

March 30, 1937.

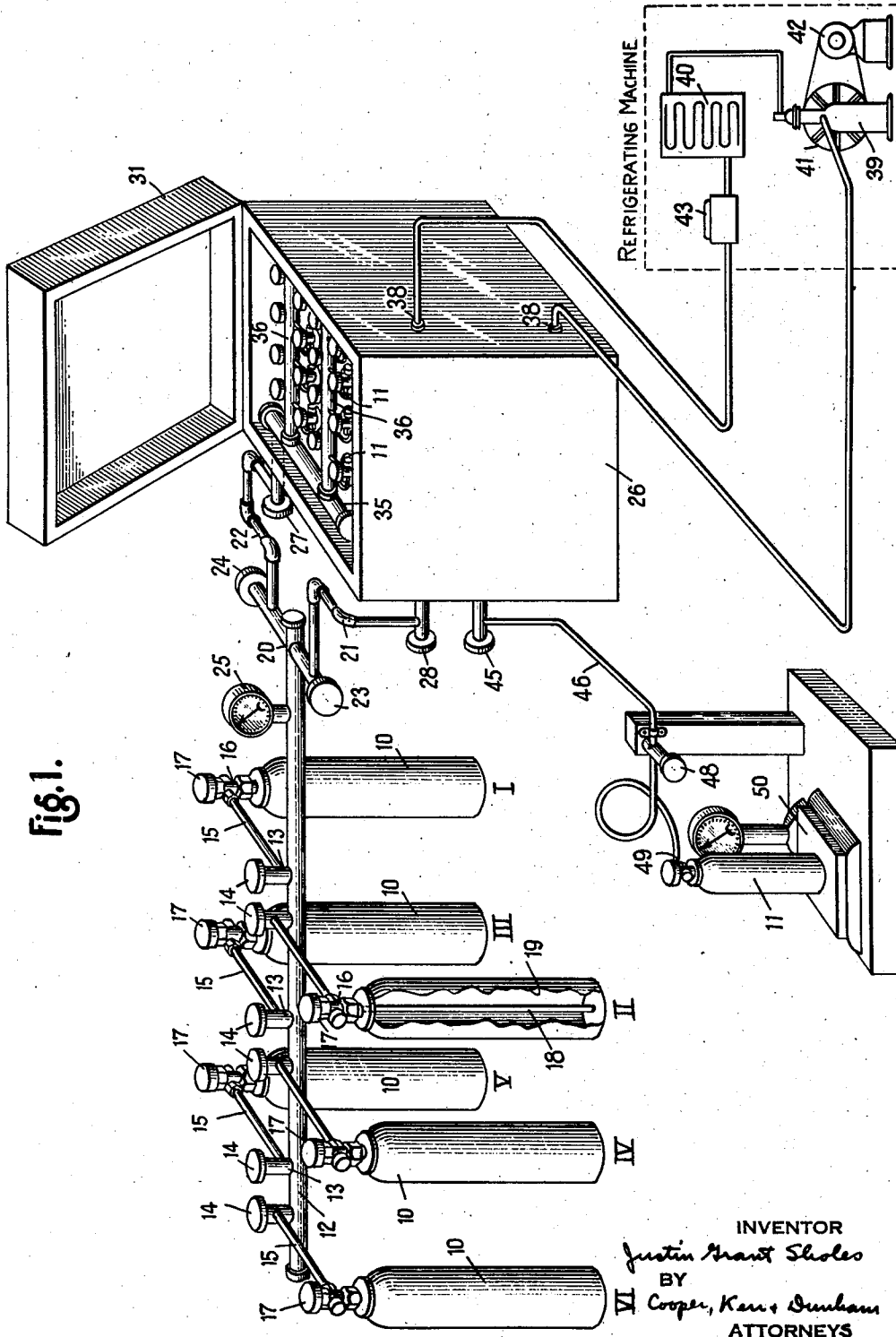
J. G. SHOLES

2,075,408

TRANSFER OF LIQUEFIED GAS

Filed Sept. 17, 1935

2 Sheets-Sheet 1



March 30, 1937.

J. G. SHOLES

2,075,408

TRANSFER OF LIQUEFIED GAS

Filed Sept. 17, 1935

2 Sheets-Sheet 2

Fig. 3.

