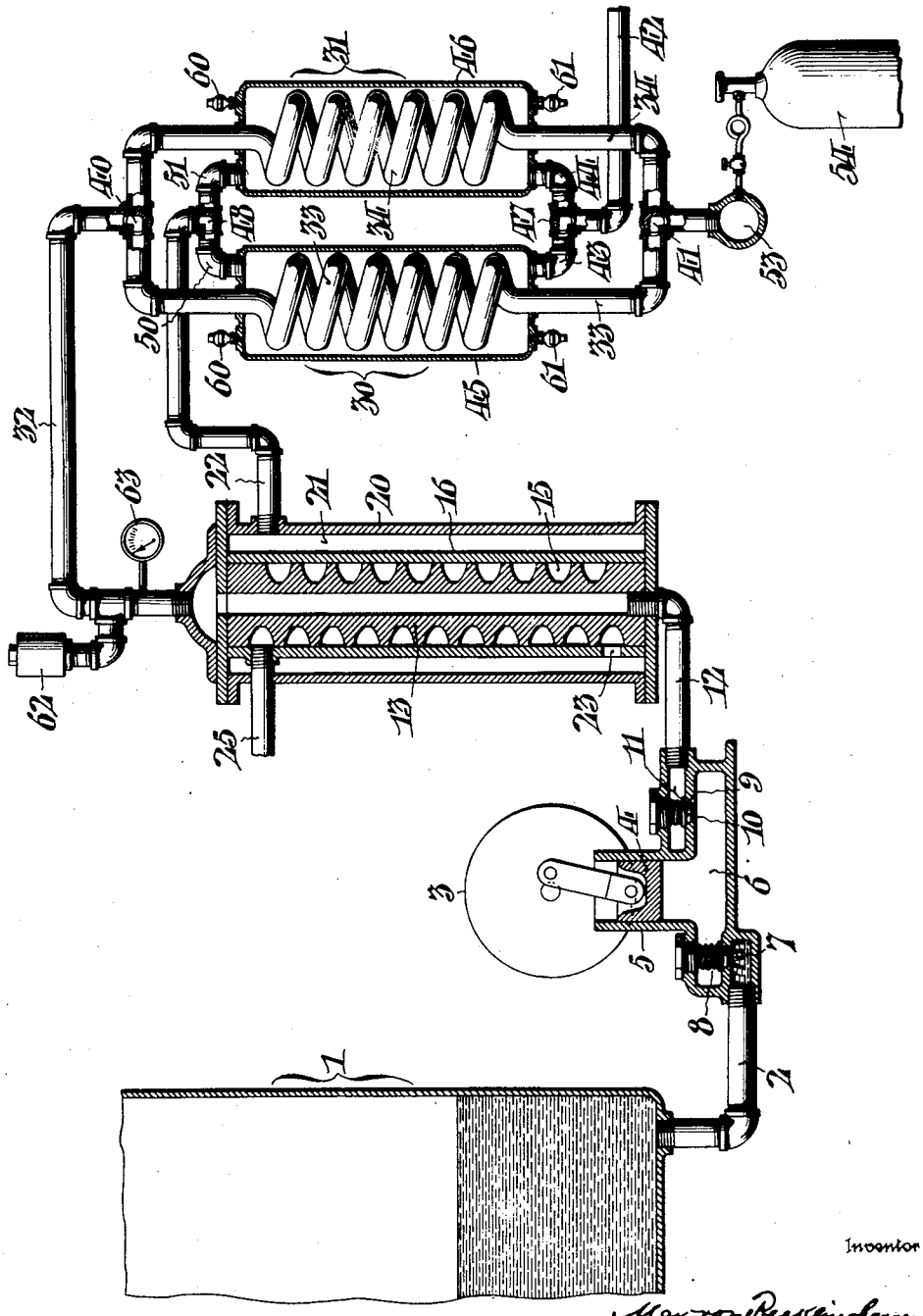
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APPARATUS FOR FILLING OXYGEN CYLINDERS.

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1,394,955. Patented Oct. 25, 1921.



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APPARATUS FOR FILLING OXYGEN-CYLINDERS.

1,394,955. Specification of Letters Patent. Patented Oct. 25, 1921.

Application filed February 23, 1917. Serial No. 150,319.

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 Apparatus for Filling Oxygen-Cylinders, of which the following is a specification.

One of the objects of my invention is to provide an efficient and simple apparatus which may be economically constructed and which is adapted for receiving a liquefied gas, as oxygen, and conducting and delivering it into cylinders or tanks under the necessary pressure or tension generated by the expansive force of the gas due to conversion of the same from liquid into gaseous form.

