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2,499,462

REGASIFIER

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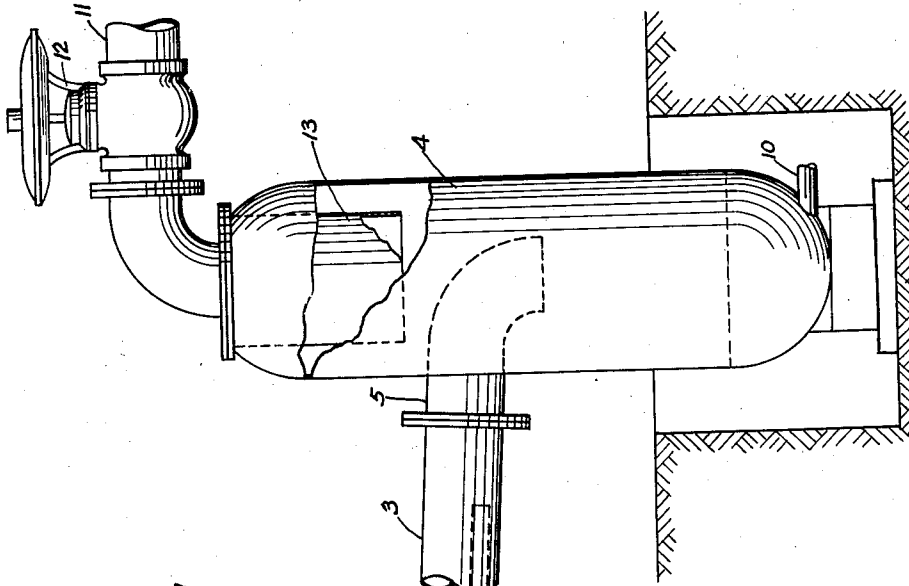


FIG. 1

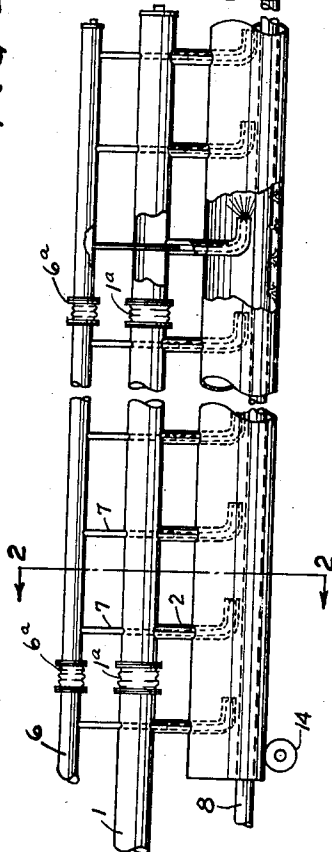
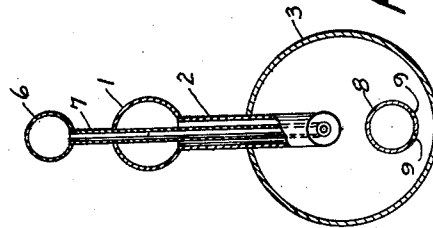


FIG. 2

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REGASIFIER

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2 Claims. (Cl. 62—1)

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This invention relates to means for regasifying liquefied natural gas.

It is known to liquefy large quantities of normally gaseous hydrocarbon fuels, notably natural gas, for conservation of storage space, the purpose being for stand-by, availability to satisfy peak load demands etc., as will be appreciated by one familiar with the art. That such gas may be stored in liquefied form at low pressures, its temperature is necessarily exceedingly low as in the order of -250° F. so that for the regasification considerable heat must be added before the gas may be fed to the distributing line or the like which it is to serve.

Also, as will be appreciated, the value of the gas to the service line is dependent, in some installations, in a large measure to the speed with which it may be converted into its gaseous state and fed to the line; the problem obviously requiring a tremendous heat exchange capacity.

It is the object of this invention to provide such heat exchange for such purpose. More particularly, the invention contemplates employment of steam and the latent heat of its conversion into water. Still more particularly, the invention contemplates atomization of the liquefied gas, by steam, and subjecting the atomized gas particles to steam for their complete gasification.

Further, the invention contemplates avoidance of hydrates in the resultant condensate water, as will appear, so that removal of the latter is facilitated.

Further objects and advantages will be apparent from the following description taken in connection with the accompanying drawings, wherein is illustrated an embodiment of the invention having capacity of many thousands of cubic feet per hour, Figure 1 being a side elevation thereof, partly in section, and Figure 2 an enlarged detail, in transverse section, as in the line 2—2 of Fig. 1.

