Oct. 29, 1946. H. J. DE N. McCOLLUM 2,410,353

HEATER

Filed April 17, 1942 5 Sheets-Sheet 1

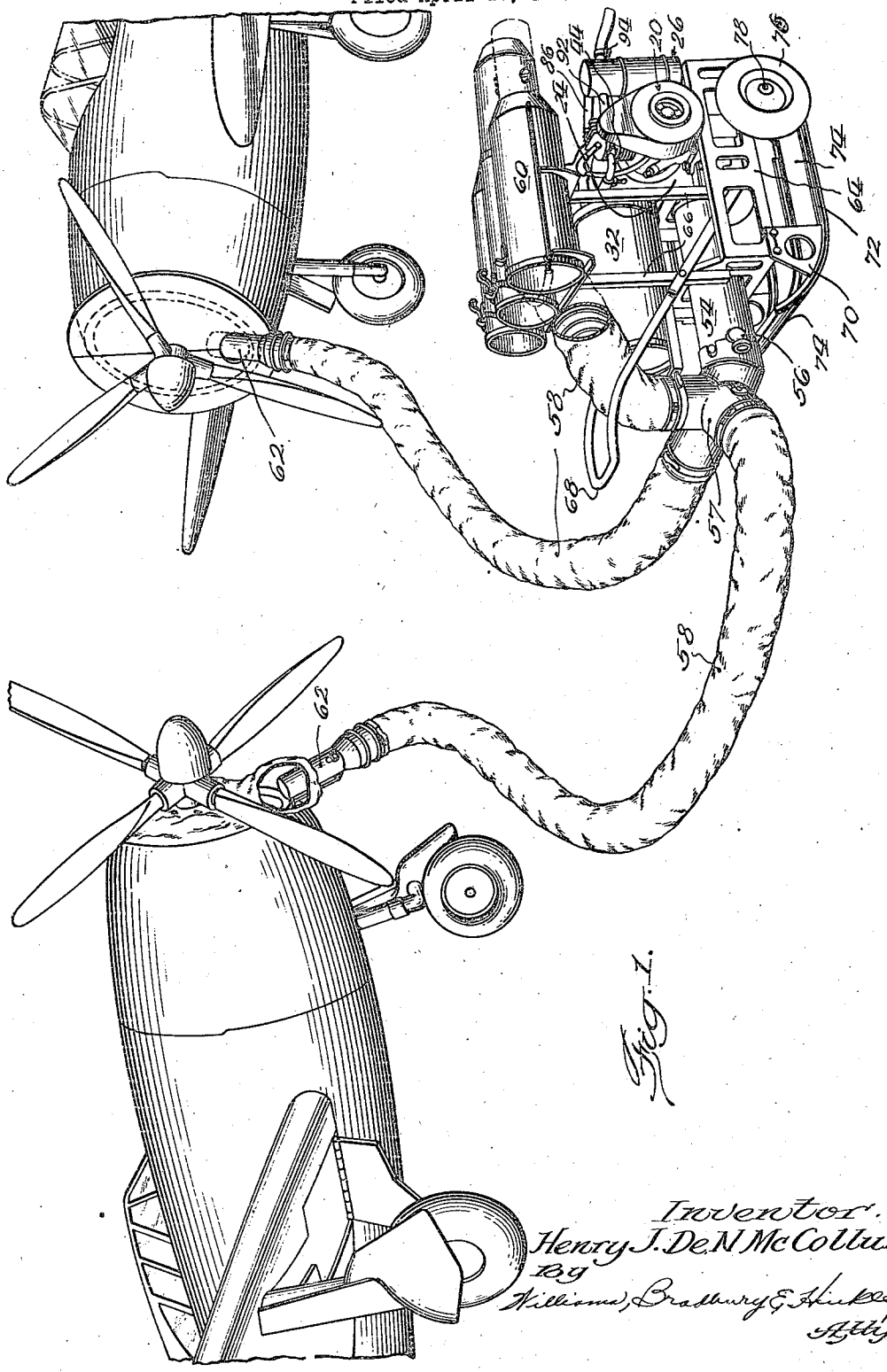


Fig. 1.

