

July 22, 1958

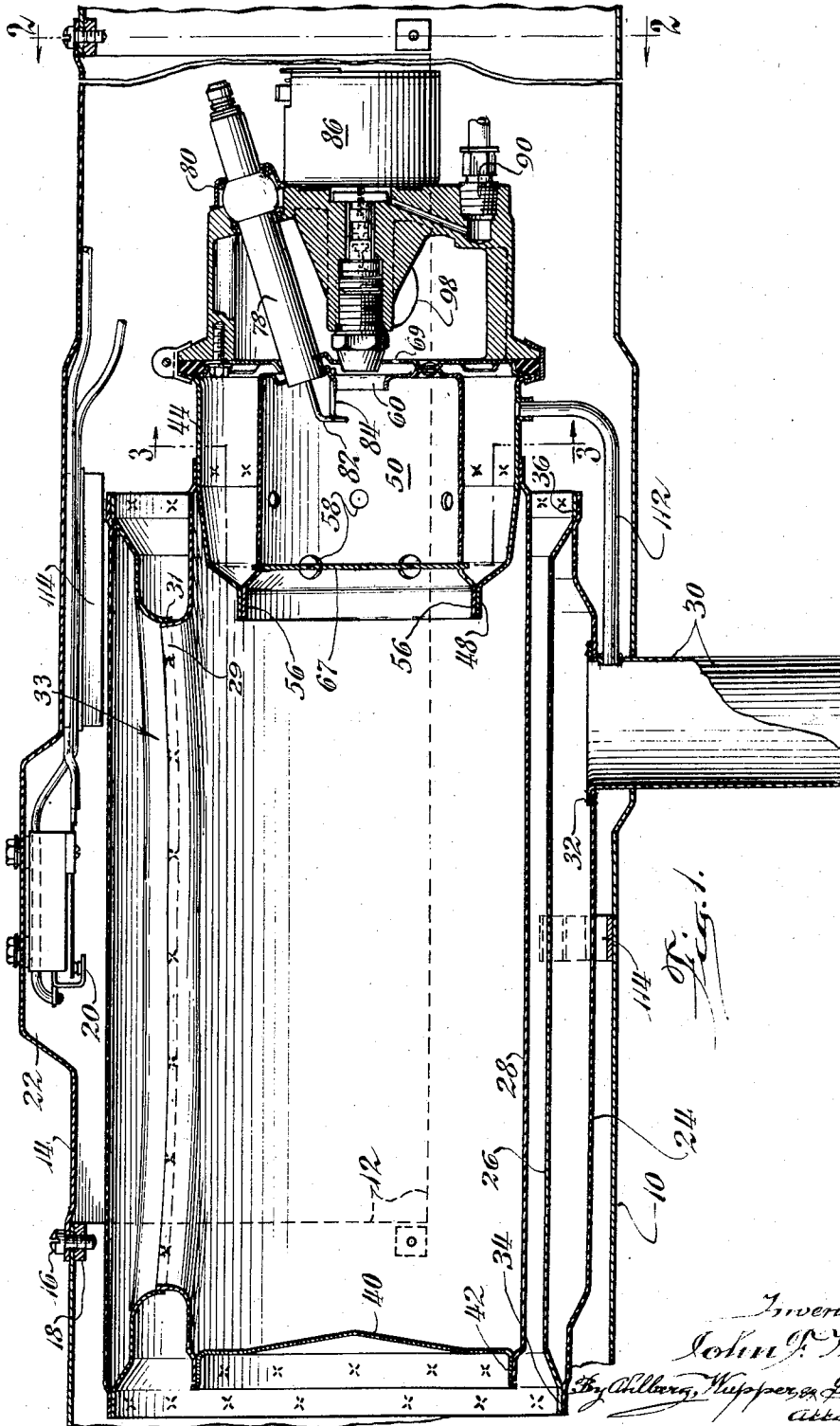
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VEHICLE COMBUSTION HEATER

