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Name ALBERT EINSTEIN AND LEO SZILARD

Assors to Electrolux Servel Corporation, of New York, N.Y. a corp of Delaware.

(1) (2)

of BERLIN BERLIN-WILMERSDORF

~~State of~~ GERMANY

Invention

REFRIGERATION ~~REFRIGERATING APPARATUS WITHOUT ABSORPTION OF THE COOLING AGE~~

ORIGINAL

APPLICATION FILED COMPLETE DEC 16, 1927

PARTS OF APPLICATION FILED:

Petition, Specification, Oath, First Fee $20, DEC 15, 1927

~~2 Sheets Drawings~~

1 SHEETS DRAWINGS 1/4 DEC 16, 1927

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By Commissioner.

Final Fee

Attorney WM. T. HEDLUND 51 EAST 42ND ST NEW YORK N.Y.

Associate Attorney

No. of Claims Allowed 5 Print Claims 1 in O.G. [illegible]

Title as Allowed

Refrigeration

GERMANY - DECEMBER 16 1926

Division of App. No. filed 19

U. S. PATENT OFFICE
DEC 20 1927
DIV. 41 PAPER No. 1

240566

Petition

TO THE COMMISSIONER OF PATENTS:

Your petitioners Albert Einstein, a citizen as well of Germany as of Switzerland, residing at Berlin, Germany, professor, whose post-office address is Berlin W 30, Haberlandstrasse 5, Germany, and Leo Szilard, a citizen of Hungary, residing at Berlin-Wilmersdorf, Germany, whose post-office address is Berlin-Wilmersdorf, Prinzregentenstrasse 95, Germany, pray that Latters Patent may be granted to them for improvements in refrigerating apparatus without absorption of the cooling agent set forth in the annexed Specification.

And they hereby appoint Wm. T. Hedlund, of 51 East 42nd Street, New York, N.Y., Registry No. 12075, their Attorney with full power of substitution and revocation, to prosecute this application, to make alterations and amendments therein, to sign their name to the drawings, to receive the Letters Patent, and to transact all business in the United States Patent Office connected therewith.

Signed at Berlin , in the ~~County of~~ and State of Germany this 2nd day of December 1927

Albert Einstein
Leo Szilard

Specification.

TO ALL WHOM IT MAY CONCERN:

Be it known that we, Albert Einstein, citizen as well of Germany as of Switzerland, residing at Berlin, Germany, and Leo Szilard, citizen of Hungary, residing at Berlin-Wilmersdorf, Germany, have invented certain new and useful improvements in Refrigeration ~~refrigerating apparatus without absorption of the cooling agent~~, of which the following is a specification:

The present invention relates to a refrigerating apparatus in which the evaporator contains a cooling agent A, for instance butane, methyl bromide or the like, in condensed state, and in which a vapor B, for instance ammonia vapor, is supplied in gaseous state to the evaporator. The vapor B then mixes with the vapor of the cooling agent A, and the mixture of said two vapors flows into a condenser which contains a third substance C, for instance water, by means of which the pressure of saturation of the auxiliary gas B is reduced. In this manner the gaseous phase in the condenser will be deprived of the gas B. As the total pressure then remains the same, the partial pressure of the vapour A in the condenser will be correspondingly increased so that the vapour A in same will be over-saturated and condensed. The condensed cooling agent A, which should be as insoluble as possible in the mixture of the substances B and C, is, in the simplest way, automatically separated from the mixture B + C on account of its different specific weight and is returned from the condenser to the evaporator. The mixture of the substances B and C is preferably supplied to a separate generator in which the substance B is transferred into gaseous state, cooled and returned into the evaporator in gaseous state, whereas the remainder, rich in the substance C, is also cooled and returned to the condenser. In this manner, vapor of the cooling agent A is continuously carried away from the evaporator by the current of the substance B, and the cold is produced in the evaporator by the evaporation of the substance A. It is to be observed that a system operating in this manner does not constitute an absorption

refrigerating apparatus and that the substance B, for instance the ammonia ~~vapour~~ vapor, does not partake directly in the production of cold, being supplied to the evaporator in gaseous state. The cooling effect depends exclusively on the quantity of substance A evaporating in the evaporator or its heat of evaporation, respectively. This substance A, the cooling agent, will, however, not be absorbed in the condenser but directly condensed in same. The condensation of the gases A and B in the condenser may take place in the same vessel or fractionally but the former seems to give the best result.