By the employment of such an apparatus I am enabled to avoid the wasteful and unnecessary practice of permitting the liquefied oxygen to gasify and thereafter compress the same to the proper tension and forcing it under such compression into the cylinders or tanks in which it is distributed in commerce to users situated at widely separated points.

By my invention I am enabled not only to eliminate the operation of compressing the oxygen gas as above indicated, but I employ the oxygen to effect cooling of warm air to be subsequently liquefied and for removing therefrom all water and carbon dioxid, such cooling being effected, as is well known, by the heat taken up by converting the oxygen from liquid to gaseous form.

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 to simplify the description of my invention and in order to render the same more comprehensible and in order that the practical advantages thereof may be more easily understood, reference should be had to the accompanying drawing in which I have illustrated more or less schematically one constructional form of embodiment thereof. It will be understood, however, that changes in the details of construction may be made within the scope of the claims without departing from my invention.

In the drawing, 1 designates a container for liquid oxygen, which container may be at the base of a rectifying column in which the oxygen is separated from the nitrogen of the air, and 2 designates a pipe leading from the said container. 3 designates schematically a force pump having a piston 4 which operates in a cylinder 5 opening from a chamber 6 having connection through an opening at 7 with the pipe 2. The opening 7 is adapted to be closed by means of a spring pressed valve 8. The chamber 6 is provided with an opening 9 closed by means of a spring pressed valve 10. It will be observed that the valve 8 is situated inside of the chamber 6 while the valve 10 is situated outside of the said chamber in a passageway 11 communicating with a pipe 12 leading into the passage of the conduit 13 of an interchanger.

It will be understood that as the piston 4 is moved upwardly or outwardly in the cylinder 5 the liquefied oxygen gas is drawn from the container 1 through the pipe 2 into the chamber 6, the valve 8 opening to permit the passage of the liquefied oxygen into said chamber.

Downward movement of the piston 4 drives the liquefied oxygen from the chamber 6 through the opening 9, the valve 10 moving to open position to permit such outward passage of the liquefied oxygen.

The conduit 13 is provided with a spiral passageway 15 formed in the exterior thereof and extending from end to end thereof. The outer wall of this passageway consists of the inclosing tubular member 16 in which the conduit 13 is situated. Preferably the said conduit 13 consists of a metal which is a rapid, that is, a good conductor of heat for reasons to which reference will hereinafter be made. The tubular inclosing member 16 is in turn inclosed by a tubular member 20, the latter being spaced a distance from the former tubular member 16 so as to provide an annular chamber 21 intermediate the two tubular members 16 and 20.

22 designates a pipe for conveying relatively warm air into the annular chamber 21. 23 designates an opening at the lower end of the tubular member 16 on the opposite side thereof from the point in the chamber 21 where the relatively warm air is delivered from the pipe 22. Such warm air entering the spiral passageway 13 through the opening 23, travels upwardly therein, passes outwardly through the pipe 25, and is conveyed

thereby to an air liquefying apparatus of known construction, not shown.

It is desirable and practically of great importance that before the air is introduced into the chamber 21 it shall have been freed of water or moisture, carbon dioxid and other readily condensible impurities. To effect such removal of these more or less readily condensible substances I provide interchangers designated as a whole respectively by the reference numbers 30 and 31.

Oxygen gas and also portions of liquefied oxygen pass from the conduit 13 through a pipe 32 and thence through either the pipe 33 or the pipe 34, the first constituting a part of the interchanger 30 and the second a part of the interchanger 31. Whether or not the gaseous oxygen or the liquefied oxygen or both, as the case may be, passes through the pipe 33 or the pipe 34 depends upon the positions of the three-way valves 40 and 41. In the position in which the said valves are shown the oxygen gas, liquefied oxygen or both, as the case may be, passes through the pipe 33 and absorbs heat from warm air or at least relatively warm air which is delivered from a suitable compression apparatus (not shown) through the pipe 42. The pipe 42 is connected with branch pipes 43 and 44, the former being connected with the interchanger column 45 and the latter, 44, with the interchanger column 46. The position of the two-way valves 47 and 48 determines through which of the columns 45 or 46 the warm air shall pass. The three-way valve 48 is situated at the junction between the branch pipes 50 and 51 connecting an end of the pipe 22 with the interchanger columns 45 and 46.

Preferably the tubes 33 and 34 should be spirally arranged within the interchanger columns 45 and 46 for greater cooling effect and efficiency.

