

Dec. 9, 1947.

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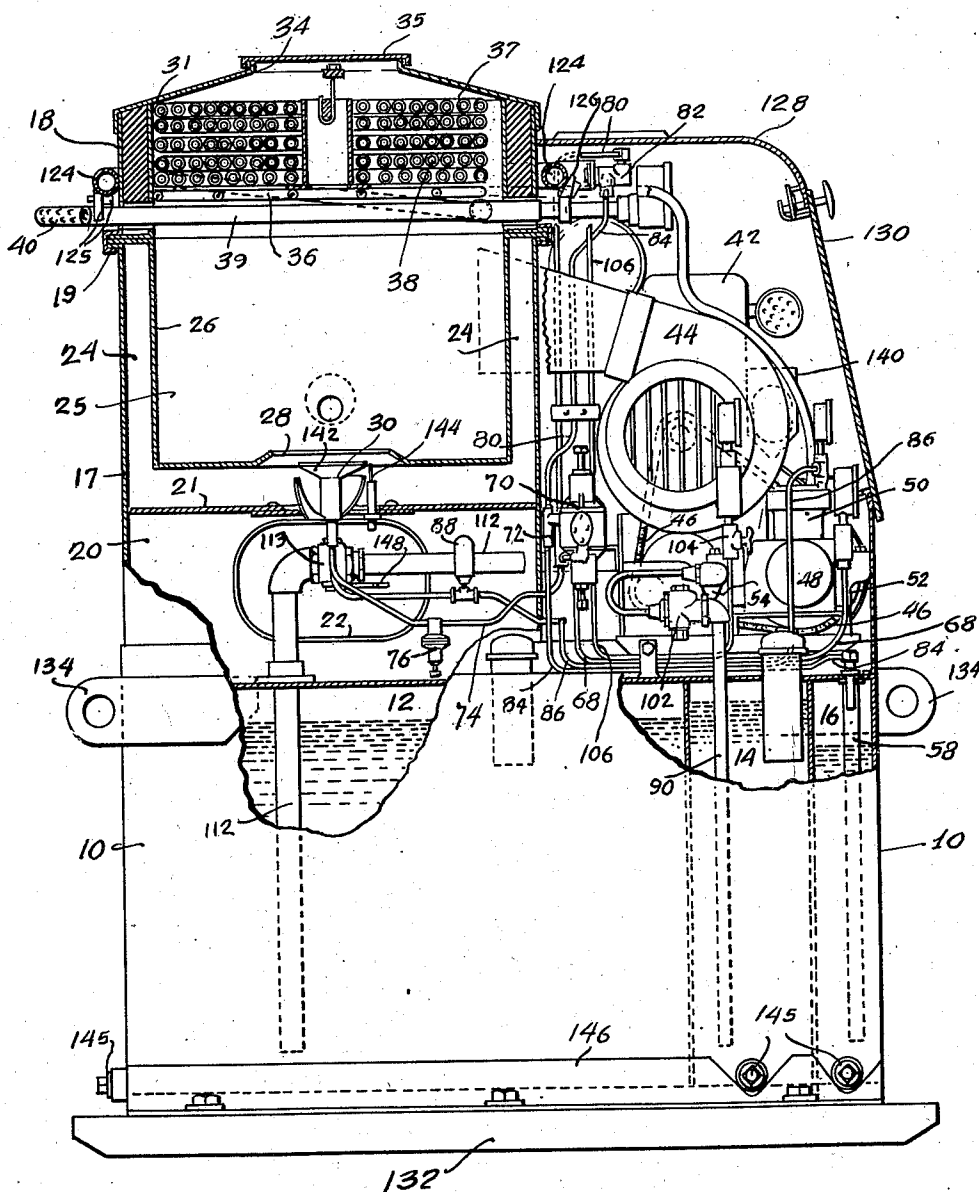
2,432,372

FOG GENERATOR

Filed Feb. 21, 1944

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Fig. 1.



