

Nov. 28, 1944.

O. A. HANSEN

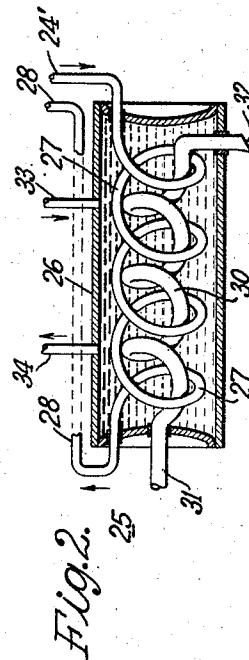
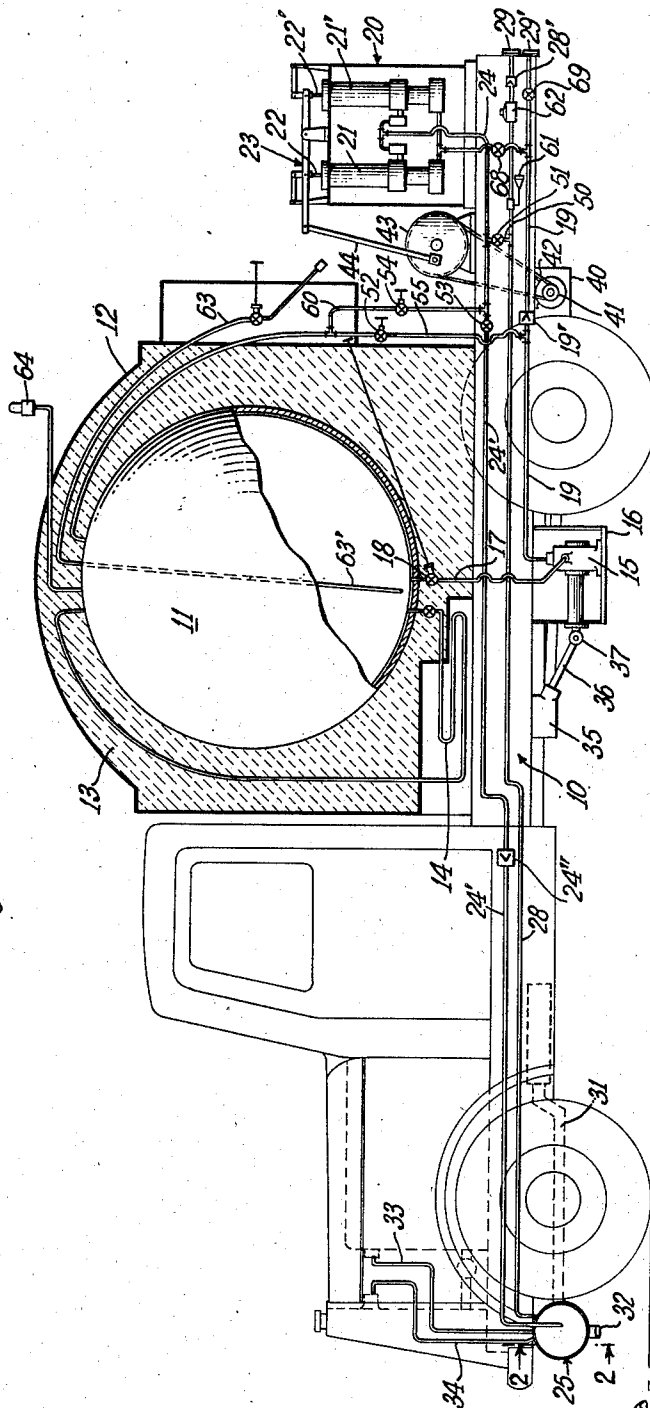
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APPARATUS FOR DISPENSING A LIQUEFIED GAS

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2 Sheets-Sheet 1

Fig. 1.



