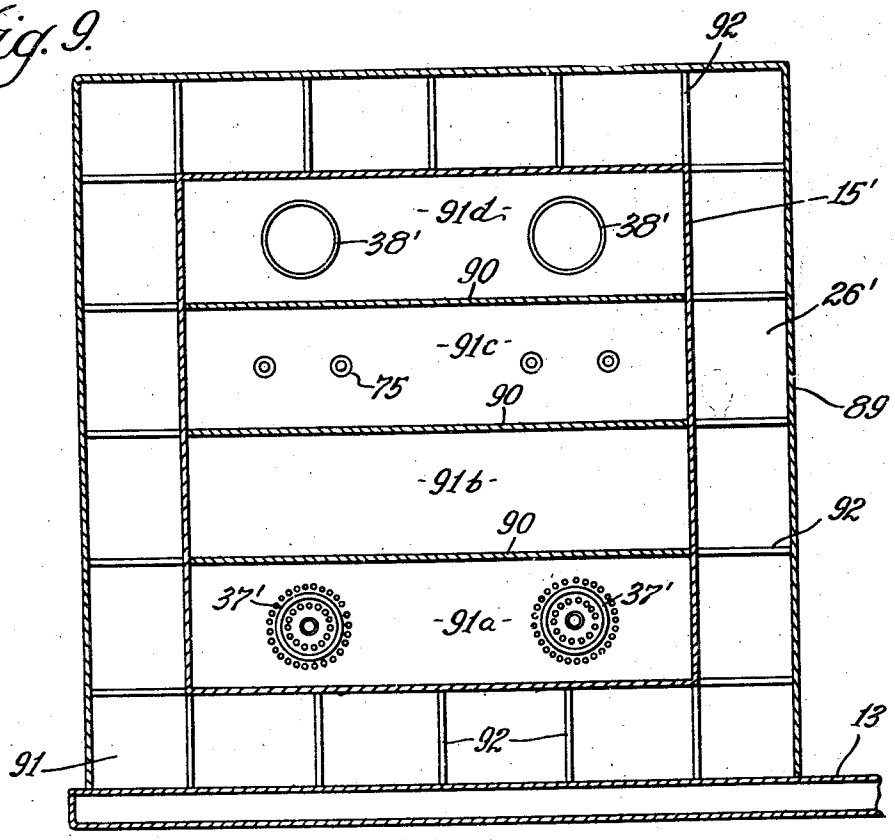
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Dec. 3, 1946. H. B. HOLTHOUSE 2,412,088

UNIT HEATER

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Fig. 9.



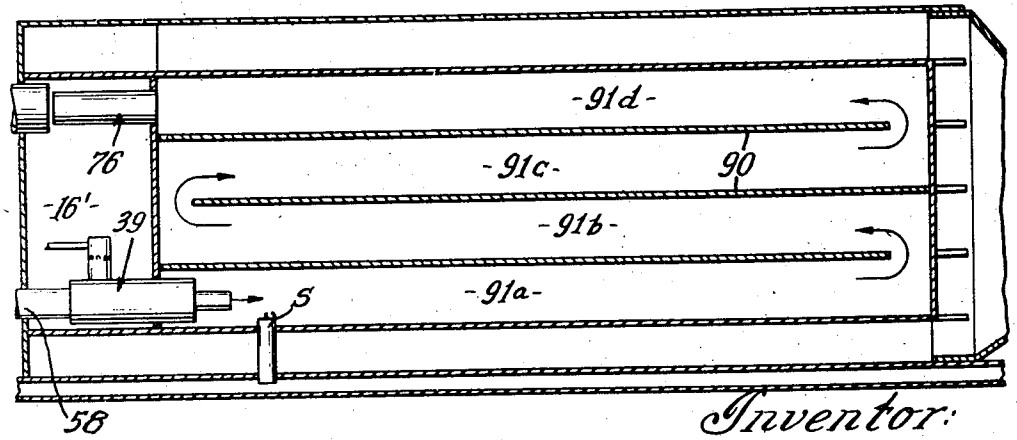


Fig. 10.

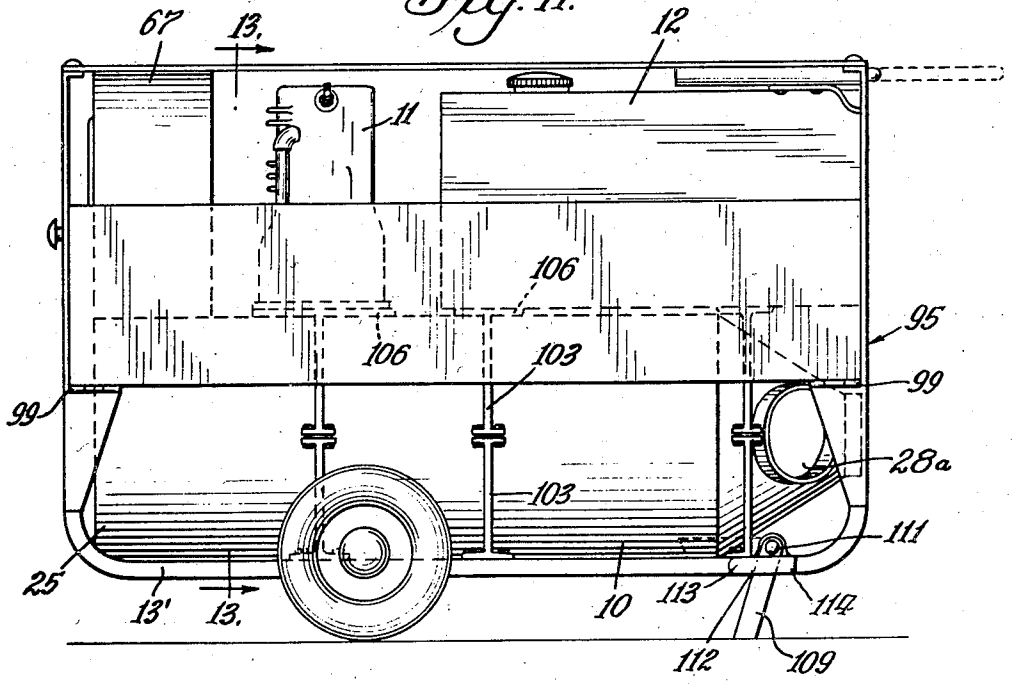
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Dec. 3, 1946. H. B. HOLTHOUSE 2,412,088

UNIT HEATER

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Fig. 11.



