Regulated Pressure to Customers Pipe Line

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The invention relates to a method and apparatus for manifolding gas containers. It relates in particular to a manifolding system for use on containers storing liquefied vaporizable gas at relatively low pressure.

The use of low pressure gas containers which operate at pressures up to about 100 p.s.i. have many obvious advantages over the usual storage tanks or cylinders which, in order to hold a sufficient amount of gas, must accommodate pressures of approximately 2000 p.s.i. For one thing, the former type of container eliminates the usual safety precautions which necessarily arise when dealing with elevated pressures. Secondly, the larger amount of gas stored by the low pressure type container greatly reduces the number of tanks or containers required at any installation and consequently reduces initial and maintenance costs. For example, a single low pressure liquid gas container contains, in liquid form, approximately 3000 c.f. of gaseous oxygen at NTP. This is in contrast to the conventional high pressure cylinder of which approximately 12 would be required to provide a similar supply.

The usual type of low pressure container for such gases as oxygen or nitrogen is so designed that a small amount of heat maintains gas pressure within the free space in the cylinder. This pressure forces liquid oxygen up through a withdrawal tube and into a vaporizing coil where it is gasified by atmospheric heat for delivery to the user’s line. During use, at normal room temperatures, it can be continuously vaporized. During non-use though, this vaporization continues at a rate of approximately 2 c.f.h. This slow vaporization during periods of non-use causes the pressure inside the cylinder to increase in excess of that required for normal operation, that is, 70–75 p.s.i. When the cylinder is brought back into use, this excess gas is by-passed through a pressure-controlling valve, and directed through the coil. The pressure-controlling valve then automatically closes this gas passage when the pressure in the free space is reduced to 75 p.s.i. At this point, liquid flow into the coil then begins and continues to supply gaseous oxygen at a constant rate. Should the pressure inside the cylinder increase over 235 p.s.i. during periods of non-use, a pre-set relief valve in the cylinder opens to vent the excess to the surrounding atmosphere.

Where large gas flow rates are required on an uninterrupted flow basis, it is necessary to couple together a number of low pressure containers, such that their individual flow rates are combined to supply the required flow. To insure uninterrupted gas flow and also to simplify replacement procedures, a second or reserve bank is used, usually with means for changing over the supply of gas from one bank of cylinders to the reserve bank. The changeover may of course be accomplished by an operator when he determines the need therefor, but to avoid the necessity for human control and possible error, an automatic changeover means is highly desirable.

It is therefore an object of the present invention to provide a manifold means particularly adapted for use on low-pressure, liquefied gas containers.

Another object is to provide a method for manifolding a plurality of such containers to avoid venting of said containers to the atmosphere due to interval pressure buildup.

A further object is to provide a method and apparatus for automatically shifting the flow of gas from one bank of low pressure manifolded containers to an alternate or stand-by bank of said containers.

The drawing accompanying this description illustrates a typical piping system and supplementary equipment essential to carrying out the objects of the present invention.

In brief, the invention contemplates a method and apparatus whereby a plurality of relatively low pressure gas containers may be interconnected by means of a manifold which will permit excessive gas accumulations due to vaporization in said containers to gradually bleed off and flow to the main gas feed line rather than vent off to the atmosphere.

Basically, as may be seen in the drawing, the system includes a manifold unit which interconnects at least two separate containers or two banks of gas containers 11 and 12. In the following description the two banks shown are referred to as an operating bank and an alternate or stand-by bank.

The manifold comprises a plurality of gas lines 13, 14, 15 and 16 which mutually terminate in a four-way adjustable valve 17 which in accordance with the particular setting will control the flow of gas between any pair of adjacent lines. For instance, in the position shown, the valve permits flow between branches 15 and 16 by way of the communicating channel 18 therebetween. This same setting of the valve simultaneously permits gas flow from line 14 to line 13 by way of branch 19. In order to alter the gas flow, the valve handle 20 may be rotated to the position indicated by the dotted lines thereby interconnecting lines 14 and 15 and also lines 13 and 16.