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HEATER

Filed April 17, 1942 5 Sheets-Sheet 2

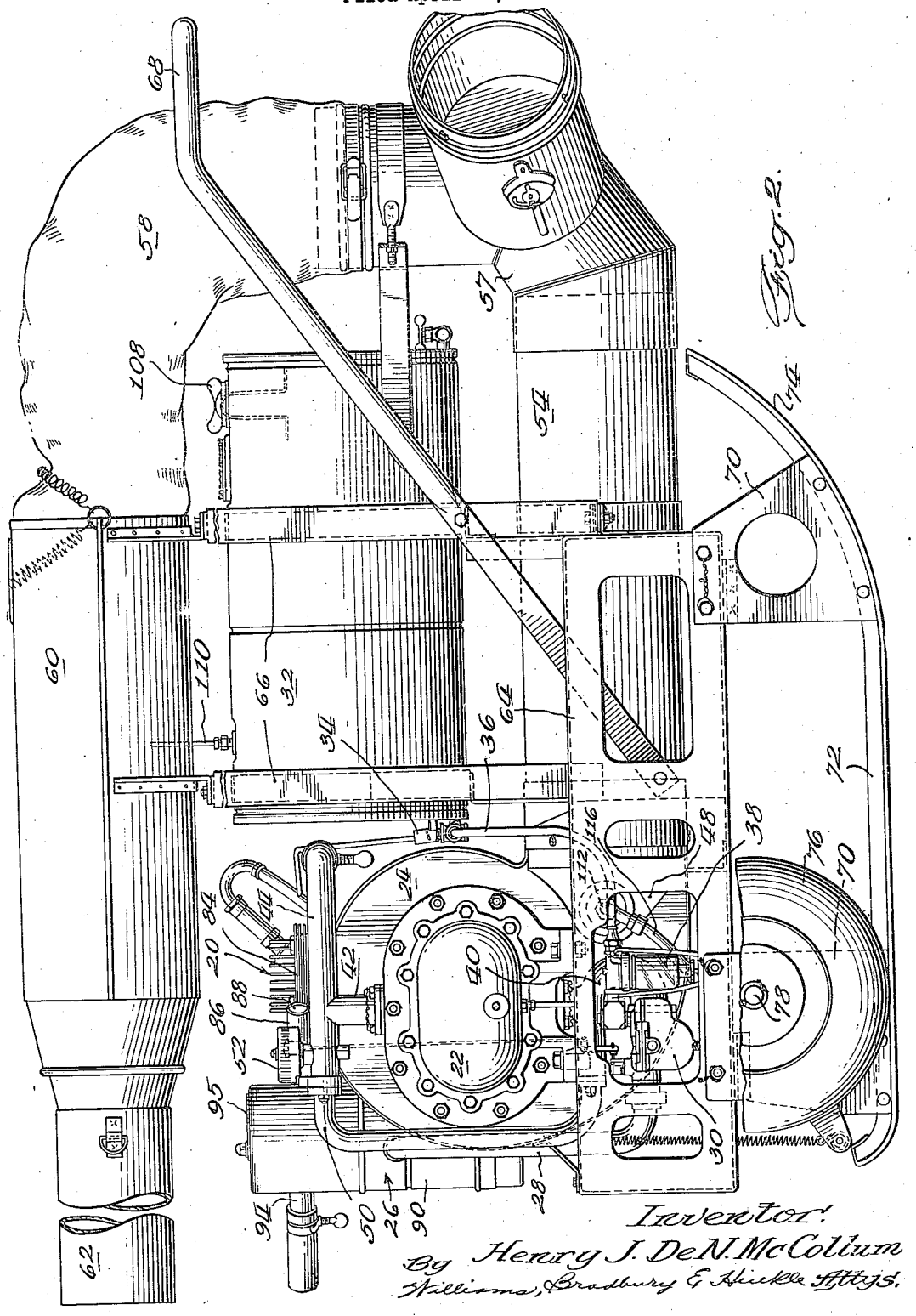


Fig. 2.

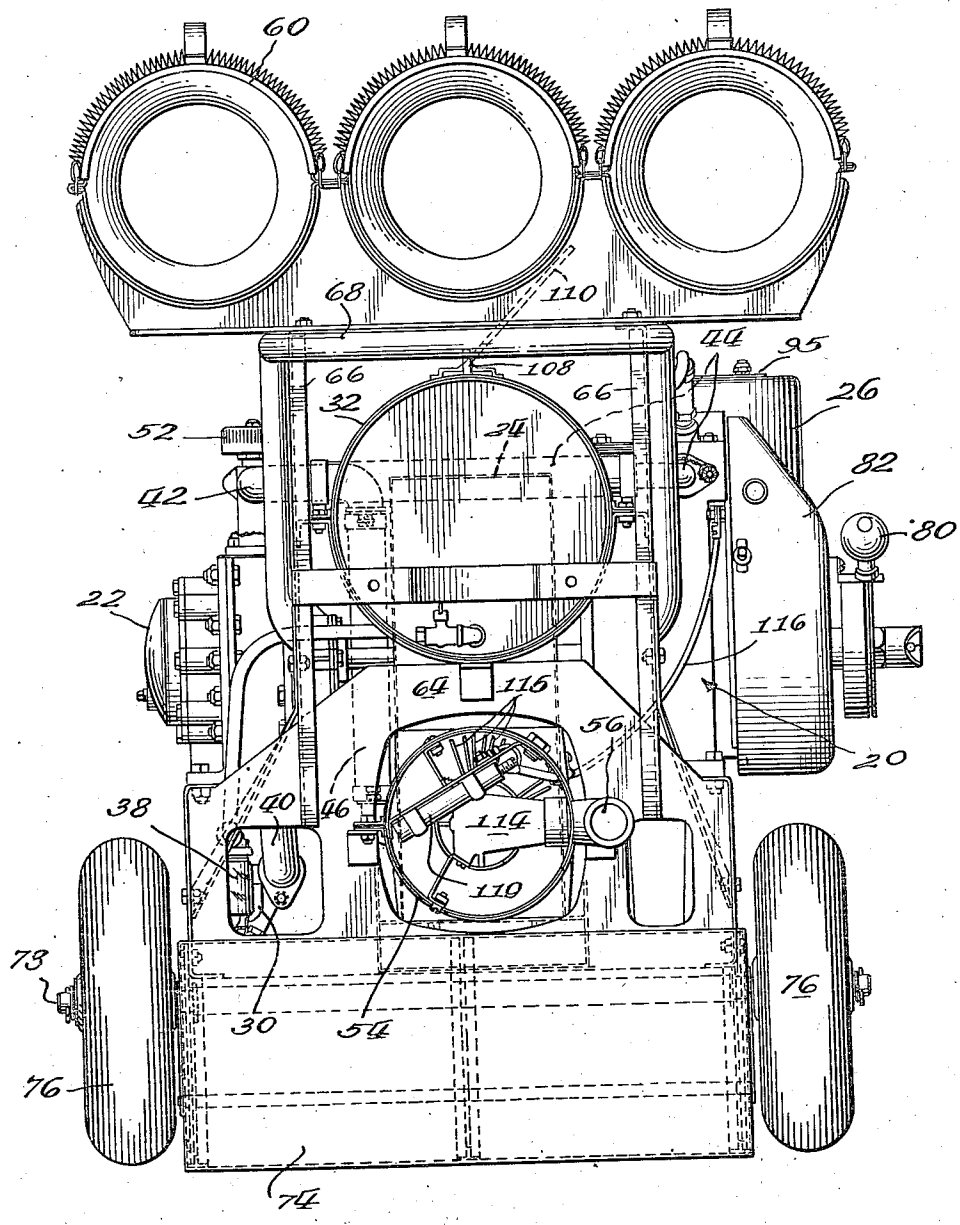
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HEATER

Filed April 17, 1942 5 Sheets-Sheet 3

Fig. 3.



