July 5, 1932. C. W. P. HEYLANDT 1,866,515

METHOD AND APPARATUS FOR USE IN STORING AND TRANSPORTING LIQUEFIED GASES

Filed Nov. 12, 1927

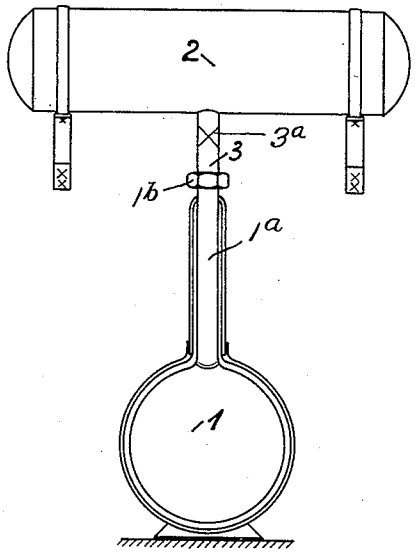


Fig. 1

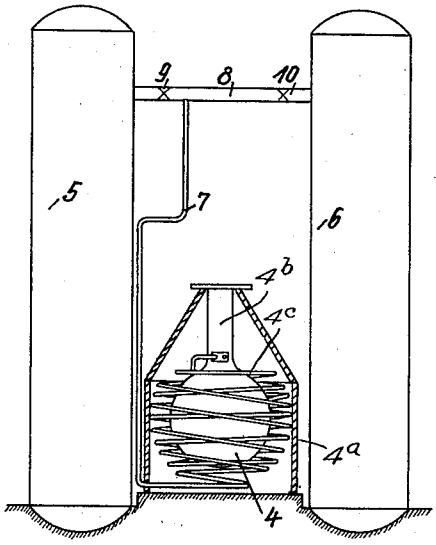


Fig. 2

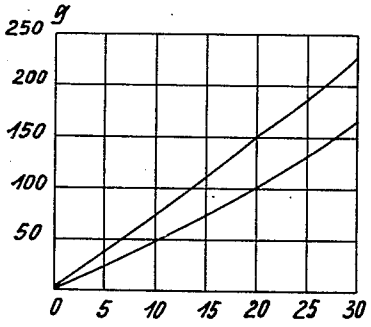


Fig. 3

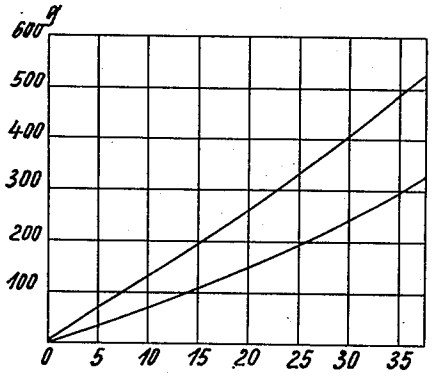


Fig. 4

INVENTOR:
Christian Wilhelm Paul Heylandt
BY: Rieger, Rayer & Bakelar
ATTORNEYS.

Patented July 5, 1932

1,866,515

UNITED STATES PATENT OFFICE

CHRISTIAN WILHELM PAUL HEYLANDT, OF LANKWITZ, GERMANY, ASSIGNOR TO FLUGA AKTIEN-GESELLSCHAFT, OF ST. MORITZ, SWITZERLAND

METHOD AND APPARATUS FOR USE IN STORING AND TRANSPORTING LIQUEFIED GASES

Application filed November 12, 1927, Serial No. 232,922, and in Germany November 13, 1926.

This invention relates to a method and apparatus for use in storing and transporting liquefied gases and has for its object generally the provision of an improved procedure and suitable means for carrying the same into effect, whereby liquefied gases may be retained in their containers substantially without losses due to evaporation during desired periods of time.

Heretofore, liquefied gases which have low boiling points, for example, liquefied air, oxygen, nitrogen and the like, were customarily stored and transported only in containers which were in free communication with the atmosphere, which permitted the gases evolved by evaporation to escape.

If it was desired to conserve the gases arising by evaporation, the containers were connected to gasometers which generally had water seals. The gas products so collected, however, could not readily be utilized without recompression, since the pressure in such gasometers is very low. No appreciable change in the rate of evaporation in such containers, however, is effected by the use of gasometers.

In the practice of the present invention, the containers used for storing and transporting the liquefied gases are connected to gas receivers of fixed size which are so dimensioned that they will hold all the gas evolved within a desired period of time from the container. The pressure which thus builds up to a certain maximum in the receiver has the beneficial result of reacting on the liquid in the container to reduce the rate of evaporation. This reduction in the rate of evaporation is of a relatively high order; for example, it has been ascertained from ample experimental observations that the rate of evaporation from liquefied gas containers open to the atmosphere is 80% higher than the rate in certain apparatus constructed in accordance with the invention. In our apparatus the rate at which pressure builds up is, of course, a very slow one. There are other advantages incident to our apparatus, especially when designed to employ relatively high pressures, for example, where pressures of more than 30 atmospheres are employed. This permits the use of relatively small gas receivers. Such receivers may be used in conjunction with containers which are either of the vacuum variety or of the variety having an insulated inner vessel, though the former, as a rule, are not able to withstand as high internal pressures as the latter, and hence in general are made smaller and are employed for the lower pressures.