A pair of check valves 22 and 23 interposed in branch lines 14 and 16 permit a flow in one direction only, that is, from the gas containers and toward valve 17. Manifold branch 15 constitutes the main line from the valve 17 and will be hereinafter referred to as such. The adjustable line regulator 25 disposed downstream of valve 17 in line 15 controls the gas flow directly to the customers pipeline 26. Between lines 15 and 25, a pressure operating gauge 24 is disposed to register the delivery pressure in line 15. This gauge, taken in conjunction with the position of the valve handle 20, affords an indication of which particular bank of containers is currently in operation, a feature which will be subsequently described in greater detail.

The gas by-passing portion of the manifold, constituting an essential feature of the invention, comprises a gas vent line 13 which registers with an outlet port of valve 17 to effectuate the venting of accumulated gas from within the container 11 while in the stand-by or non-operating status. Said vent line 13 is divided into branches 13a and 13b which connect to the changeover regulator 27 and the one-way relief valve 28 respectively.

The changeover regulator 27 is essentially a diaphragm operated, spring controlled device having an inlet port connected to previously noted line 13a, and an outlet port connected to line 29, which is in turn connected into line 15. This regulator will permit gas to flow only from the inlet to the outlet side thereof and such flow is initiated when the gas pressure in the line 15, and thus line 29, falls below a pre-determined value. For example, when said regulator is set to operate at 65 p.s.i., there will be no passage of gas to line 29.
from line 13a until the pressure in line 29 drops below 65 p.s.i., at which time the regulator diaphragm will be displaced to allow gas flow.

By such an arrangement it is possible to effect a changeover in the manifold system such that when the pressure of the operating bank or supply bank of containers 12 drops below a pre-set value, gas will be drawn from stand-by bank 11, through regulator 27, to compensate for the lack of flow from bank 12.

In accordance with the invention, the low pressure liquefied gas containers will maintain a relatively constant delivery pressure of approximately 70–75 p.s.i. until the liquid gas in the operating bank has been substantially used. The flow of gas from line 26 to regulator 27 is so high that the operating bank cannot maintain the desired 70–75 p.s.i., the result of either of these occurrences being a decrease in container delivery pressure. When such a decrease occurs, the regulator 27, as noted, will open to communicate the vent line 13 with line 29 and the discharge.

During the period when containers 11 are on stand-by status, there of course, will be continuous vaporization of the contained liquid which expands through the distributor valve 17 and into the vent line 13 up to regulator 27. Thus, when said regulator 27 is caused to open by virtue of the pressure decrease on the outlet side of the flow of gas from line 26, the regulator will maintain the desired flow into discharge line 15.

The one-way relief valve 28 disposed functionally between the vent line 13b and the discharge line 15 provides a means for utilizing vaporized gas accumulated in the stand-by containers when such accumulation has reached an elevated pressure. Ordinarily, each container, although designed to operate at a pressure approximating 70 p.s.i., is provided with a safety vent which will open to discharge accumulated gas at a pressure of about 230 p.s.i. This practice is of course uneconomical as the venting action discharges such gas to the atmosphere.

Thus, a further desirable aspect of the manifold resides in the use of valve 28 which functions according to the invention, when the inlet pressure on said valve, which is connected to line 13b, exceeds a pressure of about 125 p.s.i. While the downstream or outlet side of the valve 28 is essentially unaffected by the pressure within line 15, when the upstream pressure causes said valve to open, the accumulated gas will then be directed into the discharge line 15 rather than to the atmosphere. As the vented pressure in the stand-by containers 11 and the lines connected therewith is relieved, valve 28 will return to its normally closed position.