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HEATER

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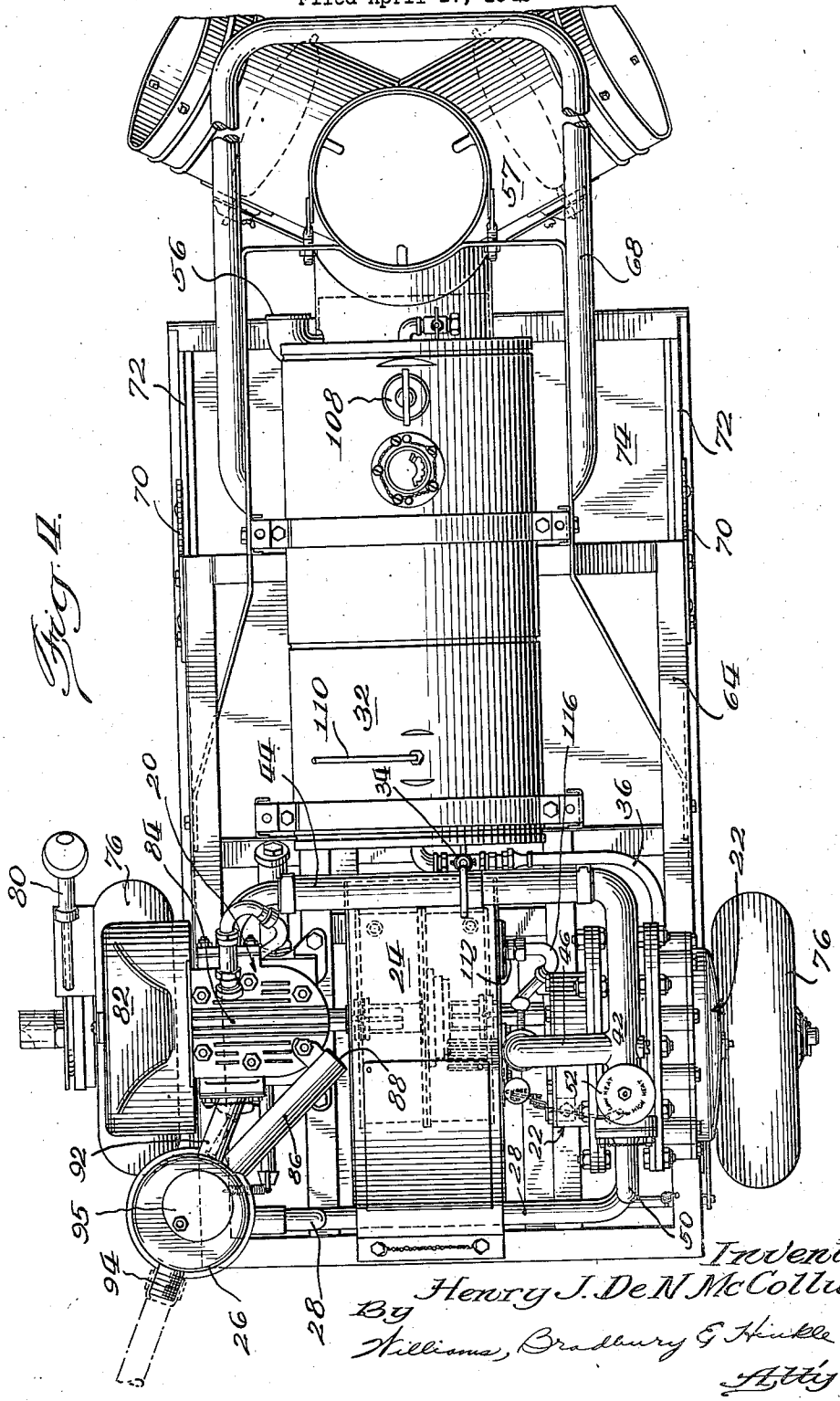


Fig. 4.

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HEATER

Filed April 17, 1942 5 Sheets-Sheet 5

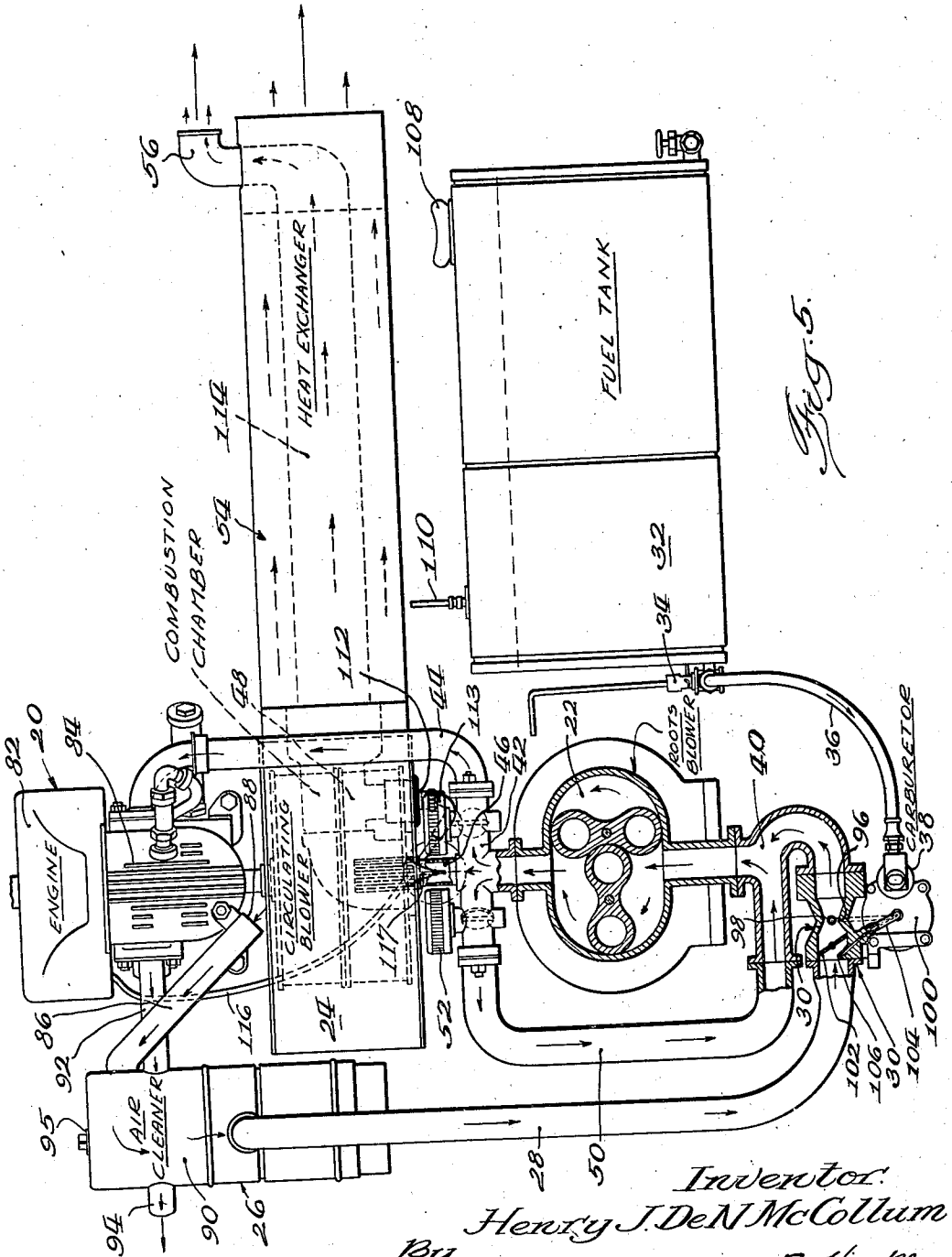


Fig. 5.

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Patented Oct. 29, 1946 2,410,353

UNITED STATES PATENT OFFICE

2,410,353

HEATER

Henry J. De N. McCollum, Chicago, Ill.; Thelma McCollum, executrix of said Henry J. De N. McCollum, deceased

Application April 17, 1942, Serial No. 439,342

16 Claims. (Cl. 126—116)

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The present invention relates to heaters and, more particularly to an internal combustion heater of the hot air, forced circulation type, which is well adapted for use in heating airplanes, other large vehicles or for use as a portable heating unit.