Referring now to the drawings, 1 is an inlet pipe for the liquefied natural gas, closed at one end, as indicated, and having a number of outlets 2 spaced therealong. These outlet pipes 2 lead into a tubular member or casing 3 providing an enlarged chamber and the pipes 2 are bent, as indicated, to discharge into the chamber toward its outlet end. The casing 3 is slopingly disposed, as indicated in Fig. 1, having its upper end closed and its lower end discharging into the drum part 4 of a separator by way of an elbow 5 disposed to discharge downwardly within the separator of which it forms a part.

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In order that the gas outlets 2 discharge in atomized form, a header 6 is disposed alongside the pipe 1 with an outlet member 7 associated with each of the outlet pipes 2 of the gas header 1. The arrangement is such that the outlet pipes 2 and 7 cooperate to form within the casing 3 atomizing nozzles in each of which liquid from the header 1 is atomized by steam from the header 6, emerging within the casing 3 in the direction toward the separator 4.

Means are provided in association with the casing 3 to supply heat to the atomized gas in addition to that which it receives from the atomizing steam. As here shown, a steam header 8 is disposed within the casing 3, having spaced openings 9, for discharge of steam with distribution along the casing.

The drum part 4 of the separator provides a sump at the bottom having a drainage outlet 10 for condensate water and a gas outlet at its upper end with a line 11 controlled by a pressure regulating valve 12, a canopy 13, open at its bottom, being provided within the drum 4 to assist in the separation, as will be appreciated by one familiar with the art.

In the range of regasifying capacities contemplated by this invention, the length of the casing 3 is such that the gasifying chamber which it provides may have length in the order of fifty feet or more, the atomizing nozzles being grouped generally adjacent its upper end and the chamber having a substantial volume or length between the nozzles and the separator, wherein gasification of the atomized particles may be completed, so that the elbow 5 will discharge into the separator substantially only natural gas in gas phase and water of condensation from the steam.

The steam supplied by the header 6 need be only sufficient to effect the desired atomization at the nozzles, and may be supplied to the header at a relatively high pressure, as necessary for the purpose.

As this amount of steam will supply insufficient heat for gasification, the line 8 satisfies this demand with steam which may be at a relatively lower pressure.

The line, according to my invention, in addition to supplying all of the necessary heat to complete gasification, is caused to supply enough heat that the water of condensation within the separator will have high enough temperature that hydrates will not exist therein at the pressure within the regasifying system. This pressure is determined by the setting of the valve 12 which

in turn is dependent upon the necessary pressure in the outlet line 11 which, in practice, will lead to the distributing system which the regasifier serves.

It will be appreciated that essentially there is a heat exchange within the gasifying chamber of the casing 3 by direct contact between the two fluids involving the latent heat content of each, the fuel fluid entering as a liquid and leaving as a gas and the heat supplying fluid entering as a gas and emerging as a liquid. Typical conditions involved may be in the order of incoming liquid gas at a -252° F., incoming steam at $+300^{\circ}$ F. and outlet temperature $+50^{\circ}$ F.

From these figures it will be apparent that in operation through such extreme temperature range great care must be exercised to avoid freezing and thermal expansion stresses. The steam line 8, properly controlled, is very useful for this purpose.

The invention contemplates fixing the lower or outlet end of the regasifying portion of the apparatus at the separator part thereof and providing for expansion along the regasifying parts as by floating provision at upper end, as here indicated conventionally by the roller mount 14 there supporting the casing 3 and its associated assembly, it being obvious that the lines 4, 6 and 8 may have associated goose necks or other expansion provisions well understood in the art, and here conventionally indicated by the expansion sections 1a in the header 1 and 5a in the header 6.

I claim:

1. Apparatus for regasifying a liquefied fuel, comprising tubular means providing an elongated sloping chamber, means spaced along said chamber providing steam distributed therewithin, and a plurality of means spaced along said chamber for atomizing said fuel and injecting the atomized fuel into said steam in the direction of slope of said chamber.

2. Apparatus for regasifying a liquefied fuel, comprising tubular means providing an elongated sloping chamber, a plurality of steam injector means, spaced along said chamber, for injecting said fuel in atomized form into said chamber directed toward the lower end thereof, and means providing steam distribution along said chamber in sufficient quantities to completely gasify the atomized fuel in its flow toward said end.

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