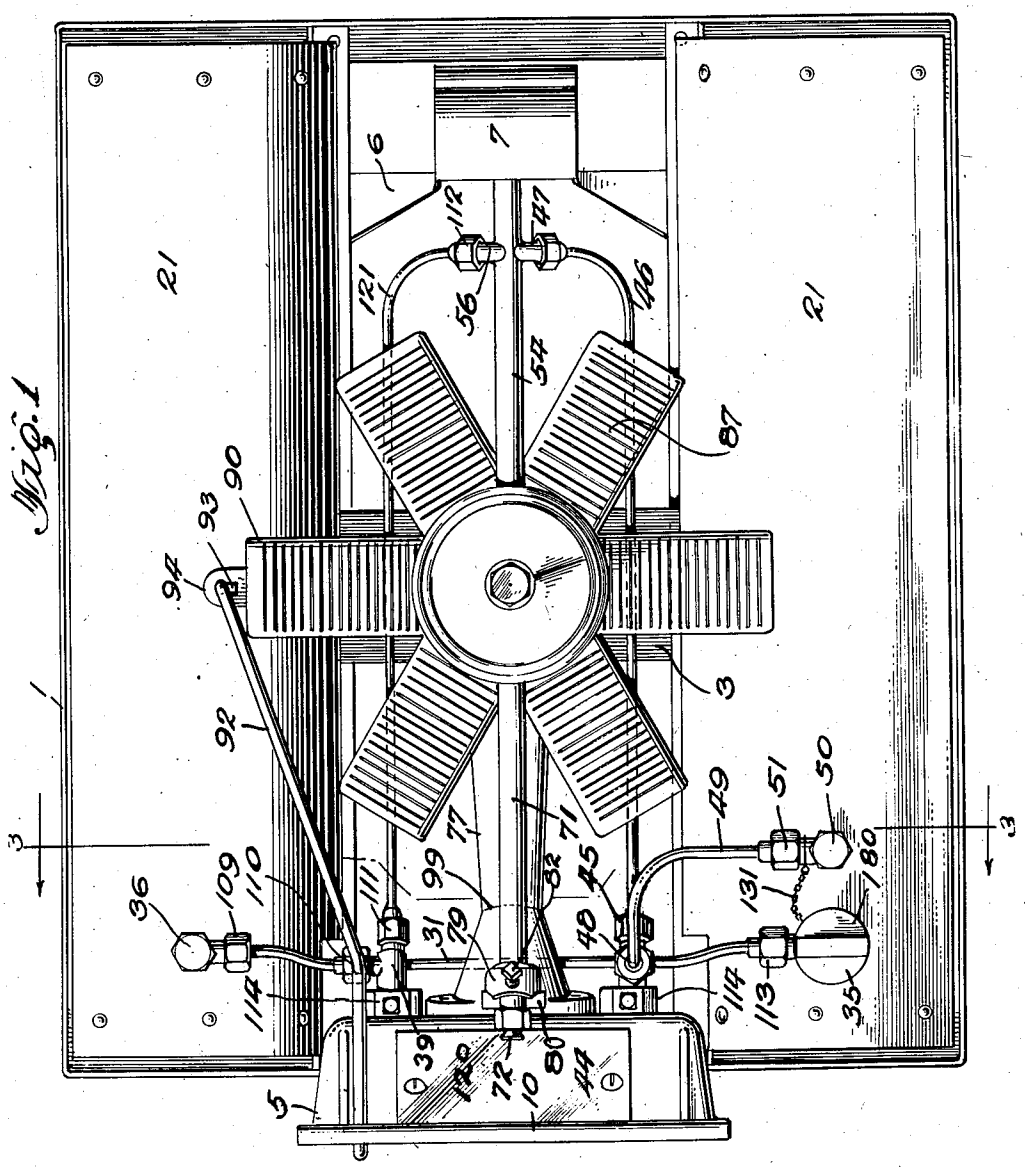
Jan. 16, 1945. S. T. HOWARD 2,367,216

FIRE UNIT

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Fig. 1



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Fig. 2

