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P. S. OTTEN

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INSULATED BAYONET TUBE VAPORIZER

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FIG. 1

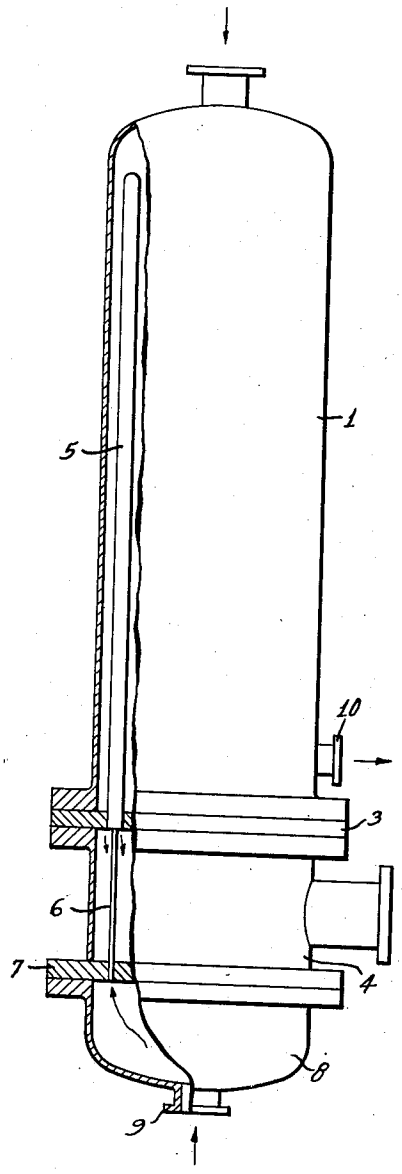
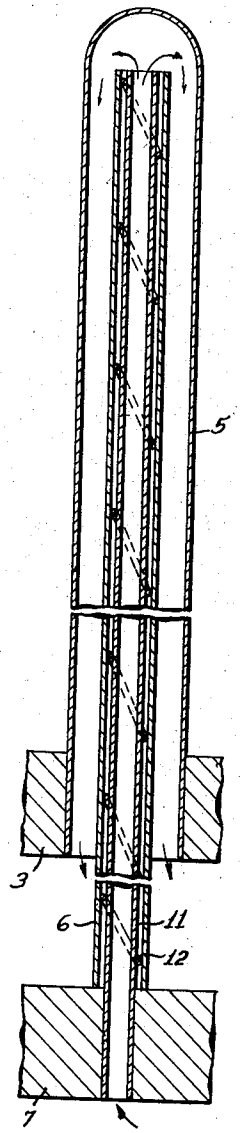


FIG. 2



INVENTOR
Philip S. Otten
BY
Dennis, Edmonds, Maton, Barrows and Taylor
ATTORNEYS

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INSULATED BAYONET TUBE VAPORIZER

Philip S. Otten, New Rochelle, N. Y., assignor to The Griscom Russell Company, New York, N. Y., a corporation of Delaware

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1 Claim. (Cl. 62—1)

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This invention relates to liquefied gas vaporizers of the type used primarily for restoring to gaseous form at atmospheric temperatures and pressures gases which have been liquefied for storage, transportation or other purposes. The boiling point of liquefied gases such as natural gas at atmospheric pressure is very low, in the order of —250° F. Natural gas can be liquefied and stored in insulated tanks and then revaporized and returned to the gas mains to supply peak load demands, thereby making it possible to supply the needs of a municipality or an industrial user of gas without providing pipeline facilities of a capacity necessary to maintain peak load operations. For industrial establishments a peak load capacity of short duration several times the normal load is frequently required, and such condition may be economically met by liquefying gas during low load intervals for utilization to meet peak load demands.

For vaporizing liquefied gas of this character it has been the practice heretofore to use a shell and tube apparatus such as disclosed in U. S. Patent No. 2,273,257, wherein the liquefied gas to be vaporized is heated by steam in the shell of the apparatus, the liquefied gas being delivered to the inner tubes of double-tube elements so that the steam constituting the heating medium does not directly contact the walls of the tubes through which the cold liquid enters the apparatus.