Filed Sept. 2, 1955

3 Sheets-Sheet 1

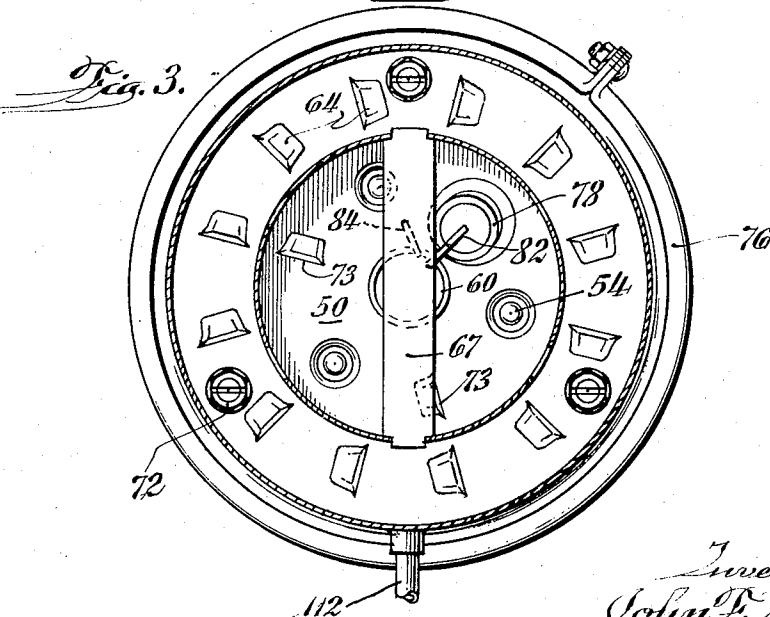


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3 Sheets-Sheet 2



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3 Sheets-Sheet 3

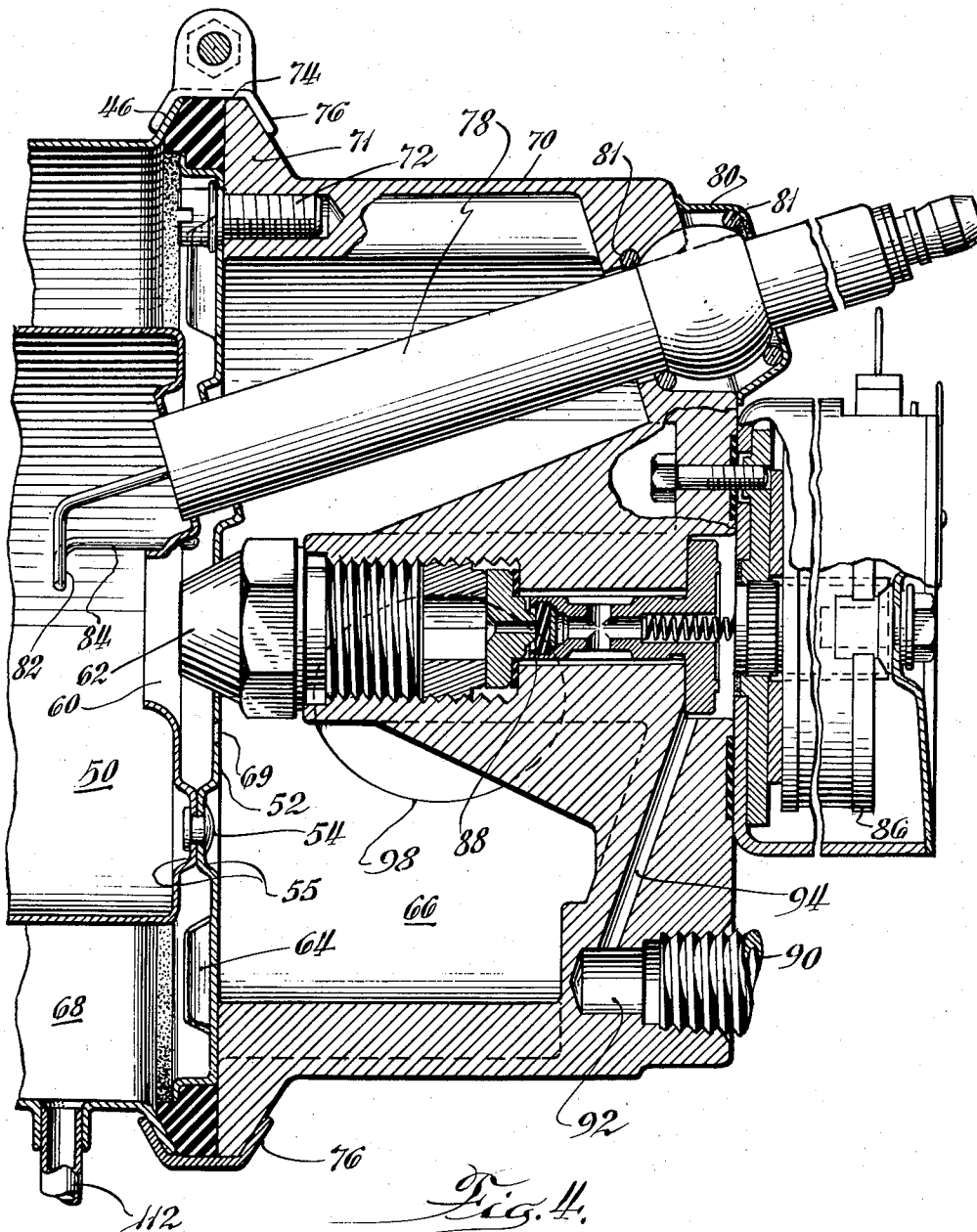


Fig. 4.

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VEHICLE COMBUSTION HEATER

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4 Claims. (Cl. 126—116)

The present invention relates generally to sealed combustion heaters primarily intended for use in automotive vehicles. More particularly the invention relates to an improved burner to be used in such heaters.

One of the objects of my invention is to provide an improved heater burner of the spark-ignited spray type which has high efficiency and which will operate for long periods without attention.

An additional object is to provide a novel heater burner of the above type which is readily removable, along with most of its accessories from the remaining portion of the heater system for servicing and is resiliently supported within the remaining portion of the heater.

Yet another object of my invention is to provide a novel heater burner which is extremely stable in operation and is not sensitive to the length of the exhaust line used with the heater nor to pulsations in the combustion air supply to the burner and which has a novel supporting and combustion air system.

Yet another object is to provide a burner having the above characteristics, which can be manufactured at low cost.

Other objects and advantages will become apparent from the following description of a preferred embodiment of my invention which is illustrated in the accompanying drawings.

In the drawings, in which similar characters of reference refer to similar parts throughout the several views,

Fig. 1 is substantially a longitudinal, vertical, medial sectional view of a heater embodying a burner which incorporates features of the present invention. In this view the sparking electrodes and the fuel intake passages have been rotated slightly so as to place them in the plane of the section, in the interests of a better understanding of the invention;

Fig. 2 is a transverse sectional view which may be considered as taken substantially along the line 2—2 of Fig. 1, showing the major portion of the heater structure in elevation from the burner end. A portion of the structure has been broken away to reveal details of construction. In this view the sparking electrode and the fuel inlet passage are shown in their true location;

Fig. 3 is a transverse sectional view taken in the direction of the arrows substantially along the line 3—3 of Fig. 1; and

Fig. 4 is a longitudinal vertical sectional view of the burner drawn to larger scale. It may be considered as an enlargement of a portion of Fig. 1.