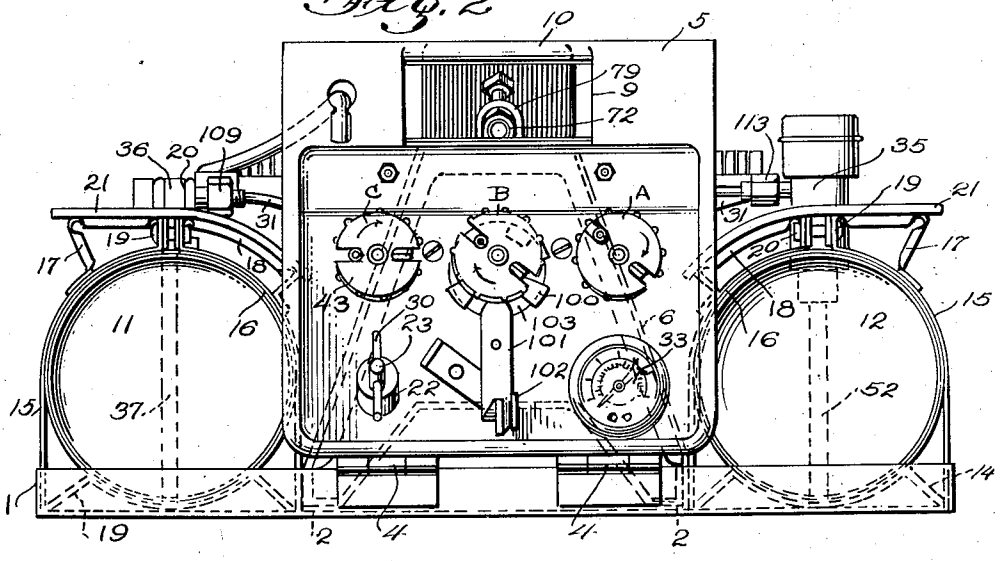


Fig. 5

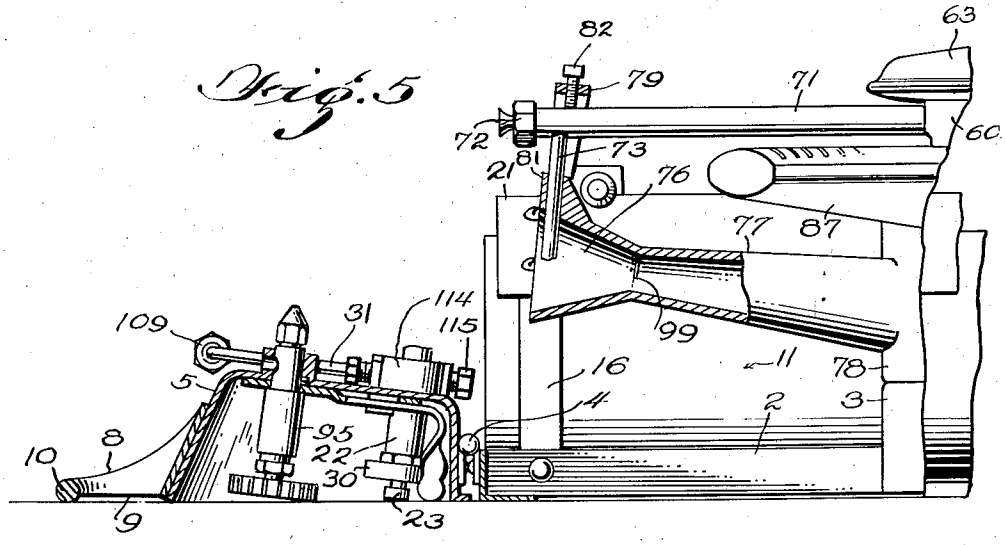
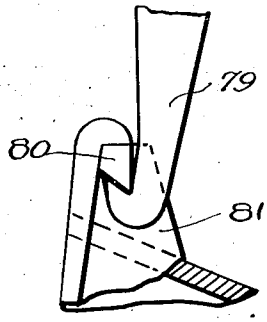


Fig. 7



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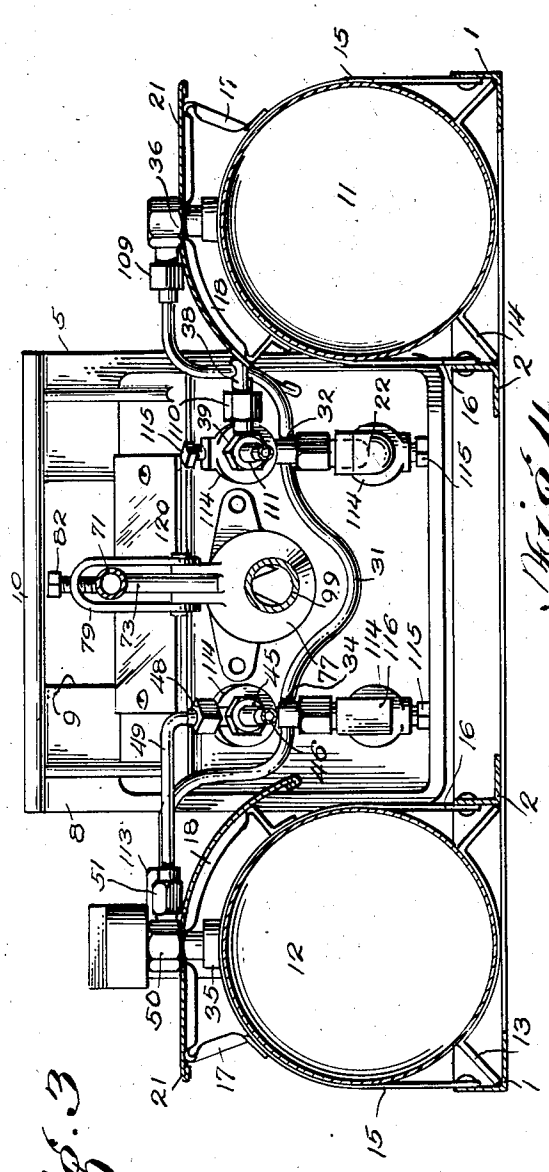


