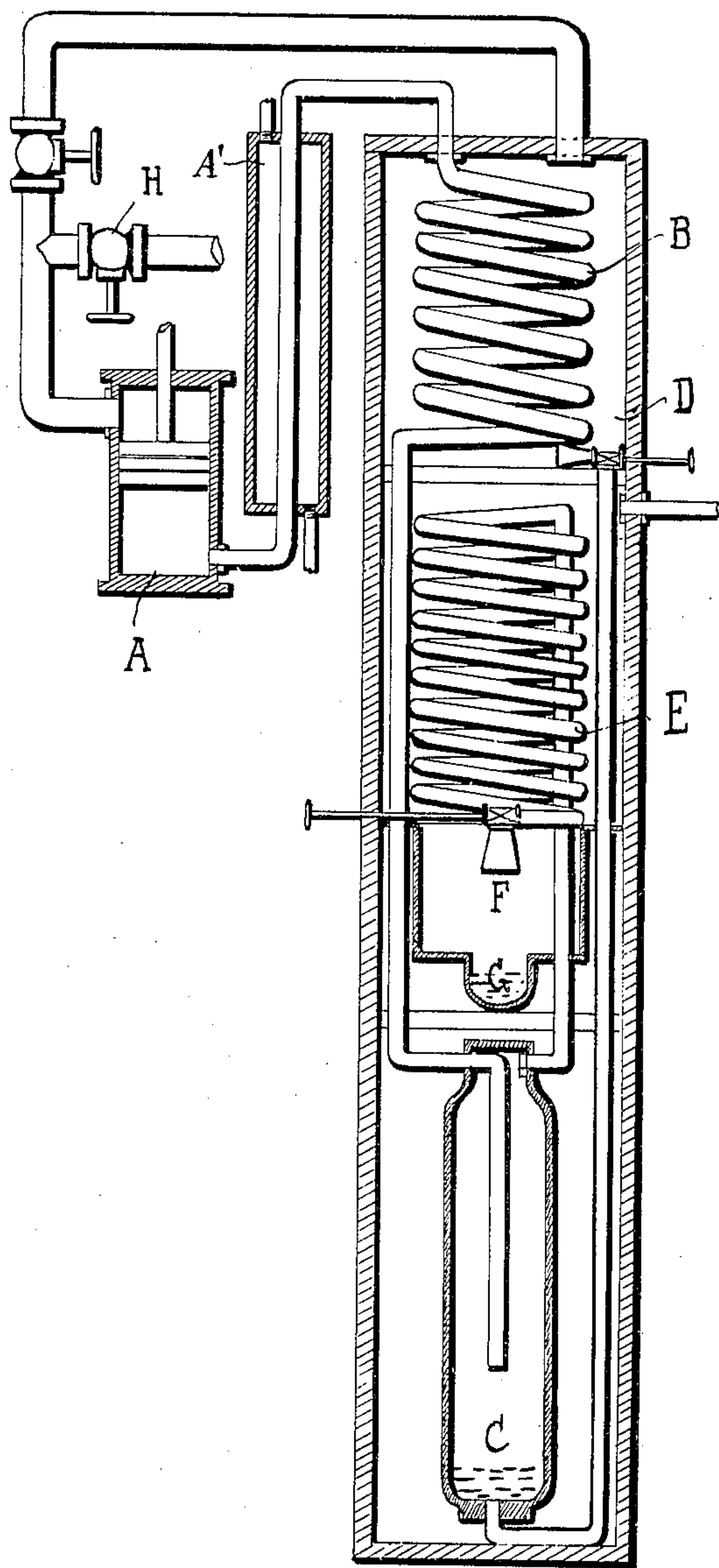


G. HILDEBRANDT.
 PROCESS FOR COOLING AND LIQUEFYING GASES.
 APPLICATION FILED DEC. 4, 1907.

962,836.

Patented June 28, 1910.



Witnesses
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UNITED STATES PATENT OFFICE.

GOTTHOLD HILDEBRANDT, OF BERLIN, GERMANY.

PROCESS FOR COOLING AND LIQUEFYING GASES.

962,836.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, GOTTHOLD HILDEBRANDT, a subject of the Emperor of Germany, residing at Berlin, Germany, have invented an Improved Process for Cooling and Liquefying Gases, of which the following is a specification.

This invention relates to the cooling and liquefying of gases and apparatus therefor.

10 Gases which are difficult to liquefy, such as oxygen, nitrogen, etc., when cooled by means of the expansion of the strongly compressed gas itself, require the expenditure of a larger amount of mechanical energy than other
15 gases which are easier to liquefy, such, for example, as ammonia, carbonic acid (CO_2), etc. For this reason refrigerating machines worked by means of ammonia, carbonic acid
20 to refrigerating machines worked with air.

