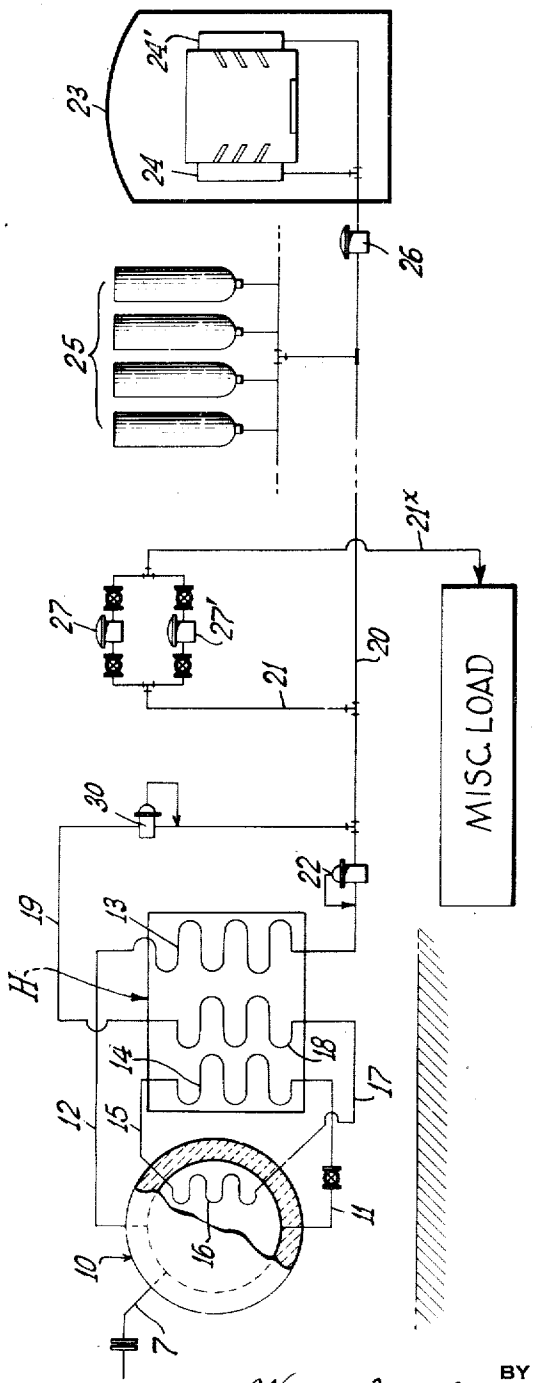
Nov. 21, 1944. P. B. PEW ET AL 2,363,200

APPARATUS FOR DISPENSING GAS MATERIAL

Filed Aug. 6, 1941 3 Sheets-Sheet 1

Fig. 1.



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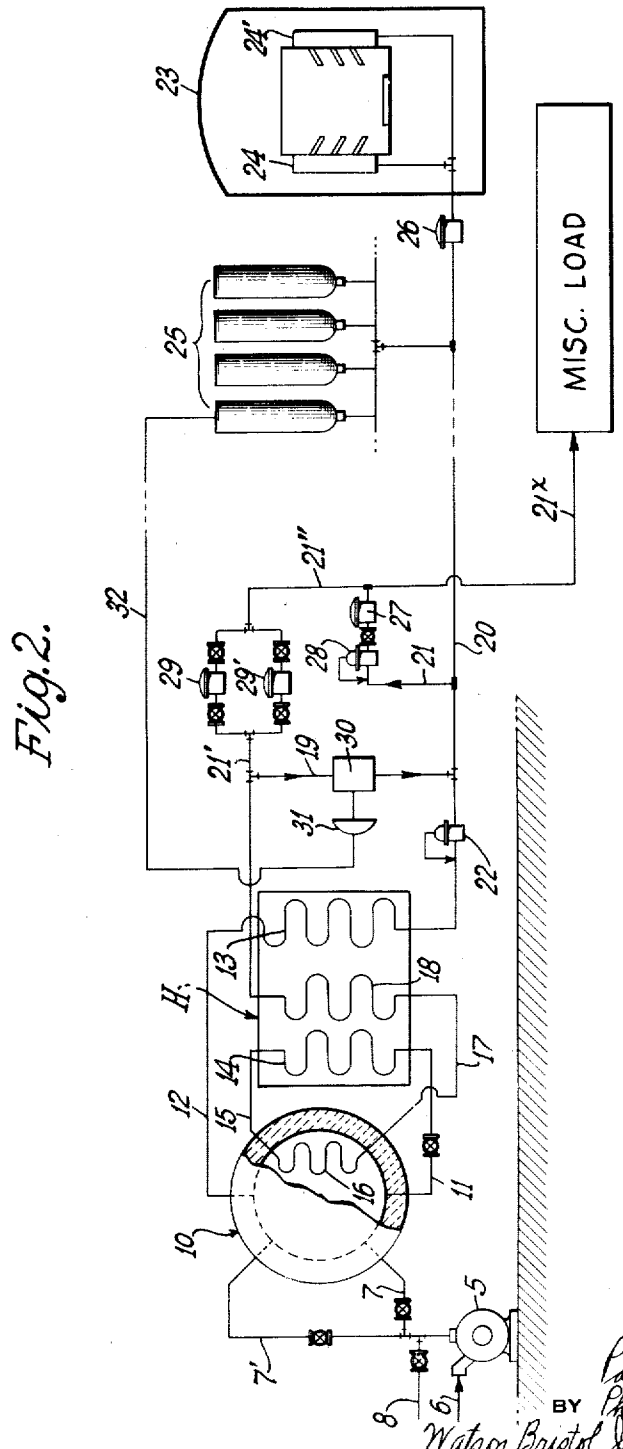

Fig. 2.