The oxygen gas under the requisite pressure created as a result of the force of expansion due to the conversion of the oxygen from liquid to gaseous form is conducted from either the pipe 33 or 34, depending upon the position of the valves 40 and 41, into a pipe 53 from which the said oxygen gas under pressure is conducted into the cylinder 54.

While only one cylinder 54 is shown, it will be understood that the pipe 53 may be of a length to enable a number of cylinders 54 to be simultaneously charged therefrom.

In order that the ice, frozen carbon dioxid, etc., may be readily removed from the interchanger columns 46 I have provided the upper ends of said columns with valve controlled outlets 60 so that warm air which may be introduced into either of said columns may escape therefrom to one or the other of said outlets. For the purpose of removing water, etc., from the said columns I have provided petcocks 61 at the lower ends of said columns.

In view of the fact that the pressure within the passageway for conducting the oxygen through the apparatus may become very great due to the conversion of the oxygen from a liquid to gaseous form I have provided a safety valve at 62 communicating with the pipe 32 as shown and have also provided a gage 63 for indicating the pressure of the gas within the said apparatus.

As already indicated the employment of an apparatus embodying my invention which permits and enables the use of liquefied oxygen or other similar gas for the filling of the cylinders or tanks eliminates certain operations present in the method of filling oxygen tanks now generally employed, whereby great economy is effected. Furthermore by reason of the elimination of such operations I reduce to a minimum, if I do not entirely avoid, the possibility of the introduction of foreign substances, such as water, into the passageways through which the oxygen is conveyed to the cylinders or tanks which impurities have heretofore found their way into the said cylinders or tanks. The presence of such impurities mixed with the oxygen in the cylinders or tanks is objectionable, therefore it is of great importance that they be eliminated.

I claim:—

1. In an apparatus of the character described, the combination of heat interchanging means having separate passages for liquefied gases and the evaporation products thereof and for the circulation of the heating agent, controllable means for restricting the discharge of said evaporation products whereby pressure developed by evaporation is maintained, and means for positively forcing liquefied gases under pressure into the passage therefor.

2. In an apparatus of the character described, the combination of a plurality of heat interchangers, each provided with a conduit for liquefied gases and the evaporation products thereof and a closed space in heat interchanging relation with said conduit for the circulation of the heating agent, means connecting the conduits in the respective heat interchangers, means connecting the circulating space in the respective interchangers, controllable means for restricting the discharge of said evaporation products whereby pressure developed by evaporation is maintained, and means for positively forcing liquefied gases under pressure into one of said conduits.

3. In an apparatus of the character described, the combination of a plurality of heat interchangers each having a conduit for liquefied gases and the evaporation products thereof and a closed space in heat interchanging relation with said conduit for

the circulation of the heating agent, means connecting the conduits in the respective interchangers, means connecting the circulating space in the respective interchangers, means for positively forcing liquefied gases into the conduit of one of said interchangers and controllable means for restricting the discharge of said evaporation products from the conduit in the other interchanger whereby pressure is maintained in both conduits.

4. In combination, a liquefied gas container, an interchanger, means for conveying the said gas in liquefied form to said interchanger, a plurality of interchangers, means whereby the gas may be conveyed from the first named interchanger to either of the second named interchangers at will, means for conveying relatively warm air into either of the said second named interchangers at will and means for conveying the cooled air from either of the said second named interchangers to the first named interchanger, substantially as described.

5. In combination, a liquefied oxygen container, an interchanger, a conduit connecting the said container with the said interchanger, means for forcing liquefied oxygen from the said container to said interchanger, a plurality of interchangers beyond and having connection with the first named interchanger, means for conveying oxygen from the first named interchanger at will to either of the second named interchangers, a cylinder, means for conveying oxygen from either of the second named interchangers to said cylinder, means for supplying warm air to either of the said second named interchangers and means for conveying the partially cooled air from either of said second named interchangers to the first named interchanger, substantially as described.

6. In an apparatus of the character described, the combination of heat interchanging means including separate passages for liquefied gases and the evaporation products thereof and for the circulation of a heating agent, auxiliary heat interchangers arranged to be alternately used and having passages for said evaporation products and surrounding chambers for said heating agent wherein moisture in said heating agent is condensed, means for delivering liquefied gases under pressure to the passage therefor in said heat interchanging means and controllable means for restricting the discharge of said evaporation products from the passages therefor in said auxiliary heat interchangers.

In testimony that I claim the foregoing as my invention, I have hereunto signed my name this 20 day of February, A. D. 1917.

MAX VON RECKLINGHAUSEN.