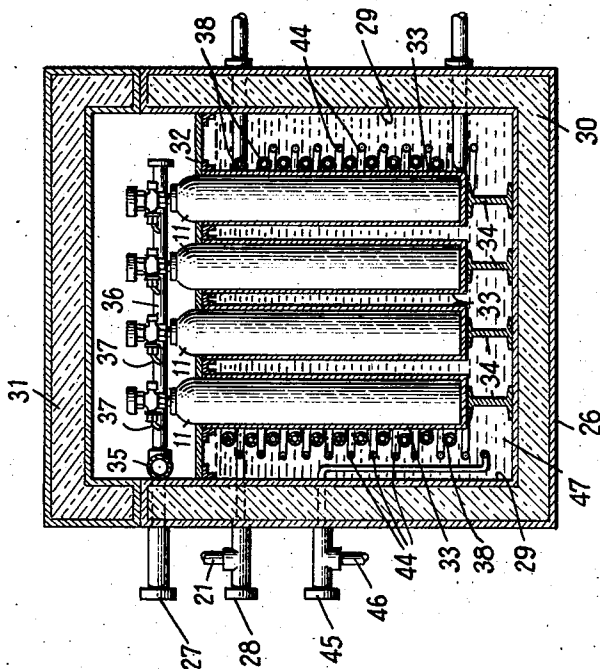
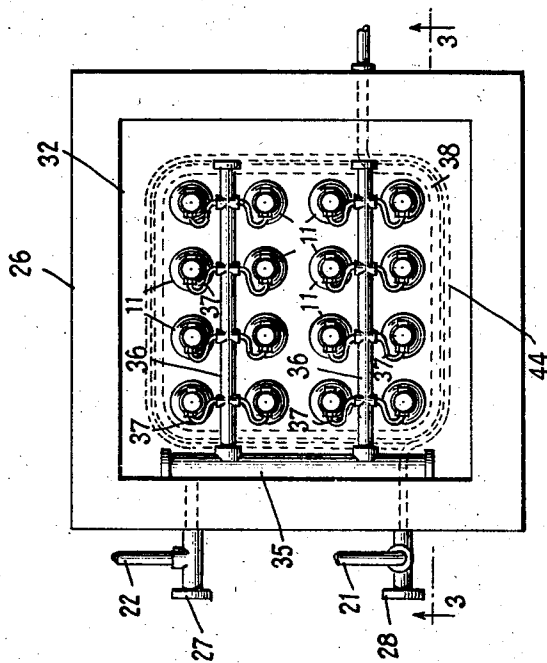


Fig. 2.



INVENTOR
Justin Grant Sholes
BY
Cooper, Kern & Dunham
ATTORNEYS

UNITED STATES PATENT OFFICE

2,075,408

TRANSFER OF LIQUEFIED GAS

Justin Grant Sholes, Cleveland, Ohio, assignor to
The Ohio Chemical and Manufacturing Com-
pany, Cleveland, Ohio, a corporation of Ohio

Application September 17, 1935, Serial No. 40,887

12 Claims. (Cl. 226—20)

This invention relates to the transfer of liquefied gas from one container to another, for example from a bulk container to others of smaller size for delivery to users, and its chief object is to provide a method and apparatus for effecting such transfer in a rapid and convenient manner, with a minimum loss of gas and particularly with the least possible evaporation of the gas from the liquefied state, and likewise without such changes in pressure, temperature and permissible volume as might lead to evaporation.

Further objects of the invention, notably in its preferred forms, are to provide for efficiently transferring liquefied gas from one or more containers to another container or a plurality of other containers, as may be required, and in such manner that in many cases intermediate containers or vessels, and gas or liquid pumps for handling the transferred gas, need not be employed, particularly during the major part of the transfer operation, nor re-liquefying arrangements and devices. At the same time, especially where the invention is employed in packaging the liquefied gas for purposes of sale or like distribution, provision can be made for accurate measurement of the quantity of gas so packaged, for example, where it is sought to fill each container with a predetermined weight of the liquefied gas.

Although the invention may be carried out in a number of ways, so as to achieve, in each instance, many or all of the foregoing objects and such additional objects and advantages as will be hereinafter apparent, it is believed that the apparatus and method of the invention, particularly in their presently preferred forms, will be best illustrated by the following description of a specific embodiment of them.