The gauge 24, as herein mentioned, is so constructed to perform a dual function in the preferred operation of the invention. Said gauge 24, which is activated by the container delivery pressure in line 15, is so calibrated as to indicate by means of a green scale when the operating bank is supplying gas to the line regulator 25. Similarly, a red scale on said gauge indicates when the stand-by bank has come into operation and the operating bank is exhausted. When the position of the gauge needle indicates that the stand-by bank is supplying the gas (on red scale), the lever 20 of the four-way valve 17 is moved to the position indicated by the dotted line in the drawing. The flow of gas through the valve is thereby changed such that the gas from the left-hand bank of cylinders 11 (which was formerly the stand-by, but is now the operating bank) flows directly through the four-way valve 17 to the line regulator 25. Residual gas from the right-hand bank 12 is shunted through valve 17 to line 13 and thence to the pre-set changeover regulator 27 again assumes a predetermined position until the inlet pressure to the line regulator 25 drops below 65 p.s.i. which would cause the cycle to repeat. Meanwhile, of course, the empty containers in bank 12 may be replaced by full ones without interrupting flow to the line 26.

What is claimed is:

1. A manifold system for a liquefiable gas contained in at least two different sources and being directed to a common discharge line, including means for feeding gas directly from each of said sources to said discharge line, means for permitting accumulated vaporized gas in each of said discharge line to flow to said discharge line when said sources being not in direct communication with said line and the pressure therein due to said accumulation of vaporized gas has exceeded a predetermined value, and means for automatically changing over the direct feed of gas to said discharge line from any one source of gas which has become depleted, to another of said sources being of course, the empty containers in bank 12 may be replaced by full ones without interrupting flow to the line 26.

2. A manifold system for a liquefiable gas contained in at least two different sources and being directed to a common discharge line including each of said sources to a distributor valve, said valve being operable to changeably communicate at least one of said conduits directly to the discharge line, the other of said conduits being also communicated to said discharge line but having an adjustable regulator interposed therebetween, said regulator being normally closed to prevent gas from said conduit through but operable to allow gas flow to said discharge line when the gas pressure in said discharge line falls below a predetermined value, and a valve also communicating said other conduit to said discharge, said last-named valve being constructed to allow passage of vaporized gas therethrough when the inlet pressure on said valve exceeds a predetermined value greater than that in the discharge line.

3. In a manifold system for feeding a liquefiable gas from a plurality of reservoirs to a common discharge line, the combination of conduits connected to each of said reservoirs terminating in a distributor valve having a plurality of ports, a valve interposed in each of said conduits allowing uni-directional flow therethrough, one outlet of said distributor valve communicably joined to said discharge line, another of said outlet ports communicating with a by-pass means, said by-pass means communicably joined to said discharge line by means of a pressure regulator interposed therein having a pre-set opening valve whereby gas flow from the by-pass means will automatically commence when the pressure in said discharge line decreases to a predetermined value.

4. A manifold system for supplying a flow of liquefiable gas from a plurality of supply points to a common discharge line, comprising a branch line leading from each of said supply points to a common distributor valve having adjustable means for alternately directing each of said branch lines to the discharge line, a check valve in each of said branch lines to permit gas flow only in the direction of the distributor valve, a conduit system extending from said distributor valve to the discharge line to effectuate the passage of vaporized gas to the discharge line from those supply points not directly connected to said discharge line, said conduit system including a gas vent line connected to the distributor valve and alternately communicable to each of those supply points not in direct communication with the discharge line, said gas vent line connected to a pair of branch lines, one of said branch lines leading to the inlet port of a pressure rated regulator, a further branch extending from the outlet port of said regulator to the discharge line, the other of said branch lines connected to the inlet of a flow valve the outlet thereof also connected to the discharge line, and a pressure gauge for registering pressure in said discharge line.

5. Method of feeding liquefiable gas susceptible to continuous vaporization from a plurality of supply points to a common discharge line comprising communicating
said supply points to a common distributor valve having means for alternately directing flow from each of said supply points to said discharge point, simultaneously accumulating vaporized gas from the other of said supply points in a by-pass means for accumulating said vaporized gas until a predetermined pressure is exceeded in said by-pass at which time said accumulated gas is automatically permitted to flow into said discharge line until the pressure in said by-pass is reduced.

6. Method substantially as described in claim 5 in which vaporized gas flow from the by-pass means to said discharge line is automatically initiated when the pressure in said discharge line is reduced to a predetermined value indicating depletion of the gas in any of said supply points.

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