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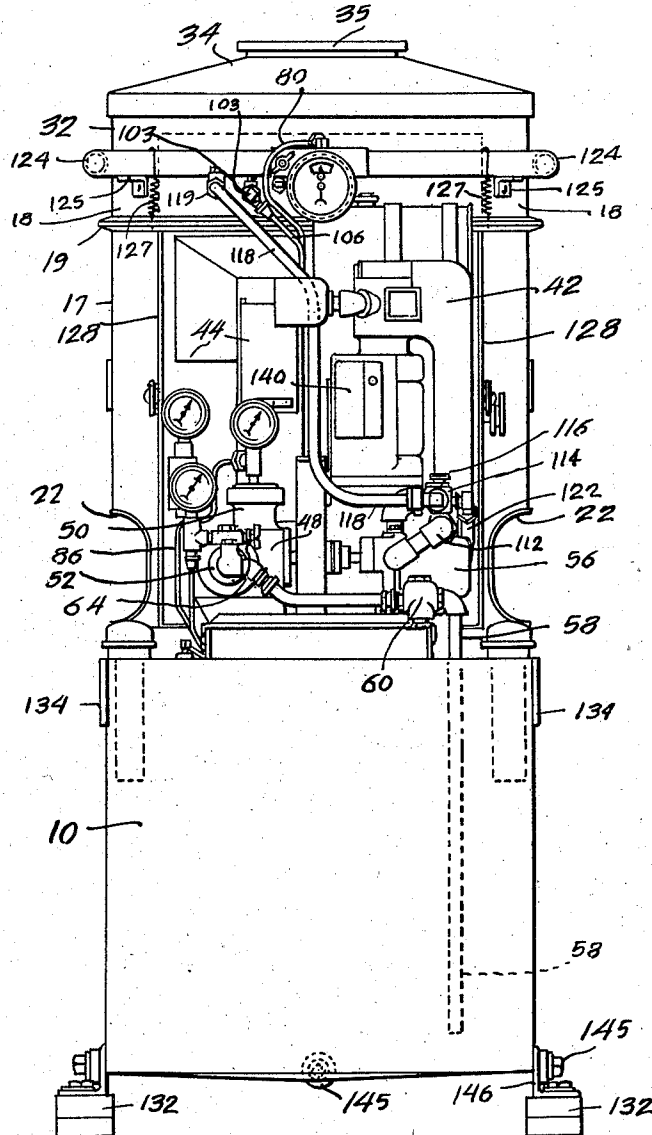
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Fig. 2.



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Fig. 3.

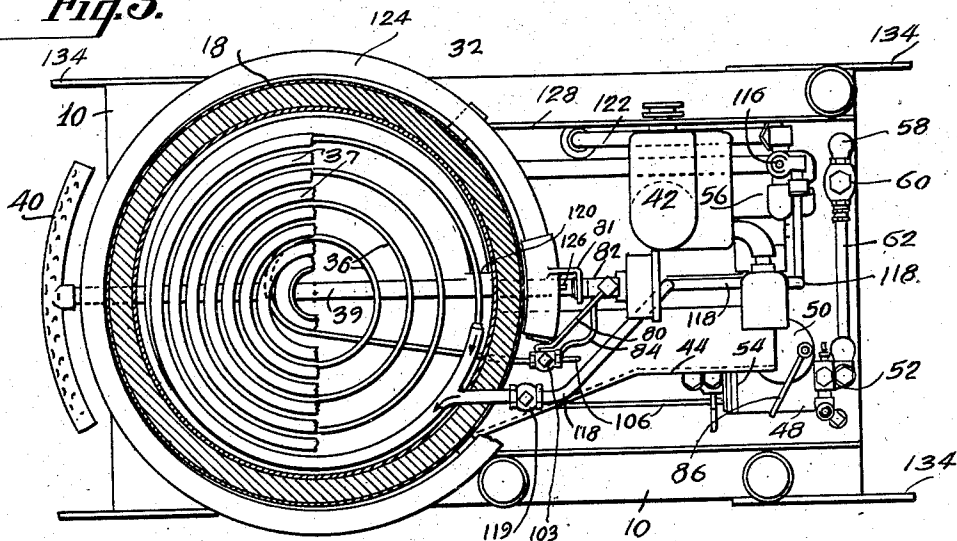


Fig. 4.