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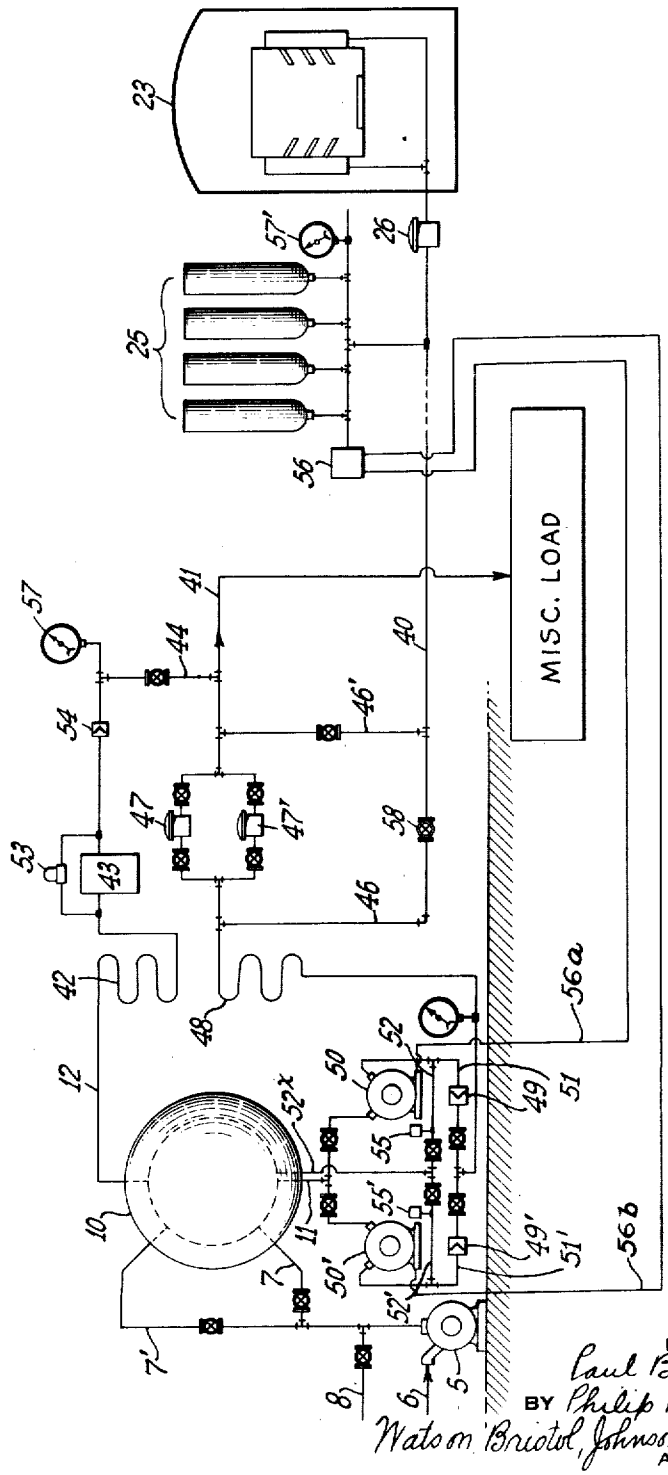
Filed Aug. 6, 1941 3 Sheets-Sheet 3

Fig. 3.



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UNITED STATES PATENT OFFICE

2,363,200

APPARATUS FOR DISPENSING GAS MATERIAL

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Application August 6, 1941, Serial No. 405,600

18 Claims. (Cl. 62—1)

This invention relates to a system for dispensing gas material, and particularly to a system for dispensing for industrial use a liquefied gas which has a boiling point temperature below 273° K. at atmospheric pressure.

The invention has for its object generally to provide an improved system of the character indicated which is efficient and economical and is adapted to respond instantly to supply adequately relatively large demands for gas, and may additionally supply a miscellaneous load.

More specifically, the invention has for its object the provision of a system with an arrangement for storing and gasifying quickly relatively large quantities of a liquefied gas of the kind indicated, for example, liquid oxygen, in order to service properly large instantaneous demands, such as are made, for example, in the steel industry, where the step of desurfacing steel billets and the like with gaseous oxygen is employed.

Another object is to provide a liquid oxygen consumer's installation with an arrangement of conduits or piping for distributing the oxygen including a gas phase receiving and storing device novelly located therein, so that the size and weight of pumps, conduits or piping, and vaporizing systems employed are economized, and need not be such as to accommodate the flow occasioned by a maximum demand.

Still another object is to provide a liquid oxygen consumer's installation, such as would be suitable for a steel mill where the step of desurfacing steel billets with gaseous oxygen is practiced, with suitable means for independently supplying a substantial miscellaneous load in addition to supply conduits leading to the surfacing device.

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 arrangements 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 shows diagrammatically an installation on the consumer's premises arranged for servicing an intermittent load, such as a desurfacing machine, and also for servicing a miscellaneous load, in accordance with the invention;

Fig. 2 is a view, similar to Fig. 1, showing a modified form of the invention depicted in Fig. 1; and

Fig. 3 is another view, similar to Figs. 1 and 2, showing another modification.

In an ordinary consumer's installation comprising a liquid phase container, vaporizer and gas distributing system arranged, for example, as shown in the United States patents to Smith, No. 1,942,944, and/or to Updegraff, No. 1,943,047, the arrangement normally employs conduits or piping leading from the vapor generating or heating means to the load, together with accessories, such as regulators, that are made of a sufficient size and weight to convey at the pressure desired sufficient gasified oxygen to meet the maximum demand which the system is intended to supply. Where the principal apparatus serviced by the system is a device which makes relatively large demands for oxygen intermittently, such as a machine for desurfacing steel billets and the like, the liquid phase container and vapor generating or heating means are necessarily installed at a safe distance from the desurfacing machine and are required to be of relatively large capacity. The desurfacing load is, of course, highly intermittent and the magnitude of the demand fluctuates widely; the maximum demands being of relatively short duration. The gas distributing piping in such a dispensing system, in consequence, would be of relatively large diameters, with relatively heavy and expensive walls, in order to insure proper supply to the intermittent load or desurfacing machine.