Fig. 3

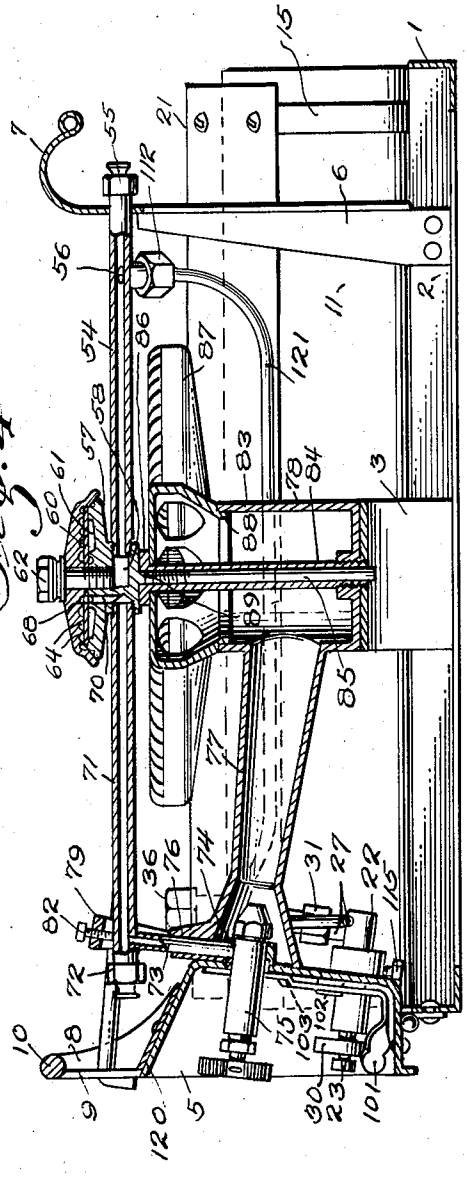


Fig. 4

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BY

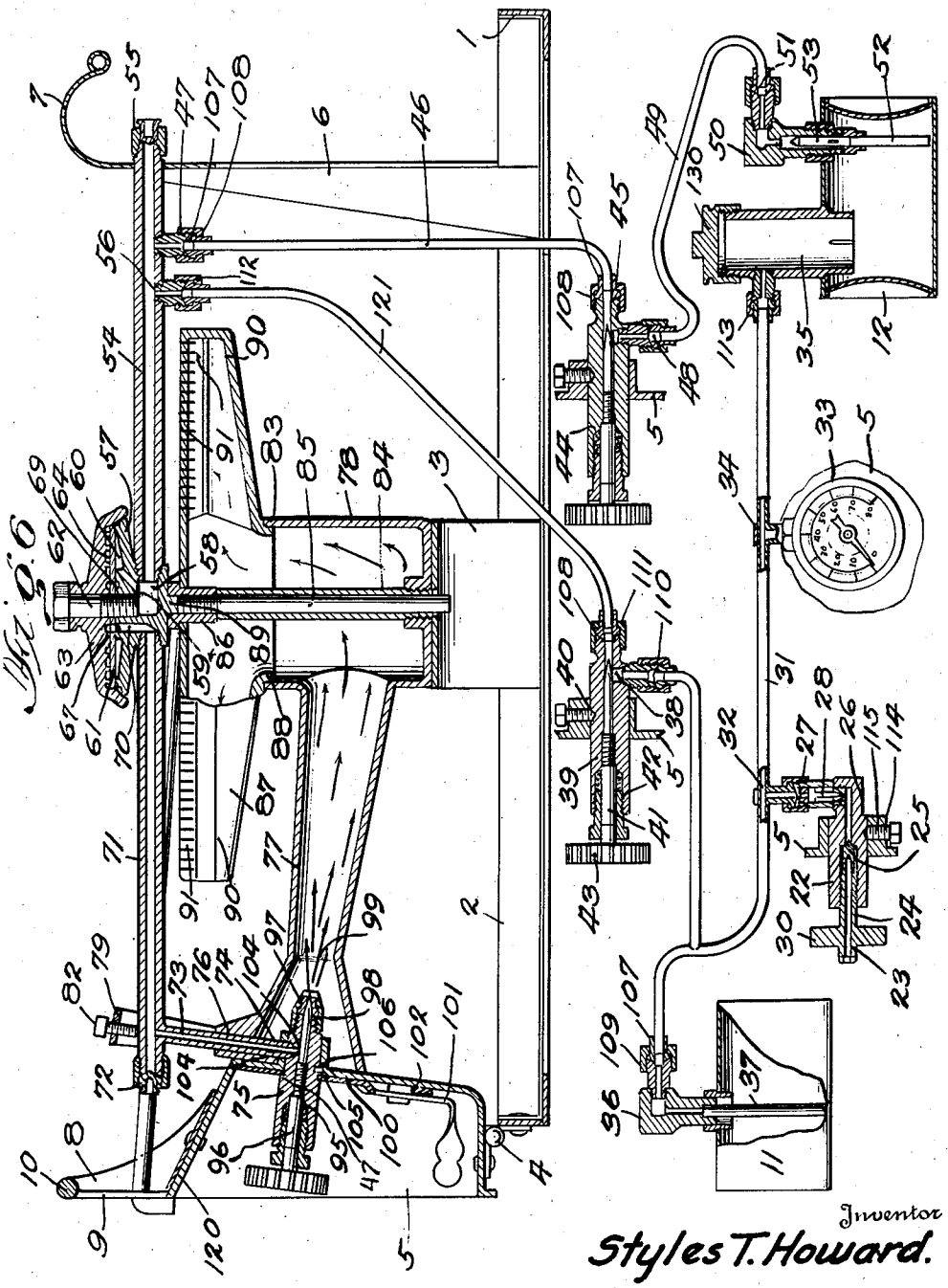
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FIRE UNIT

