Oct. 19, 1948. H. J. DE N. McCOLLUM 2,451,760

AIRCRAFT HEATER WITH COMBUSTION AIR CONTROL

Filed Aug. 2, 1943 3 Sheets-Sheet 1

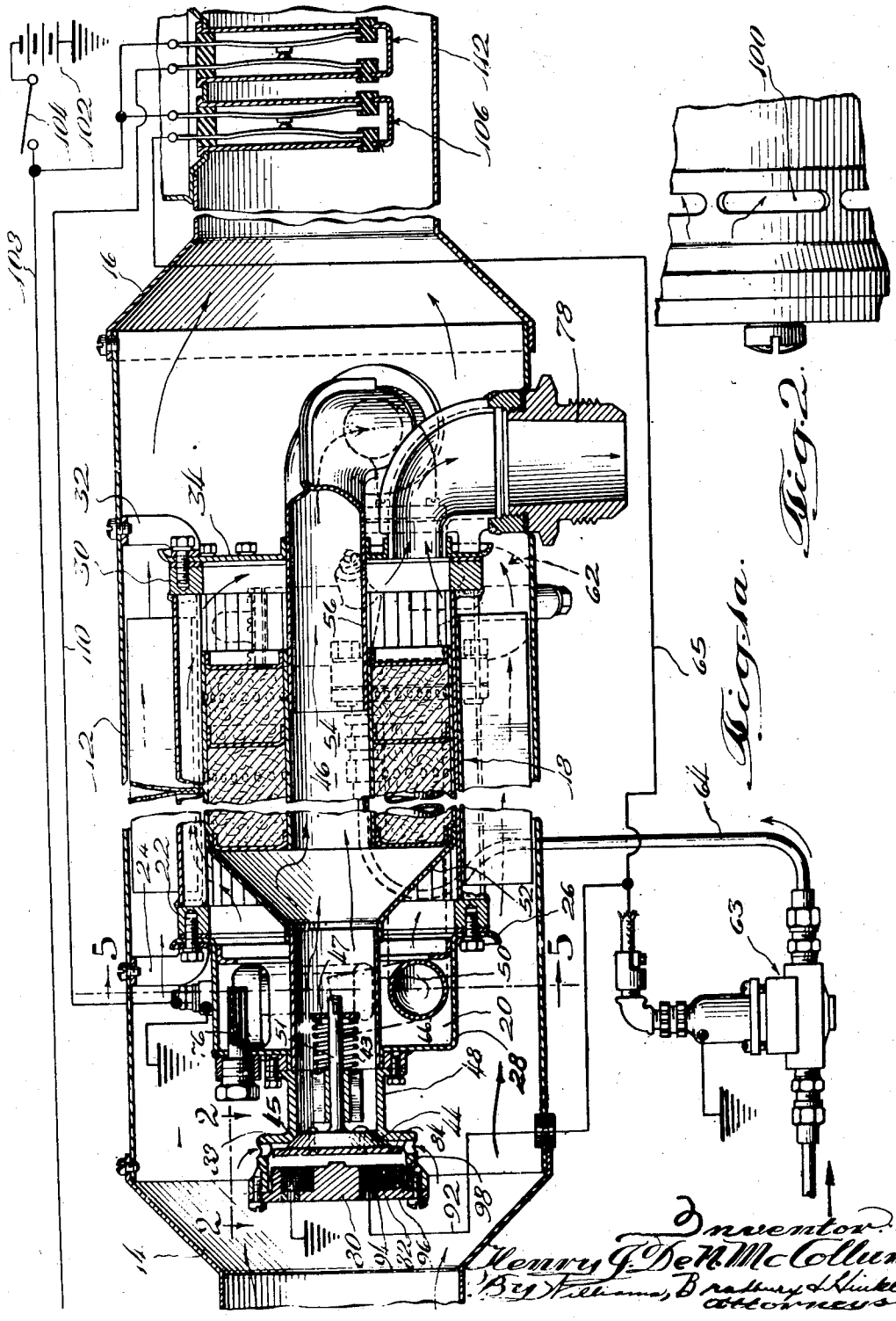


Fig. 2.

