

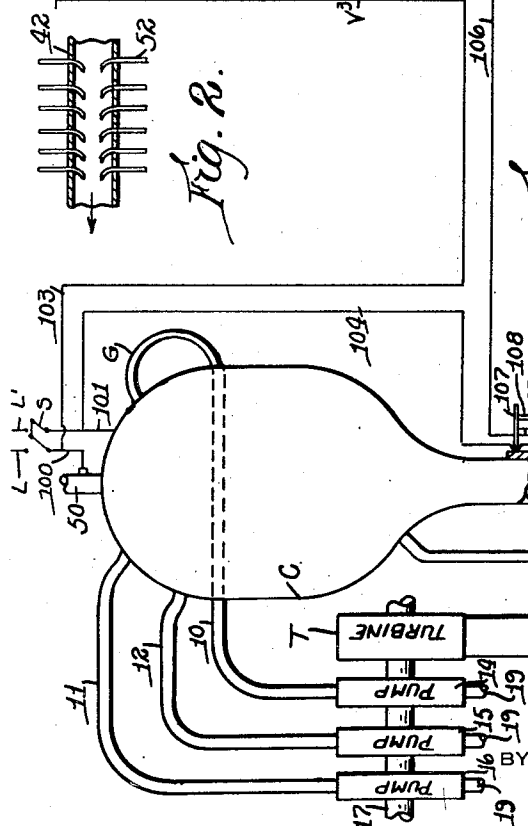
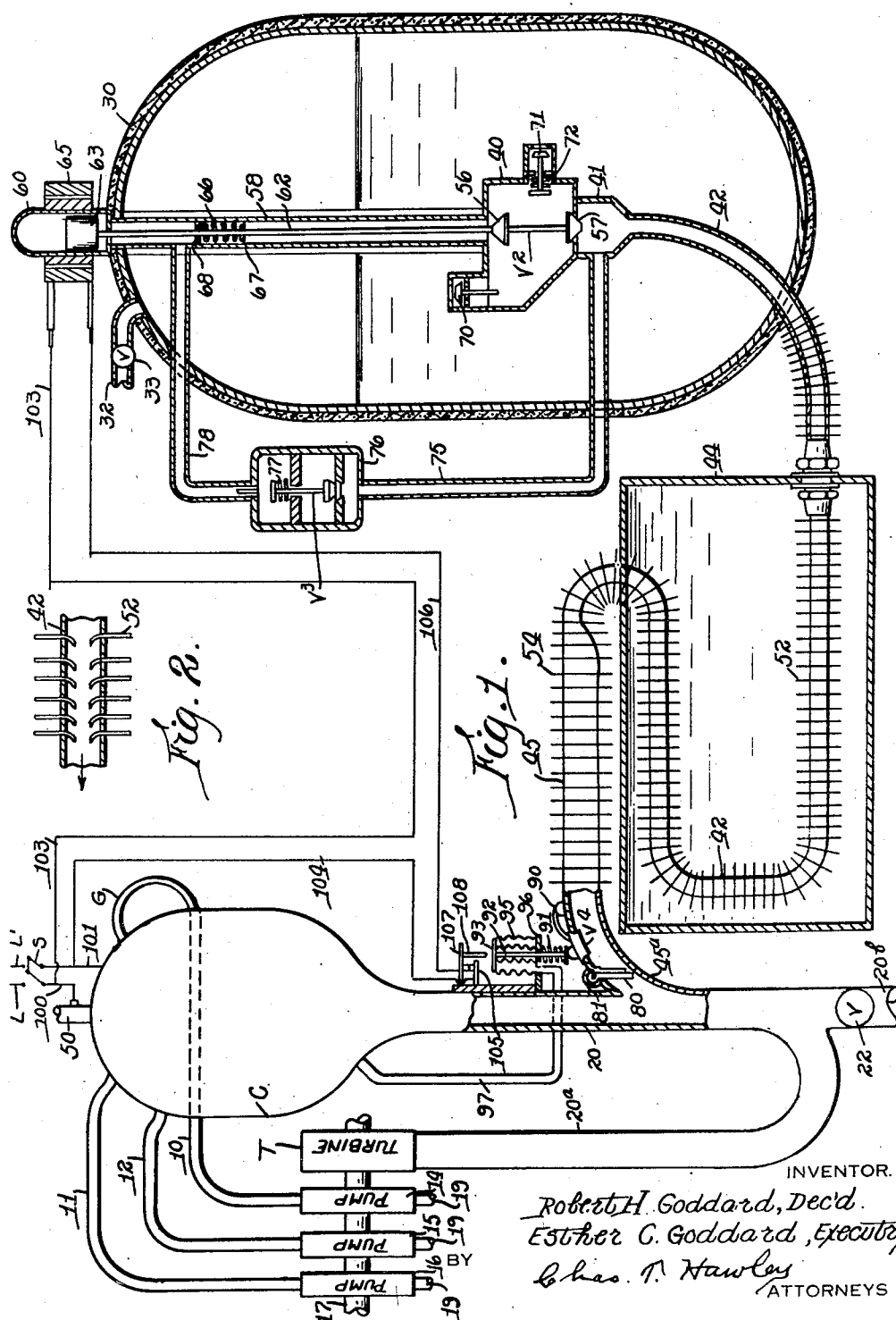
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VAPOR GENERATING AND CONTROL APPARATUS
FOR COMBUSTION CHAMBERS