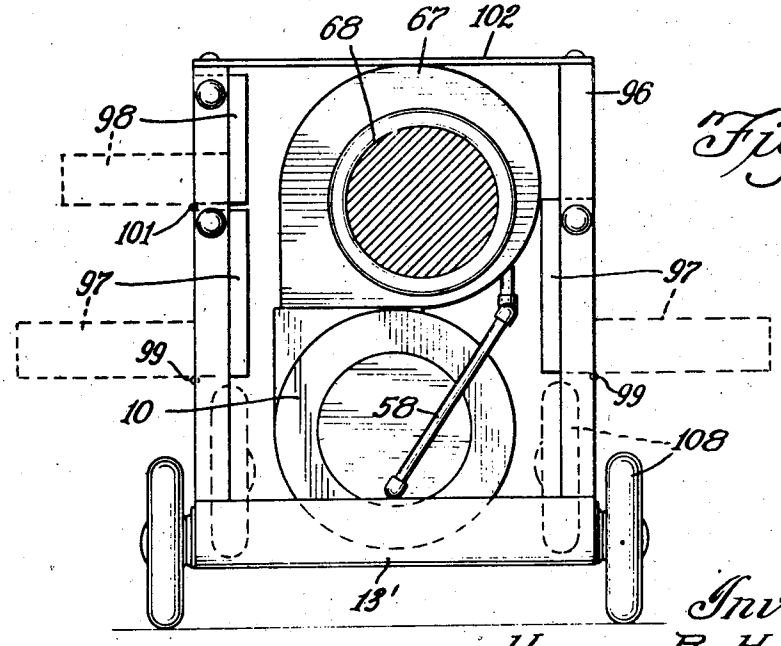


Fig. 12.

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UNIT HEATER

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Fig. 13.

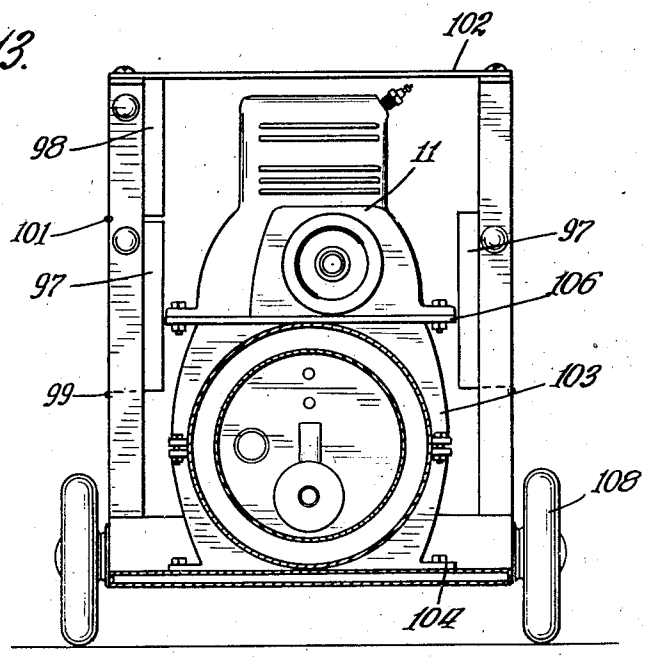
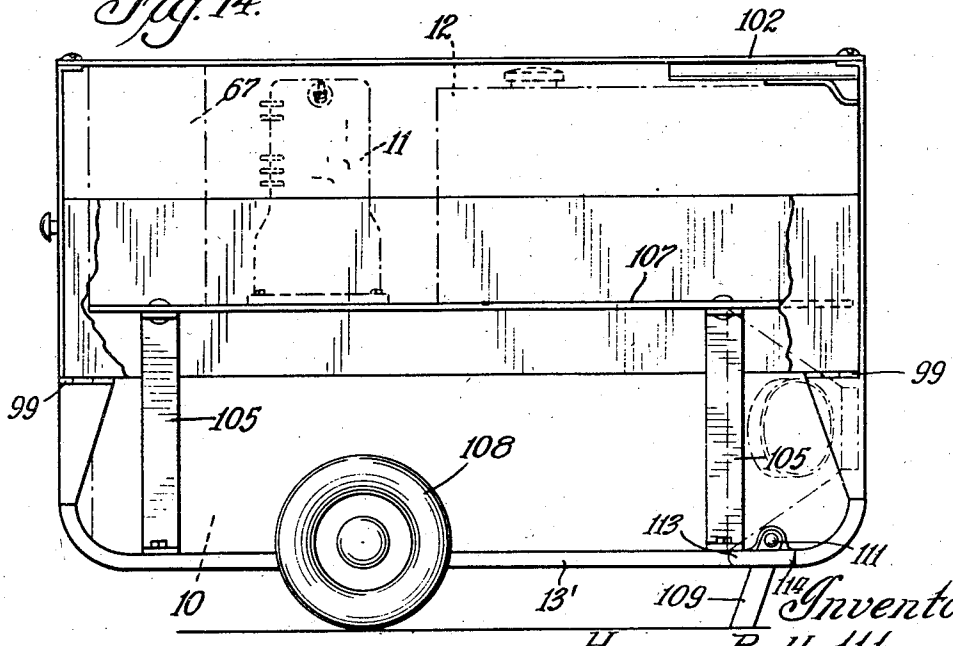


Fig. 14.