Fig. 1a.

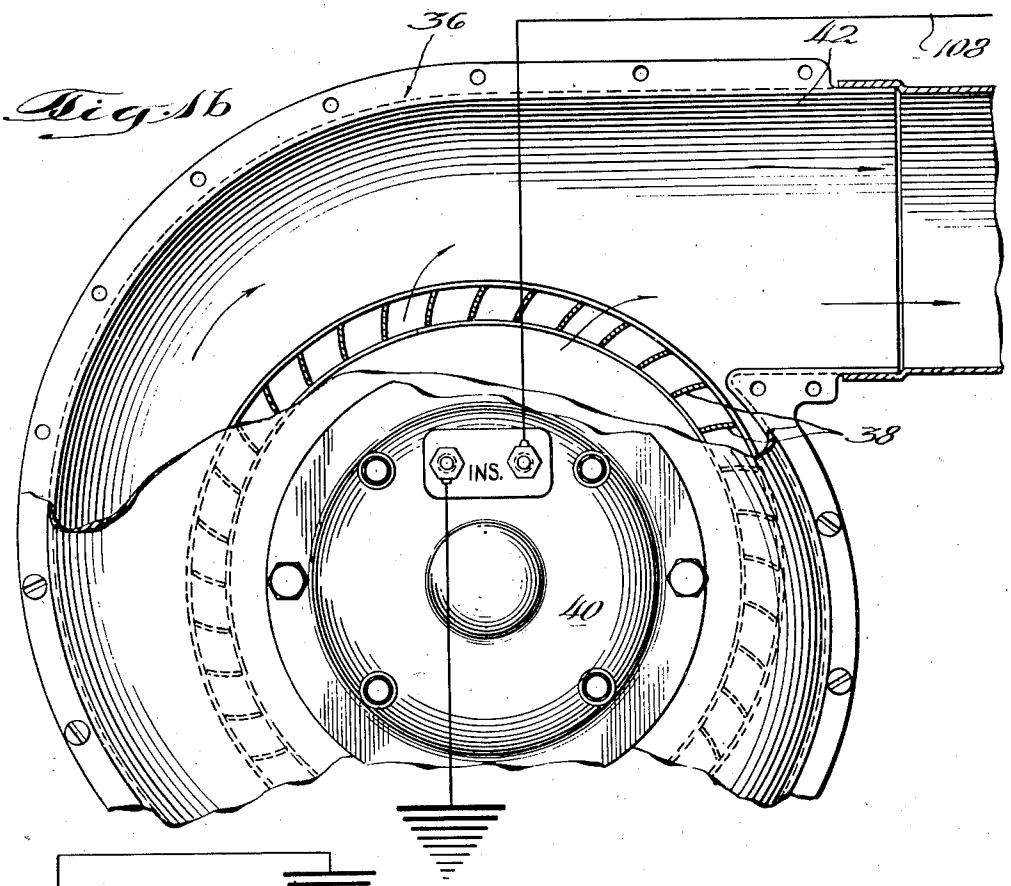
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Fig. 1b



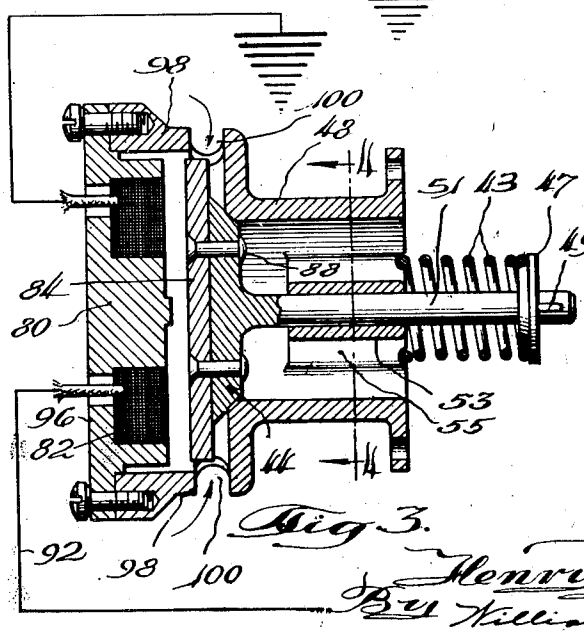
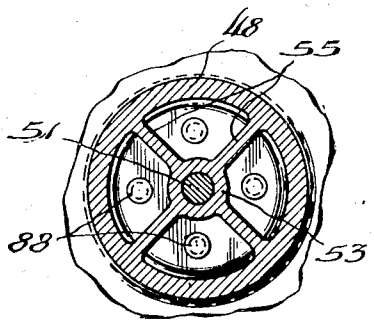