The drawings therefore show, by way of example, a suitable apparatus, constructed in accordance with the invention, and adapted for transferring liquefied gas from one or more bulk containers to a smaller container or conveniently to a large group of such smaller containers. Apparatus of the specific character shown has been found highly satisfactory for use in effecting such a transfer of liquefied nitrous oxide. In fact, the invention, although applicable to many other uses, is of special value in handling liquefied gases of that order, particularly gases having physical characteristics generally similar to nitrous oxide; for convenience and by way of example, it will be assumed in the following description that liquefied nitrous oxide is the specific material to be handled and transferred.

In the drawings:

Fig. 1 is a schematic view of the apparatus, generally in perspective, with certain portions broken away to show features of internal construction as will be noted;

Fig. 2 is a plan view of the cooling tank, with the cover removed; and

Fig. 3 is a vertical section of the cooling tank, on lines 3—3 of Fig. 2.

The apparatus shown is particularly adapted, among other purposes, for transferring liquefied gas from large bulk containers or "cylinders" 10, to smaller containers or "cylinders" 11,—the "cylinders", as they are called in the industry, being of well-known construction in each instance. A manufacturer of liquefied gas, for example, may package his product in large cylinders 10, for convenient storage or wholesale distribution, or the like, but it is often necessary at a later time to transfer the liquefied gas to smaller cylinders 11, for delivery to the ultimate user, and with the present invention, this transfer can be achieved economically and rapidly, and without requiring any unusual knowledge or skill on the part of the operator. In the case of one manufacturing plant where the invention has been so used for transferring liquefied nitrous oxide, a large cylinder 10 customarily contains from 50 to 60 lbs. by weight of the liquefied gas, whereas a small cylinder 11 usually holds from 3 to 7 lbs. Of course, the capacity of the cylinders or other containers from which liquefied gas is to be transferred, and of those which are to be filled with it, as well as the quantity of gas actually handled in any transfer operation, may vary widely, even with the specific apparatus here shown.

Referring to Fig. 1, a manifold 12 is provided for receiving the liquefied gas from a plurality of large cylinders 10, through a corresponding plurality of inlets 13 (a convenient number, six, being here shown). Each inlet 13 includes a valve 14, for controlling or shutting off the flow of gas through the inlet to the manifold 12 (without, of course, affecting the manifold itself, or the passage of gas through it, for example, from another inlet), and each inlet also includes a pipe 15, provided at its outer extremity with a yoke 16 of standard and well-known construction, for making connection with the head of a cylinder 10. Each cylinder 10 also usually has its individual valve 17, to be kept closed while connection is being made with an inlet yoke 16, as will be understood, or while taking off such removable yoke.

Preferably the valve arrangements 17 are of the "siphon tube" type, that is, provided with a so-called siphon tube 18 which extends vertically inside of the cylinder to a point near the bottom, say within $\frac{1}{8}$ of an inch from it. One of the cylinders 10 in Fig. 1 is broken away at 19 to show this style of valve construction, whereby the liquefied gas can leave the cylinder only through the siphon tube 18, being forced out by the naturally high gas pressure above the liquid in the cylinder. Particularly efficient drainage of the liquefied gas is afforded by this expeditious arrangement for withdrawing it from the bottom of the cylinder. Of course, where the siphon construction is not employed, the inlet yokes 16 and cylinders 10 can be inverted, so that the cylinders are above the manifold and drain down into it; the siphon tube arrangement, however, is generally preferable for its convenience and practicability.

The manifold 12 is closed at its left-hand end in Fig. 1, and opens at its other end into a distributing head 20, through which the liquid gas may flow into two separate pipes 21, 22, respectively controlled by valves 23, 24. A high pressure gauge 25, for recording the gas pressure of the contents of the manifold 12 and connected parts of the system, is conveniently mounted in the manifold 12 intermediate the inlets 13 and the head 20.

Pipe 22 extends into the cooling tank generally designated 26 through a suitable valve 27, conveniently described as the main transfer valve. Pipe 21 also extends into the cooling tank 26 through a valve 28, likewise mounted on the cooling tank and called, for convenience, the topping supply valve.

Referring now to Figs. 2 and 3, as well as Fig. 1, the cooling tank 26 comprises an inner tank 29 having heat-insulating walls 30, and has a hinged cover 31 of like insulated construction, which may be tightly closed to preserve the refrigeration effected in the tank. Carried by a plate 32 in the upper part of tank 29 and opening through suitably conforming apertures in that plate, as shown, a plurality of hollow metallic tubes 33 are provided in each of which there may be inserted one of the small cylinders 11 to be filled with liquefied gas. These cylinder-holding tubes 33 are closed at their lower ends against access of liquid contained in the tank 29, and are conveniently so disposed that their bottoms are a substantial distance above the bottom of the tank 29. In some instances, additional supports 34 for the bottoms of the cylinder-receiving tubes 33 may be used, preferably such as not to interfere with circulation of liquid in the tank 29 around and under the tubes.