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VAPOR GENERATING AND CONTROL APPARATUS FOR COMBUSTION CHAMBERS

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6 Claims. (Cl. 62—1)

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This invention relates to apparatus for generating steam or other vapor and for effectively controlling the period of such generation. The invention is capable of somewhat general application but is particularly applicable to the quick starting of a combustion chamber which, when in operation, provides power to pump combustion liquids thereto.

One object of the invention is to provide means for quickly generating vapor under pressure from a measured quantity only of one of the combustion liquids, as liquid oxygen, for each successive period of operation.

A further object is to provide means to salvage any unused liquid which may remain after the combustion chamber is in full operation. Means is also provided for automatically stopping vapor generation as soon as the combustion chamber is in full operation and for making the initial measured quantity of liquid available for the next operation.

The invention further relates to arrangements and combinations of parts which will be hereinafter described and more particularly pointed out in the appended claims.

Preferred forms of the invention are shown in the drawings, in which

Fig. 1 is a side elevation, partly in section, showing the improved starting and control mechanism;

Fig. 2 is a detail sectional view of a portion of a flanged pipe to be described;

Fig. 3 is a front elevation of a modified and somewhat simpler construction;

Fig. 4 is a detail sectional plan view, taken along the line 4—4 in Fig. 3; and

Fig. 5 is a partial sectional elevation showing a further modification.

Referring to Figs. 1 and 2, a combustion chamber C is supplied with gasoline, oxygen and water through pipes 10, 11 and 12. The three liquids are delivered through any suitable feeding devices or spray openings to the combustion chamber.

The liquids are supplied to the pipes 10, 11 and 12 by pumps 14, 15 and 16 mounted on a shaft 17 and rotated by a turbine T. The three liquids are led to the pumps through feed pipes 19 from storage tanks or from any other conveniently available source.

When the combustion chamber C is in full operation, the gasoline and liquid oxygen sprays intermingle and are consumed and the hot combustion gases evaporate substantial quantities of water supplied by the pump 15 through the pipe 12. The resulting mixture of steam and com-

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bustion gases is discharged from the chamber C under substantial pressure through a pipe or conduit 20 and all or a portion of this generated vapor is conducted through a pipe 20a to drive the turbine T. The turbine then operates through the shaft 17 to drive the pumps and to thus supply the three liquids to the combustion chamber.

The shaft 17 may be extended and connected to drive other mechanism, or a portion of the generated vapor may be taken off through a pipe 20b for any desired purpose, such operation being controlled by a valve 22.

Obviously such a combustion chamber would not be self-starting, as the pumps will not operate until a supply of vapor under pressure is available for the turbine T.

