Sept. 2, 1941. V. C. WILLIAMS 2,254,587

APPARATUS FOR DISPENSING GAS MATERIAL

Filed Nov. 9, 1937

FIG. 1

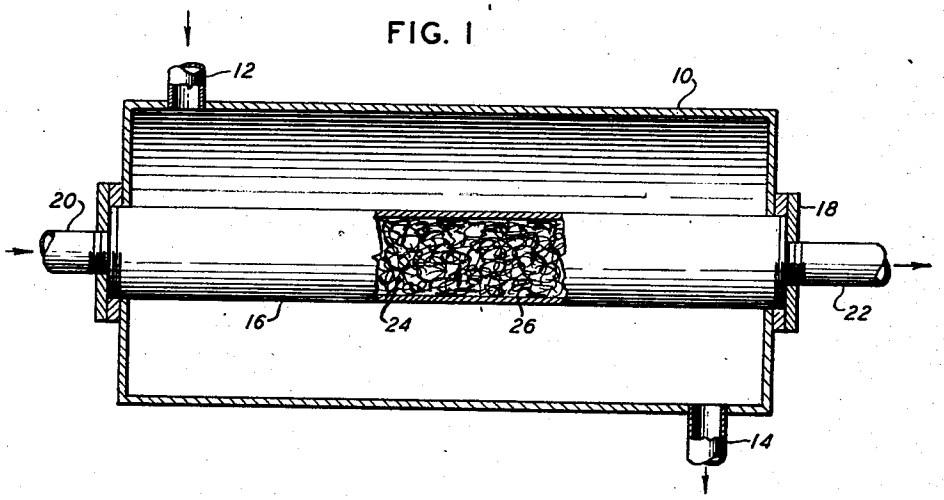


FIG. 2

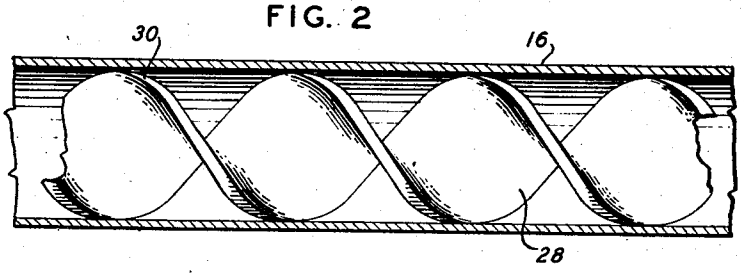
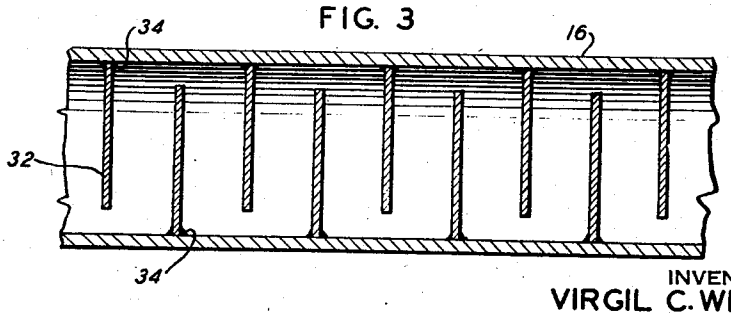


FIG. 3



INVENTOR
VIRGIL C. WILLIAMS
BY
E. E. Greenewald
ATTORNEY

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APPARATUS FOR DISPENSING GAS MATERIAL

Virgil C. Williams, Buffalo, N. Y., assignor to The Linde Air Products Company, a corporation of Ohio

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2 Claims. (Cl. 62—1)

This invention relates to apparatus for dispensing gases stored in the liquefied state and more particularly to apparatus for vaporizing liquefied gases.

In order to conserve space and weight, gases are usually stored in the liquefied state. This is particularly true in the case of oxygen supplies carried on airplanes flying at high altitudes. However, when gases have been stored in this liquefied state, some form of vaporizing device is necessary to deliver the gas supply at the proper conditions of density and temperature. The usual gas dispensing apparatus comprises a container of liquefied gas, a vaporizing device and suitable utilization apparatus. The vaporizers heretofore used have proven inefficient and unsatisfactory in many respects because of the low rate of heat transfer from the heating medium to the liquefied gas.

One well-known form of vaporizer comprises a tube through which the liquefied gas passes, and a heating medium container surrounding this tube. The heating medium may be steam, hot water or any other substance having a high coefficient of heat transfer. Difficulty has been experienced with this type of vaporizer due to the tendency of the liquefied gas within the tube to develop a thin heat insulating film of gasified liquid on the internal surface of the tube. This film diminishes or prevents heat transfer to the central portion of the liquid stream with the result that the central core of liquefied gas blows through the tube without being vaporized. Attempts have been made to remedy this undesirable condition by using parallel tubes, each having a small internal diameter. However, such a construction is awkward and heavy for airplane use.

In seeking a solution for this problem, it has been found that substantially complete vaporization of the liquefied gas may be accomplished by constructing a liquid conducting tube in such a manner that turbulence of the liquid stream through the tube results and which includes means for conducting the heat from the tube walls substantially equally to all parts of the liquid stream.

