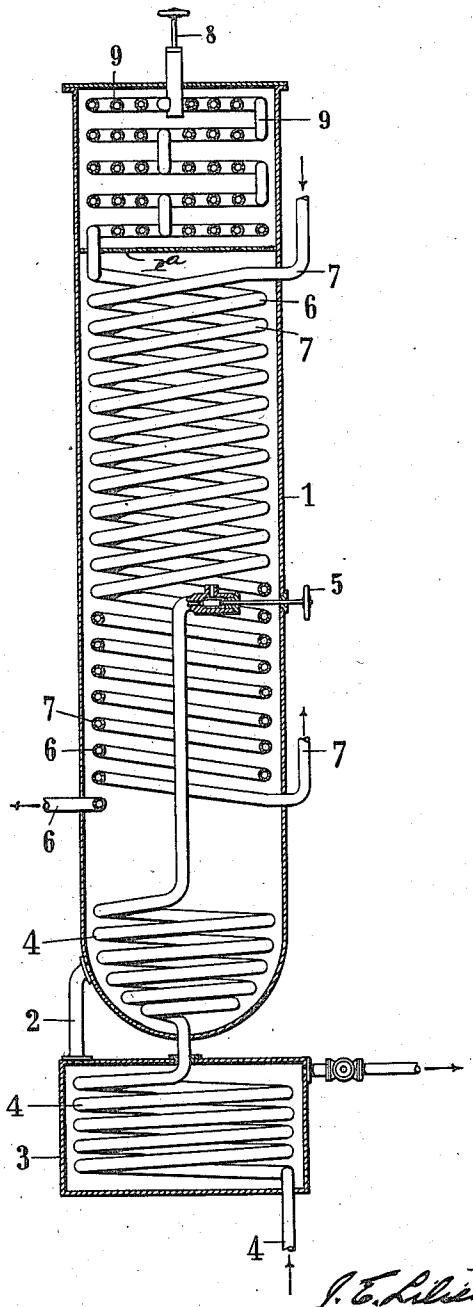
J. E. LILIENFELD.

METHOD OF SEPARATING GAS MIXTURES.

APPLICATION FILED OCT. 13, 1911.

1,163,423. Patented Dec. 7, 1915.



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UNITED STATES PATENT OFFICE.

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METHOD OF SEPARATING GAS MIXTURES.

1,163,423. Specification of Letters Patent. Patented Dec. 7, 1915.

Application filed October 13, 1911. Serial No. 654,524.

To all whom it may concern:

Be it known that I, JULIUS EDGAR LILIENFELD, doctor of philosophy, scientist, a subject of the Austrian Emperor, and resident of Leipzig, Saxony Germany, (whose post-office address is Ferdinand Rhode Strasse 24,) have invented new and useful Improvements in Methods of Separating Gas Mixtures, of which the following is a specification.

The present invention relates to improved methods of separating gas mixtures, and consists in the steps and processes hereinafter described and claimed.

Previous methods for separating the components of atmospheric air have depended for their effectiveness upon the use of the return current principle and upon the employment of as effective an insulation as possible against the outside air. In these prior methods, air, or at least a large portion thereof, is first liquefied and the oxygen then recovered from the liquefied air by rectification.

In my improved process, the gaseous component of air having the lower boiling point is not liquefied and collected in such state, nor are any intermediate liquid products collected; thus eliminating the labor which is necessary in previous methods.

According to the present invention, the increase in entropy is reduced as far as possible by the practical method in carrying out the process of separation, and by such means a considerable saving in labor is obtained compared to the best existing devices; in fact greater than if an access of heat from outside were entirely prevented.

The present process will be described with reference to the accompanying drawing, wherein the figure is a vertical sectional view of an apparatus for carrying out the process.

Referring more particularly to the drawing, 1 indicates a casing, wherein, in accordance with the present invention, a constant pressure is maintained, which pressure is lower than that to which the gas mixture introduced, has been previously subjected. The casing constitutes the chamber within which the gas mixture is introduced and wherein the process is conducted, that constituent of the gas mixture having the higher boiling point being precipitated to the bottom of the casing, whence the same may overflow through a pipe 2 and into an evaporator 3 located beneath the casing 1.

The casing 1 is provided with a perforated partition 1^a, the same dividing the casing into upper and lower compartments, in the upper compartment of which is located a coil 9 in open communication at its upper end with the interior of the compartment and under the control of a valve 8. The coil 9 in the upper compartment above the partition 1^a is arranged to communicate with a coil 6 in the lower compartment, and the coil 6 is arranged to communicate with the atmosphere. A coil 7 is further provided in the casing 1 for the circulation therethrough of an external cooling medium, which may be a gas mixture similar to that of the mixture upon which the process is operating.