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

The invention accordingly comprises the several steps and the relation of one or more of such steps with respect to each of the others, and the apparatus embodying features of construction, combinations of elements and arrangement of parts which are adapted to effect such steps, all as exemplified in the following detailed disclosure, and the scope of the application of which 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 drawing, in which:

Figure 1 is a diagrammatic view showing one form of apparatus suitable for carrying out this invention.

Figure 2 is a similar view of a second form.

Figure 3 is an evaporation diagram showing a comparison between free air evaporation in a vacuum walled container and the evaporation as in the form of device shown in Figure 1.

Figure 4 is an evaporation diagram illustrating and comparing evaporation in a heat insulated vessel open to the air and in the form of apparatus shown in Figure 2.

In the apparatus disclosed in Figure 1 there is provided a vacuum walled container 1 having an elongated neck 1*a* which is connected by a coupling 1*b* with a pipe 3 leading into a gas receiver 2, said pipe being provided with a valve 3*a*. In Figure 2 there is shown a liquefied gas container 4 which is supported within an insulating casing 4*a* and has a closed neck 4*b* from which extends a pipe 4*c* which is wound spirally around the container 4 and within the casing 4*a* and then passes out through connection with a pipe 7 to a pipe 8 which is connected to a pair of receivers 5 and 6 and is provided with valves 9 and 10 to cut off communication between the pipe 7 and the respective receivers 5 and 6. Now, it will be observed that under these conditions there is produced in the form shown in Figure 1 a closed system which consists of a liquefied gas container, a gas receiving means and an elongated and valved tube affording communication between the liquefied gas container and the gas receiving means. Moreover, the greater part of the connecting tube is preferably vacuum walled.

Substantially the same arrangement is employed in Figure 2 except that the pipe connecting the container 4 and the receivers 5 and 6 is relatively much longer but is also well insulated from external heat, being held in the insulating casing 4*a*. Under these conditions a long pressure column will exist in the communicating pipe and pressure will be produced in the liquefied gas container which will in consequence decrease the rate of evaporation. Furthermore, this pressure may be regulated by the valve or valves shown.

As a result of the provision of a head of pressure in the column connecting the container with receivers 5 and 6, they may be made smaller than in the arrangement shown in Fig. 1 when providing storage for equivalent amounts of gasified liquid. Also it is seen that if the container were enlarged along its vertical dimension, it would be necessary to have the internal volume correspondingly enlarged in order that the final pressure be not increased, since the receiver connected to the container has from the start a retarding influence which checks evaporation.

This is well seen by reference to Figures 3 and 4 in which the upper curve indicates normal evaporation in the particular type of vessel with free communication to the air while the lower curve indicates evaporation under retarded conditions produced by the long pressure column in the tube connecting the liquefied gas container and the gas receiving means.

From the data thus depicted it is possible to provide gas receivers for use in connection with containers of any desired size which will conserve all of the gas that may be evolved by evaporatiton during any period contemplated for storage or transportation or both; it being a simple matter to calculate the dimensions of the receiver desired to achieve this effect under the conditions specified. For example, assume that it is ascertained that for a certain container of 50 litres capacity the rate of evaporation when open to the atmosphere is 65 grams per hour, while if the evaporation be made to take place under a continually increasing pressure, as here proposed, the rate is reduced to from 35 to 40 grams per hour, which represents about 30 litres of gas at atmospheric pressure evolved per hour; then when it is specified that the period of storage or transport shall be 2 x 24 hours, and the maximum pressure permitted is 10 atmospheres, the required volume of the receiver is calculated as follows:

$$\frac{2\times 24\times 30}{10} = 144 \text{ litres.}$$

If any of the gas generated by evaporation during this period is to be used during the period, the volume of the receiver may be correspondingly reduced.

Since certain changes in carrying out the above process and in the constructions set forth, which embody the invention may be made without departing from its scope, it is intended that all matter contained in the above description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

Having thus described the invention, what is claimed as new is:

1. The method of conserving liquefied gases when being stored or transported, which comprises providing a gas receiver of fixed capacity to receive all the gas normally vaporized during a desired period of time and dimensioned so as to hold the same without exceeding a predetermined maximum pressure, and passing the gas normally vaporized in a container into said receiver while under a constantly increasing pressure.

2. In apparatus for use in storing and transporting liquefied gases, the combination with a liquefied gas container, of a gas receiver connected therewith of fixed size having dimensions such that it is capable of holding all of the gas normally vaporized in said container in a desired period of time and at a pressure not in excess of a predetermined maximum.

3. In apparatus for use in storing and transporting liquefied gases, the combination with a liquefied gas container, of a gas receiver connected therewith of constant volume so dimensioned that it is capable of holding the maximum amount of gas normally vaporized from said container, and insulated communicating means connecting said container and said receiver whereby the vaporization is maintained at a low rate.

4. In apparatus for use in storing and

transporting liquefied gases, the combination with a liquefied gas container, of a gas receiver of constant volume so dimensioned that it is capable of holding the maximum amount of gas normally vaporized from said container, an elongated conduit of small diameter connecting said container and receiver, and an insulating jacket encasing said container and the major portion of said conduit.

In testimony whereof I have signed my name to this specification.

CHRISTIAN WILHELM PAUL HEYLANDT.