By the present invention an improved dispensing system is provided, in which piping of reduced size is employed and a gas phase storage device or receiver of relatively large capacity is provided and disposed closely adjacent the intermittent load; the receiver being arranged for averaging or ironing out the peak loads and supplying the intermittent load adequately during the periods of maximum demand without imposing unduly heavy demands on the liquid phase withdrawal and vapor generating or heating means. Provision is also made in the system for the automatic charging of the gas phase storage device or receiver during the periods when little or no demand is being made on the distributing system.

In the present invention provision is made for supplying a miscellaneous load, such as oxygen for cutting or hand deseaming, independently of the intermittent load. This is achieved by arranging the supply for the miscellaneous load to

be in parallel with that to the intermittent load. Any tendency to fluctuations in pressure is confined to the pipeline supplying the intermittent or fluctuating load, the pipeline supplying the miscellaneous load having a pressure regulating means whereby fluctuations therein are eliminated. The gas phase receiver which is associated with the fluctuating load will as a result operate like ballast and quickly bring about equilibrium conditions in the system.

Referring now to the drawings, and particularly to Fig. 1, a consuming installation is shown, comprising a liquid phase container 10 of a capacity adapted for holding a supply of the liquefied gas, such as liquid oxygen, sufficient to last over the period normally intervening between servicing events. Container 10 is arranged to be filled when serviced, from a transport container, such as a truck or tank car, and is accordingly provided with a filling connection 7. The liquid phase container employed is of the double-walled insulated type and provided with an inner vessel of a strength sufficient to withstand the pressure required to maintain the supply lines at the operating pressure desired. Such pressure is maintained by the vapor generating and heating means, here generally shown at H. The arrangement of the installation may be made in any suitable manner, for example, as taught in copending application, Serial No. 290,969, filed August 19, 1939, in the name of O. A. Hansen, which issued September 23, 1941, as Patent No. 2,256,673. The heat insulation for the container may be that generally employed, namely, a filling of magnesium carbonate, or a powder filled evacuated space as taught in copending application, Serial No. 307,945, filed December 7, 1939, in the name of L. I. Dana.

Container 10 has a liquid phase withdrawal connection 11 leading from a point near the bottom, and a gas phase withdrawal connection 12 leading from a point near the top. The associated heating means has coils 13 and 14, the former being arranged for vapor heating, while the latter is arranged for vaporizing of liquid and superheating the resulting gas. Accordingly coil 13 is connected in series with connection 12. Coil 14 is connected in series with connection 11 and has a connection 15 at its other end leading to a coil 16, disposed in the inner vessel of container 10 and adapted to generate pressure therein by evaporation of liquid. From coil 16 another connection 17 leads the gas material to a third coil 18 in the heater at H. Coils 14 and 18 cooperate to generate a gas phase at a relatively high temperature and pressure. This supply of gas supplements that had from the coil 13.

In the installation of Fig. 1, service connections, or pipelines, are shown at 20 and 21 leading in parallel to the intermittent and miscellaneous loads respectively. Pipeline 20 is connected directly to the coil 13 and is provided with pressure regulating means, such as a back pressure valve 22, for purposes hereinafter more fully explained. Pipeline 20 is depicted as leading to a desurfacing machine 23, which has nozzle heads 24 and 24' for impinging gas at a desired velocity upon billets or the like which are to be desurfaced. The machine shown is of course, merely exemplary of a consuming device imposing an intermittent load; such load may comprise, for example, one or more of the machines shown in U. S. Patent No. 2,125,174, issued in the name of H. W. Jones.

Closely adjacent the machine 23 is disposed a gas phase receiver 25 of relatively large capacity, which is floatingly connected to the pipeline 20 whereby it supplies gas thereto for consumption in the machine during periods of maximum demand; the supply pressure to the machine being closely regulated thereat by means of a regulator 26 which may be in the pipeline at a point adjacent the machine, or incorporated as part of the equipment of the machine. The receiver 25 may have any suitable construction, but since the gas is at moderately high pressure, for example 170 lbs. per square inch gauge, a plurality of cylinders connected through a manifold to the pipeline is an advantageous arrangement, such arrangement being indicated in the drawing.

Pipeline 21, which supplies the miscellaneous load, is here tapped into the pipeline 20 at a point beyond the valve 22 and leads through regulator 27 (which may be in duplicate to provide a regulator, as shown, at 27' in parallel with the first to insure continuity of service) to the load; that portion of pipeline 21 which extends beyond the regulators to the load being designated 21x.

In order to provide pipeline 20 with an additional supply of gas material in the gas phase during periods of maximum demand, a supply connection 19 is provided, leading from the coil 18 to a point in pipeline 20 that is beyond the valve 22 but in advance of the point at which it is tapped to take off the pipeline 21. Supply connection 19 is in the nature of a cross connection and the material supplied is preferably automatically controlled. To this end, a control valve 30 is shown, which may be any suitable form of automatic valve, for example, a pressure regulator that is actuated by pressure on the downstream side of the regulator. In operation, the liquid oxygen in container 10 is maintained under a gas phase pressure of, for example, 175 lbs. per square inch gauge, by means of the back pressure valve 22.