The heater shown, briefly consists of a spray type burner which supplies hot products of combustion directly to the inside of a sheet metal heat exchanger, from which the heat is exchanged to a ventilating air stream, while the cooled products of combustion pass from the heat exchanger by way of an exhaust fitting. Combustion air is supplied to the heater burner from any convenient means. A motor driven blower is suitable for this purpose. Fuel is supplied from a pump, not shown, to the nozzle, by way of a magnetic "on-off" valve so that fuel

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is sprayed from the nozzle only when the magnetic valve is energized. The burner is spark-ignited by means of a suitable step-up transformer or spark coil, not shown.

A combustion air blower, a ventilating air blower, a source of high tension electricity, a fuel pump, and a control circuit, are not shown since they form no part of the present invention and they of course may take many optional and well known forms. The present invention is primarily concerned with the structure of the burner itself and its association with the heat exchanger.

One method of regulating the heat output of a heater of the present type calls for automatically turning the fuel on and off as heat is required, while causing the ventilating air to flow continuously so as to keep the temperature of the ventilating air leaving the heater approximately constant. Control of this type is obtained by using an on-off cycling thermostatic switch in the hot air duct downstream of the heater so that whenever the temperature of the hot ventilating air rises above some manually preset level the fuel valve previously referred to is deenergized and closed. This shuts off the burner and very quickly the continuously flowing ventilating air reduces the temperature of the heat exchanger, and hence the temperature of the ventilating air to the point where the thermostatic switch in the hot air duct recloses, thereby reopening the fuel valve and instantly restarting the heater. This cycling continues endlessly whenever the heater is in operation and serves to maintain the temperature of the ventilating air at a desirable level through the operation of a comparatively simple control system.

Regulation of the type discussed above places considerable demands upon the burner, however, since the burner should, with this type operation, start and stop substantially instantaneously, so as to prevent any accumulation of liquid fuel within the burner. The principal reasons for this necessity are that any accumulation of fuel within the heater is likely to produce an objectionable gasoline smell in the vicinity of the vehicle, and furthermore, the principal source of carbon formation within a burner of this general type is the periodic presence of unburned gasoline. Thus the service life of the burner between inspections and cleaning periods is greatly extended if the burner can be kept free of unburned fuel.

In combustion heaters it is also necessary that the metal of the heat exchanger not be overstressed by expansion and contraction, and this is a difficult problem to solve in a rapid cycling system of the type described above where the metal of the heat exchanger is rapidly heated and rapidly cooled in a cyclic fashion.

Referring now particularly to Fig. 1, I have indicated a generally cylindrical sheet metal case at 10 through which the ventilating air flows. For this purpose it may be considered that the right hand, as illustrated in Fig. 1, is connected to a source of ventilating air such as a ventilating air blower, for instance while the opposite end of the case is connected to duct work leading to the space to be heated.

In order to facilitate assembly and servicing of the heater, a generally rectangular section, as indicated by the line 12, is cut out of the duct 10 at the top, the opening thus formed which extends to about the center line of the duct being closed by a removable curved cover 14 secured to the duct 10 as by screws 16 threaded into nuts 18 which are anchored to the duct 10. Sheet metal screws may be used if desired.

A heater of this type commonly is provided with an overheat safety thermostatic switch which is for the purpose of turning off the burner, that is, shutting off the fuel, in the event that the metal of the heat exchanger becomes too hot. In the interest of completeness, I have shown such a safety switch at 20 mounted in a recess

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22 in the cover 14. This is an appropriate location for this switch, since it is thus placed close to the heat exchanger where it is subjected to radiation heating, and furthermore it is readily available for adjustment or checking simply by removing the cover 14.