Fig. 3.

Fig. 4.



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Fig. 5.

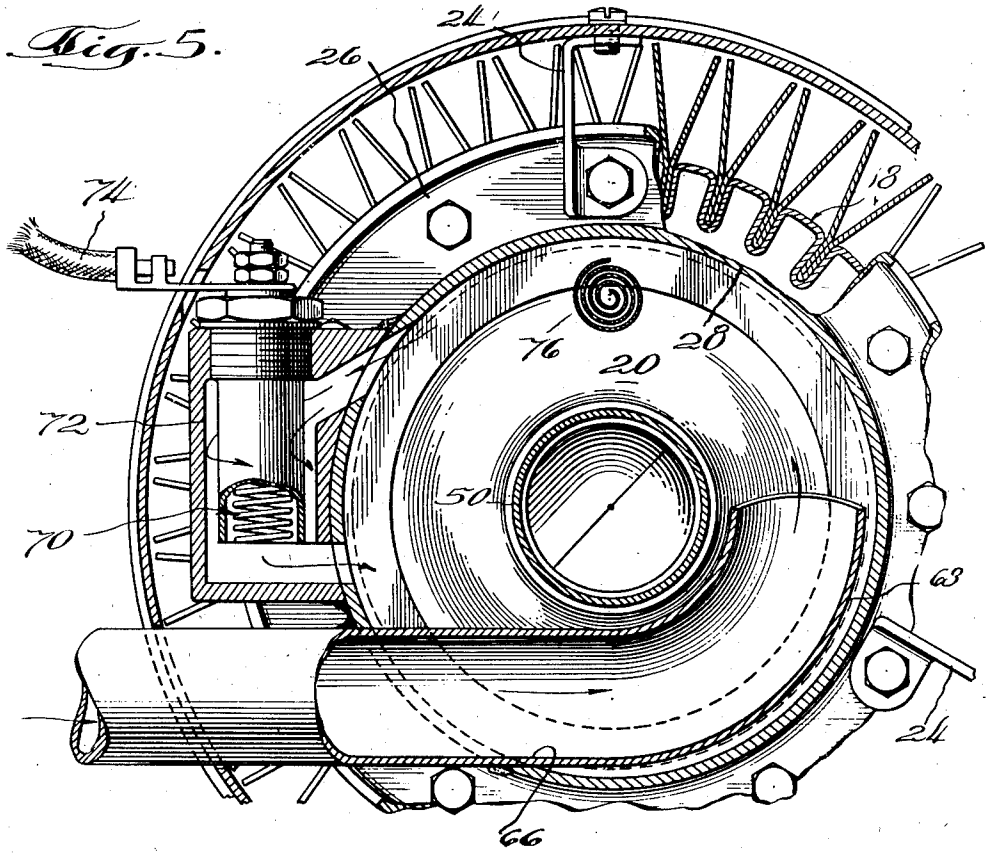
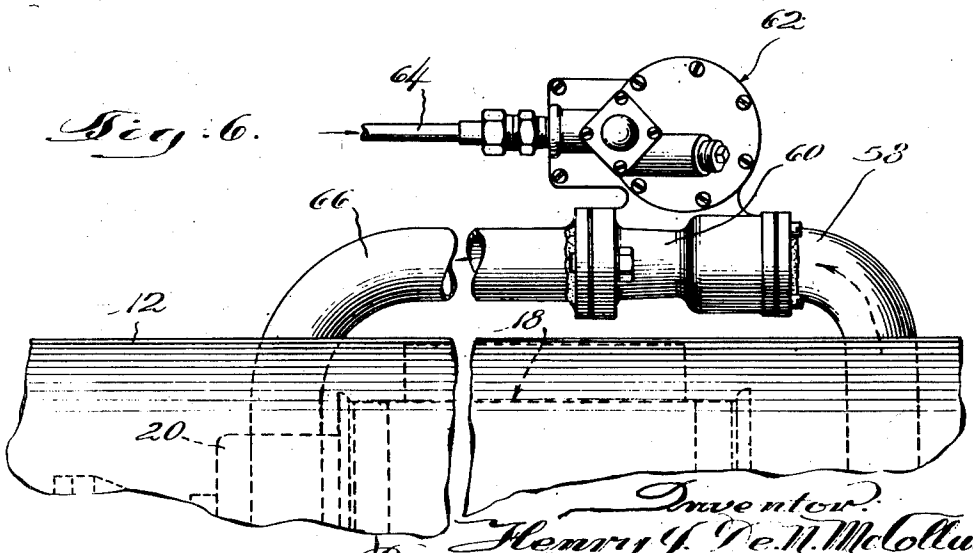