It is one of the objects of the present invention to provide an improved independently operating heating system adapted for use in airplanes, other large vehicles, as a portable heater, or for other similar purposes.

Another object of the present invention is to provide a heater of the above type which conveys its heat to the place to be heated by means of the forced circulation of hot air.

Still another object of the present invention is to provide an improved internal combustion heater of the forced circulation, hot air type which is fully independent in its operation of any outside connection.

Yet another object of the present invention is to provide such a heater in an integral unit so that it can be moved about with ease and without disassembly.

Yet another object of the present invention is to provide a novel and improved internal combustion heating system for use in airplanes or other large vehicles, or for use as a portable heater which is easily controllable to maintain a substantially uniform temperature in the hot air discharged by the heater even though the heat output of the heater may vary, or a variable temperature if desired.

Still another object of the present invention is to provide a novel heater of the above type, which is compact, light in weight, reliable and safe in operation.

Yet another object of the present invention is to provide such a heater with novel means to increase efficiency and prevent icing within the intake passages and combustible mixture forming mechanism.

Still another object of the present invention is to provide a heater of the above type, having an internal combustion engine with a novel arrangement for aiding in the starting of the internal combustion engine.

Yet another object of the present invention is to provide a novel heater, well adapted for portability, which is useful in warming cold airplane motors and cabins, and other articles or spaces.

Other objects and advantages will become apparent from the following description of a preferred embodiment of my invention, taken in

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conjunction with the following drawings, in which:

Fig. 1 is a perspective view of a portable airport heater embodying the present invention and shown in use for warming cold airplane motors;

Fig. 2 is a side elevational view of the heater illustrated in Fig. 1;

Fig. 3 is a front end view of the heater illustrated in Figs. 1 and 2, with a portion of the mechanism removed better to illustrate the structure therebeneath;

Fig. 4 is a top plan view of the heater illustrated in the previous figures with a portion thereof removed better to illustrate the structure therebeneath; and

Fig. 5 is a diagrammatic representation of the layout of the heating mechanism, the various connecting elements and control elements, so as better to illustrate the flow of gaseous and liquid substances through the system.

The invention is illustrated in the accompanying figures in a portable embodiment, that is, the heating apparatus is shown as being mounted upon a truck having both a sled base to adapt it for use over snow or other soft surfaces, and wheels which can be lowered to adapt the portable heater to be moved about over hard surfaces. This portable heater also includes a handle for moving it about, a fuel tank, several ducts and nozzles and an arrangement for stowing these ducts and nozzles. Substantially this same heating unit without the base comprising the sled and wheels, and without the handle, ducts, nozzles, and the arrangement for stowing the ducts and nozzles, can be installed in airplane cabins or in other places where an independent self-contained hot air heater is desirable. If desired, the fuel tank can be removed from the apparatus and located at some remote point and can be connected to the apparatus by a suitable pipe.

Thus, the portable heater illustrated may conveniently be considered in two portions, one of these comprising the heater itself, while the other is concerned more directly with features which lend portability to the heater. The heating system per se is the principal subject of the present invention, while the features which enable this heating system to be used in a portable manner, including the ducts and the duct stowing arrangement, are described more particularly in the copending application of Thomas F. Spackman, entitled "Portable heaters," filed on even date herewith, and which bears Serial No. 439,331. In general, the heater of the present inven-

tion may be considered as an improvement over the arrangement shown in my copending application Serial No. 377,181, filed February 3, 1941, now Patent No. 2,379,016, granted June 26, 1945, and entitled "Heating systems."

For portable use the advantages of a completely independent unit without outside connections is apparent. The advantages of the present heater when used in airplanes are quickly apparent after the heating system is understood and compared with previously used systems. In the past considerable difficulty has been experienced in devising a heating system for heating the cabins of airplanes and maintaining them at a substantially uniform temperature under the greatly varying conditions of airplane operation. In most previous heating systems used for this purpose, the source of heat has been the engine exhaust gases. In general, two types of systems have been used: In the first, exhaust gases are passed through a heat exchanger which directly heats the air passing into the cabin while in the second, the exahust gases are passed through a boiler and are used therein to vaporize a liquid, and this hot vapor then passes through a heat exchanger through which air is drawn in heat exchange relation on its way to the cabin.

In both of these systems the amount of heat available varies widely with the engine power output. For instance, during climbing operations considerable heat will be available because of the high power output of the airplane engines. During cruising operations the throttle setting of the engines is reduced, thus reducing the cabin heat available. During glides throttles are usually nearly closed and thus little or sometimes practically no heat is available while descending. Also, these previous heaters are subject to the disadvantage that they are inoperative excepting while the airplane is in flight, and it is necessary to use an independent source of heated air if the passenger compartment of the plane is to be warmed while the plane is on the ground.

In general, the heating unit comprises a small internal combustion engine indicated generally by the numeral **20**, which drives a Roots type blower **22** and an air circulating blower **24**. As will be described more fully presently, the engine **20** drives the two blowers and also serves to heat air drawn into the heater and engine induction system. This heated air is cleaned in an air cleaner **26** and is then passed through a conduit **28** to a carburetor **30**. The carburetor receives its fuel from a tank **32** and this fuel passes downwardly through a shut-off valve **34**, a pipe **36** to a sediment trap **38** connected to the carburetor fuel intake port.

The carburetor **30** is of the balanced type, as will be described more fully presently, and the combustible mixture formed within the carburetor is passed upwardly to the inlet **40** of the Roots blower **22**. The combustible mixture is forced from the outlet side of the Roots blower into a combustible mixture manifold **42**.

This manifold has a branch **44** leading to the intake side of the internal combustion engine **20**, a branch **46** leading downwardly to a heater combustion chamber **48**, and a by-pass branch **50** which leads back to the intake side of the Roots blower **22**. This by-pass branch **50** contains a regulating valve **52** of the butterfly type which, by its setting, controls the amount of combustible mixture permitted to be by-passed to the inlet of the Roots blower.

The portion of the combustible mixture passing downwardly through the branch conduit **46** is ignited and burned in the combustion chamber **48** and passes through a heat exchanger **54**, and eventually reaches the atmosphere through an outlet opening **56** located adjacent the opposite end of the heat exchanger. Fresh air is drawn in by the blower **24** and forced through the heat exchanger **54** in heat exchange relation to the hot products of combustion therein and this hot air at the opposite end of the heat exchanger passes, in the device illustrated, into a hot air manifold **57**. In this manifold it is distributed to three separate ducts **58**, which, when not in use, are housed within tubes **60** located at the top of the device. These ducts, together with their nozzles **62**, are adapted to be withdrawn from the tubes **60** and used wherever desired, a typical illustration being given in Fig. 1 wherein the heater is being used to warm cold airplane engines. The particular construction of the manifold **57**, the ducts **58**, the tubes **60** and related mechanism is given in the previously referred to copending application of Thomas F. Spackman and need not be repeated here. If the heating system shown is to be used in an airplane rather than in a portable unit, the outlet end of the heat exchanger **54** will be connected to whatever ducts are present within the airplane rather than to the manifold **57**.