Filed April 24, 1941 4 Sheets-Sheet 4



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Patented Jan. 16, 1945 2,367,216

UNITED STATES PATENT OFFICE

2,367,216

FIRE UNIT

Styles T. Howard, Jeffersonville, Ind.

Application April 24, 1941, Serial No. 390,121

3 Claims. (Cl. 158—63)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

The invention described herein, if patented may be manufactured and used by or for the Government for governmental purposes without the payment to me of any royalty thereon.

This invention relates to an improved fire unit, and more particularly to a self-contained heat-producing unit suitable for wide usage, wherein a heater is desirable in a confined space, such as a range, furnace, or under other enclosed conditions, and practically any conditions where at least semi-protection is afforded that will prevent the undesirable dissipation of heat produced, and concentrate same for the desired results, said unit being adapted for the use of any combustible liquid fuel.

The objects in view are to provide a heat-producing unit of simple, durable and inexpensive structure, conveniently operated with little skill, with the control features conveniently arranged in a small area at the front of the unit whereby same may be operated and controlled without interruption or being withdrawn from a position, for instance, within a range.

A further object is to provide a heating unit which may be arranged with little change in operation to occupy chambers of various shapes, the form shown being relatively wide and deep, but of comparatively little height, and especially adapted for use with the portable range disclosed in my application Serial No. 384,961, filed March 19, 1941.

A further object is to provide a heating unit that may be charged and adjusted in place for operation and that will have a capacity sufficient to permit the use of the heater over a reasonable period, such as the time required in the preparation of the meals of one day, at the termination of which parts requiring it may be cleansed and, if necessary, replaced, ready for the next operation of the heater.

A further object is to provide such a structure as will, if necessary, permit of its use during, for instance, the preparation of a meal or the heating of a large tank of water, at the end of which time the heater may be extinguished and again used without recharging at will or throughout its capacity.

A further object is to provide a fire unit especially adapted for Army use in the standard Army portable range, wherein it may be arranged at different elevations within the range or in a case or any form of supporting means for receptacles such as what are known as G. I. cans in heating large quantities of water for mess kit washing and rinsing.

A further object is to provide means whereby treated gasoline may be used by first filtering prior to burning said fuel.

Other objects and advantages will appear as the description of this invention in detail proceeds by reference to the accompanying drawings wherein similar reference characters designate corresponding parts throughout the several views in which:

Fig. 1 is a plan view of the improved fire unit.

Fig. 2 is a front view of the fire unit.

Fig. 3 is a sectional view on the line 3—3 of Fig. 1 looking in the direction of the arrows.

Fig. 4 is a vertical longitudinal sectional view taken centrally through the fire unit.

Fig. 5 is a vertical sectional view similar to Fig. 4 showing the front part of the fire unit with the instrument panel swung down on its hinges.

Fig. 6 is a sectional view similar to Fig. 4 showing the control elements and tanks diagrammatically.

Fig. 7 is a detailed elevation of the connection between the loop and the mixing chamber.

There is shown and described in detail a preferred embodiment of this invention, but it will be understood that it is not desired to limit the invention to the specific form disclosed; it is the intention to cover all modifications and alternative constructions falling within the spirit and scope of the appended claims.

As shown, the fire unit provides means for producing instantaneously a blue flame in starting, even in cold weather. Any grade of gasoline may be used, preferably of a rating not over 92 octane. When kept clean and handled properly the unit described will operate without fumes or odors and no gasoline taste will be imparted to the food should it be used, as contemplated, under certain conditions in a range.

The fire unit here described is a high pressure hot generator type of fluid burning unit equipped with a filter to clean the fuel when treated gasoline or other like fuel is used, but any type of straight gasoline or other volatile fuel may be used that does or does not require filtering.