The heat exchanger is preferably formed of stainless steel or similar metal and is comprised principally of three nested, generally cylindrical sheet metal tubes. The outermost of these tubes is indicated at 24. It encloses the intermediate tubular member 26 which in turn surrounds the innermost tube 28. The three tubes are well spaced from each other. At the bottom of the heater the outermost tube 24 is flattened somewhat longitudinally so as to provide a longitudinally extending larger space as will appear, for the collection of exhaust which is conveyed to a tubular outlet fitting 30. This fitting or spud is flanged at its inner end as at 32 and is seam-welded to the metal of the outermost heat exchanger tube 24. The exhaust fitting extends downwardly through an opening in the air case 10 so as to be available for the attachment of an exhaust line which may lead to any suitable location.

The ends of the intermediate tube 26 are stretch-formed to a larger diameter as indicated at 34 and 36 so that the external diameter at the stretched portions fits the internal diameter of the external tube 24. In accomplishing this some inward or outward shaping of the ends of the tube 24 may be advisable as an aid to convenient fabrication. As shown, the right end at 36 is slightly larger than the left end at 34 so that in assembling the elements the tube 26 may freely be slid endwise into the left end of the tube 24 for almost its entire length, some pressure being applied to bring about a final seating between the interfitting tube ends.

The left-hand end of the innermost tube 28 is closed by an outwardly flanged closure member 40 which is pressed into place with its flange 42 tightly fitted into the end of the opening in the innermost tube 28. To facilitate fabrication, this end of the tube 28 may also be shaped inwardly or outwardly slightly, this shaping being not so much for the purpose of altering the dimension as for the purpose of arriving at a predetermined dimension. It is easier to form sheet metal tubes, such as 28, 26 and 24, approximately to desired size and then stretch or shrink the ends sufficiently to exceed the elastic limit of the metal and thereby to arrive at a definite dimension than it is to attempt to make the tubes with the desired press fit, without this supplemental shaping.

A tubular burner adapter fitting 44 is shown at the right-hand end of the tube 28 with approximately half its length projecting into the space within the tube 28. It, like the other elements, is formed of sheet metal and is flared at its outer end as at 46 while its inner end is shaped inwardly to a smaller dimension to form a short cylindrical flange 48.

At the top, the innermost shell has a longitudinally extending portion punched out to form a slot which does not approach either of the tube ends very closely. The metal in the vicinity of this slot is also drawn outwardly and thus forms a peripheral outstanding rib 29 surrounding a generally rectangular opening with well rounded ends. The metal of the intermediate shell is similarly punched and drawn inwardly at the top so as to form a similar slot and peripheral rib 31 which is of such a size and shape as to telescope tightly over the rib 29. During assembly these two ribs are telescoped and seam-welded together, so as to be joined entirely around their periphery, thereby providing an airtight passage 33 between shells 28 and 26.

It should be noted further that the inner shell 28 together with the burner mechanism carried thereby (as will appear) is supported entirely separately from the intermediate shell 26 excepting for the connection at the joint between the ribs 29 and 31. This gives a very resilient support to the interior of the heat exchanger

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with respect to the outer portion thereof, and this prevents differential expansion and contraction of the order encountered in a device of this character from producing local wracking stresses on the metal which in more conventional structures frequently results in a breakdown of the joints between the elements.

The combustion chamber of the burner is illustrated at 50 and consists of a generally cylindrical sheet metal cup with the base thereof secured to the center of a circular plate 52 as by riveting, as shown at 54. In order to space the base of the cup slightly from the plate 52, the rivets pass through stamped bosses 55 formed either in the plate or the base or both. The cup 50 has its outer end flared outwardly to provide a cylindrical flange 56 which forms a loose sliding fit with the flange 48 of the adapter. The cup 50 is provided with several combustion air entry holes 58 in its side wall and the base thereof has an inwardly flanged opening 60 surrounding a fuel spray nozzle 62. The end of this nozzle projects through a hole at the center of the plate 52, and this plate 52 also is lanced and deformed to provide several louvers 64 which permit combustion air to pass from a chamber 66 to the left of the plate 52 into the annular chamber 68 which is formed within the adapter 44 with a swirling motion.