Fig. 6.



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2,451,760

AIRCRAFT HEATER WITH COMBUSTION AIR CONTROL

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Application August 2, 1943, Serial No. 496,975

3 Claims. (Cl. 126—116)

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This invention relates to heaters and particularly to heaters of the internal combustion type.

An object of the invention is to provide an improved internal combustion heater for aircraft, which may be operated while the aircraft is on the ground as well as when it is in flight.

A further object of the invention is to simplify the construction of an internal combustion heating system without decreasing the operational advantages thereof.

A further object of the invention is to provide improved means for circulating ventilating air through the heater and for supplying combustion air to be mixed with fuel to form a combustible substance.

A further object of the invention is to provide improved means for preventing contamination of the ventilating air by the admixture therewith of products of combustion.

Other objects and advantages will be apparent from the following description. Reference is had in the description to the accompanying drawings, in which:

Figs. 1*a* and 1*b* are complementary sectional views, which, taken together, show the component parts of an internal combustion heater together with means for supplying air thereto for ventilating and combustion purposes;

Fig. 2 is a view taken on the line 2—2 of Fig. 1*a*;

Fig. 3 is an enlarged central vertical sectional view, showing in detail the valve arrangement of Fig. 1*a* which controls communication between air supplied for ventilating purposes and air supplied for combustion purposes to the heater;

Fig. 4 is a section taken on the line 4—4 of Fig. 3, showing particularly the construction of the valve guide;

Fig. 5 is an enlarged section taken on the line 5—5 of Fig. 1*a*, showing particularly the arrangement of the combustion chamber of the heater; and

Fig. 6 is a fragmentary plan view, showing the conduits leading from the valve of Fig. 3 to a carburetor, and thence to the combustion chamber of Fig. 5.

In heating systems of the general type with which this invention is concerned, the transfer of heat from the heater to the space to be heated is accomplished by convection, the air which transfers the heat being generally referred to as ventilating air.

Furthermore, air is also supplied to the heater for the purpose of providing a combustible mixture. The air is mixed with a fuel by means of a carburetor, and the resulting mixture is conveyed to a combustion chamber to be burned.

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It is apparent that the heating system may be made less complicated and less expensive by using a single means for supplying both the ventilating and the combustion air. However, this arrangement has the disadvantage that the ventilating air is not sealed from the combustion air, and, hence, the products of combustion, including gases which may have an unpleasant odor and may in some instances have a toxic effect, may enter the space to be heated when the heater is not operating. This defect has heretofore made it desirable to separate completely the ventilating air and combustion air flow throughout the heating system and to provide separate air circulating means in order to prevent undesirable communication between the combustion chamber and the space to be heated.

The present invention provides a heating system having unitary air circulating means for supplying both the ventilating and the combustion air in which the above mentioned possibility of contaminating the ventilating air is eliminated.