It may be stated in this connection that if leaded gasoline, which is the type used in the present Army trucks, can be used in the fire unit, it will avoid the very objectionable confusion resulting, especially in the Army, when more than one type of gasoline is required.

Treated gasoline, after it reaches a certain temperature, throws off a solid sediment, and while leaded or high test gasoline is preferable in truck motors, it is inclined to clog up a gaso-

line burner due to said discharge of foreign matter when vaporized by heat. Successful filtering means for gasoline is extremely desirable for gasoline burning devices, other than motors, and has been sought after since the treatment of gasoline has been practiced. While a preferred form of a filtering attachment is illustrated and described in this application, it does not, however, form a necessary part for the successful operation of the fire unit forming the subject matter of this application for the reason that the present fire unit may be operated with certain types of fluid fuel without filtration, and also for the further reason that the filtering mechanism here shown or its equivalent may form a part of heating units different from the one here shown and therefore is covered by a separate application, Serial Number 390,122, filed April 24, 1941.

The fire unit consists of a base frame 1, longitudinal supporting members 2, and burner supporting cross member 3, aproximately across the length of the supporting members 2. Hinged to the front edge of the base frame at 4 is an instrument panel 5. A generator support 6 is mounted on the longitudinal members 2 near their rear ends, and is provided with a lifting loop 7 at its upper end. An extension 8 at the top of the instrument panel is provided with an opening 9, providing at its top a cross member 10 forming a forward lifting handle which, with the lifting loop 7 at the rear end of the unit, facilitates the handling of the unit in convenient manner without injury to the operator when the burner proper is at a high temperature.

Along the side edges of the frame, tanks 11 and 12 are mounted in tank cradles 13 and 14, tank 11 being the air tank, and 12 the gasoline or other fluid fuel tank. Outer and inner tank retaining strap members 15 and 16 are mounted at their lower ends on the frame 1 and the brace members 2, respectively, in line with the tank cradles 13 and 14. Said strap members are provided with outer and inner shield supports 17 and 18 and are drawn together at the top of the tanks by bolts 19, the nut being held in place by lock lug 20 to firmly secure the tanks in the cradles with no possibility of accidental displacement during the vibration of transportation. Shields 21 are mounted on the supports 17 and 18 and cover the portions of the tanks that are exposed to the greatest direct heat from the burner.

From the foregoing, it will be seen that an air tank 11 is arranged on one side of the unit and a fuel tank on the opposite side. The heater is usually supplied with about 40 pounds pressure of air produced very conveniently by an ordinary bicycle pump which is coupled to the outer end of air input valve 22 at 23. The filler tube 24 as shown in Figure 6 serves the dual purpose of providing a passage for the air and a cut-off valve when the pressure in the tank has reached the desired degree, said cut-off being accomplished by rotating the member 24 inwardly and seating the inner end 25 of said member in the outer end of a passage 26 of the valve. Extending from the body of the air input valve is a check valve extension 27 in which is slidably mounted a check valve 28 adapted to automatically prevent escape of air from the tank during the pumping operation. To the upper end of the check valve extension 27 is coupled tubing leading to the several parts referred to later. When the pumping process has been completed, the filler tube 24 is seated with its tip 25 closing the passage 26 and the pump may be disconnected.

By reference, more particularly, to Figures 2, 3 and 4, it will be seen that the air input valve 22 is mounted in the instrument panel 5 and extends forwardly of the same to permit attachment of the pump at 23 and operation of the stem 24 by wings 30 in front of the panel without disturbing any other parts of the unit during operation. The air manifold, as indicated at 31 in Fig. 3, is in communication with the air input valve at 32, and is also connected with an air pressure gauge 33 at 34, said air pressure gauge being mounted in the instrument panel and connected with the air manifold in a manner similar to the air input valve. The air pressure tube is connected beyond the gauge with the fuel filler tube 35 of the fuel tank 12 and thus provides in the fuel tank a pressure corresponding to that shown on the gauge and in the air tank. It will be seen that the connection with the manifold of the input valve 22 at 32 is a two-way connection, one leading, as above described, to the gauge and the fuel tank; the other leading to the air tank 11 through air output elbow 36, said output elbow functioning during the pumping process as an air input elbow. The air output elbow is provided with a tube 37 extending to the lower portion of the tank. The air tube or manifold 31 is also connected at 38 to the air control valve 39, said valve 39 being removably mounted in the instrument panel and secured therein by threaded pin 40 in a similar manner to air input valve 22. The valve is provided with a valve stem 41 and usual packing gland 42, said stem being adapted to be operated by control knob 43 which may be of a color different from the control knobs of the other valves mounted in the instrument panel, namely, the gasoline knob, as shown at A, being red, the flame control valve, as shown at B, black, and the air control knob, as shown at C, being green.