In the cooling and liquefying of gases which are difficult to liquefy, i. e., which have a very low boiling point, it has been proposed to use in addition to machinery for
25 liquefying by means of air, separate refrigerating machines worked with ammonia or carbonic acid gas in order to effect the preliminary cooling of the compressed air in a cheaper and more efficient manner than
30 would have been possible by the use simply of the compression, watercooling and expansion of the air. This arrangement has the drawback of necessitating additional machinery involving greater initial expense and
35 more supervision. According to this invention this disadvantage is obviated by mixing with the gas of very low boiling point, a gas with a higher boiling point, compressing the mixture and after removal of the heat
40 of compression, liquefying the gas of higher boiling point at an earlier stage than that at which the liquefaction of the gas with the lower boiling point takes place, such liquefied gas being then allowed to expand and
45 assist in the liquefaction of the gas with the low boiling point or to cool a further supply of the mixed gas.

Where the gas to be treated is already in the form of a mixture of gases having different boiling points, as for example in dealing
50 with atmospheric air which always contains a proportion of carbonic acid gas, the presence of the gas of comparatively high boiling point is utilized in this way, and the
55 expense and trouble of the preliminary with-

drawal of the carbonic acid gas by chemical or mechanical means is avoided.

The improved method can be carried out in various ways, and is not dependent on the use of particular forms of apparatus, but one suitable construction is illustrated by way
60 of example in the accompanying drawing.

The mixture, which for the sake of example may be assumed to consist of air and carbonic acid gas, is first compressed in a
65 compressor A, and after the compressed gas has been passed through a water or other cooler A¹ in order to withdraw the heat of compression from it, the compressed gas passes through the coils of a preliminary
70 cooler B and separates in the collector C, the carbonic acid which is liquefied before the air is liquefied. This separated and liquefied carbonic acid is allowed to expand in the vessel D which surrounds the pre-
75 liminary cooling apparatus B, and the air from which the carbonic acid has been separated passes from the top of the vessel C through another cooling or heat-exchanging
80 apparatus E, and then is allowed to expand in the chamber F in which it is liquefied, and collected as at G. Any air remaining unliquefied surrounds the heat-exchanging
85 device E and then escapes into the atmosphere or into another chamber.

The addition of the gases of higher boiling point can be effected in any convenient way. In the example illustrated, the outlet of the evaporating chamber D for the carbonic acid gas can be connected to the
90 suction valve of the compressor pump, and the pipe constituting the said connection is provided with an air-suction valve H so that at every stroke of the piston fresh air containing a small proportion of new free car-
95 bonic acid gas can be drawn in together with the carbonic acid expanded in the chamber D.

In arranging the apparatus care is taken that the liquefaction of the gas with the higher boiling point takes place in such a
100 part of the apparatus that it cannot freeze and obstruct any pipe or other passage.

What I do claim, and desire to secure by Letters Patent is—

1. The hereinbefore described process of
105 cooling and liquefying a gas having a relatively low boiling point, consisting in first mixing the said gas having a relatively low boiling point with another gas having a relatively high boiling point, then com-
110

pressing the mixture of said gases, then removing the heat of compression from the said mixture of gases and then liquefying the said gas having the relatively high boiling point and permitting the same to expand to be utilized in other cooling processes.

2. The hereinbefore described process for cooling and liquefying a gas having a relatively low boiling point, consisting in first mixing the said gas having a relatively low boiling point with a gas having a relatively high boiling point, then compressing the said mixture of gases, then removing the heat of compression from the said mixture of gases and then liquefying the said gas having the relatively high boiling point and permitting the same to expand to be utilized in assisting in liquefying the said gas having the relatively low boiling point.

3. The hereinbefore described process for cooling and liquefying a gas having a relatively low boiling point, consisting in first mixing the said gas having a relatively low boiling point with a gas having a relatively high boiling point, then compressing the said mixture of gases, then removing the heat of compression from the said mixture of gases, then liquefying the said gas having the relatively high boiling point and per-

mitting the same to expand to be utilized in assisting in liquefying the said gas having the relatively low boiling point, said gas having a relatively high boiling point being maintained in the cycle of the process.

4. The hereinbefore described process for cooling and liquefying gases having low boiling points, consisting in first mixing a gas having a relatively low boiling point with a gas having a relatively high boiling point, then compressing the mixture of said gases, then removing the heat of compression from the said mixture of gases and then liquefying the said gas having a relatively high boiling point and permitting the same to expand to be utilized in assisting in the liquefaction of the gas having the relatively low boiling point, the liquefaction of the said gases taking place in separate stages and the liquefaction of the gas of the relatively high boiling point occurring in such a stage of the process that the temperature thereof is sufficiently high to prevent it from freezing.

Signed by me this 21st day of November 1907.

GOTTHOLD HILDEBRANDT.

Witnesses:

HENRY HASPER,
WOLDEMAR HAUPT.