The heater itself may be of any desired construction. By way of example, a heater is illustrated in Fig. 1*a*, having an outer cylindrical shell 12, provided with an inlet fitting 14 and an outlet fitting 16. The ventilating air which flows through the heater to be heated therein and conducted to the space to be heated, as for example, the cabin of an airplane, flows through a generally annular passage formed between the shell 12 and a finned heat exchanger 18 having a generally tubular shape. Heat is transferred by means of the heat exchanger 18 and the fins thereof to the ventilating air from hot gases flowing inside the heat exchanger.

These gases are the products of combustion resulting from ignition of a combustible mixture in the combustion chamber 20, which is shown both in Fig. 1*a* and in Fig. 5. The ventilating air is, in general, sealed from the products of combustion flowing inside the heat exchanger. To accomplish this, the heat exchanger may be welded at one end to a supporting ring 22 which is supported by brackets 24 extending from shell 12 and which is secured to the annular flange 26 of a generally cylindrical casing 28, which forms the combustion chamber. The other end of the heat exchanger may be welded to a similar supporting ring 30, which is supported by brackets 32 and the open end of which is closed by a plate 34.

Referring to the provision of means for supplying ventilating air and air for combustion purposes to the heater, a particularly satisfactory and economical arrangement is an air ram, provided the structure on which the heater is mounted is moving. An air ram may conveniently be used in heating systems for aircraft or the like, since the dynamic pressure of the air stream causes satisfactory flow of air through the heater. Although not shown, it is contemplated that an air ram may be used as the means for causing the air flow through the heating system, provided the heater is used for aircraft or the like, and during flight of the aircraft. Ordinarily, two such rams might be used, one for supplying ventilating air and the other for supplying air for combustion purposes, the ventilating air being sealed from the combustion air throughout the heating system.

Although such sealing has certain advantages, it requires that, if the heating system of the airplane is to be operated while the plane is on the ground and stationary, two motor operated blowers or the like must be provided for circulating ventilating and combustion air. Such an arrangement is both expensive and complicated.

At the same time, it is very desirable that the heater be capable of operation when the plane is stationary, since it can then be used to defrost the windshield and to bring the cabin of the plane to the desired temperature before the flight begins.

Therefore, in the arrangement illustrated, I have provided unitary means for supplying both ventilating and combustion air while the aircraft is on the ground and means associated therewith to eliminate the difficulties and disadvantages which would normally be present were the communication between the ventilating air and the combustion air unrestrictedly permitted. The invention is not to be limited to any particular form of unitary air supply means, and the blower as illustrated is to be considered as merely one acceptable embodiment of this means. The means provided for supplying air to the heater while the aircraft is stationary may also be used during flight. It may be desired, however, in some cases to utilize an air ram for this purpose during flight. In that case, a single air ram would probably be preferable, since the provision of two such rams would have no particular advantage, the complete separation of the ventilating and combustion circulating systems having been sacrificed for the reasons explained.

The unitary means for supplying air may be of any preferred type. By way of example, I have illustrated in Fig. 1*b* a centrifugal type blower 36, having blades 38 mounted on a rotor driven by an electric motor 40. Air is supplied directly from the outlet 42 of the blower to the inlet 14 of the heater shell 12, whence it may flow between the shell and the heat exchanger and through the outlet 16 and suitable conduits to the space to be heated.

Means are provided for diverting a portion of the air to the combustion chamber, and means are also provided for controlling such diversion of air in order to prevent undesired communication between the ventilating and combustion air. The latter means comprises a valve member 44 which is adapted to seat at 45 at one end of a longitudinal passage 46 extending through the center of the heater. In the valve construction shown, which is most clearly illustrated in Figs. 3 and 4, the valve is urged to close by a spring 43 acting through a collar 47 against a protection 49 on the valve stem 51. The stem 51 is

guided by a sleeve 53 formed integral with the spoke-like arms 55 which extend radially inwardly from the cylindrical valve-seat providing member 48, the arms 55 also serving as a fixed support for one end of spring 43.