The fuel control valve 44 is similar in construction to the air control valve 39 and is mounted in a similar manner in the instrument panel. Said fuel control valve 44 communicates through connection 45, tubular member 46 and connection 47 with the generator tube 54.

The fuel control valve 44 also communicates through connection 48 and tubular member 49 with fuel outlet elbow 50 through connection 51. The elbow 50 is mounted in the top of the fuel tank 12 and has mounted therein a pickup tube carrying an automatic fuel cut-off comprising a check valve 53 mounted for vertical movement in the elbow. The weight of the tube and check valve keeps the valve open when the flow is restricted by the valve B, but if a break in the line occurs, the increased flow closes the valve, preventing excessive loss of fuel and diminishing the danger from fire.

As above described, pressure is applied through input valve 22 by pump, said input valve providing air pressure in two directions, to the air pressure tank 11 and through the air control valve to the generator tube when required. The pressure is also directed by way of the filler tube to the fuel tank 12 above the level of the fuel, the air pressure gage 33 being connected to the filler tube 31 at 34. The air pressure lifts the contents of the fuel tank through the fuel control valve to the generator as needed.

The generator tube 54 is mounted in the generator support and is provided at its rear end with a closure plug 55. Fuel is admitted to the

generator tube at 47 and air is admitted at 56 through tube 121. The tube extends to and is mounted at its forward end in the filter body 57, and communicates with a chamber 58 in the base of the body, from which the fuel is directed through ports 59 to a chamber 60 in the upper face of the filter body. A filter disk 61 is adapted to rest over the upper face of the filter body and is clamped beneath the filter cap 63 by bolt 62. The under surface of the filter cap is provided with annular channels 64.

Passages are provided in the walls between the annular channels 64 to permit the filtered fluid to reach the central communicating passage adjacent the bolt. This construction is more particularly shown in my co-pending application, Serial No. 390,122, previously referred to. Passages 68 in the filter disk 61 are in alignment with groove 67 and communicate through the filter with an annular groove 69 in the upper face of the base. A passage 70 extends down from groove 69 and communicates with the rear end of the hot vapor tube 71, which is provided with a closure cap 72 at its forward end. The hot vapor tube 71 has a downwardly extending tubular arm 73 adapted to seat at its lower end at 74 in a hot vapor valve 75, removably mounted in the instrument panel 5. The tubular arm 73 above the hot vapor valve extends down through an opening 76 in the forward end of an extension 77 of mixing chamber 78 and is held firmly and readily removable in place by yoke 79 connected beneath lugs 80 projecting from ears 81. A clamp screw 82 is threaded through the top of the yoke and into contact with the top of tube 71 and effectually clamps the parts together. This construction is more particularly shown and described in my co-pending application, Serial No. 406,203, filed August 9, 1941.

The mixing chamber 78 is provided with a ground upper edge at 83 and has centrally mounted therein sleeve 84 through which pin 85, provided with flange nut 86 at its upper end, extends to form a rotary pivot for the burner 87. The burner 87 has a bearing surface adapted to rest on the upper edge of the mixing chamber and is adapted to rotate thereon, said burner being provided with flange 88 fitting within the open end of the mixing chamber and being clamped in said position against accidental displacement by the nut 86 mounted at the upper end of the stem 85. A lug 89 extending downwardly from the filter case body 57 is adapted to fit into the upper end of flange nut 86 to permit rotary movement of the burner.

The burner is, in the preferred form shown, provided with hollow arms 90, preferably six in number, uniformly spaced and radiating from a center, the interior of said arms being in communication with the mixing chamber, and the upper faces of the arms are provided with slits 91 through which fuel is discharged and burned. A rod 92 is removably connected at its inner end, as shown at 93 in Fig. 1, in a lug 94 of one of the arms 90 of the burner, and extends out through the front of the instrument panel. When the rod is pulled forward it will rotate the burner to bring opposite arms 90 of the burner beneath the generator tube 54 and the hot vapor tube 71 when igniting the burner and pushing the rod in will return the burner to its normal burning position after ignition. Rod 92 is provided at its outer end with a notch adapted to rest over the lower edge of an opening in the instrument panel to maintain the burner against accidental displacement when it is in its normal position. The hot vapor valve 75 is removably mounted in the instrument panel and has a body portion 95 in which is mounted the stem 96 adapted to control the flow of a mixture consisting of filtered fuel and air through jet 97. The jet 97 is held in place by nut 98 and extends into the outer end of the extension 77 of the mixing chamber, said extension 77 being of Venturi form having its throat at 99 a short distance beyond the inner end of the hot vapor valve to provide for thorough mixing of the air and fuel. The damper 100, having an operating arm 101 and a stop member 102 as shown in Fig. 2, is mounted for rotary movement over passages 103 in the instrument panel to control the flow of air into the outer end of the mixing chamber extension 77 around the hot vapor valve. After the burner has been started and is burning normally the direct pressure from the air tank is cut off and said pressure remains only on the gasoline tank, air for combustion being supplied through the passages 103.