The major portion of gas supplied would normally be through liquid vaporization in the heater. Any large or extended demand is automatically met with vaporized material supplied by way of connection 19, i. e., by gasified liquid material withdrawn from container 10 through connection 11. The withdrawn liquid is, of course, vaporized and heated in coil 14 and then passed through the coil 16 in container 10 and thence through coil 18. The vaporized gas material discharged from coil 18 has been elevated by its passage through the heating means substantially to atmospheric temperature and is at a moderately high pressure, for example, 175 lbs. per square inch gauge. The regulator 30 may be set to maintain a desired downstream pressure in pipeline 20, 21 and receivers 25 of, say, 170 lbs. per square inch gauge. When withdrawal is low and pressure in container 10 is high, regulator 30 closes off the flow from the liquid phase through coils 14, 16 and 18. In this connection it is noted that while withdrawal is occurring through coil 16 in container 10 it serves to generate pressure in the container, but if the withdrawal becomes low this pressure would extend into pipeline 20 since regulator 22 would be open, and this high pressure on the downstream side of regulator 30 would cause it to close, shutting off flow through coil 16 and preventing further building up of pressure in container 10 from heat additions from coil 16. Withdrawal would continue through gas phase line 12 and regulator 22 which would reduce the pressure in container 10 until regulator 30 again opened.

During idle periods or periods of low with-

drawal, valve 22 will be open and gas material for pipelines 20 and 21x will be supplied through the gas phase line 12 and its coil 13. This condition will exist as long as pressure in container 10 is in excess of a predetermined value, for example, 175 lbs. per square inch gauge. With respect, however, to pipeline 21x the regulator valve 27 is normally set to maintain a predetermined pressure in pipeline 21x somewhat lower as, for example, 130 lbs. per square inch gauge.

Receiver 25 communicates with pipeline 20 and must be of such size as to provide for gas phase storage of liquid vaporized due to heat leak during idle or very low withdrawal periods. It is thus seen that receiver 25 fulfills two functions, namely: that of storing gas near the desurfacing machines to supply high instantaneous loads; and that of receiving normal evaporation from container 10 during periods of shutdown or low withdrawals. Operation of valves 22 and 30 is such that when pressure in container 10 is above 175 lbs. per square inch, the excess pressure is reduced by pipeline consumption, and when pressure is below 175 lbs. per square inch, the pressure is increased, thus maintaining a pressure of substantially 175 lbs. per square inch in the container 10.

In the modification shown in Fig. 2 facilities are provided for expediting the servicing of the installation and for adequately handling an intermittent load with periods of somewhat extended maximum demands. Here, the liqu'd phase container 10 has power operated filling means comprising a turbine pump 5 of a type adapted to transfer a highly volatile liquefied gas, such as liquid oxygen. Such pumps are now available and are disclosed in copending application, Serial No. 345,308, filed July 13, 1940, in the name of O. A. Hansen, which issued Feb. 1, 1944, as Patent No. 2,340,747. Such pump has a supply connection 6 and discharge connections 7 and 7' to the container 10, together with a priming connection 8, whereby connections with a tank car or the like are made for transferring a charge of liquid material to the container 10. Here the container 10 has, as in Fig. 1, a liquid phase withdrawal connection 11, a gas phase withdrawal connection 12 and associated heating means comprising coils 13, 14, and 18. Pipelines 20 and 21 service the intermittent and miscellaneous loads, respectively.

In the arrangement of Fig. 2, provision is made for supplying the miscellaneous load directly from the coils 14—16—18. Hence, a connection is provided leading therefrom to the pipeline 21x. Such connection is shown at 21'—21'' and includes a pressure regulator 29 (which may also have a duplicate, as shown at 29', in parallel therewith). Here the regulator 27 in the tapping connection 21 advantageously has an associated back pressure valve 28.

To supplement the supply of material in the gas phase delivered by the pipeline 20 during periods of maximum demand, the connection 19, which may be referred to as a cross connection, connects the discharge of coils 14—16—18 to the pipeline 20 and has controlling means, here comprising a valve 30, that is arranged to be controlled by downstream pressure at a point closely adjacent the intermittent load, for example, that in gas phase receiver 25. Accordingly, a pilot pipeline 32 is provided leading from a suitable point in receiver 25, such as a point in a cylinder thereof, to a pressure operated motor 31 that actuates the valve 30. Such valve is preferably so arranged and adjusted that a drop in pressure below a predetermined value in receiver 25 opens valve 30 and admits a supply of gas phase directly from the coils 14—16—18 into the pipeline 20. When a predetermined upper pressure is reached in receiver 25, the valve 30 closes automatically and cuts off the supplementary supply of gas material.

In operation, the modification of Fig. 2 follows generally the steps and events indicated in connection with Fig. 1. It may be noted, however, that the gas supplied by pipeline 21 is by way of the tapping connection and regulator 27.

Flow of material in the gas phase from coils 14—16—18 to the pipeline 20 is at all times directly controlled by the downstream pressure at a desired point, such as that of receiver 25. When such pressure falls below a predetermined value, for example, 150 lbs. per square inch gauge, the valve at 30 will open and when the pressure in receiver 25 and pipeline 20 attains a value in excess of 170 lbs. per square inch gauge, the valve at 30 closes. The pressure in pipeline 20 and receiver 25 may at times fall to rather low values due to a relatively high instantaneous rate of withdrawal, but the receiver is preferably so proportioned as to have a capacity sufficient to meet such demand. With adequate pressure in 10 the pressure in receiver 25 will, of course, rise again as soon as the withdrawal rate permits and until valve 30 closes. This operates to restore the pressure in receiver 25 to 170 lbs. per square inch gauge. The pressure of the gas phase at the consuming machine 23 is preferably set to have a relatively low value, for example, about 60 lbs. per square inch gauge. Such value is, of course, maintained substantially constant by the regulator 26.