The present invention relates particularly to the provision of starting apparatus for quickly supplying vapor under pressure to operate the turbine, and also relates to control devices for discontinuing the operation of the starting apparatus as soon as the combustion chamber C is in full operation.

For the defined purpose, a storage tank 30 is provided which is filled with some very cold liquid, such as liquid oxygen, through a pipe 32 and valve 33. The tank 30 is normally maintained under substantial pressure and is shown somewhat enlarged with respect to the chamber C.

A receptacle 40 is mounted in the tank 30 and has a lower extension 41 connected to a pipe 42, a portion of which is preferably submerged in any available liquid, as water, in a tank 44. This liquid should be at atmospheric pressure and temperature.

The end of the pipe 42 is preferably connected to an enlarged pipe 45, which in turn is connected through its curved end portion 45a into the combustion gas discharge pipe 20 of the combustion chamber C. As a cold liquid, as liquid oxygen, is allowed to flow through the pipe 42, the liquid is evaporated by the relatively warm liquid in the tank 44. The expansion of the liquid oxygen, when turned to vapor, fills the pipes 45, 45a, 20 and 20a with vapor under pressure, which in turn is effective to operate the turbine T and to deliver the necessary liquids under pressure to the chamber C to initiate operation thereof. A suitable ignition device, such as a spark-plug 50, is provided for the chamber C.

The pipe 42 is preferably provided with a large number of discs 52 by which the evaporative effect of the liquid in the tank 44 is greatly increased. A preferred construction is shown in

Fig. 2, in which the discs 52 preferably have portions extending into the pipe 42 and curved or offset in the direction of flow, so that they increase the exposed cooling surface and also produce vortices as indicated and which substantially increase the rate of evaporation. Additional discs 54 may be provided on the enlarged pipe 45. These latter discs are not immersed but provide substantial surfaces exposed to the surrounding air.

The flow of liquid through the pipe 42 is controlled by a double valve V2 mounted in the receptacle 40 and having upper and lower valve portions 56 and 57 adapted to close corresponding ports in the top and bottom of the receptacle 40.

A pipe 58 extends upwardly from the receptacle 40 through the top of the tank 30 to a small closed casing 60. A valve rod 62 extends upward through the pipe 58 and at its upper end is provided with an iron cylinder 63, loosely slidable in the casing 60 and disposed within a solenoid coil 65. A light spring 66 is mounted on the rod 62 between a collar 67 on the rod and an abutment or flange 68 within the pipe 58.

The valve V2 is normally held in lowered position by gravity assisted by the spring 66, but is raised when the solenoid 65 is energized. When the valve V2 is raised, the bottom port is opened to permit flow of liquid oxygen to the pipe 42. The upper port is simultaneously closed by the valve portion 56.

The receptacle 40 is provided with inwardly opening check valves 70 and 71, the valve 70 being opened by gravity and the valve 71 by a light spring 72. As soon as liquid oxygen is admitted to the pipe 42 and vapor under pressure is generated, the pressure is communicated through the liquid in the receptacle 40 and the check valves 70 and 71 are promptly closed.

Pressure in the pipes 42 and 58 is normally equalized by a by-pass connection 75 connected at its lower end to the extension 41 of the receptacle 40 and at its upper end to a casing 76 containing a check valve V3 normally held in raised or open position by a spring 77. A pipe 78 connects the upper end of the casing 76 to the pipe 58 previously described.

When the starting apparatus is in operation, the pressure in the pipe 42 will be communicated through the by-pass connection 76 and through the open check valve V3 to the pipe 58 and thence to the receptacle 40, so that there will be no unbalanced pressure on the valve V2.

When operation of the starting apparatus is discontinued, pressure in the pipes 75 and 78 will drop, and the check valve V3 will be closed by the pressure normally maintained in the tank 30.

A check valve 80 is mounted at the lower end of the pipe portion 45a and is of the depending or flap type which will open toward the pipe 20 under very slight pressure but which will close promptly against its seat when pressure drops in the starting apparatus. A light coil spring is preferably provided in the casing projection 81 in which the check valve 80 is pivoted and assists in closing the valve 80.