When it is necessary to withdraw the hot vapor valve 75, it is only necessary to back off clamp screw 82 and disconnect the lower ends of yoke 79 from lugs 80. This will permit the release of the hot vapor valve from engagement with the lower end of the tubular arm 73, which is shown as seated in the opening 104, and permit the free withdrawal of the hot vapor valve from the instrument panel. An extension 105 of the hot vapor valve enters a notch 106 in the instrument panel when the parts are assembled to prevent the withdrawal of the hot vapor valve body when locked against rotation by the arm 73.

Any preferred manner of providing against leakage under 40 to 60 pounds pressure of gasoline or air may be used for connecting the tubular members and other connecting parts together. In the form shown, as in Fig. 6, is a gland 107, in which the end of the tube is securely mounted and a union nut 108, threaded on the part to which the tube is to be connected, is adapted to draw ground joints of the male and female members of the parts referred to securely together against leakage under high pressure.

The instrument panel is hinged at its lower edge at 4 and is adapted to swing, with the parts mounted thereon, downwardly and outwardly to facilitate ready replacement of parts and cleansing operations. It will be noted in Figs. 1 and 6 that the tubular connections of the fire unit in the air supply are numbered as follows: 109 is the air connection to the air tank; from thence through connection 110 to air control valve 39, through connection 111 and connection 112 to generator tube 54. The air pressure from tank 11, as stated above, passes to the gauge 33 and is connected at 113 to the filler tube of the gasoline tank. To trace the passage of the gasoline in the above manner the connection 51 leading from the gasoline tank 12 is connected by tube 49 through connection 48 to the fuel control valve 44 and from said fuel control valve and tube 46 through connection 47 with the generator tube 54.

By means of the above connections, when it is desired to swing the control panel into its horizontal position, it will only be necessary to uncouple connection 113, connection 51 at the top of the gasoline tank and connection 45 of the control valve, also connection 109 at the top of the air tank, and connection 111 of the air con-

trol valve, whereupon the control panel may be swung into a horizontal position, as referred to above, it being understood that the rod **92** will first be disconnected from the burner by rotating the burner an abnormal distance to facilitate the release of the rod from lug **94**. If necessary the rod can be withdrawn through the opening in the instrument panel.

Should it be desired to remove the control elements from the panel for any reason, such as for cleaning or replacement purposes, there have been provided on the inner face of the instrument panel integral bosses **114** provided with openings through which the body portions of the control valves **39**, **44**, the input valve **22**, and the gauge connection are snugly fitted, said bosses being provided with lock screws **115**, adapted to clamp said members firmly against rotary or longitudinal movement in the instrument panel.

The hot vapor valve, as described above, is clamped in place by yoke **79** and clamp screw **82** and may be released and removed through the front of the instrument panel. The input valve, the connection with the air pressure gauge, the air control valve, and the gasoline control valve, can be readily removed from the instrument panel by uncoupling their connections with the tubular members, removing the split pins securing the knobs A and C, withdrawing filler tube **24** rrom the air input valve and the air gauge from positions on their respective parts and backing off the lock screws **115** in the bosses **114**, which will release the body portion of the input valve, the air gauge elbow **116**, the air control valve **39** and the gasoline control valve, permitting withdrawal of the parts referred to inwardly through the instrument panel.

The damper **100** is mounted for rotary movement on the body of the hot vapor valve between a shoulder and the face of the instrument panel and is provided with a notch for the passage of extension **105**, which permits the separation of the damper member from the body of the hot vapor valve when the valve is removed from the instrument panel. The damper is provided on its rear face with a friction leaf spring adapted to contact with the front face of the instrument panel and maintain the damper in any of its adjusted positions against accidental movement during transit.

In line with opening **9** in the instrument panel, as shown in Figs. 1, 3 and 4, and resting at an incline on the top of the depressed portion of the instrument panel is a mirror **120** in which an operator may conveniently observe the condition of the flame of the burner.

The preparation for and operation of the fire unit are as follows: The connections, including all of those in the air and fuel systems, the generator and hot vapor tubes, and the filter, should be tight to prevent leakage under pressure of from 40 to 60 pounds. Close all valves in the instrument panel. Remove captive fuel filler tube cap **130** secured against loss by flexible connection **131**, fill fuel tank **12** and recap firmly against leakage under pressure. Attach a pump, usually the ordinary bicycle foot pump, at **23** to the air input valve mounted in the instrument panel and pump the air system and the air tank **11** up to at least 40 pounds pressure, seat input valve stem and remove pump. The air pressure line is in communication with air control valve **39** and the air flow to generator tube **54** is controlled thereby; said air pressure will be indicated on the air pressure gauge and is in communication with and occupies the upper portion of fuel tank **12** to force fuel from said tank through fuel line outlet elbow and its connection at **48** with fuel control valve **44** through which the flow of fuel is controlled to the generator tube **54**.