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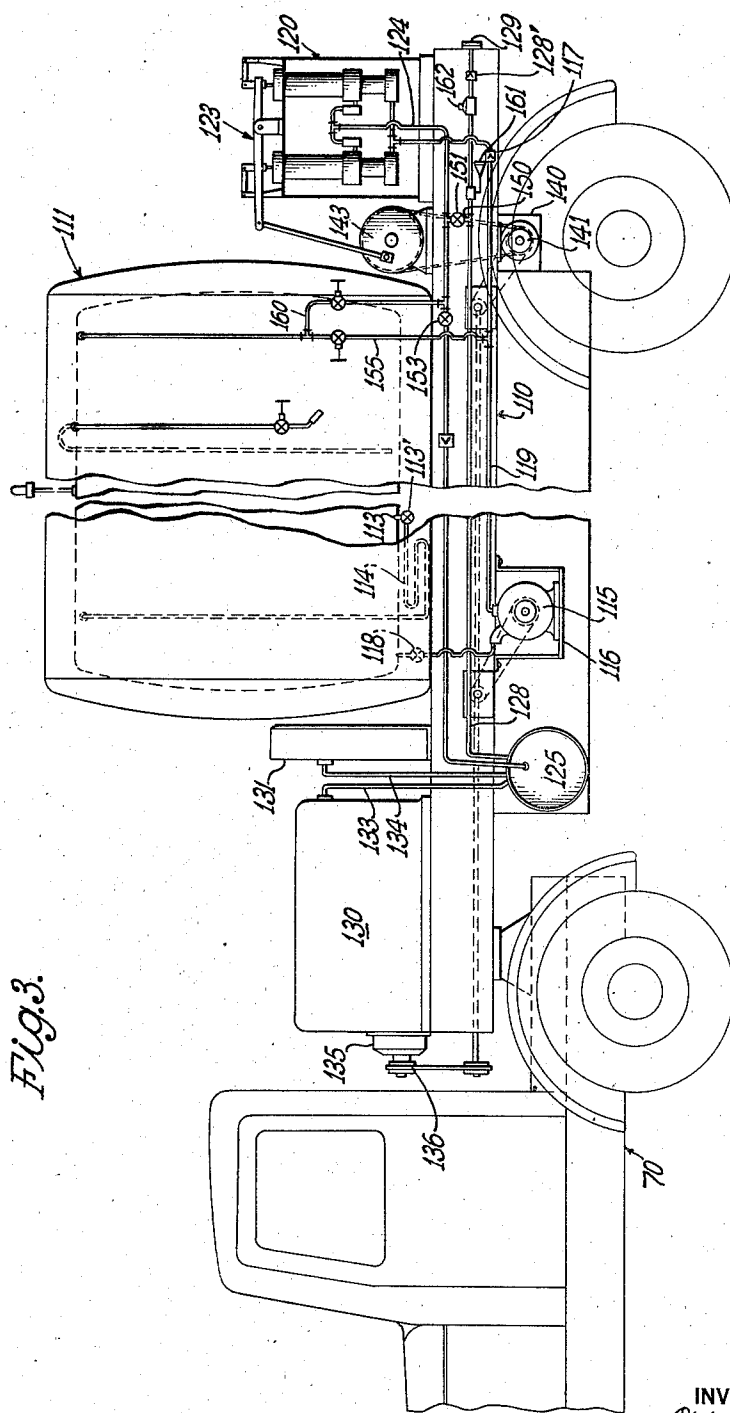
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UNITED STATES PATENT OFFICE

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APPARATUS FOR DISPENSING A
LIQUEFIED GAS

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Application December 7, 1940, Serial No. 369,023

5 Claims. (Cl. 62—1)

This invention relates to apparatus for dispensing a liquefied gas having a boiling point temperature materially below 273° K., and more particularly to a transportable apparatus or system adapted for dispensing gas material, such as oxygen in gas or liquid phase, to a consuming installation.

The invention has for its object generally an improved construction and arrangement of component devices in an apparatus of the character described whereby an economical and expeditious dispensing of gas material of the character indicated is accomplished.

More specifically, the invention has for its object the provision of an improved construction for transportable liquid oxygen dispensing systems including an arrangement of mechanically powered devices for withdrawing liquid oxygen from transport containers, together with vaporizing means, whereby such devices are in cooperative association with the vaporizing means.

Another object of the invention is to provide a transportable dispensing system for a liquefied gas with an improved arrangement of component devices which includes mechanically driven pumping apparatus, whereby the liquefied gas may be withdrawn and delivered quickly, either to a storage container or to gas phase receiving apparatus, at a relatively high pressure.

Another object is to provide a transportable dispensing system for liquid oxygen and the like, having mechanically driven liquid pumping apparatus with a power take-off associated with the heat motor, which may be that of the vehicle which transports the system, or an independent one, whereby a self-contained system is provided, adapted for delivering a desired amount of the gas material in a relatively short period of time.