In the arrangement shown the several units of the heating system are secured to a frame **64** built up of welded together channel members having a plurality of comparatively large openings therein to reduce the frame weight and to facilitate servicing of the device. This frame carries upstanding members **66** which support the fuel tank **32** and the tubes **60** within which the nozzles **62** and ducts **58** are stored. A handle **68** is connected to the upstanding members **66** and to the frame **64** and extends forwardly of the device.

The frame **64** is connected to downwardly extending plates **70** which at their lower ends are secured to runners **72** which curve upwardly at their front ends. These runners in turn rest upon and are secured to a sheet **74**. The sheet extends from end to end between the runners and provides a surface of considerable area to support the device upon soft ground or snow. To aid in the handling of the device over hard surfaces, a pair of wheels **76** are provided and these wheels are mounted upon an axle **78** which extends transversely through slots in the rearward plates **70**. These wheels are adapted to be raised or lowered, as desired, so that either the wheels or the flat bottom surface of the sheet **72** can be brought into contact with the ground. The mounting for these wheels, the manner in which the sled is made and a more detailed description of the frame generally will be found in the previously referred to copending application of Thomas F. Spackman and therefore no further detailed description is needed here.

The internal combustion engine **20** used in this apparatus may be of any well known type, the one shown being of the single cylinder, four cycle, air cooled type and including a pull type starter **80** mounted on one end of the crank shaft. An impeller, not shown, located on the crank shaft between the engine crank case and the pull type starter is housed within a shroud **82**. The impeller draws air inwardly around the lower portion of the crank case and passes this air upwardly through the shroud **82** which deflects the air across the engine cylinder and cylinder head

84 to cool the latter. The air passing beyond the engine, therefore, is quite warm. A considerable portion of this warm air is drawn inwardly through an induction tube 86 having its inlet opening 88 located adjacent the engine cylinder head in the stream of engine cooling air. Thus all of the air taken into the induction tube 86 is considerably above atmospheric temperature and the heat thus imparted to the air aids, among other things, in preventing freezing in the carburetor Venturi throat. Under ordinary conditions it also increases the heater efficiency, as will be described in greater detail presently.

The air taken into the induction tube 86 is passed downwardly through the previously referred to air cleaner 26, which may be of any well known type, into the conduit 28 from whence it passes to the carburetor 30. Under some operating conditions the heat imparted to this air by the cylinder and cylinder head 84 may be insufficient to prevent the formation of ice in the induction system. To increase the heater efficiency and to insure freedom from icing under even adverse conditions, I surround the air cleaner 26 with a jacket 90 so as to provide a space between the air cleaner and this jacket. The exhaust from the engine 20 is conveyed through an exhaust pipe 92 to this space from whence it passes outwardly through a pipe 94. Thus the warm air drawn through the air cleaner is additionally heated by the exhaust gases of the engine 20.

The two air heating arrangements just described accomplish a considerable rise in the temperature of the air taken into the system. Under some operating conditions this increase in temperature is more than desirable. The top surface of the air cleaner, therefore, has a supplementary air intake opening closed by a swivel type cover plate 95. In warm weather this cover plate can be swung to one side so as to permit air to enter the cleaner directly rather than through the air induction tube 86. In this connection it is important to note that it is desirable under ordinary conditions to heat the air taken into the system to a higher temperature than would be advisable were this air supplied to the engine alone. It is appreciated that increasing the temperature of the air taken into an internal combustion engine beyond a certain point reduces its power output. In the present instance, however, the power output of the engine is not the most important factor to be taken into consideration, since the efficiency of the heater as a whole is of greater importance. Thus with a heater of this type, it is frequently advisable to sacrifice some power potentiality in the engine itself in order to be able to make a more efficient over all use of the heater fuel. The arrangement shown, it will be seen, in addition to preventing icing, also salvages a considerable portion of the heat present in the system which would otherwise be wasted, and I have found that this saving more than offsets any loss in engine power.

Within the carburetor 30 the air passes through a Venturi throat 96 where fuel is drawn from an orifice 98 connected to a float bowl 100 of the carburetor 30. This carburetor is of the balanced type and has a butterfly choke valve 102 located ahead of the Venturi throat 96. The balancing vent connection for the bowl 100 includes a tube 104 connected to the upper portion of the carburetor float bowl at one end and to an inlet opening 106 located in the intake end

of the carburetor tube ahead of the butterfly choke valve 102. This location of the balancing connection to the carburetor I have found aids materially in starting the operation of the system. It functions as follows: When the engine 20 is to be started, the choke valve 102 is closed, or at least nearly closed. Then upon cranking the engine a partial vacuum is produced in the carburetor throat back as far as the choke valve 102. Since the balancing inlet 106 to the carburetor is ahead of this valve, the pressure on the fuel within the bowl will remain at substantially atmospheric pressure, while the pressure at the carburetor jet within the Venturi throat will drop considerably below atmospheric pressure. Fuel, therefore, will be drawn from this jet into the air stream by a pressure differential within the carburetor bowl, and this pressure differential will far exceed that which could be obtained if the balancing inlet 106 were located on the other side of the butterfly valve 102 in the customary manner. Although in some internal combustion engine arrangements this advantage might not be important, it will be noticed that in the present system the carburetor is located a considerable distance from the engine, thereby permitting considerable condensation to take place in the blower, conduits and manifolds when they are cold. For starting, therefore, a quite rich mixture is even more desirable than with ordinary internal combustion engines where the carburetor supplies a combustible mixture to the engine only and is usually located directly adjacent the engine manifold.

The carburetor bowl 100 receives liquid fuel through the pipe 36 which establishes connection through a shut-off valve 34 with the fuel tank 32. This tank is filled through an opening closed by a cap 108 and is vented to the atmosphere through a vent tube 110.

The fuel mixture formed in the carburetor 30 passes upwardly through the connection 40 to the intake of the Roots blower 22. The blower as has been previously mentioned, is connected to and is driven by the engine 20 and acts to compress the combustible mixture and pass it upwardly into a manifold 42. One branch of this manifold, indicated by the numeral 44, conveys a portion of this mixture to the intake side of the internal combustion engine 20, while another branch 46 passes combustible mixture downwardly into the heater combustion chamber 48. Thus the single carburetor and Roots blower supply the combustible mixture both to the heater combustion chamber and to the internal combustion engine, which serves as a prime mover for the apparatus and also as a means for heating the air drawn into the carburetor.