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Patented Dec. 3, 1946 2,412,088

UNITED STATES PATENT OFFICE

2,412,088

UNIT HEATER

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Application November 12, 1941, Serial No. 418,774

11 Claims. (Cl. 126—110)

1

This invention relates generally to air heating systems and in particular to a self-contained air heating unit including a burner of internal combustion type operated in conjunction with an internal combustion engine and assembled with the engine as a portable unit to provide for the supply of heated air at any desired location.

It is an object of this invention to provide an improved air heating system.

Another object of this invention is to provide a portable air heating unit which is compact in assembly, simple and rugged in construction and efficient in operation to deliver a relatively large volume of air at a high temperature to a source remote from the heating unit.

A further object of this invention is to provide a portable air heating unit capable of heating an airplane engine for starting purposes in a minimum of time.

Yet another object of this invention is to provide a self-contained air heating unit for heating airplane engines having means providing for its being simply and easily moved about under all weather conditions.

A still further object of this invention is to provide a duct system for heating airplane engines which is carried in the airplane wings and having a common inlet adapted to be operatively connected with a source of heat when the plane is stationary.

A particular feature of this invention is found in the provision of a portable heating unit including a heater of internal combustion type operated in conjunction with an internal combustion engine which is light in weight, and composed entirely of preassembled parts compactly and conveniently arranged, but individually removable from the unit to facilitate work on the unit. With the unit parts of a preassembled consrturtion a complete part can be carried for replacement purposes so that the unit may be operated with but a minimum of lost time.

Another feature of this invention is found in the provision of a duct system for carrying heated air to the engines and cabin of an airplane which is carried in the leading edge of the airplane wings and provided with a common outlet for operative connection with a source of heat when the plane is stationary. In flight means are provided for covering the inlet so that the heat developed by the engines is fed through the duct system to provide a de-icing action at the leading edge of the wings.

Further objects, features and advantages of this invention will become apparent from the following description when taken in connection with the accompanying drawings in which:

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Fig. 1 is a perspective view showing one form of the invention as applied to the heating of the engines of an airplane for starting purposes, the heater for the purposes of illustration being shown enlarged relative to the size of the airplane;

Fig. 2 is a fragmentary sectional view of the inlet to the airplane duct system shown in Fig. 1 showing the positioning of a cap thereon when the airplane is in flight;

Fig. 3 is a plan view of the complete heating unit shown in Fig. 1;

Fig. 4 is a side view of the heating unit of Fig. 1 with the engine removed therefrom;

Fig. 5 is a sectional view of the heating unit as seen along the line 5—5 in Fig. 3;

Fig. 6 is a sectional view as seen along line 6—6 in Fig. 5 showing fuel vaporizing means used in the operation of the heater or burner portion of the complete heating unit;

Fig. 7 is a plan view of another form of a complete heating unit;

Fig. 8 is a side view of the heating unit of Fig. 7;

Fig. 9 is a sectional view as seen along the line 9—9 in Fig. 7 showing the construction of the heater combustion chamber;

Fig. 10 is a sectional view taken along the line 10—10 in Fig. 7;

Fig. 11 is a side elevational view of another modified form of the invention;

Fig. 12 is an end elevational view as seen looking toward the right in Fig. 11;

Fig. 13 is a sectional view taken along the line 13—13 in Fig. 11; and

Fig. 14 is a modified form of the heating unit shown in Figs. 11–13.

In the practice of this invention there is provided a portable self-contained air heating unit comprising a heater of internal combustion type adapted to be operated entirely in conjunction with an internal combustion engine. The heater and the operating engine therefor are carried on a carriage or like portable means with the heater extending longitudinally of the carriage and the engine disposed laterally to one side of the heater. A fuel tank for supplying fuel to both the heater and the engine is arranged laterally to the same side of the heater as the engine and in substantial alignment with the engine on an axis substantially parallel to the longitudinal axis of the heater. The longitudinal length of the complete heating unit is defined substantially

by the longitudinal length of the heater so that the unit is capable of being compactly and conveniently assembled in a relatively small space. The engine includes a fan mounted on the crank shaft thereof to provide air for burning in the heater and air for circulating through a passage in the heater arranged in thermal relation with the heater combustion chamber. The engine and fan assembly, the heater, and the fuel tank are separately removable from the portable means as preassembled units to facilitate assembly and service work on the heating unit.

With reference to the drawings, one form of the heating unit of this invention is shown in Figs. 3 and 4 as including a burner or heater 10 of internal combustion type, an air cooled internal combustion engine 11 and a fuel tank 12 common to the engine and heater. These three parts are mounted on a common sled or portable supporting member 13, but individually secured thereto; securing straps 10' and 12' being used for the heater 10 and tank 12, respectively, while the base (not shown) for the engine 11 is supported directly on the sled or base member 13.

The heater 10 is comprised of a substantially cylindrical housing member 14 having a combustion chamber 15 and an air chamber 16 therein. The combustion chamber 15 has a tubular outer wall 17 closed at one end by a cover plate 18 and at its opposite end 19 by the base portion 21 of a substantially cup-shaped member 22 which defines the air chamber 16. The open end of the member 22 is closed by a cover or end plate 23 for the housing member 14. Thus as is evident from Fig. 3 the air chamber 16 and combustion chamber 15 are in alignment axially of the housing 14 and separated from each other by the base portion 21 of the cup-shaped member 22. These two chambers are spaced from the heater housing 14 by fins 24 angularly spaced about the combustion chamber 15 and extending axially thereof, to provide an annular passage 26 about the chambers 15 and 16 (Fig. 5). An inlet 27 to the passage 26 is at one end 25 of the housing 14 and an outlet 28 therefor is at the housing end 29. As shown in Figs. 3 and 4 the housing end 29 is of substantially bell shape and adapted for releasable connection with a flexible air conduit 31 for conducting the heated air to a source remote from the heater. Air to be heated is circulated through the passage 26 by a fan 32 mounted on the engine crank shaft 33 as will be later described.