Still another object is to provide a transportable liquid oxygen dispensing system of the character indicated with an improved arrangement of vaporizing apparatus which is adapted to receive the discharge from pumping apparatus, driven from the heat motor, in which the vaporizer is arranged to be heated by rejected heat from such motor in a manner which is efficient and achieves a heat balance vaporizing all of the liquid pumped regardless of the speed of the pumping apparatus.

Other objects of the invention will in part be obvious and will in part appear hereinafter.

The invention accordingly comprises the features of construction, combination of elements, and arrangement of parts, which will be exemplified in the construction hereinafter set forth,

and the scope of the invention will be indicated in the claims.

For a fuller understanding of the nature and objects of the invention reference should be had to the following detailed description taken in connection with the accompanying drawings, in which:

Fig. 1 is a view, mainly in side elevation, of a transportable liquid oxygen dispensing system having the customary housings removed and showing an arrangement of component devices in accordance with the invention;

Fig. 2 is a fragmentary sectional view, taken on the line 2—2 in Fig. 1, showing details of one of the component devices of the system; and

Fig. 3 is a view, similar to that of Fig. 1, but shows a modified form of the invention.

Referring now to the drawings, and particularly to Fig. 1, 10 denotes a wheeled chassis of a motor vehicle powered by an internal combustion motor in the conventional manner. The chassis is arranged to support a transport container comprising an inner vessel 11 adapted for holding liquid oxygen and a housing or outer casing 12 which is spaced from the vessel 11 in order to provide an insulating space 13 that is filled with suitable insulating material, such as powdered magnesium carbonate. The transport container is also indicated as provided with a pressure building vaporizing coil 14, as taught in Heylandt patent, Reissue No. 18,876.

Associated with the transport container is a pumping apparatus and a liquid oxygen vaporizer, as taught in Heylandt patent, Reissue No. 19,251. The pumping apparatus here employed comprises first- and second-stage pumps, as taught in the patent to Thompson, No. 1,930,731. The first-stage pump is shown at 15, and preferably comprises a rotary type pump of the character disclosed in the copending application, Serial No. 345,308, filed July 13, 1940, in the name of O. A. Hansen. The first-stage pump 15 is disposed below the transport container 11 a distance which provides a desired hydrostatic head of pressure that is sufficient to avoid flashing the liquid into vapor; such arrangement being taught in the copending application, Serial No. 340,848, filed June 15, 1940, in the name of O. A. Hansen. Accordingly, the pump 15 is indicated as secured in a frame 16 slung below the chassis 10 but clearing the ground by a distance sufficient to avoid ordinary obstructions. The container 11 has a liquid withdrawal connection 17 leading from a point relatively close to the bottom of the container and connected to deliver liquid oxygen

to the inlet channel of pump 15. This connection is controlled by a valve 18, preferably arranged to be manipulated from a convenient point at the rear of the truck or vehicle which transports the system.

An outlet connection 19 is arranged to lead from pump 15 to the inlet of the second-stage pumping device, shown generally at 20. This device is indicated as comprising vertically disposed reciprocating pumps 21 and 21' which have their cold ends lowermost, and are provided respectively with plungers 22 and 22' that protrude from their upper ends and are arranged to be actuated by a Watt linkage 23, as taught in the copending application, Serial No. 340,683, filed June 15, 1940, in the name of P. M. Riede. The connection 19 is accordingly branched, in order to lead in parallel to the inlets of pumps 21 and 21', which are also arranged with outlets discharging into a common outlet connection 24 that leads into a portion 24' supported by the chassis and extending forwardly to the front end of the truck or vehicle, where a vaporizer, shown generally at 25, is located. Such connections may have check valves, as shown at 19' and 24'', respectively.

The vaporizer here employed comprises a drum-like casing 26 suspended with its axis horizontal below the radiator of the internal combustion motor which propels the vehicle. Details are shown in Fig. 2, where it is seen that the drum heads are perforated to pass the ends of a coil 27 to which the connection 24' is attached in order that the liquid to be vaporized may be supplied thereto. An outlet connection 28 leads from the other end of the coil and is preferably disposed parallel to the connection 24' on the chassis; such connection preferably has a check valve 28' and leads to the rear of the vehicle and is terminated with a coupling 29. A flexible servicing connection may be attached at will to the coupling 29 for delivering oxygen to a rack of high pressure cylinders or other oxygen receivers. The vaporizer at 25 is also provided with an internal heating coil 30 which has an inlet connection 31 leading from the exhaust manifold of the internal combustion motor, and an outlet connection 32 at the other end arranged to discharge directly to the atmosphere. Such outlet is preferably provided separately from the exhaust muffler, the latter being closed when the outlet 32 is in use.