Assuming that pressure is built in container 10 to a value in excess of a predetermined value, such as 175 lbs. per square inch gauge, or that for which back pressure valve 22 is set, gas phase will flow from container 10 through heating coil 13 to pipeline 20, or to pipeline 21x, by way of regulator 27 and back pressure valve 28. Back pressure valve 28 may be set to open at a pressure slightly below the setting of back pressure valve 22, which may be, for example, 160 lbs. per square inch gauge. Regulator 27 is set to maintain a desired supply pressure, for example, 130 lbs. per square inch gauge, in pipeline 21x, which pressure causes regulator 29 (or that at 29') to close (both being set to maintain a slightly lower pressure, as 125 lbs. per square inch gauge), so that pipeline 21x will be fed preferentially by regulator 27 if the pressure in pipeline 20 is sufficiently high to open back pressure valve 28.

Excess pressure in container 10, due to idle periods or shutdowns, will cause back pressure valve 22 to open and valve 30 to close, thus permitting evaporation during such periods to be stored in 25. Withdrawal, either through line 21x or from the main service line through regulator valve 26, will cause a reduction in pressure in receiver 25 and container 10 which, if continued, will result in valve 30 opening.

Suitable safety valves may be employed where desired in the system as in the receiver 25 and container 10. This in general applies also to the systems of Figs. 1 and 3.

The modification shown in Fig. 3 dispenses with the regulators in the cross connections shown in Fig. 1 but limits the pressure in the storage container. In achieving this, the evaporation is preferably pumped by an external gas

pump and conserved. This is preferably accomplished in the manner set forth in copending application, Serial No. 409,626, filed September 5, 1941, in the name of G. J. Boshkoff. To insure an adequate supply of vaporized gas material to meet the load demands, the withdrawal of liquid phase is also advantageously mechanically achieved by the use of a pipeline pump in the liquid phase withdrawal connection, such pump being adapted to discharge against relatively high heads of pressure, for example, a head of from 200 to 400 lbs. per square inch gauge. A multistage turbine pump of a type adapted to pump a liquefied gas is advantageous in such service, a suitable pump being disclosed in copending application, Serial No. 388,048, filed April 11, 1941, in the names of G. H. Zenner and E. F. Yendall, which issued Feb. 1, 1944, as Patent No. 2,340,787.

The system shown in Fig. 3 may have its storage container and filling connections arranged in the same manner as those shown in Figs. 1 and 2, similar parts being denoted by the same reference characters; i. e., 10 is a container having liquid and gas phase withdrawal connections at 11 and 12 respectively. Here, 5 denotes a liquid transfer pump for filling with a supply connection 6 and discharge branches 7 and 7' with a priming connection 8. The system has a main pipeline or service connection 40 leading to the intermittent load, again shown as a desurfacing machine 23, and a second pipeline 41 leading to a miscellaneous load.

The gas phase withdrawal connection 12 preferably has a heating coil 42 inserted therein and leads to a gas compressor 43, provided to conserve the evaporation arising in container 10, such evaporation when compressed and raised to the desired pressure being discharged from the compressor through a connection 44 into pipeline 41. The liquid phase withdrawal passes into vaporizing coil 48 and into the main line equipped with a normally open cut-off valve 58 between the sections 46 and 40. There is also a cross connection 46' between the pipelines 40 and 41 provided with a shut-off valve and a regulating device 47, similar to that at 27 in Fig. 1. Pipeline 44 has a check valve 54, as pointed out below, for preventing a reversal of flow.

The pipeline pump above referred to is introduced in the liquid phase withdrawal connection 11, between the container 10 and the inlet to coil 48; the pipeline pump being advantageously introduced in duplicate into connection 11. In such an arrangement one pump is adapted to serve as a spare. The arrangement shown is of this character in which the pumps are denoted 50 and 50' respectively, each in a parallel branch of the connection 11. Suitable cut-off valves are in these branches by means of which the pumps may be commissioned at will. The outlet connections 51 and 51' have check valves 49 and 49' additionally interposed therein; these connections leading to the common inlet of coil 48.

In parallel with the connections 51 and 51' are branches 52 and 52' of a priming connection that have a common portion 52x leading to the container 10. Besides manually operated valves in each of branches 52 and 52', there are preferably interposed automatic devices, symbolically shown at 55 and 55', which have flow controlled cut-off valves and flow actuated motor controlling switches which are preferably pressure actuated. A master controller 56 is provided at any convenient location, for example, one adjacent the receiver 25 where it responds to the pressure therein. The respective motors for operating the pumps 50 and 50' are subject to the control of the controller 56 through suitable electric connections shown diagrammatically at 36a and 56b respectively. By this arrangement the manually actuated valves at pumps 50 and 50' are normally open and both of the flow controlled devices 55 and 55' have their priming connections open. When the pressure in the receiver 25 falls to a predetermined low value, the master controller 56 cuts in one of the pumps, for example pump 50; that pump being automatically cut out upon the attainment of a predetermined high pressure in 25. In the event of a failure of pump 50 to respond, due to wear or other cause, the pump is automatically cut out and the pump 50' is automatically cut in by operation of a contact in device 56 which is set below the normal operating pressure for pump 50. Since valve 55 is open when no pressure exists in line 52, pump 50 primes by recirculation of liquid back to container 10 whenever the pump is started. Flow of liquid in 52 causes a pressure rise, which thereupon closes valve 55 and causes pump 50 to discharge through 49. A similar set of events occurs in case pump 50' is started. The details of the devices 56, 55 and 55' are not here shown, since they comprise no part of the present invention. Any suitable controlling devices of this character may, of course, be employed, for example, that shown in copending application, Serial No. 409,626, filed in the name of G. J. Bushkoff, supra.