The combustion chamber 15 (Figs. 3 and 5) is divided into four axially extending passages 34*a*—34*d* by a partition member 36 of substantially X-shape and of a construction providing for the connecting of such four passages to form a single serpentine passage. The partition member 36 is coextensive in length with the combustion chamber 15 and is retained therein in an assembly position by welding or like means to the fins 24. By virtue of this construction of the continuous passage in the combustion chamber 15, the inlet 37 and outlet 38 of the passage are both located in the base portion 21 of the cup-shaped member 22.

Located within the air chamber 15 and at the inlet 37 to the combustion passages 34*a*—34*d* is a fuel conditioning unit (Fig. 6) designated generally as 39 and including a substantially tubular shaped housing 41 closed at one end 42 and open at its opposite or outlet end 43 for fluid connection with the combustion chamber passage 34*a*. As is evident from Fig. 6 the greater part of the conditioning unit 39 extends into the air chamber 16. The housing member 41 is constructed of a high heat conducting material and includes an air and fuel mixing chamber 43*a* at the closed end thereof, and an equalizing chamber 44 adjacent thereto, the mixing chamber 43*a* and equalizing chamber 44 being separated by a heat conducting partition plate 46 having perforations 47 over the upper portion thereof. The equalizing chamber 44 in turn is separated from the combustion passage 34*a* by a heat insulating plate 48 having perforations 49 arranged peripherally therein. Positioned axially through the housing member 41 and supported in the housing end 42, and partition plates 46 and 48 is a heating element or conduit portion 51 having an inlet end 52 extending from the housing end 42 and an outlet portion 53 projetcing outwardly from the open housing end 43 into the combustion passage 34*a*.

Arranged in a spaced concentric relation about that portion of the housing member 41 which extends into the air chamber 16 is a conduit portion 54 in sealed engagement at one end 56 with the base portion 21 of the member 22 and connected at its opposite end 57 with an exhaust conduit 58 from the internal combustion engine 11. The annular space formed within the conduit 54 and about the housing member 41 of the fuel conditioning unit 39 is divided into connected passages 45, 50, and 55 by a substantially L-shaped baffle plate 59*a* adapted to direct the exhaust gases entering the conduit 54 from the exhaust pipe 58 to travel axially in one direction of the conduit 54 to the end 56 thereof, and then axially in an opposite direction into the inlet 52 of the heating element 51, from where it is discharged through the heating element outlet 53 into the combustion passage 34*a*. As indicated by the arrows in Fig. 6 this directed flow of the exhaust gases occurs by virtue of the gas passing successively through the passages 45, 50 and 55 and thence into the inlet 52 of the heating element 51. Since the housing member 41, partition plate 46 and heating element 51 are constructed of a material having high heat conductivity, the heat from the engine exhaust gases passing about the housing 41 is readily transferred to the heat conditioning unit 39 for a purpose now to be explained.

The fuel conditioning unit 39 is provided with an inlet 60 at the closed end 42, thereof, in which is positioned an air and fuel nozzle 59. As seen from Figs. 5 and 6 the nozzle 59 has one end 65 thereof extending through the conduit 54 into the air chamber 16. The end 65 of the fuel nozzle 59 is connected through a pipe 61 with a fuel pump 62 operatively supported on the engine 11, and in fluid connection with the fuel tank 12 through pipe 63. The pump 62 is common to both the engine 11 and heater 10 so as to supply fuel to both thereof during the normal operation of the heating unit. The fuel from the nozzle 59 is introduced into the mixing chamber 43 of the fuel conditioning unit 39 together with combustion air from the air chamber 16, this air for combustion being admitted into the fuel nozzle through ports 64 in the end 65 and through tubes 66 arranged about the inlet 60 and connecting the mixing chamber 43 with the air chamber 16. The fuel thus admitted into the mixing chamber 43 is vaporized therein for mixing together with the air, the vaporous mixture passing through the apertures 47 in the partition plate 46 into the equalizing chamber 44 from where it is discharged

through the apertured heat insulating plate 48 into the combustion passage 34a. This vaporous mixture is mixed with the exhaust gases from the heating element outlet 53 for burning therewith in the combustion chamber 15, combustion being initiated by spark means S positioned in the combustion chamber passage 34a and connected in operative association with the engine magneto (not shown). Supplementary air for combustion is supplied through ports 70 connecting the passage 34a with the air chamber 16, and tubes 75 connecting the passage 34c with the chamber 16. The gases from combustion are exhausted from the combustion passage outlet 38 into the tail pipe assembly 76 for discharge from the heater.

The air for combustion is supplied to the air chamber 16 by the fan 32, which, as previously mentioned, also supplies the air for circulating through the passage 26. As is seen from Fig. 5 the housing or scroll 67 for the fan 32 is provided with an inlet 68 and an outlet or mouth 69. The inlet 71 (Fig. 4) to the air chamber 16 is positioned within the inlet 27 to the annular passage 26, with the mouth 69 of the fan housing 67 being movable within the inlet 27 to the passage 26 and releasably connected therewith. By virtue of this construction the air delivered by the fan 32 is divided so that a portion thereof is supplied to the air chamber 16, and the remaining portion circulated through the annular passage 26. The housing 67 and fan 32 are preassembled with the engine 11 so as to be movable therewith as a unit. The heater or burner 10 is completely preassembled independently of the engine and fan assembly, and tank 12, with each of these three pre-assembled units being separately secured to the base member 13, as above described. Since the connection of the fan scroll 67 with the air inlet portion 27 of the heater 10 is accomplished equally well regardless of whether the outlet 69 is inserted within the inlet 27, or the inlet 27 is fitted about the outlet 69, each part may be removed from the base 13 independently of the other to facilitate assembly and service work on the heater.