The vaporizing coil 27, here provided, is adapted to be heated by the water circulating through the internal combustion motor and its radiator. Accordingly, the connections which normally lead from the casing of the motor to the radiators are opened and connections to the vaporizer inserted. This is shown as accomplished by the provision of a connection 33 leading from the casing of the internal combustion motor and discharging into the space within the drum 26, while a similar connection 34 is led from the space within the drum 26 to the inlet of the radiator. Thus, the space within the casing of the vaporizer about coil 27 is always filled with a heating medium which is further heated by the coil 30 when exhaust gases are passed through it.

The pumping apparatus comprising the pumps 15 and 20 is here arranged to be driven by means of one or more power take-offs associated with the main drive or transmission of the vehicle. To this end, a power take-off housing 35 is depicted as disposed in driving

association with the transmission in a manner permitting its receiving power when the vehicle is not being propelled. From housing 35 there extends a transmitting shaft 36 that is coupled through a universal 37 to the power receiving end of the pump 15. Details of the power take-off device are omitted from the drawings in the interests of clearness of illustration, since any such device on the market may be employed.

In the arrangement depicted, driving power is also had from a take-off 40 disposed to receive power from the motor while the regular transmission is "neutral," and has a pulley 41 turning about a transverse axis which is preferably horizontally disposed with reference to the chassis of the vehicle. The pulley 41 is advantageously coupled by means of a belt or chain 42 in a speed reducing manner to drive a disk or pulley 43 which has a crank for actuating a connecting rod 44 that drives the Watt linkage at 23. By this arrangement, the pumps 15 and 20 may have their driving speed so chosen relatively that the pump at 20 is always adapted to receive and deliver the entire quantity of liquid discharged from the pump 15. Since the pumps are thus simultaneously propelled from the same heat motor, it is seen that the liquid may be withdrawn from the container 11 and passed through the vaporizer at various speeds by merely varying the speed of the internal combustion motor of the vehicle.

By this arrangement it is seen that there is always a heat balance in the vaporizer 25 between the liquid oxygen to be vaporized and the heat supplied, since the faster liquid oxygen is passed therethrough by the pumps the more heat from the internal combustion motor is supplied to vaporize the same.

In order that the power pump dispensing system above described may be also adapted for servicing consuming installations which have permanently installed vaporizers as well as those which have not, the system is arranged to cut out the vaporizer 25 at will. To this end, a bypass or cross connection 50, controlled by a valve 51, is inserted at a convenient point between the conduit 24' and that at 28. A cut-off valve, as shown at 53, may also be introduced in the conduit 24', for example, at a point somewhat beyond those at which connections 50 and 60 are attached. The valve 53 is normally open, while that in connection 50, i. e., a valve 51, is normally closed. In such an arrangement, it is seen that the vaporizer 25 is normally in service and that the liquid delivered by the pump 20 passes through the coil 27 and is vaporized. The vaporized material then passes out through the connection 28 for delivery at 29 to the consuming installation. If valve 51 be opened and the valve 53 be closed, then it is seen that the vaporizer 25 is cut out and the liquid delivered by the pump at 20 passes through the cross connection 50 directly into the conduit 28 to be delivered at 29. It will also be seen that if valve 51 be partially opened while valve 53 is open, cold gas material may be introduced into the vaporized material to regulate the temperature thereof.

In order that the pumps 15 and 20 when started may be readily primed, the system is provided with priming connections. Accordingly, a valved connection 55 is led from the discharge of the pump 15 to the gas space in the container 11. Such connection may be conveniently led from a point in the discharge conduit

19 which leads from the outlet of pump 15, as pointed out above. In a similar manner, a valve connection is led from the outlet of the pumps at 20 to the gas space of the container 11. Accordingly, a valved connection 60 is shown as provided leading from a convenient point in the conduit 24 to a point in the conduit 55 that is between the valve in conduit 55 and the point of entry into the container 11.

