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METHOD AND DEVICE FOR PRODUCING COMPRESSED GAS FROM LIQUEFIED GAS

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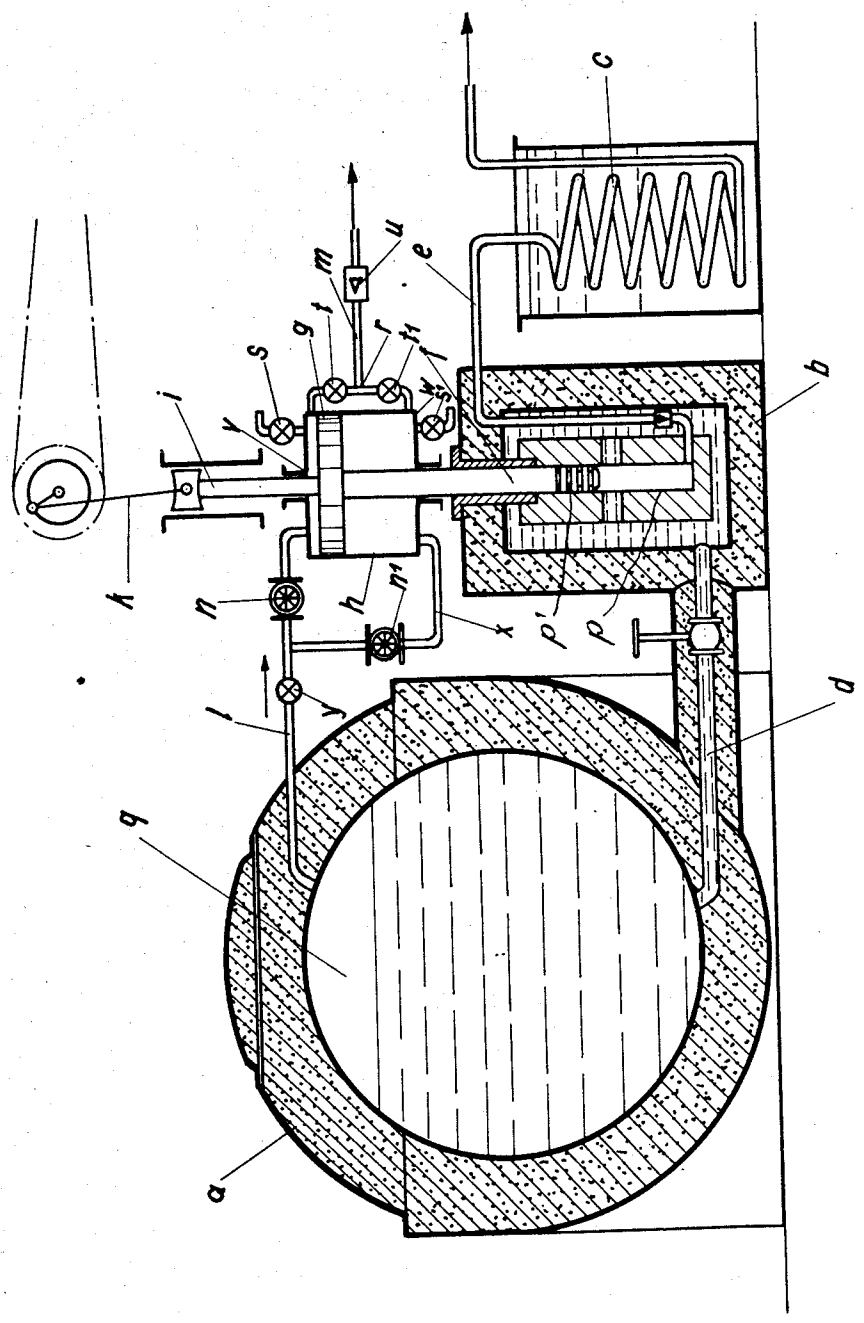

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METHOD AND DEVICE FOR PRODUCING COMPRESSED GAS FROM LIQUEFIED GAS

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The present invention relates to an improvement in processes and apparatus for delivering pressure gas, the principal object of the invention being to provide an improved process and apparatus by means of which the gas may be conveyed in liquefied state to the place of consumption and there delivered in highly compressed gaseous condition.

It has heretofore been the practice, in the handling of gases having a low boiling point, such as nitrogen, oxygen and the like, to vaporize the gas and compress it to the desired pressure in heavy steel bottles before transporting it to the place of consumption. The object of the present invention, however, is to provide means whereby not only will it be possible to transport the gas in liquefied condition and deliver it at any desired pressure, thereby eliminating the high cost of transporting the heavy steel bottles necessary for containing the compressed gas, but utilizing the ordinarily undesirable vaporization products formed during transportation to assist in transferring the liquefied gas from its storage receptacle and delivering it in vaporized condition at the desired pressure.

According to the invention the gases, such as oxygen, nitrogen, methane and the like, after being transported in a liquefied state to the place of consumption, are transferred there from the transporting vessel or from another receptacle capable of standing a higher or lower pressure by the aid of a conveying device, for instance a pump, into a high pressure system of receptacles or pumps, where the gas by the aid of known means is evaporated and raised to the required working pressure.

Such a process has considerable advantages over those heretofore known. Apart from the advantage gained by the considerably reduced cost of transporting the gases in liquefied state as compared with the transportation of compressed gases in heavy steel bottles, the amount of compression work necessary at the place of consumption is very small as the volume of such gases in relation to the liquid is in the proportion of 800 : 1. It must further be considered that the liquefied gas after having been conveyed by the liquid pump may be converted from the liquid to the gaseous state partly or entirely by self-compression alone, which may be produced by admitting heat from without. It need not be emphasized that the pressure gas when produced in this manner at the place of consumption from the liquid material is in a perfectly dry condition.

