M. VON RECKLINGHAUSEN.

HEAT INTERCHANGER.

APPLICATION FILED FEB. 27, 1917.

1,393,452.

Patented Oct. 11, 1921.

FIG. 1.

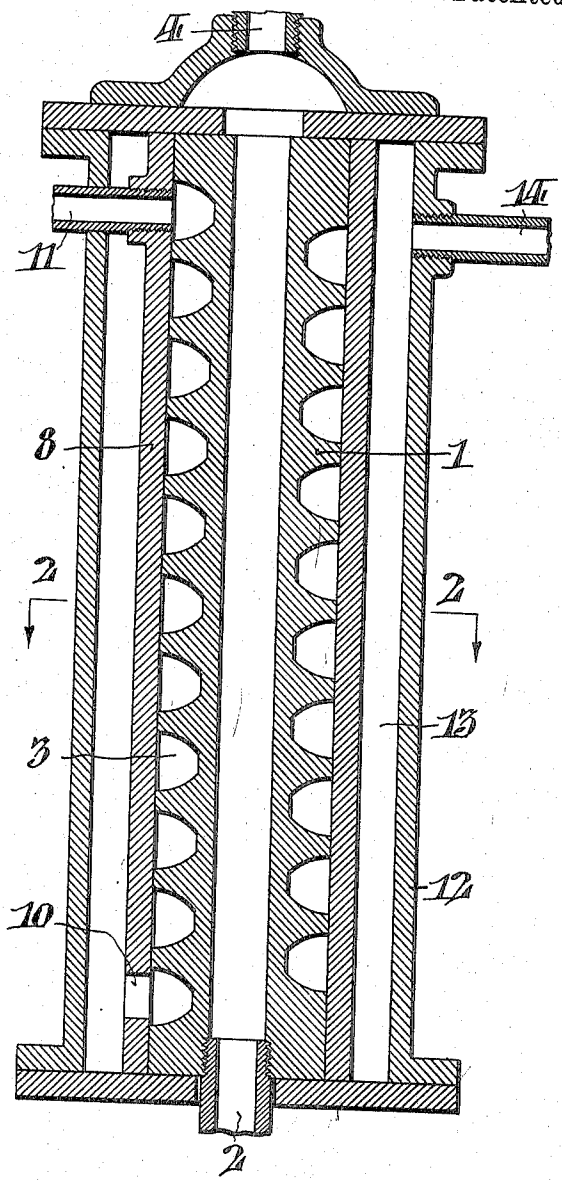
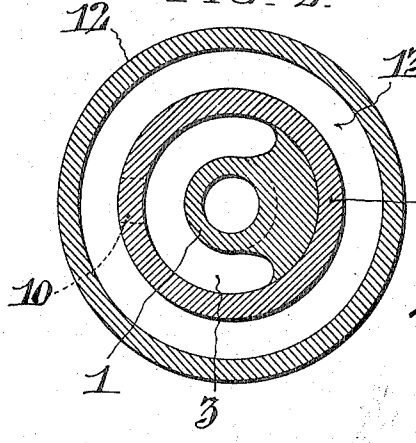



FIG. 2.




Witnesses
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# UNITED STATES PATENT OFFICE.

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## HEAT-INTERCHANGER.

1,393,452. Specification of Letters Patent. Patented Oct. 11, 1921.

Application filed February 27, 1917. Serial No. 151,158.

*To all whom it may concern:*

Be it known that I, MAX VON RECKLINGHAUSEN, a German citizen, and a resident of the city of New York, county of New York, State of New York, have invented certain new and useful Improvements in Heat-Interchangers, of which the following is a specification.

In the manufacture of oxygen from the atmosphere it is generally separated and recovered in the form of a liquid and before charging the same into the cylinders in which it is generally sent into commerce the same is permitted to gasify and is stored in containers. The result of this is that compression apparatus must be employed to compress the gas and deliver it to the cylinders under the proper tension or compression.

In order to eliminate and render unnecessary this intermediate compression operation I have conceived the idea of conducting the liquid oxygen either directly or mediately into the oxygen cylinders and taking advantage of the force of expansion due to conversion of the liquid into a gas to bring about or effect the necessary or required compression or tension of the oxygen gas in the cylinders.

It is well known that liquid oxygen vaporizes somewhat slowly and in order to cause a more rapid conversion of the gaseous oxygen into a gas I have provided an improvement in the construction of a heat interchanger which interchanger not only is of great value and advantage in that it effects more rapid conversion of the liquid oxygen into a gas but also because the relatively warm air which may be employed in connection therewith for hastening the gasification of the liquid oxygen may be employed as a part or even all of the atmosphere subsequently liquefied in the air liquefying apparatus.

One of the objects of my invention is to provide a heat interchanger of a construction adapted to effect rapid interchange of heat between a liquefied gas, as for instance, oxygen and external substances, as for instance, relatively warm air.

A further object of my invention is to provide a heat interchanger which is compact and durable and which may be cheaply and economically constructed.