The system here provided with advantage also incorporates suitable auxiliary equipment, for example, a safety bursting diaphragm, as indicated at 61, communicating with the conduit 28 in order to relieve any sudden rise in gas pressure in the servicing connections. A receptacle for the attachment of indicators, such as thermometers, etc., may be provided, as shown at 62. A connection 63 having a portion 63' depending into the container is provided and arranged for filling the container; such connection being also adapted for liquid withdrawal purposes, if desired. Other safety devices may be provided also, for example, a safety valve, as shown at 64, arranged to vent the container 11. By such arrangement, the container is adapted to be operated in a sealed condition, desired operating pressures being had by setting into operation the pressure building coil at 14. Still other auxiliary devices may be employed at convenient points, such as liquid level indicators, pressure gauges, and the like.

In order that the system may discharge directly to a liquid receiver at low pressure, the connection 19 has a branch 29' which is similar to that at 29 and controlled by a normally closed valve 69; the normal connection to pump being controlled by a normally open valve 68. By this arrangement, it is seen that both the pump 20 and the vaporizer 25 may be cut out by the closing of valve 68 and opening valve 69. The low pressure receiver is, of course, coupled at 29' in the same manner that receivers at high pressure are coupled at 29.

It will be understood also that while an internal combustion motor has been described above, it is not essential to the invention that the motor which supplies the heat for vaporization be of this variety since any heat motor may be used which is in association with the container supplying the liquefied gas. For example, a hot-air or steam engine may be employed and the exhaust therefrom be passed through the heating coil of the vaporizer, such as that shown at 30 in the vaporizer 25. In such arrangement, it is seen that the rejected heat is the source of heat for operating the vaporizer. The heat supplied would be proportional to work done in pumping the liquefied gas, i. e., the faster liquefied gas is pumped the faster will heat be supplied for vaporizing and the heat balance provided in accordance with the invention is operative.

In the event the heat motor associated with the system for supplying the gas material is arranged to do other work when the liquefied gas is being pumped, the vaporizer is, of course, designed to utilize that portion of the normally rejected heat which is sufficient to achieve the desired heating of the withdrawn gas material.

In operation, the transportable dispensing system provided in accordance with the invention is driven to a consuming installation and a service connection established from the system to the installation by attaching suitable means at 29, such as a flexible hose, which discharges into a

receiver at the installation. If such receiver be a gas phase receiver, for example, a gasometer or a rack of cylinders to be filled, the vaporizer at 25 is put in service. Accordingly, valve 53 is set in "open" position while that at 51 is in "closed" position. The valve at 18 may then be opened and the pumps 15 and 20 coupled through their power take-offs to the motor of the vehicle when it is desired to service an installation. The pumps when started running are then primed. This is accomplished by first opening valve 52 in connection 55 so as to discharge the gas at first flashed off into the container 11. The priming is completed for pump 15 as soon as the pump is found to be developing pressure and while liquid is being discharged through connection 55. Then the valve 52 in connection 55 is closed and that at 54 in connection 60 opened. When the second pump develops pressure, the valve 54 is closed and the valve 53 opened so that the discharge from the pumps is thereupon forced through the connection 24' into the coil 27 of the vaporizer 25. Valve 68 is, of course, normally open.

In the vaporizer the water circulated through the connections 33 and 34 heats the coil 27 through which the liquid oxygen is passing. The hot gases from the internal combustion motor also pass through the coil 30. This supplies additional heat so that the water in the vaporizer is not unduly cooled and danger of freezing avoided. The vaporized oxygen is discharged through the connection 28 through the coupling 29 into the receiving apparatus. The receiving apparatus may be filled at substantially any desired rate by operating the pump driving motor at the proper speed. Also, it is seen that substantially any desired high pressure may be attained, since reciprocating pumps of the character here indicated are adapted to pump against heads of the order of 2000 lbs. per square inch gauge.