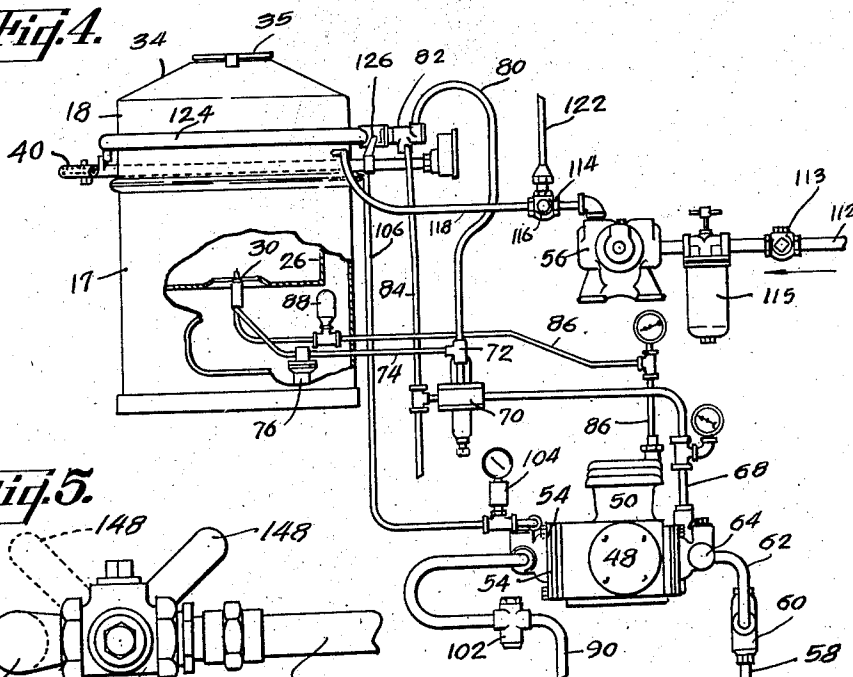
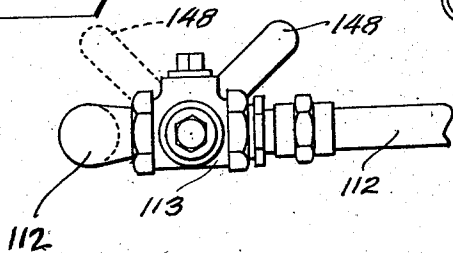


Fig. 5.



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FOG GENERATOR

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3 Claims. (Cl. 252-359)

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The present invention relates to a compact, self-contained unit for producing and releasing at will, a substantially impenetrable, persistent fog or vapor and for a sustained period of time.

It is well-known that artificial smoke and smoke from smudge pots have the distinct property of protecting growing vegetation from damage by frost or from the intense heat of the sun and for other purposes. Necessary as smudge pots are, they produce serious problems. The smoke so produced is unhealthy, irritating to the nose and throat and will lead to serious physical results if breathed in excess. The fuel used in producing the smudge results in a dirty smoke which leaves a film of partly burned fuel on everything which it contacts. Particularly if fuel oil is used, the damage to fabrics by the film of partly burned fuel oil is permanent.

It is accordingly among the objects of the present invention to provide a device for producing a fog or vapor which is not harmful to humans, even if breathed for a continued period of time, not irritating to the nose and throat, not dirty in its makeup and which will not injure or coat either the crops or any other object with which it may come in contact.

Smoke producers and fog generators also have their tactical or military use for concealing objects both on the ground or on the water and from the air. In order to accomplish this result the fog produced must be such as to completely conceal the object for the required period of time but at the same time permit the movement of troops or other persons within its protection. Such a fog must be persistent and possess the quality of remaining for a sufficient period of time and with sufficient concentration to protect the objective.

It is accordingly also among the objectives of the present invention to produce such a machine for military purposes.

A primary object of the present invention is to provide a new and improved fog generator having a simplified means for producing and dispensing a persistent impenetrable fog.

Another object is to provide a new and improved device of the character set forth having improved means for automatically metering and controlling the materials used and for automatically operating the auxiliary parts in order that a maximum efficiency may be obtained with economy of consumption of the materials used and the over all operation of the device.