The passage 46, which constitutes a part of the means for diverting air to the combustion chamber, is defined by the cylindrical valve-seat providing member 48, a tubular member 50 extending therefrom, a bell-mouthed fitting 52, a tubular member 54, and a tubular cross-section elbow fitting 56 which connects, as seen in Fig. 6, to a reversely extending pipe 58 outside the heater shell. Air flowing through the pipe 58 flows through the throat 60 of a carburetor, indicated generally at 62. The carburetor may be of the ordnary float bowl type connected to a supply of liquid fuel by a conduit 64. The fuel and air are mixed at the throat of the carburetor to provide a combustible mixture which is conducted to the combustion chamber 20 by means of an induction tube 66. As shown in Fig. 1*a*, the flow of fuel in supply conduit 64 may be controlled by a solenoid valve, indicated generally at 63, the solenoid having one terminal grounded and the other connected by means of an electrical conductor 65 to a source of electrical energy.

The particular form of the induction tube and the particular arrangement of the combustion chamber form no part of the invention, but it may be briefly noted that the upwardly curved end 68 of the induction tube enters the combustion chamber in such a way as to give a generally tangential motion to the issuing combustible mixture which then follows around the wall of the chamber. Ignition of the combustible mixture is accomplished by an igniter 70, which may be of the electrical resistance type, located in the pocket 72 at one side of the combustion chamber. Electricity is supplied to the igniter by means of a conductor 74. A reigniter 76 may be provided to store sufficient heat energy that it can ignite the combustible mixture if, after the heater has been burning for an appreciable time, said mixture should, for some extraneous reason, cease burning.

As pointed out before, the products of combustion flow from the combustion chamber along the inside of the heat exchanger 18, and subsequently escape from the heater through the outlet 78. The outlet for the products of combustion is preferably so arranged that there is an aspirating effect thereon, with the result that the pressure of the products of combustion flowing through the heater and also of the air in passage 46 is somewhat lower than the pressure of the ventilating air, thus preventing the products of combustion from escaping into the ventilating air stream, should any leak develop, as by perforation of the heat exchanger wall by a bullet.

It is important that valve 44 be so controlled as to prevent the products of combustion from backing up into the ventilating air. The valve 44 is therefore controlled so as to be open only when the heater is operating, and a unidirectional flow of air and hot gases is being maintained throughout the heating system. To this end I provide control means for the valve operable according to the will of the airplane operator, and preferably tied in with the control of the heater in such a way that the opening and closing of the valve are automatically controlled by the starting and stopping of the heater. By way of example, I have illustrated compact and efficient means for controlling the valve 44, said means constituting an electromagnetic control

for the valve. The control includes an electromagnet comprising a magnetizable core 80 and winding 82, and a magnetic plate 84 secured to the head of the valve 44, as by rivets 88. One terminal of coil 82 is grounded and the other terminal of the coil is connected by a conductor 92 to a source of electrical energy. The core 80 may be formed integral with a member 96 which is secured to an axial flange 98 of the valve seat providing member 48. As shown in Fig. 2, the axial flange 98 is provided with slots 100 to permit the entry of air into passage 46, provided valve 44 is open.

The electromagnetic valve 80—84 is preferably operated concurrently with the solenoid valve 63, and the conductor 92 is therefore shown as connected to conductor 65, thus placing the electromagnetic valve 80—84 and the solenoid valve 63 in parallel. A battery 102 may constitute the source of electrical energy and a manually operable switch 104 is provided to control operation of the heater. It is preferred that a thermostatic overheat switch, indicated generally at 106, be provided to automatically cut off conductor 65 from the source of electrical energy whenever the temperature of the ventilating air leaving the heater reaches a predetermined level.

The manually operable switch 104 also controls the connection between battery 102 and a conductor 108, which supplies electrical energy to the motor 40 of the blower, and the connection between the battery and an electrical conductor 110 which supplies electrical energy to the igniter 70. It is preferred that a thermostatic switch 112 be provided to automatically disconnect conductor 110 from the battery whenever the temperature of the ventilating air has reached a certain predetermined level.