As any condensation of the auxiliary gas B is not required, the apparatus may also work with ammonia as such auxiliary gas B at an arbitrarily small total pressure. The total pressure is practically the same in all parts of the apparatus except for the pressure differences ~~differences~~ which may be equalized by the hydrostatic pressure of liquid columns. Instead of ammonia, sulphurous acid or carbonic acid or the like may be used as auxiliary agent B in which case water may also be used as substance C. However, steam may also be used as auxiliary agent B in which case sulphuric acid may be used as substance C. Preferably, the substance C shuld at all events be as little volatile as possible.

Fig. 1 shows, as example, an embodiment of the invention. 1 designates the evaporator containing a cooling agent 2. For the sake of simplicity it may be assumed that methyl bromide is used as cooling agent. Through the pipe 3 gaseous ammonia enters the evaporator and flows from this pipe 3 into the cooling agent through a distributor 4. Divided into several small bubbles, the gaseous ammonia then rises into

the liquid cooling agent 2 and is saturated in this manner, very completely, with the vapor of the methyl bromide. The mixture of the two gases flows then through the conduit 5 into the condenser 6 into which water is dropping continuously from the conduit 7. Preferably the water flows along the wall 8 of the condenser which wall is cooled by cooling water. The pressure of saturation of the ammonia being strongly reduced in the presence of water, gaseous ammonia will be taken up by the water, the gaseous phase in the condenser 6 being in such manner deprived of said gaseous ammonia. As the total pressure remains constant in this process, the partial pressure of the methyl bromide will be correspondingly increased on account of the disappearance of the ammonia, especially close to the walls, so that the vapour of methyl bromide will be oversaturated and condensed at the walls of the condenser simultaneously with the ammonia. Gaseous ammonia and vapor of methyl bromide tend simultaneously to approach the walls of the condenser, and the condensation proceeds very rapidly, the velocity of condensation depending in the first place on the speed with which the heat is removed at the walls of the condenser. The condensed methyl bromide has a higher specific weight than the ammonia water und collects in the condenser as at 9, whereas the ammonia mixture 10 floats above. The methyl bromide in the condenser flows to the evaporator through the conduit 11. 12 designates a cooling jacket for cooling the condenser 6. The ammonia mixture is transferred into the vessel 15 through the pipe 13 by means of gas bubbles rising in the pipe 14, said gas bubbles being formed by heating said pipe 14 by means of heating jacket 15 so that gaseous ammonia is driven out from the water rich in ammonia. In the vessel 15 the bubbles of gas

are separated from the water, and the gas thus liberated enters the condenser 6 through the pipe 16, the quantity of such gas being only small and lost for the useful work of the apparatus. The water rich in ammonia is deprived of ammonia in the generator 17 which it enters from the vessel 15 through the pipe 18, said generator being disposed at a lower level than the vessel 15 which communicates with the condenser 6 through the pipe 16. As, consequently, the total gas pressure in the vessel 15 is equal to that in the condenser 6 and to that in the evaporator 1 above the liquid level of the methyl bromide, the gas pressure in the generator 17 is higher corresponding to the hydrostatic pressure of the liquid column h in the pipe 18. By this means the gaseous ammonia will be forced from the generator 17 through the pipe 3 into the evaporator beneath the liquid level of the methyl bromide, provided that the hydrostatic pressure of the column h_1 is higher than that of the column h_2 of the methyl bromide. On account of the over-pressure in the generator 17 the water deprived of ammonia is again forced into the condenser 6 through the pipe 7. Thereby throttling means must be provided, as otherwise too much liquid would be driven into the condenser from the generator on account of the high over-pressure. Preferably the opening 19 of the pipe 7 is provided with a porous cap through which liquid may pass but through which no gas can flow, when the liquid level in the generator has descended below said cap on account of the capillary action preventing the liquid from being forced out of the pores by the gas. Since the water, poor in ammonia, should enter the condenser through the pipe 7 in cold state, the pipes 7 and 14 may be combined to a heat exchanger as indicated at #6 whereby the pipe 7 may be further cooled.

In the same manner the pipes 5 and 11 may also be combined to a heat exchanger. In this way vapor of methyl bromide will be perpetually carried away from the evaporator by the gaseous ammonia, cold being produced by the evaporation of the methyl bromide.