A further object is to provide a new and improved complete and self-contained unit for gen-

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erating fogs or producing artificial weather which can and may be easily transported and which can operate independently of power lines or any other fixed power source.

A still further object is to provide a fog generator of the character described, that may be operated anywhere, especially on land or sea, fully protected against the elements during operation and otherwise.

A still further object of the present invention is to provide a machine which will produce fog in a minimum amount of time at the maximum capacity.

These objects as well as others which will occur to those skilled in the art and which are inherent in the device itself, are contemplated and are to be considered within the scope of the present invention. It is understood that the drawings used in describing the present device are illustrative only and are not to be construed as limiting the present invention to the precise embodiment shown therein.

Referring now more particularly to the drawings illustrating the present invention:

Figure 1 is a side elevational view, partly in broken section;

Figure 2 is an end elevational view;

Figure 3 is a plan view, partly in section;

Figure 4 is a schematic view; and

Figure 5 is a fragmentary view showing the fog oil supply valve.

In the drawings which illustrate the present invention like numerals have been used to indicate similar parts in the several views. The base of the unit consists of a large tank 10 which is a reservoir for the several liquids used. It is divided into three compartments, the fog oil compartment being designated 12, the water compartment being designated as 14 and the fuel compartment being designated as 16.

Mounted above and at one end of the reservoir 10, is a boiler assembly of novel construction, designed for economy of material, space, cost and speed of initial operation. It comprises preferably a lower casing 17 and an upper casing 18 both flanged at the juncture and held together in a rigid construction by clamping ring 19. The lower casing 17 is separated transversely to provide by the partition 21 a lower compartment 20. Openings 22 are provided to furnish easy access to the interior of compartment 20. The fire box 25 is formed by the concentric wall 26 flanged at the top and held by the clamping ring 19, all in such a manner as to provide an annular space 24 between the wall 26 of the fire box and the outer

casing wall 17. As will hereinafter be described, low-pressure air for combustion purposes is supplied into this space 24 and serves also to cool and keep cool walls 26 and 17. In the bottom of the wall 26 forming a bottom for the fire box 25, there is a central opening or fire box burner throat 28 into which projects a suitable burner nozzle assembly 30, a diffuser 142 and an electrode 144.

The space between the outer casing wall 18 and the wall 31 is insulated in any suitable manner and is covered by a flue pan 34 provided with a central stack opening. This opening is covered when the device is not in operation by stack cover 35 which is hinged for suitable manipulation. Within the chamber formed by wall 31 in the upper casing is a series of pancake or spiral heating coils. The lowermost coil or the coil nearest the flame, which is numbered 36, is known as the water coil in which the steam for the fog is produced. Coil 36 leads directly into coil 37 which is the uppermost or farthest from the flame of a series of pancake or spiral coils designated 38. The flow in coils 38 is generally termed counter-flow with respect to the flow of the products of combustion, and leads directly into a transverse controlled thermostat tube 39 terminating on the outside of the boiler assembly upper casing 18 in a dispensing manifold or multiple nozzle 40.

Adjacent to the boiler assembly just described, preferably upon the other end of the reservoir base 10 of the unit, are the auxiliaries. A suitable engine or motor 42, which is here shown as a conventional gasoline engine, for driving the auxiliaries is provided and directly connected to the shaft of the motor is a blower 44 which delivers low-pressure air to the annular chamber 24 and then through the central opening or throat 28 to the interior of the fire box 25 for combustion purposes.

Through a chain or other suitable drive 46, the motor 42 drives on a single shaft the assembly 48 which comprises an air compressor 50, a pulsating fuel pump 52 and a pulsating water pump 54 as well as an independent fog oil pump 56.