In the interior of the tank above the plate 32 there is mounted a manifold 35, having its inlet connected through valve 27 to pipe 22, and having a plurality of outlets (in this instance, two) to each of which a distributing manifold 36 is removably attached. Each of these removable manifolds 36 has a plurality of outlet tubes 37, which may be flexible copper tubes, and each of which, in turn, is provided with a yoke of standard construction for removably connecting it to the valve-head of a small cylinder 11, as will now be understood. It will be appreciated that the arrangement of the supporting tubes 33 and the manifolds 35 and 36 is such that when a number of small cylinders 11 are respectively inserted in the supporting tubes, the neck and valve portion of each cylinder extends above the

plate 32, for ready attachment and connection of the yoke of the corresponding flexible outlet tube 37 extending from the nearest manifold 36. In this way, with the yokes attached to the valve heads of the small cylinders, an unobstructed conduit for liquefied gas is provided from pipe 22 to all of the small cylinders 11, assuming, of course, that valve 27 is open, and that each of the individual valves on the small cylinders are likewise open.

In the present embodiment, the cooling tank is provided with sixteen of the supporting tubes 33, for receiving a corresponding number of small cylinders; and the removable manifolds are disposed as shown, with four outlets spaced along either side of each, affording satisfactory distribution to each of the small cylinders 11. The number of supporting tubes 33 may of course be varied in accordance with requirements, and corresponding changes effected in the arrangement of the manifolding system 35, 36, as needed.

Within the tank 29 and extending around the entire group of supporting tubes 33, a coil of tubing 38 is provided for refrigerating the interior of the tank. To this end, the coil 38 preferably has sufficient convolutions to extend it helically through the entire height of the tank below plate 32, and is located close to the walls of the peripheral units of the group of tubes 33. The ends of the coil 38 extend through the wall of the tank, conveniently as shown, to a suitable refrigerating unit, which may comprise the usual compressor 39, condenser 40, fan 41 and motor 42 (for operating the fan and compressor), and the usual thermostatic control 43; as this refrigerating unit may be of any standard construction, it is only diagrammatically shown in the drawings. For example, in using the apparatus for transferring liquefied nitrous oxide, satisfactory results were obtained with a cooling coil 38 comprising a 200 foot coil of 7 mm. by 9 mm. copper tubing, connected (as shown) to a 75-lb. capacity ice machine of the standard make known by the trade name "Kelvinator". In that case it was found that a non-freezing liquid placed in the tank 29, for circulation around the tubing 38 and supporting tubes 33, was cooled to plus 13° F., and that the air in the tubes 33, and the small cylinders placed in them, were cooled to plus 25° F.

An additional coil of tubing 44 is similarly disposed in the space intermediate the tubes 33 and the walls of tank 29, adjacent but preferably outside the refrigerating coil 38. The coil 44 may advantageously be made of tubing smaller in size than that in the coil 38, but with more convolutions about the interior of the tank. One end of the tubing 44 is connected through the topping supply valve 28 to pipe 21 and the other end is connected through a large valve 45, called the "operating valve", to a pipe 46.

The space in the tank 29 below the plate 32, around the coils 38 and 44, and around and under the supporting tubes 33 and each of them, is filled with a non-freezing liquid or solution, such as brine, or a solution of calcium chloride, or glycerine; that is, a solution which will not freeze at the low temperatures attained by the refrigerating coil 38. The refrigerating action of coil 38 is thus transmitted through the non-freezing solution or bath 47, to cool the supporting tubes 33, the cylinders 11 inserted in them, and tubing 44; effective refrigeration is provided for the entire contents of tank 26.

Pipe 46 extends through a suitable valve 48 to

a yoke 49, similar to those on outlets 37 and adapted for connection with one of the small cylinders 11. This yoke 49 comprises part of a filling stand which also includes a weighing device, such as the platform scale 50 upon which a cylinder 11 rests, as shown in Fig. 1. It will be understood that the arrangement is such that a cylinder 11 may be weighed on the scale, either standing alone, or as connected to the pipe 46 through yoke 49.