It is of the utmost importance that the pressure of the ammonia in the generator is chosen in a suitable manner. When working with very small pressures of the ammonia, the cooling effect of the apparatus will be very small. On the contrary the pressure of the ammonia vapor in the generator has a definite limit upwards. This fact may be easily proved by a calculation which also gives an idea of the manner of dimensioning the apparatus. Assuming the temperature of the cooling water to be (centigrade) 25°, and, consequently, also that of the condenser to be 25° and the temperature in the evaporator to be -5°, then it is, for instance, quite impossible to operate with a pressure of ammonia vapor of 10 atm. (atmospheres) in the generator, as the total pressure is approximately the same in all parts of the apparatus. As almost only gaseous ammonia is supplied to the generator, the partial pressure of the ammonia in the same would, consequently, be equal to the total pressure, i.e.10 atm. In the evaporator the partial pressure of the ammonia must be smaller than the pressure of saturation of ammonia at -5°, that is to say smaller than approximately 3 1/2 atm. As the total pressure in the evaporator is also 10 atm., then the partial pressure of the cooling agent in the evaporator must, consequently, amount to 6 1/2 atm. However, the partial pressure of the ammonia in the condenser is at all events different from zero, so that in this vessel less than 10 atm. are to be supported by the cooling agent. When assuming a temperature

of the condenser of 25°, the ~~vapour~~ vapor of the cooling agent must, consequently, be saturated at a lower pressure than 10 atm., but it is shown above that the pressure of saturation at -5° can not amount to higher than 6 1/2 atm. The ratio of the pressures of saturation of the cooling agent at 25° and -5° would, consequently be smaller than 10:6,5, i.e. 1,54. A substance that can be used as cooling agent under these circumstances and for which this ratio is so low can probably not be found. From this it is evident that it is necessary at all events to operate with pressures of gaseous ammonia that are far below 10 atm. Consequently, any condensation of the gaseous ammonia driven out can not take place at chamber temperature or normal temperature of cooling water, so that, certainly, the ammonia at all events enters ~~in a gaseous state~~ in a gaseous state the evaporator containing the cooling agent. When operating with relatively high temperatures of the gaseous ammonia, then at low temperatures in the evaporator condensation and re-evaporation of the gaseous ammonia may occur. It is evident that in this case the heat of evaporation of the ammonia does not partake in the cooling effect of the apparatus, as on evaporation of the condensed ammonia only the heat is removed that is liberated on the condensation.

Fig. 2 shows another embodiment of the invention. Also in this case it is assumed that the cooling agent has the higher specific gravity. In this embodiment the water rich in ammonia leaves the condenser 20 and is ~~riced~~ passing through conduit raised to the ~~point~~ level P by the aid of gas bubbles in the pipe 21 which forms a heat exchanger together with the pipe 22 through which the water poor in ammonia leaves the generator 23. ~~From~~ After leaving pipe 22, the water, still rich in ammonia, flows ~~over~~ past the fins ~~of~~ on the

pipe 22 in the pipe 24, which is shown in ~~section I-B~~ fig. 5, downwards into the generator 23. The gaseous ammonia driven out which may contain ~~any~~ some steam rises in the pipe 24 and will in this manner come into intimate contact with the water rich in ammonia dropping downwards. In this manner cooling of said ammonia will be effected and, moreover, the ~~vapour~~ vapor of ammonia will be deprived of any steam entrained therewith. The cooling is effected by ammonia evapporating from the water rich in ammonia ~~while being~~ which evaporation requires the absorption of heat. The separation of steam will be effected firstly by said cooling and secondly by the fact that the partial pressure of the steam in the water rich in ammonia is decreased. The ~~vapour~~ vapor of ammonia thus cooled and deprived of water is conducted into the evaporator through the pipe 25. The manner of operation of the apparatus shown in fig. 2 is the same as that of the embodiment shown in fig.1.

Fig. 3 shows diagrammatically a third embodiment. ~~Contrary~~ In distinction to the two embodiments described above, the cooling agent ~~is~~ in this embodiment is assumed to have a smaller specific weight than the mixture of ammonia water. Such a cooling agent may be butane. The water rich in ammonia indicated at 26 flows through the pipe 27 and the heat exchanger 28 into the generator 29 in which the ammonia is driven out by heating and supplied to the evaporator through the pipe 30. The gaseous ammonia in the generator stands under a pressure of a liquid column h_1 and this hydraulic pressure is sufficient to permit the gaseous ammonia to enter the evaporator as at 31 beneath the liquid level of the cooling agent (the butane). It is only necessary that the height of the liquid column h_2 is held lower than h_1.