It is, accordingly, among the objects of this invention to provide a vaporizing apparatus for gases stored in the liquefied state which apparatus has a high coefficient of heat transfer from the heating medium to the liquefied gas, insures turbulence in the stream of liquefied gas flowing therethrough and is simple in construction, light in weight and designed to adequately withstand any shocks encountered by its medium of transportation.

These and other objects of the invention will in part be obvious and in part become apparent from the following description and the accompanying drawing, in which:

Fig. 1 is a longitudinal sectional view of one form of apparatus embodying the present invention;

Fig. 2 is a longitudinal sectional view of a portion of the apparatus shown in Fig. 1 and illustrating a modified form of the invention; and

Fig. 3 is a view similar to Fig. 2 showing a still further modified form of the invention.

The form of the invention illustrated in Fig. 1 comprises an external container 10 having heating fluid inlet and outlet openings 12 and 14, respectively. A liquefied gas conduit 16 is mounted substantially centrally within the container 10 and sealed thereto at either end by suitable sealing means 18. An inlet pipe 20, for liquefied gas, communicates with the conduit 16 at one end and an outlet pipe 22, for gasified liquid, communicates with the conduit at the opposite end.

In accordance with the principles of the invention, the conduit 16 is internally packed with an insert 24 essentially consisting of copper wire bunched in random fashion, and the entire unit is subjected to a solder dip before assembly in the container 10. The bunched wire insert 24 is thus removably sealed to the conduit 16 as at 26, resulting in a good thermally conductive contact between the inner wall surface of the conduit and the insert. Instead of copper, any other suitable thermally conductive metal wire may be used.

In operation, suitable heating fluid is admitted to the container 10 through the inlet 12, contacts and heats the conduit 16 and is exhausted through the outlet 14. At the same time, liquefied gas enters the conduit 16 through the inlet pipe 20 and in its passage through the conduit 16, receives heat by conduction through the conduit walls. The bunched wire insert 24 conducts heat from the conduit walls to all parts of the liquid stream. Furthermore, the insert 24 breaks up the liquid stream so that the liquid showers through the conduit. This prevents the formation of the afore-mentioned heat insulating film of gasified liquid on the internal surface of the conduit 16. Consequently, due to the efficient conduction of heat to all parts of the stream of liquefied gas, the latter is substantially completely vaporized during its passage through the conduit and gasified liquid is conducted from

conduit 16 through outlet pipe 22. The flow of gas through the outlet pipe is thus smooth and continuous and not composed of alternate slugs of gas and liquid as has heretofore often been the case.

The form of the invention shown in Fig. 2 differs from that shown in Fig. 1 in that the bunched wire insert 24 of the construction shown in Fig. 1 is replaced by a twisted metal strip 28 of nearly the same width as the internal diameter of the conduit 16. This strip is twisted to form nodes about one inch apart for a ⅜ inch tube, for example, the nodes being proportionally more closely spaced for a smaller diameter tube, and the strip is then drawn into the conduit 16 and sealed thereto as at 30.

Instead of the single wide strip 28, two or more considerably narrower twisted strips could be mounted in conduit 16 in the same manner. To further increase the turbulence of the liquid stream these strips may be oppositely twisted or have widely different pitches, to reduce the tendency of the strips to overlap.

The twisted metal strips perform the same function as the bunched wire insert 24 of Fig. 1; conducting heat from the conduit wall to internal portions of the liquid stream and causing the liquid to shower through the conduit 16 inhibiting the formation of a heat insulating film of gasified liquid on the internal surface of the conduit.

Still another form of vaporizing apparatus embodying the principles of the invention is shown in Fig. 3, wherein alternately oppositely projecting baffles 32 are sealed to the conduit 16 as at 34. These baffles act as heat conductors from the wall of the tube into the body of the liquid, breaking up the liquid as it passes through the tube so that the core of liquid does not pass directly through the tube and substantially preventing formation of the heat insulating film on the internal surface of the tube. Another alternative, which, for the sake of simplicity in the drawing has not been shown, is to use Raschig rings in the conduit to break up the liquid stream and conduct heat thereinto from the conduit wall.

It will be obvious that each of the above modes of achieving the objects of the invention results in a rugged light-weight liquefied gas vaporizer, which is relatively simple and sturdy in construction, has a high coefficient of heat transfer, and the external dimensions of which are no greater than those of apparati heretofore used.

Although several embodiments of the invention are disclosed in detail, it will be evident that numerous changes may be made in such details without departing from the principles of the invention.

What is claimed is:

1. In apparatus for dispensing gaseous oxygen from a storage vessel containing liquid oxygen, a light weight vaporizer comprising, in combination, an oxygen conduit disposed within and in heat exchange contact with a surrounding heating medium; and heat conducting means, essentially consisting of wire bunched in random fashion, within said conduit, said bunched wire being removably sealed to and in heat conducting contact with the inner wall surface of said oxygen conduit and being so disposed within said conduit as to impede the flow of oxygen therethrough.

2. In apparatus for vaporizing liquid oxygen including a conduit for the liquid oxygen having walls in heat exchange contact with a heating medium surrounding said conduit, means for preventing the formation of a film of gasified liquid oxygen on the internal surface of said walls and for transferring heat to substantially all parts of a stream of liquid oxygen passing through said conduit, said means comprising wire bunched in random fashion within said conduit, said bunched wire being removably sealed to and in heat conducting contact with the inner wall surface of said conduit.

VIRGIL C. WILLIAMS.