From a consideration of Figs. 3 and 4 it is seen that the burner 10 is positioned longitudinally of the base or supporting member 13 with the engine and fan assembly disposed laterally to one side and at the end 25 thereof. The fuel tank 12 is arranged laterally to the same side of the heater 10 and in alignment with the engine 11 on an axis substantially parallel to the longitudinal axis of the heater 10. This arrangement of the heater 10, engine 11, and fuel tank 12 provides for a compact assembly of the heating unit in a confined space, the height and length of which is determined essentially by the height and length of the heater 10 and the width by the combined dimensions of the heater 10 and engine 11 laterally of the heating unit. Since the engine shaft 33 extends parallel with the longitudinal axis of the heater 10, the fan 32 for the heater 10 and fan unit 77 for cooling the engine 11 are also positioned in alignment on an axis substantially parallel to the longitudinal axis of the heater 10, with the two fans 32 and 77 and exhaust conduit 58 all being arranged within the dimensions of the base 13. In one embodiment of the invention the overall height of the heating unit is less than 15 inches and of a length not exceeding four feet, these dimensions defining substantially the corresponding dimensions of the heater 10. The transverse dimension of this embodiment, as determined by the combined dimensions of the heater 10 and engine 11 laterally of the heating unit is twenty-four inches. This embodiment includes an internal combustion engine rated at about one horse power and a half, with the heater and engine having a fuel consumption during a run of one hour under full load conditions of 2.3 gallons. The fuel tank 12 is relatively large for an engine of this size and has a capacity of about 8 gallons. The fan 32 is capable of delivering about 1100 cubic feet per minute from the heater outlet 28 when running at a speed of about 3600 R. P. M., the temperature of the heated air at the outlet 28 during normal operating conditions being about 140° C. The entire weight of the complete heating unit including the base 13 does not exceed 270 pounds so that the unit can be moved about rather easily by one man by sliding the base 13. The relatively solid assembly arrangement of the heater 10, engine 11 and fuel tank 12 adapts the heating unit for installation in a minimum of space, the low height of the unit providing for a low center of gravity which increases the ease with which the unit can be handled and moved about without danger of tipping over, and also serves to retain the unit more rigid during its operation so as to reduce excessive vibration thereof.

The portability of the heating unit under some conditions of its operation, such as where it is utilized for the heating of airplane engines, may be facilitated by providing the base 13 with wheels 120 (Figs. 3 and 4). The wheels 120, a pair of which is illustrated, may be rubber-tired and are rotatably supported at the end 121 of the base member 13 on mounting means including a bracket or brace 122 having one portion thereof secured to the base member 13, and the other portion 123 thereof extending outwardly from the base end 121 in a direction inclined upwardly from the longitudinal plane of the base member. The longitudinal extent of the portion 123 is proportioned relative to a corresponding wheel 120 such that the wheel is lifted above the ground, when the base member is in a horizontal position. In other words the wheel is in substantially a clearing position relative to the ground when the heating unit is being slidably moved about on the base member 13. By virtue of this assembly the wheels 120 are fixedly retained in an operating position so as to be constantly ready for use. When sliding of the heating unit on the sled or base member 13 becomes inconvenient or difficult the heating unit may be wheeled about on the wheels 120 by simply raising or lifting the base end 124, a handle 126 being provided for this purpose. The handle 126 is of substantially U-shaped configuration with the legs 127 thereof being slidably supported in brackets 128 so as to be extensible from the base member. Stop portions 129 at the free end of each leg member 127 prevent the handle 126 from being pulled out of operative connection with the base member 13. On lifting of the base member end 124 the wheels 120 are lowered into engagement with the ground, with the continued raising of the base member resting the entire weight of the heating unit on the wheels. The lifting and lowering of the base member end 124 is accomplished with the wheels 120 functioning as a pivot point so that the unit is gradually lifted and lowered to completely eliminate any sudden dropping thereof. The heating unit is thus capable of being slidably moved about on the base 13, or wheeled about on the wheels 120 with equal facility since

both manners of moving the unit are equally available for use.

A heating unit of the type described is illustrated in Fig. 1 applied to the heating of airplane engines for starting purposes. The airplane is shown as including a fuselage 78 having wings 79, with each wing 79 carrying a pair of engines 80 and 81 thereon enclosed by a cowl 90. The plane cabin 82 is disposed between the wings 79 and in the fuselage 78 in a usual manner. A duct 83 is positioned transversely of the cabin 82 and at the leading edge of each wing 79, the opposite ends of the duct terminating substantially at the wing ends the outermost engines 81 within a corresponding cowl 90. As is clearly shown in Fig. 1 the duct 83 is of a reduced section after leaving the inner engines 80, with outlets 85 and 86 being provided in the duct 83 at the inner engines 80 and outer engines 81, respectively, so that the heated air entering the duct inlet 87 is substantially equally distributed about the engines 80 and 81 within the space defined by their corresponding cowls. The inlet 87 is arranged substantially intermediate the inner engines 80 and below the cabin 82 and is adapted for operative releasable connection with the heater 10 through the flexible conduit 31. This operative connection may be of the usual bayonet type. A duct portion 88 is attached to the duct 83 for carrying heated air into the cabin 82. With the duct system in the plane connecting the engines and cabin, heat is readily supplied thereto by simply connecting the heater 10 to the inlet 87.