The gas mixture, having been pre-cooled under suitable pressure, is introduced at the lower end of the lower section of the coil 4 which latter is located in the evaporator 3, and the gas mixture is circulated therethrough, yielding in its passage its heat to the condensed constituent in the evaporator, which thereby operates to volatilize the condensed constituent, and the latter may be drawn off in the gaseous state and conducted to storage tanks for use.

After passing through the lower section of the coil 4 the gas mixture thereupon ascends to the upper section, which is located in the bottom of the casing 1 and is surrounded by the liquid constituent which acts to further cool the gaseous mixture. Under the control of the valve 5 the gaseous mixture is permitted to issue into the casing 1, and, as the pressure therein is lower than that to which the gas mixture has been previously compressed, such gas mixture will be permitted to expand in the casing and will thereby become still further cooled. It is to be understood that the various steps in cooling the gas mixture are to be so arranged that after the mixture has issued into the casing 1 the same will be cooled to a very low degree above that of liquefaction.

In issuing past the valve 5, the gas mixture will rise in the casing 1, and a portion thereof will be admitted through the perforated plate 1^a into the upper compartment of the casing and thence into the coil 9, as controlled by the valve 8. The coil 9, being in communication with the atmos-

phere, will permit a further cooling of the gas mixture by expansion, and the portion so cooled will be led downwardly through the coil 6 and assist in cooling the gas mixtures in the lower compartment of the casing. It is to be understood that the temperature of that portion of the mixture admitted to the coil 9 has been reduced, by expansion to atmospheric pressure, to a degree lower than that of the constituent element having the higher boiling point. The medium thus cooled and passed through the coil 6 will therefore be very effective in condensing the constituent of the gas mixtures in the casing 1, having the higher boiling point, which condensed mixture will be precipitated to the bottom of the casing, and, as above explained, will overflow through the pipe 2 into the evaporator 3, from which the same is drawn off in the gaseous state.

The coil 6 is assisted in its action by a similar coil 7, arranged to receive and circulate a cooling medium, which may be a gaseous mixture of the same constituent elements as that of the mixture subjected to the process, and which cooling medium is to be maintained at a temperature higher than that of the finally expanded portion of the gas mixture.

It will be understood from the foregoing that, in accordance with the present process, the component having the higher boiling point is recoverable from the gas mixture without the necessity for liquefying the entire mixture and without producing any intermediate products.

It is obvious that those skilled in the art may vary the details of construction and arrangement of parts without departing from the spirit of my invention, and therefore I do not wish to be limited to such features except as may be required by the claims.

I claim:

1. The herein described method of separating two components of a gaseous mixture, which consists in compressing and cooling the mixture, then expanding the compressed and cooled mixture to a constant pressure within a chamber for further cooling the mixture to a temperature above that of liquefaction, then finally expanding a portion of the mixture to atmospheric pressure for cooling such portion to a temperature below the critical temperature of the gaseous component having the higher boiling point, then progressively subjecting successive portions of the mixture at constant pressure in said chamber to the cooling action of such finally expanded portion of the mixture, and simultaneously subjecting the successive portions of the mixture at constant pressure in said chamber to the action of a cooling medium having an initial temperature higher than that of such finally expanded portion of the mixture.

2. The herein described method of separating two components of a gaseous mixture, which consists in pre-cooling the gas mixture under pressure, progressively subjecting said pre-cooled compressed gas mixture to the action of a cooling medium at different temperatures, expanding the compressed cooled gas mixture to a constant pressure for further cooling the mixture to a temperature above that of liquefaction, finally expanding a portion of the mixture to atmospheric pressure for cooling such portion to a temperature below the critical temperature of the gaseous component having the higher boiling point, progressively subjecting successive portions of the mixture at constant pressure in said chamber to the cooling action of such finally expanded portion of the mixture, and simultaneously subjecting the successive portions of the mixture at constant pressure in said chamber to the action of a cooling medium having an initial temperature higher than that of such finally expanded portion of the mixture.

In testimony, that I claim the foregoing as my invention, I have signed my name in presence of two witnesses, this 3d day of October 1911.

DR. JULIUS EDGAR LILIENFELD.

Witnesses:
RUDOLPH FRICKE,
MAX PRESSLER.