A pressure actuated by-pass valve 53 is also preferably provided about the compressor 43, the by-pass being arranged to open whenever the pressure in the connection 44 attains a predetermined high value, or whenever pressure in container 10 reaches a predetermined low value. In this way, compressor 43 can be allowed to run continuously. To assist the by-pass valve 53 to operate and relieve back pressure thereon when closed, the check valve 54 is provided at a suitable point in connection 44. Pressure indicators may, of course, be inserted in the system at suitable points whenever desired. Two such indicators are shown thus inserted in the system at 57 and 57'. The gate valve 58 in the pipeline 40 is for emergency purposes and is normally open. The cross connection 46' in this arrangement is normally closed.

In operation, the modification shown in Fig. 3 has the container 10, which normally operates at a pressure not greatly different from atmospheric, filled by means of the transfer pump 5. When the pressure in the distributing system falls below a predetermined value, the motor control 56 will operate to start the motor of pump 50 and force liquid oxygen through the heater and vaporizer 48. The vaporized material will flow into the pipeline 46 and 40 and charge the receiver 25. Withdrawals of gaseous oxygen for servicing the miscellaneous load at a desired pressure may be had at will through the pipeline 41, since it is maintained at a predetermined level of pressure by the regulator 47. Gaseous oxygen will also be withdrawn from the container 10 through the connection 12 by the compressor 43 which is normally continuously running. This will tend to supply the miscellaneous load without withdrawal through the regulators 47. The gaseous oxygen in the container 10 is that which has accumulated through heat leak or the priming of the pumps

50 and 50'. In this modification, the main receiver 25 is also preferably disposed close to the desurfacing machine, in order to supply large instantaneous demands for gaseous oxygen without the use of pipeline connections, such as shown at 40, having a capacity adapted to supply a maximum demand. Such maximum demand may be of the order of 500,000 cubic feet per hour. The duration of such demand, however, is relatively short, for example from 28 to 30 seconds, followed by off-periods of 45 seconds duration, or more. The regulator 26 installed at or on the desurfacing machine maintains a suitable nozzle head pressure for the gas impinged during a desurfacing process, for example, a pressure of 60 lbs. per square inch gauge, or higher.

The pipeline 41, which supplies the miscellaneous load, need have but a relatively small part of the capacity of pipeline 40, for example, 8,000 cubic feet per hour at a pressure of about 125 lbs. per square inch gauge.

The pipeline pump 50 is preferably set to maintain a pressure in excess of the pressure in the distributing system such as 250 lbs. per square inch gauge. The controller for such pump may be set to start the pump whenever the pressure falls to a predetermined low value, for example, 175 lbs. per square inch gauge, and stops when the pressure reaches a suitable high value, for example, 260 lbs. per square inch gauge.

Details of the electric controls here employed are not shown, since many suitable devices for such purpose are known to the prior art and can readily be installed by skilled workmen and engineers.

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 our invention, what we claim as new and desire to secure by Letters Patent, is:

1. In a system for dispensing liquid oxygen and distributing the same as gas to consuming devices comprising at least one which constitutes a load of intermittent character having a known maximum and one or more others forming a miscellaneous load, the combination with a container for holding and storing liquid oxygen, of a service connection including a heat receiving section leading therefrom to said intermittent load, a gas phase receiver connected to said service connection, said service connection being provided with a pressure regulator adjacent said intermittent load, a second service connection for supplying said miscellaneous load leading from a point of communication with said first service connection between said heat receiving section and said pressure regulator, said second connection including pressure regulating means, a liquid supply conduit means including a heat receiving section leading from said container and communicating with one of said service connections whereby material converted into the gas phase may be supplied directly to the corresponding service connection, and automatic means associated with said conduit means responsive to downstream pressure for regulating the passage of gas therethrough.

2. In a system for dispensing liquid oxygen and distributing the same as gas to consuming devices comprising at least one which constitutes a load of intermittent character having a known maximum and one or more others forming a miscellaneous load, the combination with a container for holding a charge of liquid oxygen for supplying said devices, of heating means, a service connection leading from said container through said heating means to said intermittent load, a second service connection for supplying said miscellaneous load, said second service connection being branched off of said first-named service connection and provided with pressure regulating means for maintaining a substantially constant pressure therein, a liquid supply conduit means leading from said container through said heating means to said first-named service connection for supplying thereto material converted into the gas phase, and automatic means responsive to downstream pressure for regulating the passage of said converted gas phase.

3. In a system for dispensing liquid oxygen and distributing the same as gas to consuming devices comprising at least one which constitutes a load of intermittent character having a known maximum and one or more others forming a miscellaneous load, the combination with a container for holding a charge of liquid oxygen for supplying said devices, of heating means, a service connection leading from said container through said heating means to said intermittent load, a gas phase receiver connected to said service connection, a second service connection for supplying said miscellaneous load, said second service connection being branched off of said first-named service connection and provided with pressure regulating means for maintaining a substantially constant pressure therein, a back pressure valve in said first-named service connection located at a point in advance of the point at which said second service connection is branched, a supply connection from said container leading through said heating means to said first-named service connection at a point between said back pressure valve and said branch point and arranged to provide a supply of material converted from the liquid phase into the gas phase, and automatic means in said supply connection responsive to downstream pressure for regulating the passage of said converted gas phase.

4. In a system for dispensing liquid oxygen and distributing the same as gas to consuming devices comprising at least one which constitutes a load of intermittent character having a known maximum and one or more others forming a miscellaneous load, the combination with a container having a space for holding and storing liquid oxygen and also a gas space, of heating means including elements connected to both spaces of said container, a service connection leading from said heating means to said intermittent load, a gas phase receiver connected to said service connection, said service connection being provided with a pressure regulator adjacent said intermittent load, a second service connection for supplying said miscellaneous load, said second connection including pressure regulating means, the arrangement of the connections being such that regasified oxygen may be supplied directly to said miscellaneous load and material in the gas phase supplied directly to said first-named connection, a cross connection between said service connections, and means for automatically passing gas through said cross connection into said second service connection when an excess of desired pressure obtains in said first-named service connection.