It will also be noted that valves (including the individual valves of all cylinders 10, 11) are provided throughout the system on each side of points where removable connections are made, and at each end of every appreciably extensive section of manifold, pipe or tubing; in effecting transferring operations, every valve is preferably kept closed at all times, except when actual flow must be permitted through it. The arrangement and operation of valves in this manner is of distinct advantage in reducing loss of gas, or evaporation of gas from the liquefied state, during the manipulation of the apparatus and also during replacement or removal of parts of the apparatus,—for example, during connection or disconnection of cylinders 10 and 11 at various points, or connection of manifolds 36, or while one or more units of the system are changed, as they may readily be, for others of different character to accomplish different kinds of work.

As a specific example of the method of the invention, for transferring liquefied gas, it will be assumed that it is desired to fill a group of sixteen small cylinders, such as cylinders 11, with liquefied nitrous oxide, that each of them holds, when full, 3 lbs. 12 oz. of the liquefied gas, that the transfer is to be made from large cylinders 10 which contain 50 lbs. of liquefied nitrous oxide apiece, and that apparatus of the type shown in the drawings is to be used for the procedure. All valves in the system are closed, and after the empty small cylinders have been suitably inserted in the supporting tubes 33 of the tank 26, the yokes of outlets 37 are securely attached to the valveheads of the cylinders, and the removable manifolds 36 are in turn connected to manifold 35, as will now be understood. Six of the full large-sized cylinders 10 are connected respectively to the six inlet yokes 16 of manifold 12.

With main transfer valve 27 closed, the individual small cylinder valves are now opened, and the cover 31 of the cooling tank 26 is tightly closed. The cooling tank is allowed to stand until the temperature inside, as read upon a thermometer (not shown) which may extend through the cover into the air space above the cylinders, has dropped to a steady and preferably predetermined figure,—say, 25° to 30° F. where liquefied nitrous oxide, or a like liquefied gas, is to be handled. During this time, all valves on the manifold 12, and elsewhere in the system should be closed.

The large cylinders 10 will be hereinafter identified by the Roman numeral characters (i. e. from I to VI) shown on the drawings.

The valve 17 of cylinder I and the valve 14 of the corresponding inlet are opened, and the gauge 25 now registers the pressure of gas in cylinder I. Valve 24 is then opened, and the operator "cracks", i. e., opens very slightly, the main transfer valve 27. This last operation permits the liquefied gas from cylinder I to flow into the small cylinders 11 in the cooling tank, without setting up too large an accumulation of unliquefied gas (by immediate evaporation) and with-

out causing freezing of the gas (and consequent clogging) anywhere in the part of the system now open, by reason of sudden expansion through valve 27 into the small cylinders. The rush of liquid gas can now be plainly heard by the operator, and when it is no longer heard, he opens valve 27 wide and permits the apparatus to stand in this condition for a considerable period of time, such as about 12 hours, or until the air temperature in the top of the cooling tank has again reached 25° to 30° F. and cylinder I has again attained room temperature. Valves 17 and 14 are thereupon closed for cylinder I.

Under the specific conditions hereinabove stated for this example, there should now be from 4 to 6 lbs. of liquefied nitrous oxide remaining in cylinder I, and from 44 to 46 lbs. of the liquid gas deposited in all of the small cylinders 11 taken together. For economical results with this type of apparatus, the small cylinders should be preferably about 75 to 80% filled at this stage of the operation. If there is not enough gas in cylinder I to fill the small cylinders to this extent, cylinder II may be opened (at its valves 14 and 17) after cylinder I has been shut off, and following the same procedure just described for transfer from cylinder I, the proper amount of additional gas may be allowed to flow from cylinder II into the small cylinders, and cylinder II may then be shut off. On the other hand, if cylinder I contains more than enough gas to fill the small cylinders to about 85% of their proper capacity, care should preferably be taken to close the valves of cylinder I before the small cylinders have been more than 85% filled. Any possibility of overfilling the small cylinders, occasioned by the low temperature to which they are subjected in tank 26, can be readily avoided with simple and moderate care on the part of the operator. For example, readings of gauge 25 will give a rough indication of the quantity of gas in the large cylinder 10 which is in use at a given time,—not only at the beginning of operations, but also, if valve 24 is temporarily closed, at any subsequent stage. In fact, the actual weight of gas in each of the large cylinders at the start will usually be known, and the arrangement shown is such that any one of them can be easily removed for re-weighing at any time. In fact, a modicum of experience will enable the average operator to control the transfer as accurately as desired, without any intermediate weight-checking at all. The suggested safety limit of about 85% or less, for the initial filling step may vary somewhat with conditions, but for economy, and particularly for accuracy of filling each cylinder, an underfilling of this order is advisable at this stage in the procedure.