The automatic fuel metering and supply control of fuel for the boiler is accomplished by the fuel pump 52 which pumps the fuel from the supply compartment 15 through a fuel suction pipe 53. The fuel passes through this pipe to strainer 60, through pipe 62, thence through the bleeder or shut-off valve 64 to the pump 52 and thence by line 68 to a combined snubber or pulsation damper and pressure regulator 70. At the tee 72 the fuel travels by line 74 through a pressure valve 76 to the burner nozzle 30 of the boiler assembly. The valve 76 is provided to maintain the fuel pressure in the line so that a temperature control valve, later described, will pass sufficient fuel for a small opening, thus avoiding wide fluctuation in pressure while the device is controlling. The fuel pump always operates to pump a slight excess of fuel in order to insure the instantaneous operation of the temperature control valve. As shown in the diagrammatic view of Figure 4 a fuel pressure gauge may be placed in the line 68 or in any other suitable position for a quick, visual reading of the pressure in the fuel supply line.

There is another line 80 which leads from the tee 72 and carries fuel to a normally closed temperature control valve, actuated by a thermostat 39 as hereinafter described. A return or by-pass line 84 leads from the outlet of valve 82 to the fuel supply compartment 15 in the reservoir base 10.

Water is continuously and automatically proportioned and supplied to the system. The water pump is set to supply the correct amount of water required and operates always at full "on" position. The water pump 54 of the assembly 48 pulls water from compartment 14 of the reservoir base 10 through suction line 90 into a strainer 102 and then through the bleeder or hand valve 104 (which may be opened and used to prime the pump if necessary) and line 106 into the water coil 36 in the upper portion of the boiler, which coil is arranged and located nearest to the point of greatest heat as represented by the burner nozzle 30. A check valve 103 to prevent a back-flow is located in the line just before it enters the boiler assembly. The water circulates through the coil 36 until it is converted into steam which is then injected into the inlet end of coil 37, the most remote of the group of spiral coils 38.

Likewise the requisite amount of fog oil is automatically metered to the system and is also operated at full "on" or full "off" positions. The fog oil pump 56 pumps the oil from compartment 12 of the reservoir base 10 through suction pipe 112 through the three way valve 113 (see Figure 5) through strainer 115 to the inlet end of the pump. The fog oil is then pumped through a three way cock 114 controlled by valve 116, via line 113 through check valve 119 to the top of the boiler assembly where this line leads to the outer coil of the spiral coil 37 which is the top or most remote, with respect to the flame, of the spiral coils 38. The outlet end of the bank of spiral coils 38 leads into the transverse thermostat tube 39, as at 120.

On the exterior of the upper portion of the boiler assembly is a thermostat or constant temperature ring 124. This is a cold ring which entirely surrounds the outer wall of the boiler assembly. It is mounted in a floating manner and merely rests upon the angle supports 125 which are attached to the outer upper casing 18. As shown in Figure 1, it is held against vibration by the coiled spring 127. The only rigid attachment of ring 124 is by means of lugs 125 located immediately behind the manifold outlet 40, whereby it is secured to the portion of tube 39 extending outside the outer casing of the boiler assembly. The tube 39 is free to move through the walls of the boiler assembly and in fact projects therethrough in both directions. On the portion of the tube which extends outside the boiler casing and at the opposite end from that where it is rigidly attached to the ring 124, there is rigidly mounted an operating finger or lug 126 which is adapted to contact and actuate the normally closed temperature control valve 82. Upon contact the normally closed temperature control valve 82 is opened to by-pass fuel oil into return line 84 under conditions hereinafter more fully set forth.

In order that the device may be operated in the open during inclement weather and without undue exposure of the several metering devices and auxiliaries, a hood 128 is provided to enclose said auxiliaries and controls and otherwise provide a covering for all of the operating accessories. If it becomes necessary to operate the device with the hood in place, access may be had through a hinged panel or door 130. It is to be understood that the hood 128 may be removed entirely to provide greater accessibility for required operation or adjustment.

As shown in the drawings the device may be provided with skids 132 secured to the angle irons

146 at the bottom of the reservoir base 10. The device is also provided with lifting eyes 134 making the device completely portable and readily movable to any desired location. It will be seen that by merely removing the skids 132 the device may be secured in place by means of the angles 146 and firmly attached to the deck of a ship or barge or in a truck. It is to be understood that portability may require the draining of the individual compartments, and in this event suitable drain plugs 145 are provided for each compartment.