A small amount of air also flows without spin from the space 66 through five small holes 69 placed substantially evenly around the central hole in the plate 52. The air thus admitted insures pressurization of the space between the base of the cup 50 and the plate 52 even under high air flow rate conditions where the rotary effect produced by the louvers 64 might otherwise produce a low pressure at the nozzle opening 60. Air from the annular chamber 68 then passes inwardly through the previously mentioned holes 58 with a rotary component and that flowing through the holes 69 passes through the opening 60 around the end of the nozzle 62 and through other openings to be mentioned presently. In order to provide desirable turbulence within the burner, a narrow strip of metal 67 extends across near the mouth of the combustion chamber. It is secured simply by snapping its ends, which are slightly narrower than the main portion thereof, into two of the holes 58 which are opposite each other.

A cup 70, which can be readily formed as a die casting for instance, since it remains cool, is provided with a peripheral flange 71 at its open end. This cup is secured with its open face against the back of the previously mentioned plate 52 by means of screws 72; and the flanges 71 and 46, together with a resilient sealing gasket 74 are all secured together by a screw tightened split peripheral clamping band 76. As shown, the insulator for one of the electrodes of the spark-igniter is indicated at 78. It extends through an opening at the base of the cup 70 and aligned openings in the plate 52 and combustion chamber 50, and is secured in place and sealed by a screw-held clamp fitting 80 and copper gaskets 81. It is so positioned that its electrode 82 extends into the combustion chamber in close proximity to a grounded electrode 84 welded to the base of the combustion chamber cup 50 in an appropriate location.

The nozzle 62, which is conventional, is secured in the end of a hollow stem formed at the center of the cup 70, and this stem also contains the elements of the magnetically actuated poppet type fuel valve 88. The coil for actuating the valve is indicated at 86 and is secured against the base of the cup 70. Fuel is brought to the valve by way of an inlet fitting 90, and a cored passage-way 92 which intersects a passage 94 drilled in the die casting so as to intersect the valve chamber in the stem 69.

In addition to the combustion air louvers 64 which serve as air inlets to the space 68 around the combustion chamber 50, there are also two similar louvers 73 formed in the base of the combustion chamber 50. These are about 120 degrees apart and are equally spaced with re-

spect to the opening in the base of the combustion chamber through which the electrode insulator 78 passes. The clearance at this point (between the insulator and combustion chamber base) acts as a third air inlet opening. These three air inlets, together with that provided by the central opening 60 around the nozzle, supply sufficient air for starting and are a great aid in preventing the formation of carbon deposits upon the nozzle face and sparking electrodes.

The central opening in the plate 52 fits tightly against the tapered end of the nozzle and insures proper centering and spacing of the elements. During this assembly operation there is no objection if the center of the plate 52 is sprung inwardly slightly, and therefore the parts involved can be made to ordinarily observed manufacturing tolerances.

The close proximity of the poppet fuel valve 88 to the nozzle insures that there will be almost no residual fuel trapper between the valve and nozzle when the nozzle is closed. This is extremely helpful in preventing dribbling of fuel from the nozzle after the burner has been shut off.

Air for combustion is brought into the space 66 within the cup 70 through one of a pair of horizontal hollow bosses 96 or 98. These bosses are formed as a portion of the die casting 70. Two are provided, one on each side, so that the tube from the combustion air blower can be connected on whichever side is the more convenient for a particular installation. The opposite opening is partially closed by a pressed-in flanged disc 100 which has a small hole 102, in the present example about one-quarter inch in diameter, therethrough. This hole helps in preventing noisy or uneven operation of the burner and has proved to be very effective for this purpose even under conditions where the combustion air supplied to the burner pulsates considerably. This feature is important because the most customarily used source of combustion air is a blower of the centrifugal type which produces a pulsating air stream caused by the passage of the blades of the rotor in near proximity to the blower outlet opening.