It will be remembered that valves 23, 28, 45, and 48 have been closed during the foregoing steps. Valves 24 and 27 are now closed (as well as all inlet valves for the large cylinders) so as to prevent wasting gas in line 22, as already explained. If cylinder II has not as yet been used, its valve 17 and corresponding inlet valve 14 are now opened; if considerable gas has been removed from cylinder II it may be advisable to use cylinder III instead, at this point. Valves 23 and 28 are also now opened, valves 45 and 48 remaining closed, and the coil 44 in the refrigerating bath is consequently filled with liquid gas, which is thereby cooled to the temperature of the bath.

With the cover of the cooling tank temporarily opened for the purpose, (except when removing and replacing parts in the tank, the cover should

always be kept closed, to conserve refrigeration) all of the individual small cylinder valves are closed and the removable manifolds 36 taken out. One of the small cylinders is also taken out and placed on the scale 50 of the filling stand. Assuming that the gross weight which the small cylinder will have when ultimately filled is known, the weight of the small cylinder (and its present contents) just placed on the scale is now read and subtracted from the predetermined ultimate gross weight, to obtain the weight of liquefied gas still needed to complete the filling. The filling stand yoke 49 is next attached to the cylinder and the individual valve of the cylinder and the filling stand valve 48 are opened. The weight of the cylinder as it now stands, with the yoke and valve attached, is noted; as will now be understood, additional liquefied gas must be introduced in the cylinder to increase this present reading of the scale by the difference previously obtained, i. e., by the amount of gas needed to complete the filling.

The operating valve 45 is thereupon opened and is kept open until sufficient liquefied gas has flowed into the small cylinder, while it stands on the scale, to bring it up to the desired weight, as just determined. The operating valve 45, valve 48 and the small cylinder valve are then closed, and the filling stand yoke 49 is removed from the cylinder. The weight of the small cylinder and its contents, as now read on the scale, should be identical with the predetermined gross weight for a completely filled cylinder.

The same operations are repeated for each of the other small cylinders remaining in the cooling tank until all of them have been completely filled. After this "topping" step has been performed on the last of the group, and valves 45 and 48 have been closed for such final operation, the topping supply valve 28 is closed, and likewise valve 23 and the valves 17 and 14 of the large cylinder (presumably cylinder II) used for the topping operation. It will now be appreciated that in the specific example here described (where the small cylinders require 3 lbs. 12 oz. of liquefied gas apiece, or a total of 60 lbs., for filling) about 14 to 17 lbs. of gas will have been required from the large cylinder for actual topping, in addition to that needed to fill the coil 44.

If the procedure is to be repeated the cooling tank may be refilled with an additional group of sixteen empty small cylinders, the removable manifolds connected and replaced and the entire operation carried out in the same way. In the first or main filling stage (as distinguished from the topping operation), cylinder I may again be opened at the outset. Assuming that it had left from the previous operation about 4 to 6 lbs. of gas and that the capacity of the small cylinders is as previously stated, opening of the valves in the lines 12, 22, 35, and 37 should reduce the quantity of gas in cylinder I to about 2 to 3 lbs. after pressure is equalized between cylinder I and the small cylinders; the difference has thus been transferred to the small cylinders. To continue filling the latter in this stage of the operation as far as possible, say to about 80%, one or more of the other large cylinders must be opened. For example, the remainder of the gas in cylinder II (left from the previous topping operation) may now be transferred to the small cylinders, to leave a residue of about 4 lbs. of liquid gas in this large cylinder II, upon equalization of pressure; and additional gas may be taken from cylinder III, as needed. The topping

operation, for which cylinder III is again put to use, then follows in the manner described above, and the second set of small cylinders is thus completely filled.

For a third lot of small cylinders, cylinder I is again used at the outset, and equalization of pressure after opening the valves to the small cylinders in the cooling tank should leave about one pound of gas in this large cylinder. Cylinder II which, it will be remembered, now contains about 4 lbs. of gas, is also used, and a residue may then be left in it of about 2 lbs. Other large cylinders are used in succession, as needed to fill the group of small cylinders to the requisite extent, and the topping operation is carried out as before.