Referring to Figure 5, the three way valve 113 there shown controls the supply of fog oil to the pump 56. Since the valve is always in open position, the normal position of the handle 148 is in the position shown in full lines in the drawing as in this position the pump is drawing on the supply in compartment 12. However, it may be necessary to continue operation after the supply in compartment 12 is exhausted and with no opportunity to refill it. In this event a barrel or drum of fog oil can be moved alongside and by means of a section of flexible hose attached at one end to the valve 113, when the handle is moved to the position shown in dotted lines, the fog oil can be pumped directly from the original container.

In the event positive priming of the water pump 54 is required or desirable, a line may be taken off of the compressed line 86 and run through a pressure reducing valve and then to the water compartment 14. Merely by putting the compartment under a pressure of approximately 2 p. s. i. in this or any other suitable manner, water may always be supplied directly to the pump through line 90.

The operation of the unit is best described by setting forth the steps which take place and the functions of each.

The motor 42 is started. This motor drives the assembly 48 which comprises the fuel pump 52, the water pump 54 and the compressor 50. On the same shaft as the assembly 48 and simultaneously driven by motor 42 is the fog oil pump 56. Also driven by the motor by chain 46 but on a separate shaft is a magneto 140, which supplies high frequency electricity for igniting the fire in the boiler. On the same shaft with the engine and also driven thereby, is the blower 44. It will therefore be understood that when the engine is started, all of these separate functions are immediately put into operation.

The fuel is pumped by means of pump 52, from the reservoir 16 through line 58, strainer 60, into the supply line 68, to the combined snubber or pulsation damper and pressure regulator 70, into line 74 through pressure maintaining valve 76 and thence to the burner nozzle 30 where it is atomized with compressed air coming from the air compressor 50. As before indicated the line supplying the compressed air from the compressor 50 is line 86 which leads directly to the burner nozzle 30 through the air bell 88 for insuring a smooth flow of compressed air.

The atomized fuel is released at burner nozzle 30 within diffuser 142. The atomized fuel is ignited by an electric spark which arcs between the electrode 144 and the diffuser. The current for supplying this electric spark is generated by the magneto 140.

It should be remembered, however, that simultaneously water is being supplied to the water coil 36. The water is pumped from the supply source 14 through the suction line 90, to the strainer 102, 75

thence to the pump 54 and out through line 106 through check valve 103 and into coil 36 where it is converted into steam.

With oil being supplied to the burner nozzle and water being supplied to the coil the unit can run indefinitely, even though there is no fog oil flowing into the system. The thermostat tube 39 will limit the fire to the point where the boiler cannot overheat or burn out the tubes. This is because the thermostat operates entirely in response to tube temperature. Accordingly it is possible to run the boiler without water and still do no damage or injury to the unit.

It will be observed that up to this point and although the device has been operating without the fog oil, the fog oil pump 56 has been operating and pumping oil but the oil pumped is merely conveyed to the valve 114, which is a two-way valve set at the start for by-passing the oil into line 122 and back into the supply tank 12. The device is usually operated in this manner for a few moments until the boiler has had an opportunity to come up to temperature, which of course is very rapid. The fog oil valve 114 is then turned to full "on" position and fog oil is then supplied by pump 56 through line 118 and check valve 119 to coil 37, which is the coil nearest the flue opening, where steam from coil 36 is injected into it and this mixture then travels through the spiral coils 37 to the outlet coil 38, then through the control thermostat pipe 39 and out through the outlet manifold 40 in a great volume of fog-like vapor.

The point at which the fog oil enters the coil 37 is just ahead of the point where the steam from water coil 36 is injected into the same coil 37. Thus from the moment the fog oil is supplied to the coil 37, it is co-mingled and mixed under pressure with steam and this mixture is circulated and further heated in coils 37 until released in the form of a vapor cloud at the manifold outlets.