It should be noted that each of the air bosses is fitted into a molded soft rubber tubular member 104 or 106 which extends outwardly and provides a flat vertical face 108 or 110 which engages the inside surface of the sheet metal around openings formed between the case 10 and the cover 14 to permit the passage of the members 104 and 106. This arrangement acts as a seal for the openings in the air case 10 and also provides resilient support for the burner, combustion chamber, and heat exchanger with respect to the air case. One of these tubular members 104 is connected to the end of the combustion air inlet hose and serves as the means for conducting air to the chamber within the cup 70. The other tubular member 106 terminates just outside the wall of the case 10 and acts as an atmospheric pressure outlet for any air flowing through the hole 102.

Additional means for loosely supporting and locating the heat exchanger outer shell 24 within the casing 10 may take the form of sheet metal spacing clips secured to the inside surface of the case 10 as at 114 for instance. With the above structure it will be seen that the heat exchanger and the burner are secured together as a single unit which is mounted within the air casing 10 and supported therefrom in a manner which provides for free movement within a limited range. No strain is put upon the metal of the heat exchanger or burner therefor due to expansion and contraction which occurs differentially as between the heat exchanger and the air case 10.

It will be apparent that by removing the cover 14, the spark plug wire and fuel line connection, and by removing or sufficiently loosening the clamping band 76 the burner casting 70, the combustion chamber 50, the sparking electrode 78, the nozzle 62, the fuel valve and actuator therefor 66-88, may all be removed from the heater in one piece simply by slipping the combustion

chamber 50 to the right out of its adapter tube 44. Thus all of the elements of the heater which might require attention, including the over-heat switch 20, which is attached to the cover 14, are readily accessible. The heat exchanger and air case 10 and its mounting brackets and connections to the ventilating air duct work may be allowed to remain in place undisturbed.

Note also that the only sealed joint between the burner mechanism and the heat exchanger is at the clamping band 76 which remains cold. It is well removed from the hot portions of the heat exchanger and burner, and also cold ventilating air flows over the joint while cold combustion air flowing through the space 66 and air chamber between the combustion chamber 50 and adapter 54 has a cooling effect. This permits the use of a simple, molded, rubber sealing gasket at 74 and insures that the burner mechanism will be well sealed and will be readily removable even after extended use, since there will be no warping or roughening of the matching surfaces such as is usually caused by repeated heating and cooling and by combustion gases. The joint between the flanges 48 and 56 can be quite loose and, therefore, gives no difficulty, it being appreciated that looseness will merely result in a small and unimportant amount of additional combustion air flowing into the heat exchanger around the combustion chamber.

As shown, all of the elements of the heat exchanger and the burner adapted tube, which is directly attached thereto, are joined and sealed by seam resistance welding and, therefore, the structure may be fabricated at low cost.

In order to remove any unburned fuel that may possibly leak from the nozzle 62 into the combustion chamber 50, an L-shaped drain tube 112 extends from a low point in the adapter fitting 44 to exhaust spud 30. This tube may be sealed to the sheet metal at both ends by silver soldering, since the temperatures encountered at these joints are never very high.

In this heater, assuming a supply of ventilating air, combustion air, fuel under pressure, and high tension electricity, all appropriately connected as previously mentioned, opening the fuel valve causes fuel to be sprayed from the nozzle, mixed with combustion air and ignited by the spark between the igniter electrodes. Hot products of combustion thus formed pass from the combustion chamber into the inner shell 28 and thence through the passage 33 into the space between the intermediate shell 26 and the outer shell 24. The hot gases then flow circumferentially in both directions and longitudinally to the exhaust fitting 30. Hot products of combustion, therefore, heat all of the heat exchanger surfaces. Ventilating air removes the heat by flowing longitudinally between the air case and the outer shell 24 and between the intermediate shell 26 and the inner shell 28.