5. In a system for dispensing liquid oxygen and distributing the same as gas, the combination

with a container for holding and storing liquid oxygen and having a heating means including a gasified element connected thereto, of a service connection leading to a load which intermittently imposes on the system demands for gas of a predetermined maximum, a gas phase receiver in communication with said service connection at a point relatively close to said load, a pressure regulator in said service connection between said point and said load, a power operated pipeline pump interposed in the liquid phase connections which lead from said container to said heating device, an automatic power controlling means associated with said gas receiver and responsive to the pressure therein for controlling the transfer of liquid oxygen by said pipeline pump.

6. In a system for dispensing liquid oxygen and distributing the same as gas, the combination with a container for holding and storing liquid oxygen and having a heating means including a gasifying element connected thereto, of a service connection leading to a load which intermittently imposes on the system demands for gas of a predetermined maximum, a gas phase receiver connected to said service connection, said service connection being provided with a pressure regulator adjacent said intermittent load, a power operated pipeline pump interposed in the liquid connection which leads from said container to said heating means, automatic power controlling means for said pump associated with said gas phase receiver and responsive to the pressure therein, a second service connection for supplying a miscellaneous load in parallel with said first-named service connection, said second-named connection including pressure regulating means, a plurality of cross connections interposed between said service connections, and means associated with each of said cross connections for regulating the passage of gas therethrough.

7. In a system for dispensing liquid oxygen and distributing the same as gas, the combination with a container for holding and storing liquid oxygen and having a heating means including a gasifying element connected thereto, of a service connection leading directly to a load including a desurfacing machine which intermittently imposes on the system demands for gas of a predetermined maximum, a gas phase receiver connected to said service connection, said service connection being provided with a pressure regulator adjacent said desurfacing machine, a power operated pipeline pump interposed in the liquid connection which leads from said container to said heating means, automatic power controlling means for said pump associated with said gas phase receiver and responsive to the pressure therein, a second service connection connected to said heating means for supplying a miscellaneous load in parallel with said first-named service connection, said second-named service connection including pressure regulating means, a cross connection interposed between said service connections, valve means in said cross connection for regulating the passage of gas therethrough, and a mechanical compressor arranged for withdrawing oxygen in the gas phase from said container and transferring the same to said second-named service connection.

8. In a system for dispensing a liquefied gas and distributing same as a gas to consuming devices including at least one which constitutes a load of intermittent character but of a relatively large known maximum, the combination with a container for holding a charge of the liquefied gas for supplying said devices, of heating and vaporizing means connected to said container, a servicing connection leading from said heating and vaporizing means to said intermittent load, gas receiver means in continuous communication with said servicing connection relatively close to said load, said servicing connection leading from said heating and vaporizing means to the point of communication with said receiver means being of less capacity than required for supplying gas material at a rate equal to said maximum, and regulating means disposed in said servicing connection substantially at said intermittent load between it and said gas receiver means.

9. In a system for dispensing gas material to consuming devices at least one of which constitutes a load of intermittent character having a known maximum, the combination with a container for holding a charge of liquefied gas for supplying said devices, of heating and vaporizing means connected thereto, a servicing connection leading therefrom to said intermittent load, a gas phase receiver in communication with said servicing connection adjacent said intermittent load, said servicing connection to the point of communication with said gas phase receiver being of less capacity than required for supplying gas material at a rate equal to said maximum, a pressure regulating means disposed in said servicing connection adjacent said intermittent load, a second servicing connection to the miscellaneous load connected into the system in advance of said pressure regulating means, and means for maintaining a pressure in said second servicing connection of a predetermined value independent of that supplied to said intermittent load.

10. In a system for dispensing gas material to consuming devices, the combination with a container for holding a charge of liquefied gas for supplying said devices, of heating and vaporizing means connected thereto, a servicing connection leading therefrom to a first consuming means to one character, a pressure regulating means disposed in said servicing connection for supplying gas to said first consuming means at a pressure appropriate thereto, a second servicing connection for supplying gas to a second consuming means of a different character connected into the system in advance of said pressure regulating means, and regulating means in said second servicing connection for supplying gas to said second consuming means at a pressure appropriate thereto independent of the pressure supplied to said first mentioned consuming means.

11. In a system for dispensing gas material to consuming devices, the combination with a container for holding a charge of liquefied gas for supplying said devices, of heating and vaporizing means connected to both the liquid and gas spaces of said container, servicing connections leading from said heating and vaporizing means provided with a first branch leading to a first consuming means of one character, a pressure regulating means disposed in said first branch for supplying gas to said first consuming means at a pressure appropriate thereto, a second branch leading from said servicing connections to a second consuming means of a different character, regulating means in said second branch for supplying gas to said second consuming means at a pressure appropriate thereto independent of the pressure supplied to said first mentioned consuming means, and automatic means associated with said servicing connections responsive to downstream pressure for regulating the supply of liquid from said container to said heating and vaporizing means.

12. In a system for dispensing gas material to consuming devices comprising at least one which constitutes a load of intermittent character having a known maximum and one or more others forming a miscellaneous load, the combination with a container for holding a charge of liquefied gas for supplying said devices, of heating and vaporizing means connected thereto, a servicing connection leading therefrom to said intermittent load, a gas phase receiver in communication with said service connection adjacent said intermittent load, said service connection up to the point of communication with said gas phase receiver being of less capacity than required for supplying gas material at a rate equal to said maximum, a pressure regulating means disposed in said service connection adjacent said intermittent load, and a second service connection to said miscellaneous load having a withdrawal connection from the system between the heating means and said pressure regulating means and arranged in parallel with said first-named service connection.