In order to secure a quick drop in pressure in the starting apparatus as soon as the chamber C is in full operation, a vent valve V4 is provided in the pipe portion 45a. The valve V4 is pivoted at 90 and is normally pressed downward and closed by a spring 91 surrounding a rod 92 pivoted to the valve V4 and having an end plate 93. A double bellows 95 is mounted between the end

plate 93 and a fixed bracket 96, and the interior of the bellows 95 is connected by a pipe 97 to the interior of the combustion chamber C.

As pressure rises in the chamber C, the bellows 95 is inflated to open the vent valve V4, and the check valve 80 immediately closes. The vent valve V4 will remain open as long as pressure is maintained in the chamber C but will automatically close when the pressure drops to atmospheric on discontinuance of chamber operation.

It is desirable that the ignition device or spark-plug 50 be in operation when the solenoid 65 raises the valve V2 to start the generation of vapor for operating the turbine T and pumps 14, 15 and 16. It is also desirable that the solenoid circuit be broken as soon as the vent valve V4 is opened.

Line wires L and L' are connected through a double pole switch S to a wire 100 extending to the spark-plug 50 and to a wire 101 grounded on the combustion chamber C or otherwise completing the spark-plug circuit. A branch wire 103 extends from the wire 100 to the solenoid 65, and a branch wire 104 extends from the wire 101 to an insulated contact bracket 105. A return wire 106 connects the solenoid 65 to an insulated spring contact plate 107 having a depending plunger 108.

The contacts on the parts 105 and 107 are normally closed to complete the circuit through the solenoid 65 but are opened when the bellows plate 93 engages and lifts the plunger 108. Consequently, the operating circuit of the solenoid 65 is broken at the same time that the vent valve V4 is opened, but is restored when the vent valve is again closed.

The operation of the several parts of the apparatus has been described in connection with the detailed description thereof and it is believed that the general operation will be clearly apparent.

Manual closing of the switch S energizes the spark-plug 50 and also causes the solenoid 65 to raise the valve V2, which allows liquid oxygen to flow through the pipe 42 in the tank 44 to the pipe 45 and its end portion 45a, which latter is connected with the combustion chamber outlet pipe 20. Evaporation of the liquid oxygen promptly takes place, building up pressure in the pipes 42, 45, 45a, 20 and 20a and starting the turbine T, which then promptly pumps gasoline and liquid oxygen to the combustion chamber C where they intermingle and are ignited.

Water is also admitted, producing a substantial volume of steam which is intermingled with the combustion gases under pressure and thereafter operates the turbine T. Any surplus power may be taken off of the shaft 17, or additional pressurized vapor may be taken off through the pipe 20b.

As soon as substantial generation of pressurized vapor takes place, the bellows operator 95 opens the vent valve V4 and lifts the contact spring plate 107 to break the solenoid circuit and to allow the valve V2 to close. At the same time, the check valve 80 automatically closes. Any liquid oxygen remaining in the receptacle 40 is conserved for the next operation.

As soon as the valve V2 drops, the check valves 70 and 71 open and the receptacle 40 is refilled. When the vent valve V4 opens and the pressure in the pipe 42 drops, the check valve V3 closes and prevents escape of pressurized liquid oxygen

through the pipe 58 and the by-pass connection pipes 78 and 75.

A simplified construction with manual control is shown in Fig. 3. A storage tank 110 for liquid oxygen has a filler pipe 111 and valve 111a and contains a receptacle 112 in which a double valve V5 may be manually raised or lowered to alternately open and close ports 114 and 115.

At its lower end, the receptacle 112 is connected to a pipe 118 which extends downward to a tank 120 mounted in a casing 121 and having a heat-insulating covering 122. The tank 120 is held in spaced relation within the casing 121 by perforated annular partitions 124 of some material which is a poor heat-conductor.