In the drawing I have illustrated a construction of interchanger embodying my invention, said interchanger being provided with a conduit, the material of which consists of a metal, as for example copper, which is a relatively good conductor of heat so that there may be a rapid interchange of heat between the liquid oxygen in its passage through the said conduit and the relatively warm air surrounding the said conduit and being in the passageways provided for its passage around the said conduit. The pressure of expansion exerted by the oxygen gas formed in the said conduit is great, rendering it necessary to provide reinforcing or supporting means around the said conduit for preventing the latter from giving way or yielding under the force exerted by the internal pressure of the oxygen gas therein.

Other objects and advantages of my invention will be referred to in the detailed description thereof which follows or will be apparent from such description.

In order that my invention may be clearly understood and its practical advantages more fully appreciated, reference should be had to the accompanying drawing in which I have illustrated one constructional form of embodiment thereof. It will be understood, however, that changes may be made in the details of construction without departing from my invention or from the principle thereof as the same is described in the specification and particularly pointed out in the claims.

In the drawing:—

Figure 1 is a central longitudinal sectional view of a heat interchanger embodying my invention; and

Fig. 2 is a transverse sectional view taken on the line 2—2 of Fig. 1.

Referring to the drawing, 1 designates a conduit or passageway for the passage of a liquefied or a cold unliquefied gas, for example, oxygen. It is my idea that liquid oxygen, for instance, shall be introduced into the conduit or passageway 1 from a tube 2 leading from a supply, not shown, of liquid oxygen. The conduit 1 preferably should consist of a metal, such as copper, which is a good conductor of heat.

In the construction shown the conduit 1 is provided externally with a groove or duct 3 which extends spirally around the said conduit from near one end thereof to near

the other, as is clearly indicated in the drawing. The said groove or duct need not, however, extend spirally around the said conduit as shown, but may be otherwise placed and otherwise extended around the same. The oxygen which enters the conduit or passageway 1 in the form of a liquid leaves the same as a gas through the pipe 4 and may be conducted through the pipe 4 directly to an oxygen cylinder or to a pipe common to a plurality of oxygen cylinders to be filled or charged with gaseous oxygen under proper tension or pressure. The metal of the conduit or passageway 1 in the construction shown consisting of copper and the latter being relatively weak would be liable to burst or break open due to internal pressure of expansion of the oxygen gas therein, consequently I have provided a surrounding tubular member 8 of relatively strong metal which fits closely against the exterior surface of the said conduit or passageway 1.

There are various ways in which the surrounding tubular member 8 may be applied to and fitted closely against the exterior surface of the member 1, but such different ways of effecting such close fitting relationship will not be described as they form no part of the invention intended to be claimed herein. The spiral groove or duct as already indicated may be replaced by an equivalent groove or duct.

The relatively warm air or equivalent fluid is introduced into the spiral passageway 3 through an opening at 10 and travels thence forwardly through the said spiral passageway and issues therefrom through the pipe 11.

In order to secure greater efficiency I prefer to surround the tubular member 8 with a second or outside tubular member 12, the said tubular member 12 being spaced from the member 8 so as to form or provide an annular chamber 13 between the inner surface of the tubular member 12 and the outer surface of the tubular member 8. The relatively warm air or equivalent substance enters the annular chamber or space 13 through a pipe 14 near the top thereof and passes downwardly in the annular chamber 13 and around the tubular member 8 and finally passes from the said chamber through the opening 10 into the spiral passageway 3 and upwardly therein and finally out through the pipe 11.

It will, of course, be understood that the interchanger may be employed with very satisfactory results without the presence of the outside tubular member 12, in which case the pipe 14 should be connected with the opening 10 so as to discharge directly into the spiral passageway 3.

I claim:—

1. A heat interchanger comprising a central conduit for the passage of a cold or a liquefied gas, the said conduit having a passageway exteriorly thereof, a tubular member fitting closely against the exterior of the said conduit, a tubular member surrounding the said first named tubular member and spaced therefrom to form an annular chamber intermediate the said tubular members, the first named tubular member having openings therein communicating with the opposite end portions of the said passageway, means for supplying a relatively warm fluid to the said annular chamber and means for conveying such fluid from the said passageway.

2. A heat interchanger comprising a central conduit consisting of a metal which is a relatively good conductor of heat, said conduit having a spiral passageway formed upon the exterior thereof, means for supplying a cold or a liquefied gas to the passage through the said conduit, a tubular member surrounding and fitting closely against the exterior of the said conduit to close the outer sides of the said spiral passageway and to support and reinforce the said conduit to resist internal pressure and means for delivering a relatively warm fluid to the said spiral passageway and conveying the same therefrom.

3. A heat interchanger comprising a conduit consisting of a metal which is a relatively good conductor of heat, said conduit being provided with a spiral passageway formed exteriorly thereof, a tubular member of relatively strong metal surrounding and fitting closely against the exterior of the said conduit and closing the outer side of the said spiral passageway, a second tubular member surrounding the first named tubular member and being spaced therefrom to form an annular chamber intermediate the said tubular members, means for delivering relatively warm air to the said annular chamber which air enters the spiral passageway adjacent to one end thereof and means communicating with the said spiral passageway at a point adjacent its opposite end for conveying the said relatively warm air therefrom.

In testimony that I claim the foregoing as my invention, I have hereunto signed my name this 23 day of February, A. D. 1917.

MAX von RECKLINGHAUSEN.