13. In a system for dispensing gas material to consuming devices comprising at least one which constitutes a load of intermittent character having a known maximum and one or more others forming a miscellaneous load, the combination with a container for holding a charge of liquefied gas for supplying said devices, of heating and vaporizing means connected thereto, a servicing connection leading therefrom to said intermittent load, a gas phase receiver in communication with said service connection, said connection up to the point of communication with said gas phase receiver being of less capacity than required for supplying gas material at a rate equal to said maximum, a pressure regulating means disposed in said service connection adjacent said intermittent load, a second service connection leading in parallel to said first-named service connection to said miscellaneous load, and means for maintaining a substantially constant pressure in said second service connection.

14. In a system for dispensing gas material to consuming devices comprising at least one which constitutes a load of intermittent character having a known maximum and one or more others forming a miscellaneous load, the combination with a container for holding a charge of liquefied gas for supplying said devices, of heating and vaporizing means connected thereto, a servicing connection leading therefrom to said intermittent load, a gas phase receiver in communication with said service connection adjacent said intermittent load, said heating and vaporizing means and service connection up to the point of communication therewith of said receiver being of less capacity than required for supplying gas material at a rate equal to said maximum and said receiver being of adequate capacity to supply the deficiency during periods of large demand, a pressure regulating means disposed in said service connection between said point of communication of said receiver and said intermittent load, and a second service connection to said miscellaneous load connected into the system between the heating means and said pressure regulating means and arranged in parallel with said first-named service connection.

15. In a system for dispensing gas material to consuming devices comprising at least one which constitutes a load of intermittent character having a known maximum and one or more others forming a miscellaneous load, the combination with a container for holding a charge of liquefied gas for supplying said devices, of heating and vaporizing means connected thereto, a servicing connection leading therefrom to said intermittent load, a gas phase receiver in communication with said service connection at a point relatively close to said intermittent load, said heating and vaporizing means and servicing connection up to said point of communication of said receiver being of less capacity than required for supplying gas material at a rate equal to said maximum and said gas receiver being of adequate capacity to supply the deficiency during periods of large demand, a pressure regulating means disposed in said service connection adjacent said intermittent load, a second service connection to said miscellaneous load leading in parallel to said first-named service connection, and pressure regulating means in said second service connection.

16. In a system for dispensing liquid oxygen and distributing the same as gas to consuming devices comprising at least one which constitutes a load of intermittent character having a known maximum and one or more others forming a miscellaneous load, the combination with a container for holding and storing liquid oxygen having a space for gas, of a withdrawal conduit connected to the gas space of said container, a second withdrawal conduit connected to the liquid space of said container, heating means associated with said conduits, a service line leading to said intermittent load from one of said conduits, said service line being of less capacity than required for supplying gas material at a rate equal to said maximum, a gas receiver in communication with said service line, a pressure regulator adjacent said intermittent load, a second service line leading from said conduits for supplying said miscellaneous load in parallel with said first-named service line, said second line including pressure regulating means, and automatic means associated with said conduit means responsive to downstream pressure for regulating the passage of gas therethrough.

17. In a system for dispensing liquid oxygen and distributing the same as gas to consuming devices comprising at least one which constitutes a load of intermittent but relatively large character and one or more others forming a miscellaneous load, the combination with a container for holding and storing liquid oxygen having also a space for gas, of a withdrawal conduit connected to the gas space of said container, a second withdrawal conduit connected to the liquid space of said container, heating means associated with said conduits, a service connection leading to said intermittent load from one of said conduits, said service connection being provided with a pressure regulator adjacent said intermittent load, a second service connection from the other of said conduits for supplying said miscellaneous load, said second connection including pressure regulating means, and a cross connection between said service connections provided with automatic means controlled by predetermined pressure conditions in said connections for delivering gas from one service connection to the other.

18. In a system for dispensing liquid oxygen and distributing the same as gas to consuming devices, comprising at least one which constitutes a load of intermittent but major character and one or more others forming a miscellaneous load, the combination with a container for holding and storing liquid oxygen having also a gas space, of a withdrawal conduit connected to the gas space

of said container, a second withdrawal conduit connected to the liquid space of said container, heating means associated with said conduits, a service connection leading to said intermittent load from one of said conduits, said service connection being provided with a pressure regulator adjacent said intermittent load, a second service connection leading from the other of said conduits in parallel with said first named service connection for supplying said miscellaneous load, said second connection including pressure regulating means, a plurality of cross connections selectively operable whereby material from the gas phase may be supplied to said second conduit and regasified oxygen supplied to said first conduit, and a pressure operated valve in each of said cross connections for controlling the passage of gas therethrough.

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CERTIFICATE OF CORRECTION.

Patent No. 2,363,200. November 21, 1944.

PAUL B. PEW, ET AL.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 1, first column, line 42, for "arrangements" read --arrangement--; page 4, second column, line 5, for "36a" read --56a--; page 6, first column, line 3, claim 5, for "gasified" read --gasifying--; and second column, line 41, claim 10, for "to" after "means" read --of--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 20th day of February, A. D. 1945.

Leslie Frazer

(Seal) Acting Commissioner of Patents.

of said container, a second withdrawal conduit connected to the liquid space of said container, heating means associated with said conduits, a service connection leading to said intermittent load from one of said conduits, said service connection being provided with a pressure regulator adjacent said intermittent load, a second service connection leading from the other of said conduits in parallel with said first named service connection for supplying said miscellaneous load, said second connection including pressure regulating means, a plurality of cross connections selectively operable whereby material from the gas phase may be supplied to said second conduit and regasified oxygen supplied to said first conduit, and a pressure operated valve in each of said cross connections for controlling the passage of gas therethrough.

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