Another branch of the manifold 42 is connected to a conduit 50 which by-passes combustible mixture to the intake side of the Roots blower 22. This by-pass includes a manually operated regulating valve of the butterfly type, indicated by the numeral 52. When this valve is closed, substantially no combustible mixture is returned to the intake side of the Roots blower, while when this valve is opened in varying degrees, varying amounts of mixture are returned to the intake side of the blower. When the valve 52 is moved toward closed position, thus by-passing less mixture around the Roots blower 22, a greater amount of combustible mixture will be supplied to the combustion chamber 48 and to the engine 20. The speed of operation of the engine and the heat output of the heater com-

bustion chamber are, therefore, simultaneously increased. As has been previously mentioned, the engine 20 is connected to the low pressure blower 24, which passes air through the heat exchanger 54 in heat exchange relation to the hot products of combustion issuing from the combustion chamber 48. Increased heat output of the heater is, therefore, reflected in an increased volume of hot air issuing from the heat exchanger 54 rather than in an increase in temperature of the hot air issuing from the heat exchanger. Similarly when the valve 52 is opened, thus permitting more combustible mixture to by-pass the Roots blower, less combustible mixture will reach the engine 20 and the combustion chamber 48. The heat output of the heater, therefore, decreases simultaneously with the decrease in the speed of operation of the blower 24. The result is that less hot air will issue from the heat exchanger 54, but this hot air in less quantity will be of approximately the same temperature as existed before the valve 52 was opened.

This arrangement, it will be seen, automatically insures the temperature of the air issuing from the heat exchanger being maintained substantially constant, regardless of the heat output of the heater. If it is desired to change the temperature of the air issuing from the heat exchanger, this can be done by providing separate valves in the manifold branch 44 leading to the gas engine, or in the manifold branch 46 leading to the heater combustion chamber, or both. Two valves for this purpose similar in construction to the valve 52 are indicated in Fig. 5 by the numerals 113 and 117, the valve 113 being located in the manifold branch 44 leading to the engine, and the valve 117 in the branch 46 leading to the heater.

If one or both of these supplementary valves are provided, it is apparent that by operating either or both so as to decrease the flow of air through the manifold branch 44 relative to the branch 46, such as by partially closing the valve 113, or by partially opening the valve 117, the heater combustion chamber 48 will receive a relatively larger proportion of the fuel mixture than will the engine 20. Thus the blower 24 will run slower while the heat output of the heater will be increased with the result that the air issuing from the heat exchanger 54 will decrease in volume and increase in temperature. Opening the valve 117 will, of course, have the reverse effect.

Ordinarily, if it is desired to increase the temperature of the air without changing its rate of flow, the valve 117 will be opened somewhat, thus increasing the rate of flow of combustible mixture to the combustion chamber. If this causes the engine to decrease in speed somewhat, it is easily and quickly brought back to its original speed by slightly closing the valve 52. If it is desired to increase the rate of flow of heated air from the device while simultaneously reducing its temperature, this can be effected by slightly opening the valve 113, which increases the rate of flow of combustible mixture to the engine, while simultaneously decreasing the rate of flow to the combustion chamber.

The arrangement of the three valves 52, 113 and 117, enables an operator to obtain any desired hot air temperature and any desired volume of air flow within the capacity of the device, or if as is usually the case, once the temperature has been adjusted, the volume of heated air can be increased or decreased without materially affecting its temperature.

The portions of the heater comprising the heat exchanger 54 and the combustion chamber 48 are preferably formed as an integral unit and may be of the construction shown in the copending application of Henry J. DeN. McCollum for "Heating units," Serial No. 378,262, filed February 10, 1941, now Patent No. 2,379,017, granted June 26, 1945. In general, it comprises a combustion chamber within which the combustible mixture is ignited by an igniter 112. The hot products of combustion are then passed through a heat exchange conduit 114 provided with fins 115, Fig. 3, which are located within a housing so that air from the blower 24 can be passed over these fins, the hot air passing directly from the end of the heat exchanger, while the exhaust gases from the heater pass outwardly through an elbow 56. This housing also contains a thermostatic switch 119, Fig. 3, in the engine ignition circuit which operates to stop the engine if the temperature in the heat exchanger should become excessive. Although a hot wire igniter of the type shown in the last previously mentioned copending application can be used in this heater, and will in fact preferably be used in some types of installations for this heating equipment, it is preferable in the embodiment shown to use an igniter of the high voltage spark plug type. This is because the engine magneto, which supplies the high voltage ignition current for the engine, also can be used to operate the igniter 112, the igniter being connected to the engine magneto by a cable 116. In some installations where a source of electrical current of low potential is present, a hot wire igniter of the type shown in the last previously mentioned copending application may be used.

The heater operates in the following manner: Assuming that the tank 32 contains fuel, that the fuel shut-off valve 34 is open and that the engine ignition has been turned on by whatever appropriate switch is provided for the purpose; the engine is choked and the throttle, which in the present instance comprises the valve 52, is opened about halfway. If the supplementary valve 113 is also provided, it is opened. The engine is then turned over by pulling the cable of the starter 80. The operation of pulling the starter cable rotates the engine crank shaft, the blower 24 and the Roots blower 22. The Roots blower thus produces a suction in the Venturi throat of the carburetor 30 which causes a considerable pressure differential to exist in the carburetor bowl 100 inasmuch as the vent to this bowl is located ahead of the choke valve 102. The fuel, therefore, readily flows into the carburetor Venturi throat, mixes with air passing the choke valve 102, thereby producing a combustible mixture which is pumped by the Roots blower to the intake side of the engine 20 by way of the manifold 42 and the branch conduit 44.

As soon as the engine starts, the choke valve is opened, gradually if necessary, and the engine as it warms up is brought up to operating speed by adjusting the valve 52. The running engine rotates the blower 24, thus blowing air to be heated through the heat exchanger 54. It also rotates the Roots blower 22 which pumps the combustible mixture into the manifold 42 where it is distributed to the engine, to the combustion chamber 48 of the heater and to the intake side of the Roots blower, through the valve 52 and by-pass conduit 50. By regulating the valve 52, any desired quantity of the combustible mixture can be by-passed around the Roots blower and conse-

quently any desired portion of the combustible mixture pumped by the Roots blower can be distributed to the engine and to the heater. As has been previously described, moving the valve 52 from any particular setting toward closed position will increase the speed of the engine 20 and will simultaneously increase the heat output of the heater, while at the same time increasing the speed of the blower 24, thereby supplying more air to absorb the increased heat developed within the heater combustion chamber 48. If one or both of the valves 113 and 117 are provided, they can be adjusted, in the previously described manner, to regulate the temperature and rate of flow of the air issuing from the heat exchanger.