In order to illustrate the operation of the thermostat control, assume that the fire from the nozzle 30 has become too intense. Beginning at the moment the coils become heated by the flame in the fire box, the tube 39 will commence to expand relative to the degree of heat to which it is being subjected. It will also expand relatively to the thermostat ring 124 which is the reference point for the temperature control system. The thermostat control ring 124 is a cold ring and maintains a relatively uniform or constant temperature. As has already been noted, the only point at which ring 124 is rigidly attached is by means of lugs 125 located just behind the outlet manifold 40. The lugs rigidly secure ring 124 to the outlet end of tube 39. Thus as tube 39 heats it will expand lengthwise and relatively with respect to ring 124, but being fastened by the lugs 125 as indicated, its expansion will be registered by movement away from the point of fixed position. As this movement takes place it moves finger 126 which is secured at the opposite end of tube 39 and as the movement increases the finger 126 will impinge upon the actuating point of valve 82, which will in turn by-pass a proportion of the supply of oil to the burner or nozzle 30 and cause it to return to the reservoir 16 by means of by-pass line 84. At the same time and as a consequence of the by-passing of fuel, the flame and consequently the heat therefrom, is diminished and reduced. As the temperature is reduced pipe 39 contracts causing the finger 126 to move away from valve 82 and release the pressure on the valve. This again allows more fuel to be

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supplied to the nozzle 30. The hunting, i. e., the fluctuations in the supply of fuel to nozzle 30, does not continue indefinitely but given a constant source of fuel (as this apparatus produces) at a constant pressure, a stable temperature will be quickly arrived at which will be the operating temperature for the device.

Assume, for example, that in the operation of the unit something occurs, even though valve 114 is in full "on" position, so that fog oil will not be supplied to the coil 37. The most frequent reason for this situation is that the supply of fog oil in the reservoir 12 has been exhausted. The failure of the fog oil to reach coil 37 causes the flow through coils 37 and 38 and tube 39 to be reduced. Accordingly there is more fire than necessary to meet the demands of the reduced flow—the additional heating will expand the thermostat tube 39 to by-pass fuel into line 84 and back into the fuel tank. In this manner the flame will be cut down and the temperature reduced, insuring a safe operation of the unit regardless of the conditions.

There is so little water used in the system that the failure of the water supply will not reduce the operating temperature of the device to any great extent. It should be noted, however, that the quality of the fog or vapor being produced from manifold 40 without the admixture of water is much inferior and is inclined to be wetter and heavier and is less sustaining.

I claim:

1. A device for producing and dispensing a dense and persistent fog comprising in combination a boiler having a water and steam circuit joining with an oil circuit at a point after steam generation but within said boiler for combined vaporization of oil and steam, a fuel burner for said boiler, a pump for supplying both fuel and water to the boiler, a pump for supplying oil for vaporization, a single source of power for driving said pumps synchronously to supply the correct proportions of each liquid, and means for dispensing fog from the circuit for combined vaporization of oil and steam.

2. A device for producing and dispensing a dense and persistent fog comprising in combination a base divided into non-communicative compartments for oil, fuel and water, a boiler mounted on said base having a water and steam circuit

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joining with an oil circuit at a point after steam generation for vaporizing of the oil in the steam, a fuel burner for said boiler, means for igniting said fuel burner mounted on said base, a first pump mounted on said base for supplying both the fuel to said burner from the fuel compartment and the water to the water circuit from the water compartment, a second pump integrated as to quantity of supply mounted on said base for supplying oil to the oil circuit of said boiler from said oil compartment, a single source of power mounted on said base for driving said first and second pumps and said ignition means simultaneously, and means for dispensing fog from the circuit for combined vaporization of oil and steam.

3. A device for producing and dispensing a dense and persistent fog comprising in combination a base divided into non-communicative compartments for oil, fuel and water, a boiler mounted on said base having a water and steam circuit joining with an oil circuit for vaporizing of the oil in the steam, a fuel burner for said boiler, means for igniting said fuel burner mounted on said base, a first pump mounted on said base for supplying both the fuel to said burner from the fuel compartment and the water to the water circuit from the water compartment, a second pump integrated as to quantity of supply mounted on said base for supplying oil to the oil circuit of said boiler from said oil compartment, a single source of power mounted on said base for driving said first and second pumps and said ignition means simultaneously, and thermostatic means responsive to the temperature of the boiler circuits for automatically cutting down or increasing the supply of fuel to the fuel burner.

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