With the apparatus described in the above mentioned patent the liquefied natural gas can be vaporized with exhaust steam as the heating medium in a satisfactory and economical manner, and such apparatus has been in continuous commercial use for years. However, in some cases it has been found that the vaporized gas leaving the apparatus varies considerably in temperature so that when the gas is delivered to the mains and added to the normal gas supply, difficulty has been experienced in maintaining the desired constant pressure in the gas mains. In some instances it has been found desirable to interpose a heat exchanger between the vaporizing unit and the gas main to maintain the vaporized gas at a uniform temperature, so that its addition to the gas mains will not result in undesirable pressure variations.

I have found that this variation in delivery temperature of the vaporized gas from vaporizing units constructed in accordance with the above mentioned patent is largely due to variations in the reabsorption of heat by the vaporized gas at the discharge end of the vaporizer tubes from the liquid gas as it enters the inner tube of the vaporizer element, and the invention of the present application constitutes an improvement on the apparatus of the above mentioned patent whereby a more uniform discharge temperature of the vaporized gas may be maintained.

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In the accompanying drawings I have illustrated a preferred embodiment of my improvement, and in the said drawings,

Fig. 1 is a side elevation partly broken away of a liquid gas vaporizer embodying my improvements; and

Fig. 2 is a vertical sectional view on an enlarged scale of one of the vaporizing elements.

Referring to the drawings, particularly Fig. 1, 1 indicates the shell of the apparatus to which the exhaust steam is delivered through an opening 2 at the top, the condensate being withdrawn through a discharge opening 10 near the bottom of the shell. The shell is flanged at its open bottom end and is seated on a tube sheet 3 forming the upper wall of a gas discharge header 4. Seated in the tube sheet 3 are the outer tubes 5 of the vaporizer elements, the structure of which is shown in detail in Fig. 2. Each vaporizer element comprises an outer tube 5 closed at its upper end and an inner tube 6 seated in a lower tube sheet 7 forming the bottom wall of the discharge chamber 4 and projecting upwardly within the tube 5 to a point near the top of said tube. Underlying the tube sheet 7 is an end cap 8 forming an inlet chamber for the liquefied gas which is delivered to the apparatus through the inlet opening 9.

In the apparatus disclosed in the above mentioned patent the inner tubes 6 of the vaporizer element are provided with longitudinal fins to increase the heat transfer surface of the tubes 6 and thereby increase the heat transfer from the liquefied gas in the tube 6 to the vaporized gas in the annular space between the inner and outer tubes. I have found, however, that this increase in the heat transfer from the liquefied gas to the vaporized gas does not have the effect of increasing the overall efficiency of the apparatus, but on the contrary results in lowering the discharge temperature of the vaporized gas and also makes it difficult to maintain a uniform discharge temperature of the vaporized gas. I have found that this difficulty can be largely corrected by constructing the inner tube 6 of two concentric sections separated from each other in a manner to reduce heat conduction so that the outer wall of the double tube section will

throughout its length be at a substantially higher temperature than the inner wall section which is in direct contact with the liquefied gas, thereby reducing instead of increasing, the heat transfer from the liquefied gas in the inner tube to the vaporized gas in the space between the inner tube 6 and outer tube 5.

In the construction illustrated in the drawing, the inner tube 6 of the vaporizing element is surrounded by a concentric tube section 11 separated from the tube 6 by a spacing wire 12 which is wound around the tube 6 and spot-welded thereto at intervals. The tube 11 rests at its lower end against the face of the tube sheet 3 closing the end of the annular space between the tubes 6 and 11 and thereby forming between the tubes a dead air space which serves to reduce the rate of heat transfer between the liquefied gas in the tube 6 and the vaporized gas in contact with the exposed surface of the tube 11. By so constructing the inner tubes of the heat exchange element the transfer of heat from the exposed surface of the tube 11 to the vaporized gas in the discharge chamber 4 is negligible, thereby making it easier to maintain the vaporized gas at a uniform discharge temperature of the desired value.

In the foregoing specification and accompanying drawings I have shown and described my improvement in the preferred form in which it has been developed for commercial installation, but it is to be understood that the invention is not limited to the construction shown and described except insofar as included in the accompanying claim.

I claim:

In a liquefied gas vaporizer, a heat exchange element consisting of an outer tube closed at the end, an inner tube projecting into said outer tube through its open end, said inner tube consisting of inner and outer tube sections and a separator between said tube sections comprising a wire of a diameter equal to the space between said tube sections, said wire being wound helically around the inner tube section, and a closure for the space between the tube section at one end.

PHILIP S. OTTEN.

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