To start the operation of the fire unit, pull the burner control rod **92** forward until two arms of the burner lie beneath the generator tube and hot vapor tube, **54** and **71**, respectively. Open the air valve **39** one-half turn. Fully open air damper **100**. Open the fuel valve **44** one-half turn. Open the hot vapor valve **75** one-half turn. The combustible mixture of gasoline and air will pass through the generator tube, through the filter, from thence through hot vapor tube **71**, down through extension **73**, through hot vapor valve **75** into mixing chamber **78**, and up through the burner. Said mixture is combustible and by applying a lighter above one arm of the burner and by the adjustment of the air valve, a flame of a clear green color will form above the burner slits.

As the generator becomes heated, less air will be required to keep the flame green. When the air valve can be closed without causing the flame to become yellow the generator is hot, which, if properly controlled, will require about two minutes' time. Leave the parts with the burner arms beneath the generator tube and hot vapor tube for about two more minutes after the air valve is closed, then push the burner control rod in as far as it will go, thus bringing the burner, as shown in Fig. 1, with its arms out of alignment with the tubes **54** and **71**, somewhat diminishing the intensity of the heat that would otherwise reach said tubes when the burner is operating at maximum temperature. Any gasoline that may collect in the lower portion of the mixing chamber during the lighting of the burner will evaporate and be dissipated through the burner in a few minutes.

After the parts above referred to are thoroughly heated, the color of the flame will change from green to blue, which is maintained by the adjustment of the air damper. By observing the flame at the burner in the mirror mounted on the upper surface of the instrument panel, the color of the flame can be seen and can be controlled by the air damper to maintain the flame green in color; too much air through the damper will cause the flame to turn blue and the top of the burner become red hot. Adjustment of the hot vapor valve controls the size of the flame and intensity of heat developed.

The filter, as shown, may be used to permit the burning of treated gasoline with a minimum of accumulation of dirt and lead particles at the jet of the hot vapor valve and in the burner slits. Frequent observation should be made to maintain a green flame for the production of a maximum amount of heat and to keep the burner and generator members at a high temperature and avoid the passage of fuel improperly prepared for perfect combustion prior to reaching the burner. The flame may be cut off by closing the fuel valve.

Should it be necessary to refill the fuel tank, care should be taken that the flame is extinguished and none of the parts of the burner are red hot.

Provision is made to cut off the flow of fuel should a break occur in the fuel line which consists of a vertically movable check valve mounted in the fuel output elbow and having flattened sides for the passage of the normal flow of fuel.

Said check, under the influence of an abnormal flow of fuel, will be lifted and seated in the valve at its upper end and cut off the flow of fuel.

In using leaded or otherwise treated gasoline in the fire unit, it has been found that the small passages in the flame valve and burner slits have become clogged, and it was necessary to provide means for relieving said trouble. Therefore, a filter was added. Said filter is located in such position as will provide for the passage of the fuel through the filter after it has reached a certain temperature, for the reason that the treated fuel, after it reaches a certain temperature, throws off the foreign matter in flakes or particles that are suspended in the fuel, and it is after the separation above referred to that the filtering process takes place, leaving in the filter the suspended foreign matter. The fuel proceeds thereafter through the hot vapor tube to the hot vapor valve and burner as a vaporized straight or white gasoline and air mixture.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A liquid fuel burner comprising a frame, an air pressure tank and a liquid fuel tank mounted on the frame in spaced relation, a fuel mixing chamber arranged between said tanks, a burner having opposed radial arms mounted for rotary movement on the mixing chamber, generator and vapor tubes arranged above and across the burner and adapted to receive heat from the burner for generating vapor, the tubes normally lying between the arms of the burner, and means for rotating said burner to bring two opposed arms under the generator and vapor tubes during the starting period, and for returning the arms to normal position to reduce the heating of the tubes after the starting period.

2. A fire unit comprising a frame having an instrument panel, an air pressure tank, a liquid fuel tank, a burner and a vapor generator and mixing chamber mounted thereon, a hot vapor valve mounted on said panel, said mixing chamber including an extension mounted at its outer end on said panel in surrounding relation to said valve and communicating with the atmosphere through openings around said valve, a damper rotatable on said valve for controlling said openings, means connecting said fuel tank to said mixing chamber by way of said generator and vapor valve, means connecting said air pressure tank to said fuel tank and also to said generator, and means controlling the flow of air to said generator, whereby the mixing chamber can be supplied with compressed air through the generator during starting.

3. A portable vapor fuel burning unit comprising a frame, an instrument panel hinged at its lower edge to the front of the frame, and an air pressure tank, a liquid fuel tank, a burner and a vapor generator and mixing chamber, all mounted on said frame, said mixing chamber having an extension secured to said panel and providing an air intake communicating with openings in said panel, said panel having control elements for the air and fuel mounted thereon, said elements and said mixing chamber being detachably connected to said panel, whereby the panel can be detached from said parts to be swung on its hinge.

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