The combustible mixture which passes into the heater combustion chamber 48 is ignited by a spark plug 112 which receives high tension electrical current through a cable 116 from the engine magneto, not shown, but located within the shroud 82. This magneto also supplies the ignition current for the engine 20.

The air drawn into the system to be mixed with fuel in the carburetor 30 normally enters the inlet opening 88 of the induction tube 86. Since this inlet opening is located directly behind the engine cylinder head opposite the shroud 82, the air entering this opening will be elevated in temperature considerably above the surrounding atmosphere. This air passes into the air cleaner which is jacketed, the jacket being connected to the exhaust pipe 92 of the engine so that the air within the the heater has its temperature additionally increased before passing downwardly to the carburetor. In hot weather, or whenever for some reason the air entering the system is hotter than advisable, the cover plate 95 at the upper end of the air cleaner is swung to one side to permit air to enter the induction system directly without passing through the induction tube 86.

Normally in cold weather when the heater is used for warming airplane engines, cabins and the like, the cover plate 95 will be in closed position. In warm weather when the heater is used principally for drying out crevices and exposed hinges and the like parts of wet airplanes or for other purposes for which a heater is useful in such weather, the cover plate 95 will be swung to one side inasmuch as the heat supplied to the incoming air, by the cylinder and cylinder head 84 and by the exhaust of the engine 20, will be more than is advisable.

The portable embodiment of the heater is shown in Fig. 1 of the drawings in use for warming cold airplane motors. In this figure the ducts and nozzles are removed from the cylinders 60 and the nozzles are secured to the engine cowls adjacent the air inlet openings thereof. At the left-hand portion of this figure a blanket is shown as being wrapped around the engine cowl and stuffed into place to prevent the leakage of warm air away from the engine. In the right-hand portion of the figure a more formal arrangement is used wherein a special cover is provided to close the motor cowl air inlet opening, this covering having an opening to permit insertion of the end of the nozzle 62. A more detailed discussion of this figure and of the advantages of the apparatus for warming airplane motors is given in the previously referred to copending application of Thomas F. Spackman.

From the above description of an embodiment of my invention, it will be seen that a device incorporating this invention is admirably adapted in a portable embodiment for use about airports or other places where a portable heating unit is desirable and that in a fixed embodiment, it is similarly admirably adapted for use in heating airplanes, other large vehicles or other spaces where a self contained heating unit has advantages. Further, it is apparent that this invention accomplishes all of the objects set forth for it in an earlier portion of this specification.

While I have shown and described my invention as embodied in a particular device, it will be apparent to those skilled in the art that the invention is not limited to the particular construction disclosed. I, therefore, wish to include within the scope of the following claims all constructions by which substantially the results of my invention are obtained by substantially the same or equivalent means.

I claim:

1. In a heating system for airplanes and the like, the combination of an internal combustion heater burning a combustible mixture of fuel and air, an internal combustion engine, a source of fuel, a carburetor receiving fuel from said source, a pump driven by said engine to withdraw and compress a combustible mixture of vaporized and atomized fuel and air from said carburetor, means including a passage conveying said mixture to said engine for combustion therein, means including a passage conveying said mixture to said heater for combustion therein, and means including a blower driven by said engine to pass air in heating relation through said heater.

2. In a heating system for airplanes and the like, the combination of an internal combustion heater burning a combustible mixture of vaporized and atomized fuel and air, an internal combustion engine, a source of fuel, a carburetor receiving fuel from said source, a pump driven by said engine to pass air through said carburetor to mix it with fuel to form a combustible mixture, means including a passage connecting the inlet and outlet of said pump and having a valve therein for regulating the rate of flow therethrough, means including a passage to convey combustible mixture from said carburetor to said heater for combustion therein, means including a passage to convey combustible mixture from said carburetor to said engine for combustion therein, and means including a blower driven by said engine to pass air in heating relation through said heater.

3. In a heating system for airplanes and the like the combination of an internal combustion heater burning a combustible mixture of vaporized and atomized fuel and air, an internal combustion engine, a source of fuel, a carburetor receiving fuel from said source, a pump driven by said engine to pass air through said carburetor to mix it with fuel to form a combustible mixture, means including a passage connecting the inlet and outlet of said pump and having a valve therein for regulating the rate of flow therethrough, means including a passage to convey combustible mixture from said pump to said heater for combustion therein, said passage having a valve therein for regulating the rate of flow of combustible mixture therethrough, means including a passage to convey combustible mixture from said pump to said engine for combustion therein, said last named passage having a valve therein for regulating the rate of flow of combustible mixture therethrough, and means including a blower driven by said engine to pass air in heating relation through said heater.

4. In a heating system for airplanes and the

like, the combination of an internal combustion heater burning a combustible mixture of vaporized and atomized fuel and air, an internal combustion engine, a source of fuel, a carburetor receiving fuel from said source, a pump driven by said engine to pass air through said carburetor to mix it with fuel to form a combustible mixture, means including a passage to convey combustible mixture from said carburetor to said heater for combustion therein, said passage having a valve therein for regulating the rate of flow of combustible mixture therethrough, means including a passage to convey combustible mixture from said carburetor to said engine for combustion therein, said last named passage having a valve therein for regulating the rate of flow of combustible mixture therethrough, and means including a blower driven by said engine to pass air in heating relation through said heater.

5. In a heating system for airplanes and the like, the combination comprising an internal combustion heater burning a combustible mixture, an internal combustion engine, a source of combustible mixture, blower means driven by said engine to cause combustible mixture to flow from said source to said heater and to said engine for combustion therein, and means for controlling the total amount of combustible mixture supplied to said heater and said engine independently of the speed of said engine.

6. In a heating system for airplanes and the like, the combination of an internal combustion engine, an internal combustion heater, a source of combustible mixture, a positive displacement blower means actuated by said engine to cause combustible mixture to flow from said source, means including a duct for conducting combustible mixture from said blower means to said engine for combustion therein, means including a duct for conducting combustible mixture from said blower means to said heater for combustion therein, a by-pass duct connecting the inlet and the outlet of said blower means, and means for controlling the rate of flow through said by-pass duct, thereby controlling the total amount of combustible mixture supplied to said engine and to said heater independently of the speed of said engine.

7. In a heating system for airplanes and the like, the combination of an internal combustion heater deriving its heat from the combustion of a combustible mixture of fuel and air, a source of combustible mixture, an internal combustion engine, blower means driven by said engine to supply combustible mixture from said source to said engine and to said heater for combustion therein, means for regulating the net output of said blower means independently of its speed, and means including a blower driven by said engine for passing air in heating relation through said heater to the space to be heated.