A discharge pipe 130 extends downward from the lower end of the tank 120 into a receptacle 131 which is closed at its lower end and which connects with the casing 121 at its upper end.

The receptacle 131 is immersed in water or some other suitable liquid in an open tank 133 and is provided with vanes 135 (Fig. 4) extending both inward and outward of the receptacle 131 and thus providing much increased cooling surface with which the liquid oxygen engages on the inside of the receptacle and with which the warming liquid engages on the outside of the receptacle 131.

Vaporization of the liquid oxygen thus takes place quickly, and the generated vapor may be taken off through a pipe 137 to a pump-driving turbine T', as previously described in connection with Fig. 1.

A pipe 138 (Fig. 3) is connected at its lower end into the receptacle 131 and at its upper end into the pipe 118 and serve to equalize pressures above and below a control valve 140 which normally closes the lower end of the tank 120 but which may be manually opened by pulling upward the valve rod 141. The tank 110 may be under moderate pressure.

In the operation of this form of the invention, the valves V5 and 140 are both normally in lowered position and it may be assumed that the tank 120 is empty.

The valve V5 may now be raised to permit the contents of 112 to flow downward into the tank 120, after which the valve V5 is pushed downward and the receptacle 112 refills itself from the liquid oxygen stored in the tank 110.

The starting apparatus may now be put in operation by raising the valve 140, so that the liquid oxygen in the tank 120 flows down through the pipe 130 to the lower end of the receptacle 131 in which it is rapidly evaporated and from which pressurized vapor is delivered through the pipe 137.

Production of vapor will continue until the valve 140 is closed and any liquid remaining in the receptacle 131 is evaporated. The valve 140 should be manually closed as soon as the associated combustion chamber is in full operation.

In Fig. 5 an even more simple construction is shown, in which a tank 120a is supplied with liquid oxygen directly through a filler pipe 150 having a valve 151. An equalizing pipe 138a connects to the upper part of the tank 120a, and a valve rod 141a extends upward through a suitable packing 152 and may be manually operated to discharge the liquid oxygen from the tank

120a, as described in connection with Fig. 3. The tank 120a may be under moderate pressure.

Having thus described several forms of the invention, the advantages and utility thereof will be readily apparent. It will also be understood that the invention is not to be limited to the details herein disclosed, otherwise than as set forth in the claims, but what is claimed is:

1. A vapor-generating and control apparatus for a combustion chamber comprising a tank of very cold liquid under pressure, a small inner tank, a vapor-generating device connected to said small tank, a receiver for the vapor, a double valve for said small tank which when in raised position permits flow of liquid from said tank to said vapor-generating device, and which when lowered allows said small tank to fill from said large tank, a by-pass connection around said double valve, and a check valve in said connection and opening upward.

2. The combination in a vapor-generating apparatus as set forth in claim 1, in which the vapor-generating device comprises a pipe immersed in a relatively warm liquid, and said pipe having a plurality of heat-transferring discs mounted thereon.

3. The combination in a vapor-generating apparatus as set forth in claim 1, in which the vapor-generating device comprises a pipe immersed in a relatively warm liquid, and said pipe having a plurality of heat-transferring discs mounted thereon, which discs project both inward and outward of said pipe.

4. The combination in a vapor-generating apparatus as set forth in claim 1, in which the vapor generating device has a discharge pipe and in which a check valve is provided in said discharge pipe, which check valve opens outward with respect to said vapor-generating device.

5. The combination in a vapor-generating apparatus as set forth in claim 3, in which a solenoid is provided to raise the double valve, a circuit is provided for said solenoid, and a pressure-responsive device is provided which is effective to break the solenoid circuit and release said valve when a predetermined vapor pressure is attained at said pressure-responsive device.

6. The combination in a vapor-generating apparatus as set forth in claim 5, in which a vent valve is provided for said vapor-generating device and in which said pressure-responsive device is also simultaneously effective to open said valve and vent said vapor-generating device at said predetermined vapor pressure.

ESTHER C. GODDARD,

Executrix of the Last Will and Testament of Robert H. Goddard, Deceased.

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