Whenever it is desired to operate the heater, the operator closes switch 104. This causes the following events to occur substantially simultaneously. The motor 40 begins to operate the blower, the igniter 70 begins to heat, the solenoid on valve 63 is energized to open the valve and permit flow of fuel through conduit 64, and the electromagnetic valve 80—84 is energized to lift the valve 44 from its seat. Air supplied by the blower, therefore, not only provides ventilating air for the heating system, but also provides air which is mixed with the fuel by means of carburetor 62 to be transmitted to the combustion chamber 20 and ignited therein. When either the thermostatic switch 106 or the manually operable switch 104 is opened, electromagnetic valve 80—84 is deenergized, permitting spring 45 to close the valve 44 and cut off communication between the ventilating and combustion air. At the same time, the solenoid valve 63 is closed to cut off communication between the fuel supply and the carburetor. The blower motor will continue to operate as long as switch 104 is closed. The igniter 70 will cool as soon as switch 112 is opened by the increased heat of the ventilating air. It will be appreciated that, as a general rule, the switch 112 will be arranged to open at much lower temperature than switch 106, inasmuch as switch 112 is desired to open as soon as the combustible mixture is burning normally, whereas switch 106 is designed to open in case the heater reaches a condition of overheat, and must be stopped as a safety measure.

The heating system disclosed has several advantages. One of these is the prevention of communication between the combustion air and the ventilating air except when the heater is operating, making it impossible for the burning gases in the heater to back up into the ventilating air when the heater is shut off. Another of the advantages is that an added safety feature is provided. This safety feature results from the closing of valve 44 whenever overheating causes switch 106 to open. Closing valve 44 stops combustion in the heater immediately, even though a certain amount of gasoline or other fuel remains in the float bowl of the carburetor.

Although I have described, for purposes of illustration, a specific embodiment of my invention, it will be apparent to those skilled in the art that numerous modifications of the invention may be developed without departing from the underlying principles thereof. It is therefore my intention to cover by means of the appended claims all modifications and variations which come within the scope of said claims.

I claim:

1. In an airplane heater of the internal combustion type having a combustion chamber and a heat exchanger, the combination of unitary blower means for supplying ventilating air to the heat exchanger and additionally to supply combustion air to the combustion chamber, a valve normally preventing flow of the combustion air, and remote control means to open said valve to permit said unitary blower means simultaneously to supply ventilating and combustion air, said last named means including a thermostat responsive to the temperature of the heater and operative to cause closure of the valve independently of the continued operation of said blower means.

2. In a heater of the internal combustion type, the combination of an elongated tubular shell, a combustion chamber in the front end portion of said shell in spaced relation to the wall of the shell and having an opening at its forward end for the entrance of combustion air, a heat exchanger through which the hot combustion gases pass backwardly from the combustion chamber, means for causing a stream of air to flow backwardly through the shell and the heat exchanger and be heated, a forwardly opening valve for closing the opening at the forward end of the combustion chamber, a spring normally holding said valve in its closed position so as to prevent the entrance of combustion air into said combustion chamber, means comprising a manually movable member adapted by movement into one position to start said air flow producing means into operation and to open said valve for admitting combustion air into said combustion chamber, and means controlled by the temperature in said shell adapted at a predetermined temperature to cause said valve to close while said air flow producing means continues to operate.

3. In a heater of the internal combustion type having a combustion chamber and a heat exchanger for transferring heat from the products of combustion to ventilating air, an air blower, an electric motor connected to the blower to drive the latter, means forming a passageway for the flow of air from the blower to the combustion chamber, means forming a duct for the flow of air from the blower to the heat exchanger, a valve in said passageway to control the flow of air therethrough, yielding means to hold said valve in closed position, a source of electrical energy, electrically operated means to open said valve, a thermostatic switch, a manually operated switch, a first circuit including said source, said switches, and said valve opening means, said

thermostatic switch operating to open said first circuit whenever the heated ventilating air attains a predetermined excessively high temperature, and a second circuit including said source, said electric motor, and said manually operated switch.

HENRY J. DE N. McCOLLUM.

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