On a fourth lot of small cylinders, cylinder I is opened for the last time, as in this operation the amount of gas remaining in it should be reduced to much less than one pound. When cylinder II is in turn opened for this transfer operation, its gas content may be reduced to about one pound, and corresponding reductions may be made in other cylinders in succession. Cylinder I can now be removed from the manifold 12 and refilled, or a full cylinder substituted for it. In other words, by thus discharging cylinder I into four lots of small cylinders in succession, the gas remaining in it has been reduced to a convenient minimum, justifying refilling. On the succeeding, i. e., fifth lot of small cylinders, large cylinder II will reach the same condition and may be removed for refilling or for substitution of a full cylinder. This cycle, it will now be seen, repeats itself for each of the large cylinders in turn so that each of them becomes ready for refilling or replacement after it has been used for enough principal transfer operations, or topping operations, or both, to deplete it to whatever may be the predetermined minimum,—in the example chosen, less than one pound of liquefied gas.

In these respects the process is continuous and cyclical, and it will now be understood that preferably a sufficient number of large cylinders are employed so that there will be no actual interruption of operation for refilling or substitution. That is, in the example just given, six large cylinders are connected to the manifold, and in general, in any of a series of transfer operations to small cylinders of the assumed capacity, there will never be more than two or three of the large cylinders fully depleted in immediate succession. Actual gas transfer can always proceed from one or more other cylinders of the set of six while the depleted units are being replaced, and at no time is there any interruption of either the principal filling operation or the topping operation at all.

It should now be appreciated that the procedure and apparatus of the invention are both expeditious and economical, not only in attaining a relatively rapid transfer to a large number of small cylinders with a minimum loss of liquefied gas, but also in achieving high accuracy in filling each of the small containers with a predetermined quantity of the gas. Flexibility and ease of operation are also inherent advantages of the described arrangements; for example, in order to fill a group of less than sixteen cylinders with the specific apparatus shown, it is only necessary to insert blank valves in the unattached yokes of the removable manifolds 36. As explained, the operations are cyclical in nature when repeated for successive groups of receiving containers, and are adapted to effect an expeditious transfer of liquefied gas from one plurality of containers to

another plurality of containers without interruption for refilling or replacing the constituent units of the group of containers from which the transfer is made.

5 It is to be understood that the invention is not limited to the specific procedure and apparatus hereinabove described and shown, but may be carried out in other ways without departure from its spirit as defined by the following claims.

10 I claim:

1. A method of transferring liquefied gas from one container to another, comprising partially filling the second container by causing liquefied gas to flow from the first container directly into
15 said second container, cooling said second container during said flow of liquefied gas, and thereafter completing the desired filling of said second container without cooling the same, by passing additional gas into said second container and
20 cooling said additional gas during its passage to maintain it in liquefied form.

2. A method of transferring a predetermined quantity of liquefied gas to a container, comprising passing liquefied gas, in less than the
25 predetermined quantity, into said container, cooling said container during said passage of gas thereto, and thereafter passing additional liquefied gas into said container while weighing the latter and while cooling said additional gas
30 while en route to the container to maintain the gas in liquefied form, and controlling said additional passage of gas in accordance with the weight of the container and its contents.

3. A method of transferring a predetermined
35 amount of liquefied gas to a receiving container therefor, comprising establishing a direct line between a supply container of liquefied gas to a cooled receiving container and thereby causing liquefied gas to flow directly from the supply
40 container, and in quantity less than the predetermined amount, to the receiving container while cooling the latter to maintain the received gas in liquefied form, and thereafter completing the desired filling of the receiving container with-
45 out cooling the latter, by causing additional gas to flow to said receiving container while maintaining said additional gas in liquefied form as introduced into said container and while measuring the quantity of liquefied gas introduced in-
50 to said container to determine that the predetermined amount has been transferred thereto.

4. A method of transferring liquefied nitrous oxide gas between containers therefor, comprising cooling to about 25° to 30° F. a plurality of
55 containers in which the gas is to be received, causing the gas to flow directly to said cooled receiving containers from the original containers thereof and in quantity about 15% to 25% less than desired in the receiving containers, main-
60 taining the latter in cooled condition during said flow, thereafter completing transfer to each of the receiving containers, without cooling them, by causing additional liquefied nitrous oxide gas to flow directly thereto from the original con-
65 tainers and cooling said additional liquefied gas to about 25° to 30° F. during said flow.