In the event the consuming installation to be serviced has a vaporizer or a liquid phase receiver requiring a relatively large charge of liquid oxygen, such as a storage tank, the servicing is carried out in substantially the same manner as that above described, except that the vaporizer 25 is cut out. To effect this, the valve at 53 is closed and that at 51 opened. When the pumps are primed, the discharge from the pump 20 is seen to pass first through the connection 24, then through the connection 50 into connection 28, and thence through the coupling 29 to the liquid phase receiving apparatus. In order to assist in keeping the pump 15 primed, especially when pumping liquid with a low static head on the inlet side, it is advantageous to set the coil 14 into operation since the container is closed. The coil 14 then builds a non-equilibrium pressure on the liquid in container 11. This, of course, adds to the low static head available from the height of the liquid alone with consequent increase in the efficiency of the first-stage pump. From the above it is seen that the two pumps in series are used whenever it is desired to pump against a substantial pressure, such as into a cold converter at a moderately high pressure, for example, at a pressure of 200 p. s. i. gauge, or into a vaporizing apparatus at a relatively high pressure, for example, at a pressure of 700 p. s. i. gauge, or greater.

The connection of the vaporizer to receive the heat dissipated by the internal combustion motor on the vehicle is seen generally to insure a

supply of the heat to effect vaporization in an amount proportional to the rate at which liquid is passing through the vaporizer, since at any speed of the motor the rate at which heat is dissipated is proportional to the rate at which the pumps are operated. Thus, a heat balance is achieved in an economical manner.

In the event that the supply of heat from the internal combustion type of motor is insufficient properly to vaporize the liquid oxygen, it may be necessary to retard the spark, so that more of the motor fuel is consumed than in ordinary operation, by the combustion of which greater heat is furnished. Adjustment of the spark which may be manual or automatic thus affords a control of the amount of heat supplied to the vaporizer.

Another control that may or may not be used is that afforded by a so-called "winter-front" that is generally provided on the radiator as standard equipment for trucks of the character here generally employed. By regulating the opening on the winter-front, either manually or automatically, the amount of heat supplied to the vaporizer by the engine cooling medium can be varied. Thus, in the event of an excess supply of heat, for example, when no liquid is passed through the coil 27, the heat can be dissipated to the atmosphere by simply opening the winter-front.

In the modification shown in Fig. 3, the internal combustion motor that drives the pumps is not that which propels the vehicle, the arrangement here employed being on a trailer 110 which is attached to the chassis 70 of automotive portions of the coupled vehicles. The trailer 110 is arranged to support a transport container 111 which is generally similar to that shown in Fig. 1 and has a liquid phase withdrawal connection 113 with controlling valve 113' and is preferably provided with a pressure building vaporizing coil 114. In the connection 118 there are disposed the liquid pumps in series and denoted 115 and 120 respectively. Such pumps are of the same character as those shown at 15 and 20 in Fig. 1, the pump 115 being supported from the vehicle 110 by a frame 116 at a point somewhat below the bottom of the container, while the second is mounted on a rear portion of the vehicle. A valve 118 controls the connection leading to pump 115. A discharge connection 119 leads from the outlet of pump 115 and has a check valve 117 therein, such connection leading to the inlet of the second pump 120. Such pump also comprises a pair of vertically arranged cylinders having reciprocating plungers therein that are actuated by a Watt linkage 123. These pump cylinders have a common discharge connection 124 that is connected to their outlets and leads to a vaporizer 125 on the vehicle 110. The vaporizer here employed is preferably similar to that shown in Fig. 2 and has a vaporizing coil connected to receive the discharge from connection 124. From the other end of the vaporizing coil leads a discharge conduit 128 which is terminated with a coupling 129 by means of which a flexible hose, or other conduit conveyance, is attached for making a service delivery. Connections 133 and 124 are arranged to permit circulation of the engine cooling medium through the vaporizer, the engine and radiator being here denoted respectively 130 and 131.

The engine 130 on the trailer has a power transmission that is independent of that which propels the vehicle. Such transmission may have

a housing 135 associated therewith from which extends a sprocket or pulley 136 that is appropriately coupled through chain or belt to drive the pump 115. A second housing 140 associated with the transmission is also provided and has a sprocket or pulley 141 that is similarly coupled to drive the pump 120 through the actuation of its Watt linkage 123; there being a driven crank disk shown as provided at 143 for this purpose.

A cross connection 150 is shown disposed between connections 124 and 128, the whole being provided with suitable control valves, as shown at 151 and 153.

Priming connections with controlling valves are shown at 155 and 160; the connections leading from the pumps also having check valves, as shown at 119' and 128'. This modification is also provided with suitable accessories as pressure gauges, safety valves, certain of which are shown at 161, 162, etc.