8. In a heating system for airplanes and the like, the combination of a heater deriving its heat from the combustion of a combustible mixture of fuel and air, blower means for forcing air to be heated through said heater, an internal combustion engine driving said blower means, a source of combustible mixture under pressure, means including a passageway conducting combustible mixture from said source to said heater for combustion therein, means including a passageway conducting combustible mixture from said source to said engine for combustion therein, and means determining the relative amounts of combustible mixture supplied to said engine and to said heater, thereby to maintain the temperature of the air heated by said heater relatively constant while the total heat output of the heater is varied.

9. In a system for heating aircraft, the combination of an internal combustion engine, an internal combustion heater, a source of combustible mixture, means actuated by said engine for forcing combustible mixture to flow from said source to said heater and to said engine, means for determining the relative rates of flow of the combustible mixture to said engine and to said heater, and a valve for controlling the rate at which the combustible mixture is supplied to both said heater and said engine by said engine actuated means.

10. In an aircraft heater system, the combination of an internal combustion engine, an internal combustion heater, a source of combustible mixture, a pump having an inlet and an outlet and actuated by said engine, a conduit connecting the inlet of said pump to said source, a duct for conducting combustible mixture from the outlet of said pump to said engine for combustion therein, a duct for conducting combustible mixture from the outlet of said pump to said heater for combustion therein, blower means actuated by said engine to pass air to be heated past said heater, means controlling the relative proportions of the combustible mixture supplied to said engine and to said heater through said ducts, and means for controlling the aggregate amount of combustible mixture supplied to said engine and to said heater.

11. In an internal combustion heater system, an internal combustion engine, an air circulating blower connected to be driven by said engine, a combustible mixture pump also connected to be driven by said engine, carbureting means adapted to supply a combustible mixture to the intake side of said pump, conduit means connecting the output side of said pump to the intake side of said internal combustion engine, means providing a heater combustion chamber, conduit means connecting the output side of said pump to said combustion chamber, means to ignite the combustible mixture in said combustion chamber to form hot products of combustion, means connected to said blower adapted to pass air from said blower in heat exchange relation to the hot products of combustion formed in said combustion chamber, an air induction system for said carbureting means, said air induction system including heat exchange means connected to transfer heat from the hot exhaust gases of said internal combustion engine to the air induced into said air induction system, said internal combustion engine having heat radiating cooling means adapted to transfer engine heat to the air in the vicinity thereof, and said air induction system having an inlet positioned in the zone of heated air adjacent said engine so that air drawn into said induction system is preheated by said engine heat radiating means.

12. In an internal combustion heater system, an internal combustion engine, an air circulating blower connected to be driven by said engine, a combustible mixture pump also connected to be driven by said engine, carbureting means adapted to supply a combustible mixture to the intake side of said pump, conduit means connecting the output side of said pump to the intake side of said internal combustion engine, means providing a heater combustion chamber, conduit means connecting the output side of said pump to said combustion chamber, means to ignite the com-

bustible mixture in said combustion chamber to form hot products of combustion, means connected to said blower adapted to pass air from said blower in heat exchange relation to the hot products of combustion formed in said combustion chamber, an air induction system for said carbureting means, said air induction system including heat exchange means connected to transfer heat from the hot exhaust gases of said internal combustion engine to the air induced into said air induction system, said internal combustion engine having heat radiating cooling means adapted to transfer engine heat to the air in the vicinity thereof, said air induction system having an inlet positioned in the zone of heated air adjacent said engine so that air drawn into said induction system is preheated by said engine heat radiating means, said air induction system having a separate opening positioned out of said zone of heated air, and means operable to close one of the last said openings.

13. In an internal combustion heater system, an internal combustion engine, means providing a heater combustion chamber, carbureting means adapted to supply a combustible mixture to both said internal combustion engine and said combustion chamber, an air induction conduit connected to said carbureting means on the inlet side thereof, said air induction conduit including heat exchange means connected to transfer heat from the hot exhaust gases of said internal combustion engine to the air induced into said air induction conduit upstream of said carbureting means, said internal combustion engine having heat radiating cooling means adapted to transfer engine heat to the air in the vicinity thereof, and said air induction conduit having an inlet upstream of said heat exchange means positioned in the zone of heated air adjacent said engine so that air drawn into said induction conduit is preheated prior to carburetion by said engine heat radiating means.

14. In an internal combustion heater system, an internal combustion engine, an air circulating blower connected to be driven by said engine, a combustible mixture pump also connected to be driven by said engine, carbureting means adapted to supply a combustible mixture to the intake side of said pump, conduit means connecting the output side of said pump to the intake side of said internal combustion engine, means providing a heater combustion chamber, conduit means connecting the output side of said pump to said combustion chamber, means to ignite the combustible mixture in said combustion chamber to form hot products of combustion, means connected to said blower adapted to pass air from said blower in heat exchange relation to the hot products of combustion formed in said combustion chamber, an air induction system for said carbureting means, said air induction system including heat exchange means connected to transfer heat from the hot exhaust gases of said internal combustion engine to the air induced into said air induction system, said internal combustion engine having heat radiating cooling means and including means to produce a blast of air across said heat radiating cooling means to absorb heat from said engine, and said air induction system having an inlet positioned in said blast of air so that air drawn into said induction system is preheated by said engine heat radiating means.

15. In an internal combustion heater system, an internal combustion engine, means providing a heater combustion chamber, carbureting means adapted to supply a combustible mixture to both said internal combustion engine and said combustion chamber, an air induction conduit connected to said carbureting means on the inlet side thereof, said air induction conduit including heat exchange means connected to transfer heat from the hot exhaust gases of said internal combustion engine to the air induced into said air induction conduit at a point upstream of said carbureting means, said internal combustion engine having heat radiating cooling means and including means to produce a blast of air across said heat radiating cooling means to absorb heat from said engine, and said air induction conduit having an inlet positioned in said blast of air so that air drawn into said induction conduit is preheated by said engine heat radiating means prior to carburetion.

16. In an independent unit heating system, the combination of an internal combustion type heater having a combustion chamber and a heat exchanger, a spark plug ignition means for igniting the fuel mixture in said combustion chamber, an internal combustion engine having a high tension ignition system, means connecting said spark plug to said ignition system for energization thereby, a blower driven by said engine for forcing ventilating air through said heat exchanger, a source of a fluid combustible mixture, a positive displacement pump driven by said engine, said pump having an inlet connected to receive combustible mixture from said source and having an outlet, a bypass conduit connecting said inlet and outlet, a throttle valve in said bypass conduit, and means for conveying a combustible mixture from the outlet of said pump to said engine and to said combustion chamber for combustion therein.

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