

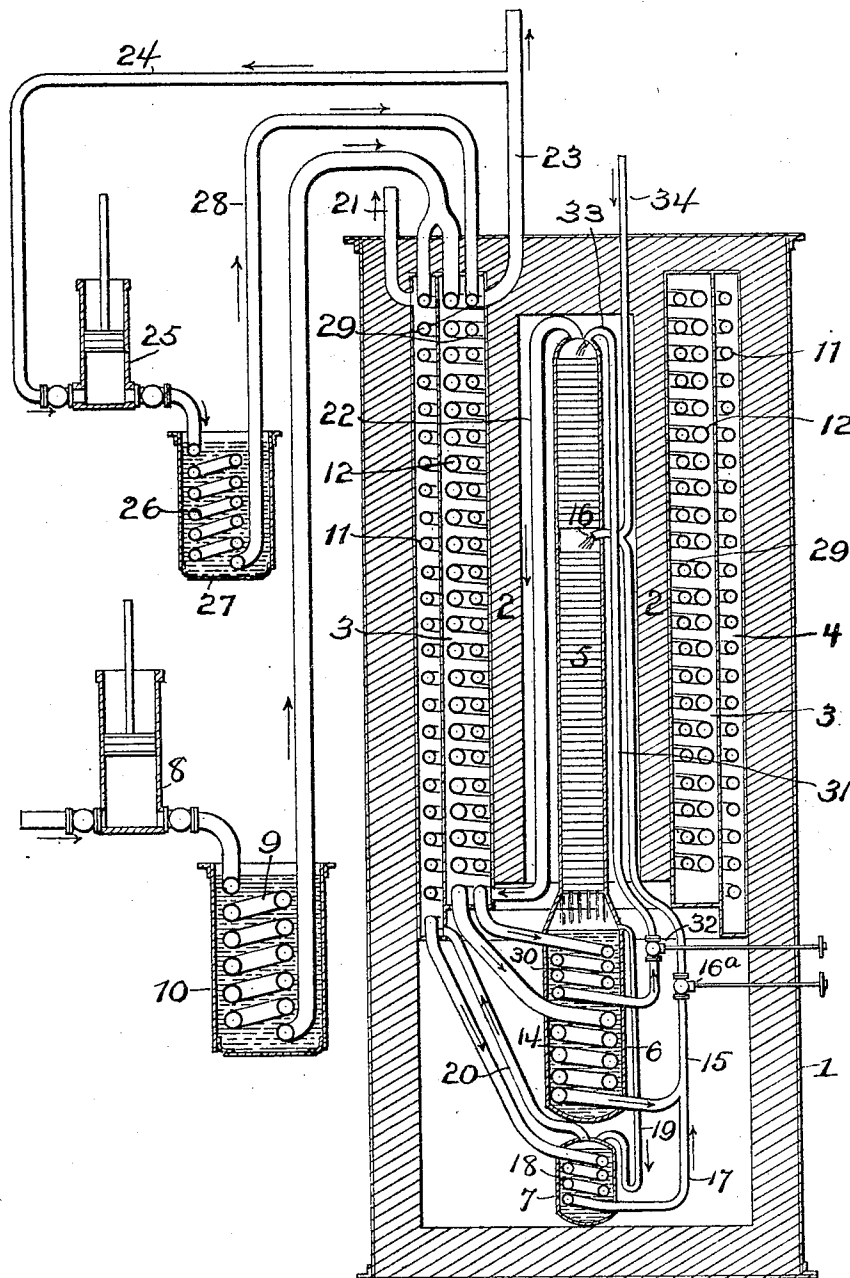
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C. LINDE.

APPARATUS FOR PRODUCING PURE NITROGEN AND PURE OXYGEN.

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WITNESSES  
*E. A. Vottrough*  
*G. F. Downing*

INVENTOR  
*Carl Linde*  
*By H. A. Seymour*  
Attorney

# UNITED STATES PATENT OFFICE.

CARL LINDE, OF MUNICH, GERMANY, ASSIGNOR OF ONE-THIRD TO  
CHARLES F. BRUSH, OF CLEVELAND, OHIO.

## APPARATUS FOR PRODUCING PURE NITROGEN AND PURE OXYGEN.

No. 795,525.

Specification of Letters Patent.

Patented July 25, 1905.

Application filed October 22, 1903. Serial No. 178,162.

*To all whom it may concern:*

Be it known that I, CARL LINDE, of Munich, in the Kingdom of Bavaria, Germany, have invented certain new and useful Improvements in Apparatus for Producing Pure Nitrogen and Pure Oxygen; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to an improved apparatus for producing pure nitrogen and pure oxygen, the object of the invention being to provide an improved apparatus in which liquefied gas is rectified in repeated operations to separate the liquid and vapors therefrom into the constituent elements thereof; and with this object in view the invention consists in certain novel features of construction and combinations and arrangement of parts, as will be more fully hereinafter described, and pointed out in the claims.

The accompanying drawing is a view in longitudinal section, illustrating my improvements.

1 represents a casing or receptacle lined with suitable insulating material and provided with a depending cylindrical partition 2, between which and the outer wall of the casing inner and outer cylindrical counter-current chambers 3 and 4 are located, and my improved rectifying-column 5 is located in the central portion of the casing and has a liquid-chamber 6 at the lower end thereof and a separate liquid-tank 7 below the same.

8 represents an air-pressure pump from which the air is conveyed through a coil 9 in cooling-tank 10, and the pipe divides into two coils 11 and 12, the former located in counter-current chamber 4 and the latter in chamber 3. The pipe 12 after passage through chamber 3 enters the lower portion of liquid-chamber 6 and coils therein, as shown at 14, and a pipe 15 connects the discharge end of this coil 14 with a discharge-nozzle 16, directing the liquid downward into the lower portion of column 5, a suitable throttle-valve 16<sup>a</sup> being provided in said pipe 15.