By virtue of the arrangement of the duct 83 in the wings 79 and at the leading edge of such wings, it may be utilized during normal flying operation to provide a de-icing means. Thus when the plane is in flight a cover or cap means 131 (Fig. 2) having pins 132 for bayonet assembly with corresponding slots 133 in the inlet 87, is positioned over the inlet to plug the same. With the inlet 87 stopped a portion of the air within the cowls 90 heated by the engines is fed into the duct 83 to heat the same, circulation of the air in the duct being accomplished by the several openings therein at 85 and 86.

In Figs. 7–10 there is shown a heating unit which is substantally similar in all respects to the heating unit of Figs. 1–6, except for some changes in the construction of the burner, the heating unit of Fig. 7 being somewhat larger than the heating unit of Fig. 2 so that the burner thereof is constructed to provide for a relatively higher output of heated air. Similar numerals of reference primed shall be used, therefore, in Figs. 7–10 to indicate parts thereof corresponding to Figs. 1–6.

Referring to Figs. 7 and 9, the heater or burner 10' is seen to include a housing member 89 of substantially rectangular form and having an open side 91 which is supported directly on the base member 13. Enclosed within the housing 89 are a combustion chamber 15' and an air chamber 16', these two chambers being of a substantially rectangular cross-section and arranged longitudinally of the housing member 89 but spaced therefrom by radiating fins 92. The fins 92 are substantially co-extensive in length with the combustion chamber 15' and form an air circulating passage 26' thereabout having an inlet 27' and an outlet 28'. As is best seen in Fig. 9 the fins 92 at the bottom of the heater 10' serve to space the chamber 15' from the base member 13 so that the member 13 forms one of the confining walls for the air circulating passage 26'. The combustion chamber 15' (Figs. 9 and 10) is divided longitudinally by partition members 90 into four passages 91*a*—91*d* which are interconnected to provide a continuous passage through the combustion chamber 15'. These passages are of a size to provide for the use of a pair of inlets 37' leading to the passage 91*a* and a pair of outlets 38' leading from the passage 91*d*. Each inlet 37' is operatively associated with a fuel conditioning unit 39 which is similar in all respects to the unit 39 fully described above in connection with Fig. 6. In turn, each outlet 38' is provided with an exhaust tail assembly 76 which is similar to the corresponding assembly of Fig. 3. The two fuel conditioning units 39 in the inlets 37' are operated concurrently with only one spark S being needed to initiate combustion.

The engine 11' and fuel tank 12' operatively associated with the heater 10', are correspondingly larger than the like parts in the heating unit of Fig. 3 but are relatively arranged and operated in all respects similar thereto. A further description thereof is believed, therefore, to be unnecessary. Because of the relatively low or pancake assembly of the complete heating unit, a platform or shelf 92*a* (Fig. 8) may be supported above the heater or burner 10' for supporting a second heating unit or to carry flexible connecting tubes, such as the tube 31, for conveying the heated air from the heater outlet to a desired location remote from the heater. The platform 92*a* is supported on frame members 93 located about the heater 10' and extending upwardly from the base member 13 to a position above the heater 10'. By virtue of the flat assembly of the heating unit, the platform 92 is relatively low so that a second heating unit can be very conveniently positioned thereon without being too high to operate or service. It is obvious, of course, that a similar platform structure is also applicable for use with the heating unit of Fig. 3.

An arrangement of the heating unit of Figs. 1–6 with the engine 11 and 12 in a superposed relation with the heater 10 is shown in Figs. 11–14. The base 13' is provided with a frame structure designated generally as 95 and including upright corner posts 96. Side trays 97 and 98 extending longitudinally of the heating unit are pivotally supported at 99 and 101, respectively, between corresponding posts 96 for pivotal movement laterally outwardly from the unit. Except for the trays 97 and 98 the sides and ends of the frame structure 95 are entirely open, a top 102 providing a cover for the heating unit and functioning also as a brace for the uprights 96. The outlets 28*a* of the air passage in the heater, three of which are used in the heating unit of Fig. 11, are thus readily accessible for operative connection with flexible conduit means 31.

The heater 10 is secured directly to the base 13' by mating gusset plates 103 (Fig. 13) of semicircular shape and adapted together to extend completely about the heater 10. The pairs of mating plates 103 are spaced longitudinally of the heater and in their mating assembly provide supporting legs 104 at the bottom of the heater, and a longitudinally extending platform portion 106 at the top thereof. As shown in Fig. 11 the platform portion 106 at the heater end 25 is adapted to alone support the engine 11 thereon, with the remaining top portions 106 serving as supports for the fuel tank 12. The scroll 67 for blower or air circulating fan 32 is carried directly on the top of the heater at the end 25 thereof.

The scroll 67, the engine 11, and the fuel tank 12 are thus positioned in longitudinal alignment laterally of the heater 10 and directly thereabove, with the engine 11 located between the scroll 67 and the fuel tank 12, but with all of these parts confined within the longitudinal length of the heater 10. By virtue of this assembly of the heating unit the over all length of the heating unit is defined substantially by the length of the heater 10, while the width thereof is determined substantially by the transverse dimension or diameter of the heater 10.

With reference to Fig. 14 the heating unit of Fig. 11 is shown with a platform structure 107, in place of the gusset plates 103, for supporting the engine 11 and fuel tank 12. The platform 107 is carried on upwardly extending frame members 105 positioned at the ends and to each side of the heater 10 and extending upwardly from the base 13' to a position immediately above the heater 10. The engine 11 and fuel tank 12 are suitably mounted on the platform 107 in alignment on an axis substantially parallel to the longitudinal axis of the heater 10, the engine 11 being positioned between the fuel tank 12 and the fan scroll 67 which is supported directly on the heater 10.