A device enabling the utilization of the undesired products of vaporization according to my invention is illustrated in the accompanying drawing.

Referring to the drawing *a* designates a double-walled insulated container or vessel adapted to contain a liquefied gas for transportation to the place of use. A second double-walled, insulated casing *b* communicates by way of a valved pipe *d* with the interior of the vessel *a* at the lowermost point thereof, the said pipe being also insulated. Within the casing *b* is disposed a pump housing *p*, the wall of said housing being spaced from the inner wall of the insulating casing thereby to provide a space for the reception of liquefied gas within said casing so as to completely envelope the pump housing. The housing *p* communicates by way of a pipe *e* with a vaporizer *c* the outlet from which may be adapted for connection with a high-pressure vessel. The piston *p'* of the pump is carried by a rod *f*, which extends through a housing *h* within which a second piston *g* is secured to the rod *f*. The extension of the piston rod beyond the housing *h* is designated *i* and is driven through the medium of a connecting rod *k* from a crank shaft which in turn may be operated from any suitable source of power. The housing *h* is provided with a lid or cover *v* through which passes a pipe *l* in communication with the space *q* at the upper part of the container *a*, above the liquid in said container. The housing *h* further communicates with the pipe *l*, and therefore with the space *q* of the liquid container, by way of a pipe *x* which enters the housing through the bottom thereof, the pipes *l* and *x* being provided with valves *n* and *n'* respectively which are operative to admit pressure gas from the space *q* of the container *a* alternately to opposite sides of the piston *g*. The

pipe l is further provided with a valve y for shutting off all communication between the housing h and the container a. The housing h is provided adjacent its opposite ends with a pair of outlet ports communicating by a pipe r with an exhaust pipe m, the pipe r being provided with valves t, t' disposed respectively at opposite sides of its connection with the pipe m, the opening and closing of said valves being controlled by the movements of the piston g in opposite directions for exhausting the housing h. The housing h is further provided in its top and bottom with ventilating ports controlled by valves s and s' respectively, which may be manually opened if for any reason the pressure in the space q has fallen so low that it is no longer capable of assisting to drive the piston g, in which case the valve y is closed. The exhaust pipe m is provided with a non-return valve w.

Assuming that during transportation of the liquefied gas, or while no withdrawal thereof is taking place the pressure within the space q of the vessel a has for instance been increased to 5 atmospheres and in case of stationary apparatus to 15 atmospheres. If now after the place of consumption has been reached and the withdrawal of the liquefied gas has begun by starting the liquid pump p, the pressure existing above the liquid in the vessel a will act upon the piston g so that a part of the power necessary for driving the pump is supplied by the pressure of the undesired products of vaporization.

If for any reason the pressure prevailing above the liquid in the transporting vessel has fallen to such an extent that it is not worth while to use it for assisting to drive the liquid pump, the valve y is closed. In order to avoid the production of objectionable compression within the casing h, the valves s and s' communicating respectively with the casing h at its upper and lower ends, are opened. The non-return valve u disposed in the conduit m prevents the return of pressure gas from said pipe to the housing h and out through the open valves s and s'.

If the pipe line l is shut off by the closing of valve y as above described, the pressure within the space q of vessel a will act on the liquid, whereby the suction effect of the pump is increased and the load partially taken off from the driving machine.

An advantageous development of the process is that the transporting vessel, or the receptacle in which the gas prior to its transfer to the high pressure system is stored, may be so constructed as to permit a partial or total heating of its contents thereby to produce gas at a predetermined pressure, which may be employed for driving the liquid feeding installation. It will then only be necessary that the gases from the liquid container be brought to a slightly higher pressure than usually required by self-compression in the service pipe line in order to make them available for use as high pressure gas. This pressure gas may then be allowed to pass into a power engine aggregate (cylinder with piston, turbine or the like) and with the power thus obtained the liquid delivering aggregate will require very much less mechanical work for driving the same.

I claim as my invention:

1. The method of producing pressure gas from liquefied gas of low boiling point, which consists in transferring the gas in liquefied state from a closed storage vessel to a low-pressure chamber, mechanically transferring the liquefied gas from said low pressure chamber to a high pressure chamber, utilizing the working pressure of the gas in the storage vessel to assist in driving the mechanical device which transfers the liquefied gas to the high pressure chamber, and vaporizing said gas and converting it into gas of predetermined high pressure.

2. An apparatus for producing pressure gas from liquefied gas of low boiling point, comprising in combination, an insulated, closed, low pressure storage vessel, a second insulated, closed, vessel communicating with said low pressure vessel below its liquid level, a pressure pump disposed within said second vessel, a piston in said pump having a rod extending outside of said second vessel, a housing outside of said second vessel and having an axial opening for the passage of said piston rod therethrough, a piston secured to said rod within said housing, valve-controlled communicating means connecting said housing at opposite sides of its piston with said low pressure vessel above its liquid level, thereby to admit pressure gas from said vessel to the housing to assist in causing reciprocation of said piston rod and pistons, means for permitting exhaust of pressure gases from said housing at opposite sides of its piston, mechanical means connected with said piston rod for reciprocating the same, and a vaporizer communicating with said pump.

In testimony whereof I affix my signature.

CHRISTIAN WILHELM PAUL HEYLANDT.