The pipe 11 passes out of chamber 4 at its lower end and coils in separate liquid-tank 7, as shown at 18, and a pipe 17 connects the discharge end of coil 18 with pipe 15, below the throttle-valve 16<sup>a</sup> therein.

A pipe 19 connects the upper portion of liquid-chamber 6 with tank 7 to form a siphon

and drain the overflow of liquid from chamber 6 to tank 7.

A pipe 20 connects the top of tank 7 with the lower end of chamber 4, and an oxygen-outlet 21 is provided at the upper end of said chamber 4. A pipe 22 connects the upper end of column 5 with the lower end of chamber 3 for the passage of nitrogenous vapors, and a nitrogen-outlet pipe 23 communicates with the top of chamber 3. A pipe 24 connects this pipe 23 with the inlet of a pump 25, which latter forces the vapor or gas through a coil 26 in a cooling-tank 27, from which it passes through pipe 28 and coil 29 in chamber 3 and then coils in the upper portion of chamber 6, as shown at 30, and a pipe 31, having a throttle-valve 32 therein, communicates with the discharge end of coil 30 and has a nozzle 33, discharging into the top of column 5.

A liquid-air-supply pipe 34 communicates with nozzle 16 to supply liquid air thereto to start the apparatus and to make up deficiencies in work.

The operation of my improvements is as follows: Air or other mixed gas is compressed by pump 8, cooled in the coil 9 in tank 10, and further cooled in the coils 11 and 12 in counter-current chambers 3 and 4. From coil 12 the gas passes to coil 14 in liquid-chamber 6; liquefying therein and boiling the liquid in said chamber. The liquid in coil 14 passes up pipe 15, past throttle-valve 16<sup>a</sup>, and is discharged through nozzle 16 into the lower half of column, when in its downward passage through the column it contacts with the ascending vapor from chamber 6 to exchange its nitrogen for the oxygen of the vapor. The vapor escaping from the top of column 5 passes through chamber 3 and pipe 23 and a portion is again compressed by pump 25, cooled in the coil 26 in tank 27, and passes through pipe 28 and coil 29 and into a coil 30 in chamber 6, where it is liquefied, boiling the liquid in said chamber. The liquid from coil 30, which contains at first, say, seven per cent. oxygen, flows through pipe 31 past valve 32 and is discharged by nozzle 33 into the top of column 5 and in the upper portion of said column exchanges its nitrogen for oxygen in the ascending vapor, so that a continued operation of the apparatus results in a gradual self-intensified rectification in the upper portion of column 5 until pure nitrogen escapes from the top thereof and pure liquid oxygen escapes from chamber 6 through pipe 19 into

tank 7, when it is vaporized by the incoming gas in coil 18 and escapes as pure oxygen from outlet-pipe 21.

A great many changes might be made in the general form and arrangement of the parts described without departing from my invention, and hence I would have it understood that I do not restrict myself to the precise details set forth, but consider myself at liberty to make such slight changes and alterations as fairly fall within the spirit and scope of my invention.

Having fully described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In an apparatus for producing pure nitrogen and pure oxygen, the combination of a rectifying-column, a chamber for liquefied gas at the lower end thereof, a pipe-coil in said liquid-chamber in which a mixed gas is liquefied and boils a quantity of the liquid in said chamber, a pipe conveying the liquid in the coil into the column between its ends to rectify the ascending vapor from the chamber, another coil in the liquid-chamber, into which the escaping vapors from the top of the column are forced and liquefied therein, and a pipe conveying the liquid from said last-mentioned coil to the top of the column.

2. In an apparatus for producing pure nitrogen and pure oxygen, the combination of a rectifying-column having a liquid-chamber at its lower end, two pipe-coils in said liquid-chamber, means for forcing a compressed mixed gas into one of said coils to be liquefied therein and boil the liquid, a pipe directing the liquid in said coil into the column between the ends of the latter to be rectified in the lower portion thereof, means for forcing the escaping vapor from the top of the column into the other coil to be liquefied therein, and a pipe for directing the liquid in said last-mentioned coil into the top of said column.

3. In an apparatus for producing pure ni-

trogen and pure oxygen, the combination of a rectifying-column having a liquid-chamber at its lower end, two pipe-coils in said liquid-chamber means for forcing compressed air into one of said coils to be liquefied therein and boil the liquid, a pipe directing the liquid in said coil into the column between the ends of the latter to be rectified in the lower portion thereof, means for compressing, cooling, and forcing the escaping vapor from the top of the column into the other coil in the liquid-chamber to be liquefied therein, a pipe conveying the liquid from said last-mentioned coil to the top of the column to be again rectified in the upper portion thereof, and means for drawing off and vaporizing the excess of liquid in the liquid-chamber.

4. In an apparatus for producing pure nitrogen and pure oxygen, the combination with a rectifying-column having a liquid-chamber at its lower end, two pipe-coils in said liquid-chamber, means for compressing, cooling and forcing air into one of said coils to be liquefied therein, a pipe conveying the liquid from said coil to the rectifying-column between the ends of the latter, an outlet for the vapor from the top of said column, means for compressing a portion of said vapor, cooling the same and conveying it to the other coil in the liquid-chamber, a pipe conveying the liquid from said last-mentioned coil to the top of the column to be self-intensified in its rectification therein, a tank, means for conveying the excess of liquid in the chamber into said tank, and means for evaporating said liquid and a separate outlet therefor.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

CARL LINDE.

Witnesses:

ABRAHAM SCHLESINGER,  
ANNIE LUTHER.