As previously mentioned side trays 97 and 98 are extended longitudinally of the heating unit and pivotally supported from the uprights 96. The trays 97 and 98 in their open positions, as indicated in dotted lines in Fig. 12, are adapted to receive therein the flexible conduit means 31 corresponding to the three outlets 28a (Fig. 11), each conduit when deflated being foldable into a compact bundle. With the conduit means in a folded condition within a corresponding tray, the trays are closed against the heating unit so as to appear as a side thereof, as shown in full lines in Fig. 12. The flexible conduits are thus completely out of the way when the heating unit is to be transported or moved about, and immediately available simply by the pivotal moving of the trays laterally outwardly from the heating unit.

The maneuverability of the heating unit for all weather conditions is facilitated by the provision of collapsible or folding wheels 108 which are operatively mounted on the sled member 13' substantially intermediate the ends thereof. When the wheels 108 are not in use they are adapted to be folded to a position indicated by dotted lines in Fig. 12 above the base member 13' and to opposite sides of the heater 10. They are thus removed entirely within the confines of the frame structure 95 whereby to increase the ease in handling the heating unit for moving it about on the base or sled member 13'. When the wheels 108 are in an operating position the heating unit is maintained substantially level by the provision of a pivotal end support or foot 109 pivoted to the sled member 13' at 111. As shown in Fig. 11 the foot member 109, is pivotally movable in a counter-clockwise direction to its dotted line position on the top of the sled member 13'. In its unit supporting position the foot member 109 is moved to its full line position and retained therein by a clip member 112 secured at its end 113 to the base member 13' and open at its opposite end 114 to provide a slotted recess for receiving the foot 109.

From a consideration of the above description and drawings, it is seen that the invention provides a portable self-contained heating unit composed of a burner an internal combustion engine for operating the burner, and a fuel tank common to both the burner and the engine, each of which is of a preassembled construction and adapted for individual mounting on a common supporting or base member. Assembly as well as servicing work is thus appreciably simplified since each of these units is capable of being completely checked before being assembled into its relative position in the complete heating unit. Since these unit parts for a particular heating unit are interchangeable, they may be kept in stock in their preassembled form so as to be readily substituted for corresponding parts which require servicing. The heating units are thus adapted for heavy duty service since a part requiring attention can be worked on while the corresponding workable part is in operation.

The overall heating unit is very compactly arranged and capable of a high heat output so as to make it particularly applicable for use in heating the engines of transport or bombing planes for starting purposes. It is readily appreciated that in cases of emergency, the engines must be heated in a minimum of time and by means capable of being quickly and easily moved about under all weather conditions. This ease of handling is accomplished in the unit by the provision of both sled and wheel means which are equally available for use. The heating unit of this invention is entirely complete within itself and its operation is initiated concurrently with the operation of the internal combustion engine associated therewith. It is apparent, of course, that the heating unit may be retained in operation while it is being transported or moved about so that it need be started only once regardless of the number of engines to be heated or the location of the planes carrying these engines.

Although specific reference has been made to the use of this invention for heating airplane engines, it is to be understood that this is only one application thereof, and that the heating unit may be satisfactorily used for the heating of cabins, tents, and auto trailers or the like.

Further, although the present invention has been described with specific reference to several preferred embodiments thereof, it is to be understood that it is not to be so limited since changes can be made therein which are within the full intended scope of this invention as defined by the appended claims.

I claim:

1. A portable air heating unit having a base member for supporting a burner of internal combustion type and an internal combustion engine for operating said burner, a fuel tank common to said burner and engine, housing means for said burner having therein a combustion chamber and a passage for the air to be heated in thermal relation with said combustion chamber, said housing means having a length substantially equal to the longitudinal length of said base, means driven by said engine for supplying fuel from said fuel tank to said combustion chamber and engine, air moving means operatively connected with said engine for supplying air to said combustion chamber and air passage, means operatively associated with said combustion chamber for vaporizing the fuel supplied thereto for mixing together with the air for combustion, and conduit means for the exhaust gases from said engine arranged in thermal relation with said fuel vaporizing means to heat the same, said engine and fuel tank being positioned in substantial alignment on an axis substantially parallel to the longitudinal axis of

said housing means and being confined substantially within the longitudinal length of said housing means.

2. In a self-contained air heating system including means providing for its portability, a heater of internal combustion type having a length substantially coextensive with the length of said portable means, an internal combustion engine for operating said heater, a fuel tank common to said heater and internal combustion engine, said heater having a passage therein for air to be heated, means driven by said engine and fluid connected with said tank for supplying fuel to said engine and heater, air moving means operated by said engine for circulating air to be heated through said passage and supplying air for combustion to said heater, means in said heater for vaporizing the fuel supplied to said heater for mixing together with said combustion air, with said engine and fuel tank being positioned in substantial alignment on an axis substantially parallel to the longitudinal axis of said heater, and means supporting all of said heater, engine, fuel tank and air moving means substantially within the dimensions of said portable means.

3. A unit for heating air including a longitudinally extending heater of internal combustion type adapted for operation in conjunction with an internal combustion engine having a fuel tank, said heater including means defining a combustion chamber, said engine being disposed at one end of said heater and said fuel tank being disposed at the opposite end of said heater, means supporting said engine and tank in alignment on an axis substantially parallel to the longitudinal axis of said heater and substantially within the longitudinal length thereof, said heater including means defining a passage for air to be heated arranged in thermal relation with said combustion chamber, air moving means operatively connected with said engine for circulating air through said passage, conduit means fluid connecting said air moving means and said air passage, means in said conduit means for by-passing a portion of the air delivered by said air moving means to said combustion chamber, and means for supplying fuel to said combustion chamber and engine from said tank including fuel moving means common to said heater and engine and operatively connected with said engine.