5. A method of transferring liquefied gas from one container to a receiving container, comprising cooling the receiving container, causing the
70 liquefied gas to flow from the first container directly into the receiving container by siphoning liquefied gas from the first container under the pressure of the evaporated gas confined above the liquefied gas in said first container, while
75 maintaining the receiving container in cooled

condition during said flow of liquefied gas into it, to keep the introduced gas in liquefied condition, and controlling said flow of liquefied gas to prevent complete filling of the receiving container therewith.

6. In a method of transferring of liquefied gas between containers therefor, wherein a receiving container has been partially filled with liquefied gas, the procedure of completing the filling of
10 said receiving container with a predetermined amount of liquefied gas, comprising causing additional gas to pass directly to said container from a supply container of liquefied gas, while cooling said additional gas during its flow to maintain
15 it in liquid form and while weighing said receiving container to determine that the predetermined amount of gas has been transferred there-
to.

7. Apparatus for transferring liquefied gas between containers therefor, comprising means for
20 selectively receiving liquefied gas from a plurality of containers containing the same, means for conducting the liquefied gas from said first mentioned means to a refrigerated container, refriger-
25 erated conduit means through which liquefied gas can also be conducted from the receiving means, means for connecting said last mentioned conduit means to a container for transferring
gas from said conduit means into the container, and means for selectively controlling the flow of
30 liquefied gas from the receiving means into the first mentioned conducting means or the refrigerated conduit means.

8. Apparatus for transferring liquefied gas to receiving containers therefor, comprising means
35 for containing a supply of liquefied gas, means for conducting the liquefied gas from said first mentioned means to a refrigerated receiving container, refrigerated conduit means through which
40 liquefied gas can also be conducted from the first mentioned means, means for connecting said refrigerated conduit means to a receiving container for transferring gas from said conduit
means into the container, and means for weighing the receiving container while it is connected
45 by said connecting means to said refrigerated conduit means.

9. Apparatus for transferring liquefied gas to containers therefor, comprising a transfer line
50 for conducting liquefied gas to a container, means for supporting said container while receiving gas from said transfer line, a second transfer line for conducting liquefied gas to a container, and common means for simultaneously cooling both
55 the first mentioned container while it is supported by the supporting means, and the liquefied gas passing through the second mentioned transfer line.

10. In apparatus for transferring liquefied gas to containers therefor, the combination compris-
60 ing cooling means, means for supporting a container for cooling action thereon by said cooling means, means for conducting liquefied gas to said container while supported by said supporting means, and supplementary gas-handling
65 means disposed adjacent said cooling means for receiving liquefied gas and cooling the same under the action of the cooling means.

11. In apparatus for transferring liquefied gas to containers therefor, in combination, a tank
70 adapted to hold a cooling bath, means for removably supporting gas containers in the tank and in position to be cooled by the cooling bath, refrigerating means for maintaining the cooling
75 bath at a predetermined low temperature, means

for conducting liquefied gas to the containers retained in the supporting means, and supplementary gas-handling means disposed in the cooling bath in the tank for cooling liquefied gas received by said supplementary means.

12. Apparatus for transferring liquefied gas from cylinders thereof to receiving cylinders therefor and for minimizing loss of gas during such transfer, comprising manifold means for receiving liquefied gas from a plurality of the first-mentioned cylinders, valve means for selectively controlling reception of gas by said manifold means from any predetermined one of said first-mentioned cylinders, cooling means, means for removably supporting a plurality of receiving cylinders for cooling action thereon by said cooling means, means for conducting liquefied gas from the output of the manifold means to said receiving cylinders while supported by said

supporting means, valve means for controlling passage of liquefied gas from said conducting means to the receiving cylinders, means including a cooling coil disposed for cooling action thereon by the cooling means, for receiving and cooling liquefied gas from the output of the manifold means, valve means for controlling flow of liquefied gas into and out of said cooling coil, valve means for controlling output of liquefied gas from said manifold means to the conducting means and to the cooling coil, means for weighing a receiving cylinder, means for conducting liquefied gas from said cooling coil to a receiving cylinder while it is being weighed by the weighing means, and valve means for controlling flow of liquefied gas from the last-mentioned conducting means to said last-mentioned receiving cylinder.

JUSTIN GRANT SHOLES.