From the above description of a preferred embodiment of my invention it will be seen that the heater burner and its physical connection to the heat exchanger and air case provides all of the advantages set forth for it. It will also be understood that alterations and variations in the structure can be made without departing from the scope or spirit of the invention and that the scope of the invention is to be measured by the scope of the following claims.

Having described my invention, what I claim is new and useful and desire to secure by Letters Patent of the United States is:

1. In a burner intended for direct attachment to an automotive vehicle heater heat exchanger, means forming a combustion chamber, means forming an air casing behind said combustion chamber in communication with said combustion chamber, means securing said casing and said chamber forming means together, means providing a housing enclosing said combustion chamber and said casing, said casing having a pair of substantially oppositely extending hollow members communicating from

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outside said housing with the interior of said casing, a pair of hollow pliable elements secured at one end to said hollow members and passing through and being attached to said housing and serving to support the burner from said housing, one of said pliable elements and its hollow member serving to supply combustion air to said casing, means for restricting the opening through the other of said hollow members, means for supplying fuel to said combustion chamber, means including perforations through said chamber forming means for conducting air from said casing to said combustion chamber, and means in said chamber forming means for igniting a fuel and air mixture therein.

2. In a vehicle heater burner intended to be disposed within a ventilating air case and adapted for direct attachment to a heat exchanger, means forming a combustion chamber, means forming an air chamber behind said combustion chamber in communication with said combustion chamber, means securing said chambers together, said air chamber forming means having a pair of outwardly radiating hollow members communicating with the interior of said air chamber, pliable tubular members fitted to said hollow members and extending outwardly through openings in said ventilating air casing and being secured to said air casing, said pliable members serving to give resilient support to said burner and heat exchanger from said casing and fitting said openings to seal said openings in said air casing, one of said tubular pliable members and hollow members forming a substantially unrestricted passage and adapted at its outer end for connection to a source of combustion air and serving to supply air for combustion to said air chamber, the other of said hollow members having means providing restricted communication with the other of said tubular pliable members, the outer end of said other pliable member being open to the atmosphere surrounding said casing, means for supplying fuel to said combustion chamber, and means for conducting air for combustion from said air chamber to said combustion chamber.

3. In a burner intended for supplying hot products of combustion to a heat exchanger, means forming a combustion chamber, means forming an air inlet chamber in restrictive communication with said combustion chamber, means forming a housing enclosing said chambers, a pair of hollow pliable members connected at their inner ends to said air inlet chamber and passing through

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and being connected to said housing for resiliently supporting said air chamber from said housing, means including one of said hollow pliable resilient supporting members adapted at its outer end for connection to a source of combustion air for supplying air for combustion under pressure to said air inlet chamber, the other of said pliable members being open to the atmosphere outside said housing, means forming a restricted vent from said air inlet chamber to permit a limited escape of air therefrom, means including the other of said pliable supporting members for connecting said restricted vent to the atmosphere, and means for supplying fuel to said combustion chamber.

4. In a vehicle combustion heater, means forming a casing for air to be heated, means forming a combustion chamber, means forming an air chamber behind said combustion chamber in communication with said combustion chamber, means securing said chambers together, means forming a heat exchanger, means securing said chamber forming means to said heat exchanger, said air chamber forming means having a pair of outwardly extending hollow members communicating with the interior of said air chamber, said chambers and heat exchanger being disposed within said casing for air to be heated, resilient tubular members fitted at their inner ends to said hollow members and extending outwardly through openings in said casing, said resilient members tightly fitting and sealing said openings and serving to give resilient support to said burner and heat exchanger from said casing, one of said tubular resilient members being adapted at its outer end to receive a supply of combustion air and serving to supply air to said air chamber, means providing a closure with a restricted opening therethrough for the other of said hollow members, said other of said resilient tubular members having an opening outside said casing communicating with the atmosphere and providing a vent passage for said chamber, means for supplying fuel to said combustion chamber, and means for conducting air for combustion from said air chamber to said combustion chamber.

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