4. A system for heating air including a burner of internal combustion type adapted for operation in conjunction with an internal combustion engine and operatively assembled therewith on a common mounting means for transportation as a unit, a housing member for said burner having a combustion chamber therein and an air passage arranged in thermal relation with said combustion chamber, air moving means operated by said engine for delivering air to said burner and air passage, a fuel system for said burner and engine including a fuel tank carried on said mounting means and pumping means operatively supported on said engine, means supporting said fuel tank, engine and air moving means in alignment to one side of said housing member and within the distance defined substantially by the longitudinal length of the housing member, with the vertical height of said transportable unit being defined substantially by the vertical height of said housing member.

5. A portable air heating unit including a longitudinally extending burner of internal combustion type adapted for operation in conjunction with an internal combustion engine, common supporting means for said engine and burner, a housing member for said burner having a combustion chamber therein and a passage for air to be heated arranged in a thermal relation with said combustion chamber, means for supplying fuel to said engine and combustion chamber including a fuel tank carried on said supporting means, air moving means in driven connection with said engine, and means dividing the flow of air from said air moving means to said combustion chamber and said air passage, means supporting said air moving means, fuel tank, and engine in substantial alignment laterally to one side of said burner, with the longitudinal length and vertical height of said unit being defined substantially by the corresponding dimensions of said burner, and the dimensions of said engine and fuel tank laterally of said burner being substantially equal so as to provide for a substantially uniform width of said unit over the complete length thereof.

6. A unit for heating air including a burner of internal combustion type adapted to be operated in conjunction with an internal combustion engine having a fuel tank and conduit means for exhaust gases, a housing member for said burner having therein a combustion chamber and an air passage arranged in thermal relation with said combustion chamber, said engine and fuel tank being disposed laterally to one side of said housing, means supplying fuel to said combustion chamber from said fuel tank, air moving means operated by said engine for delivering air to said combustion chamber and air passage, heat transfer means in said housing member adapted to utilize the exhaust gases from said conduit means to prepare the air and fuel supplied to said combustion chamber for burning therein, means for carrying the exhaust gases in said conduit means into thermal relation with said fuel preparing means, and portable means for said unit including a mounting member adapted to carry said engine, burner and fuel tank in their above-defined relative positions, with the longitudinal dimension of said mounting member being defined substantially by the length of said housing member, and the lateral dimension of said mounting member substantially by the combined dimensions of said housing member and engine laterally of said unit, with said fuel tank, housing member and engine all being confined within the dimensions of said mounting member and within a vertical dimension defined substantially by the vertical height of said housing member.

7. An air heating system having a burner of internal combustion type and adapted for operation in conjunction with an internal combustion engine, a portable base member adapted to carry said burner and engine, housing means for said burner having the lower side thereof open and positioned against said base member, a combustion chamber within said housing means spaced from said base member and housing means to form an air passage, means operated by said engine for supplying air to said combustion chamber and air passage, a fuel system for said burner and engine including a fuel tank, and means supporting said engine and fuel tank in substantial alignment between opposite ends of said housing means and on an axis substantially parallel with the longitudinal axis of said housing means.

8. An air heating unit including portable means for carrying a burner of internal combustion type and an internal combustion engine opera-

tively associated with said burner, with said burner being of a preassembled construction and including a housing member having therein a combustion chamber and a passage for air to be heated arranged in thermal relation with said combustion chamber, air moving means operatively connected with said engine for delivering air to said combustion chamber and air passage, a fuel system for said engine and burner including a fuel tank mounted on said portable means and full moving means operatively supported on said engine, said air and fuel moving means being preassembled with said engine, and said engine and fuel tank being disposed laterally to one side of said burner, and means for independently securing said burner, engine, and fuel tank on said portable means so that each of said three parts is separately removable from said portable means.

9. A portable air heating unit including a heater of internal combustion type operated in conjunction with an internal combustion engine, said heater having a combustion chamber and a passage for air to be heated thermally related with said combustion chamber, a supporting member for said heater, a fuel tank common to said engine and heater, a plurality of means for securing said heater to said supporting member, said securing means being spaced longitudinally of said heater with each thereof having a portion positioned at the top of said heater, with at least one of said top portions serving as a support for said engine, and at least another of said top portions serving as a support for said tank, air moving means operatively connected with said engine for supplying air to said combustion chamber and air passage, and means for moving fuel to said engine and combustion chamber from said fuel tank operatively supported on said engine, with said fuel tank, engine and air moving means being confined substantially within the longitudinal length of said heater, and said heater defining the longitudinal length of said supporting member.

10. A portable air heating unit including a heater of internal combustion type operated solely by an internal combustion engine, said heater having a combustion chamber and a passage for air to be heated thermally related with said combustion chamber, a base member for supporting said heater, frame means secured to said base member and extending upwardly therefrom about said heater, a mounting member carried on said frame means above said heater for supporting said engine, a fuel tank common to said heater and engine supported on said mounting member, air moving means operatively connected with said engine for supplying air to said combustion chamber and air passage, and means for supplying fuel to said engine and heater from said fuel tank operatively supported on said engine, with said fuel tank, engine and air moving means being arranged substantially within the longitudinal length of said heater, and said base member and mounting member being substantially co-extensive in length with said heater.

11. A heating system including a longitudinally extending burner and a power unit, said burner being of the internal combustion type and adapted for operation in conjunction with said power unit and operatively assembled therewith on common mounting means for transportation as a unit, said burner having a combustion chamber therein, means forming a passage for air to be heated arranged about said combustion chamber, and in heat conducting relation therewith, a fuel supply system including a fuel tank and means operated by said power unit for delivering fuel to said combustion chamber, air moving means operated by said power unit, means for dividing the flow of air from said air moving means to said combustion chamber and said air passage, and means supporting said air moving means, fuel tank and power unit in substantial alignment on an axis substantially parallel to the longitudinal axis of said burner and substantially within the longitudinal length thereof.

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