In this modification of the invention, the mode of operation is substantially the same as that for the apparatus shown in Fig. 1. The truck-trailer arrangement, however, permits the truck portion to be detached while a service delivery is being made at a consuming installation, the motor for running the pumps and furnishing the heat for vaporization being on the trailer 110, so that delivery is made without the presence of the truck portion.

It will also be seen that while the arrangements here shown are those which are adapted for servicing consuming plants with oxygen, the invention is in no way confined thereto, since any gas material, such as liquid propane, which has a boiling temperature at atmospheric pressure below 273° K., may be handled by apparatus provided in accordance with the invention.

Since certain changes may be made in the above construction and different embodiments of the invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

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

1. In a system for dispensing a liquefied gas, the combination with an insulated container for the liquefied gas, of pumping apparatus connected to withdraw liquid from said container, said apparatus comprising two volatile liquid type pumps in series, at least the first of which is positioned relatively low with respect to said container whereby the supply is under a gravity head of pressure, the second pump in the series being arranged to discharge against a relatively high head of pressure, a vaporizer having an inlet connection connected to receive the discharge from said second pump, a discharge connection leading from said vaporizer and terminating in a service coupling, a by-pass connection in parallel with said vaporizer extending between said vaporizer inlet and said discharge connection, a heat motor, driving means for coupling said pumps to be driven by said motor, and connections associated with said vaporizer for passing a medium conveying heat from said motor and utilizing the same in effecting vaporization.

2. In a system for dispensing a liquefied gas transportably mounted on a vehicle having an internal combustion motor, the combination with a container for the liquefied gas disposed on said vehicle, of pumping apparatus connected to

withdraw liquid from said container, a vaporizer for vaporizing withdrawn liquid and having an inlet connection connected to receive liquid discharged from said pumping apparatus, a discharge connection leading from said vaporizer for dispensing the gas produced, driving means for coupling said pumping apparatus to said motor, a by-pass connection between said vaporizer inlet and said discharge connection for by-passing cold liquid to said vaporizer discharge connection, and connections associated with said vaporizer for conveying the heat of the cooling medium of said motor to said vaporizer whereby vaporization of the liquid supplied thereto is effected.

3. In a system for dispensing a liquefied gas, the combination with a container for the liquefied gas, of pumping apparatus connected to withdraw such liquid from the container, a vaporizer for vaporizing withdrawn liquid and having an inlet connection arranged to receive liquid discharged from said pumping apparatus, a discharge connection leading from said vaporizer for dispensing the vaporized gas produced, driving means for said pumping apparatus, means for supplying heat to said vaporizer to vaporize and superheat the gas material passed therethrough, a by-pass connection between said vaporizer inlet and said discharge connection for by-passing said vaporizer, and means for controlling said by-pass operable to pass cold gas material into the vaporized and superheated gas material to regulate the temperature of the gas material dispensed.

4. In a system for dispensing a liquefied gas transportably mounted on a vehicle having an internal combustion motor, the combination with

an insulated container for the liquefied gas disposed on said vehicle, of pumping apparatus connected to withdraw liquid from said container, a vaporizer for vaporizing withdrawn liquid and having an inlet connection arranged to receive liquid discharged from said pumping apparatus, a discharge connection leading from said vaporizer for dispensing the vaporized gas produced, coupling means for operating said pumping apparatus from said motor, a by-pass connection between said vaporizer inlet and said discharge connection for by-passing said vaporizer, means for controlling said by-pass, and connections associated with said vaporizer for conveying thereto for heating purposes both the exhaust gases from said motor and the circulating cooling medium of said motor.

5. In a system for dispensing a liquefied gas, the combination of a container for the liquefied gas, a vaporizer for vaporizing liquefied gas, pumping apparatus connected both to said container and to said vaporizer and operable to withdraw liquefied gas from said container and to discharge liquefied gas into said vaporizer, means for supplying heat to said vaporizer to vaporize liquefied gas passing thereto, a discharge connection leading from said vaporizer for dispensing vaporized gas, a liquefied gas by-pass connection leading to said discharge connection from the connection between said pumping apparatus and said vaporizer, and means for controlling said by-pass and operable to deliver variable quantities of liquefied gas directly from said pumping apparatus into the vaporized gas in said discharge connection to regulate the temperature of such vaporized gas.

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