Opening into the container 33 is a pipe 32 extending upwards from the generator 29. Through said pipe 32 the water poor in ammonia is by means of gas bubbles raised into the container 33 in which the water is deprived of its gas bubbles. From this container 33 the gas flows through the pipe 34 into the condenser 35 and is lost for the efficiency of the apparatus. Heat may be supplied to the portion 36 of the pipe 32 in order to produce the gas bubbles necessary to transport the water. From the container 33 the water poor in ammonia flows under the action of gravity through the pipe 37 into the condenser 35 in which it drops downwardly. The pipe 37 extends through the heat exchanger 28, and the water poor in ammonia contained therein is further cooled by cooling water, before it enters the condenser. This is indicated in the drawing by the fact that the pipe 37 is shown passing through the cooling jacket of the condenser. The gaseous ammonia leaving the generator may in known manner be conducted through an ascending branch of the pipe 30 through a cooler or rectifier whereby the ammonia is deprived of any steam entrained therewith (not shown in fig.3).

Fig. 4 shows an embodiment in which the cooling agent has the lower specific weight as in the embodiment shown in fig. 3. In distinction to the embodiments described above the mixture of vapour enters the ammonia water mixture through the pipe 38 as at 39 in which mixture gas bubbles in the liquid rise and the ammonia is driven out and the cooling agent is condensed. The circulation of the liquid between the condenser 40 and the generator 41 is maintained essentially on account of the difference in specific weight between the mixture rich in ammonia and that poor in ammonia.

What we claim is:

1. A refrigerating apparatus in which the cold is produced by the evaporation of one ore more cooling agents and in which one or more supplemental gases are supplied in a gaseous state to the evaporator which contains the cooling agent or agents, characterized by the fact that at least one of said supplemental gases is on its circulation brought into contact with one or more substances by means of which the pressure of saturation of said supplemental gas or gases is reduced so far as to deprive the gaseous phase of said supplemental gas or gases.

2. A refrigerating apparatus according to claim 1 characterized by the fact that the supplemental gas enters the evaporator through a conduit which opens beneath the level of the cooling liquid in the evaporator.

3. A refrigerating apparatus according to claim 1 or 2, characterized by the fact that the absorbed supplemental gas is again evaporated in a generator and further characterized by the fact that the gas leaving said generator is in heat exchange with the concentrated liquid mixture flowing to the generator.

4. A refrigerating apparatus according to claim 1 to 3, characterized by the fact that the gases leaving the generator are in direct contact with the concentrated liquid mixture flowing to said generator.

5. A refrigerating apparatus according to claim 1 to 4, characterized by the fact that the poor liquid mixture from the generator is forced into the

condenser through a conduit by means of rising gas bubbles.

6. A refrigerating apparatus according to claim 1 to 4, characterized by the fact that the concentrated liquid mixture is sucked from the condenser through a conduit by means of rising gas bubbles.

IN TESTIMONY WHEREOF we hereunto affix our signature ~~in the presence of two witnesses:~~

Albert Einstein

Leo Szilard

OATH

Consulate General of the United States of America
City of Berlin Empire of Germany } ss:

Albert Einstein and Leo Szilard, the above-named petitioners, being duly sworn, depose and say that they are citizens: Albert Einstein as well of Germany as of Switzerland, and Leo Szilard of Hungary, and residents respectively of Berlin and Berlin-Wilmersdorf, Germany, and that they verily believe themselves to be original, first, and joint inventors of improvements in refrigerating apparatus without absorption of the cooling agent, described and claimed in the annexed specification; that they do not know and do not believe that the same was ever known or used before their invention or discovery thereof, or patented or described in any printed publication in any country before their invention or discovery thereof, or more than two years prior to this application, or in public use or on sale in the United States for more than two years prior to this application; that said invention has not been patented in any country foreign to the United States on an application; filed more than twelve months before this application, or in public use or on sale in the United States for more than two years prior to this application; and that no application for patent on said improvements has been filed by them or their representatives or assigns in any country, except as follows: Germany, filed December 16, 1926 (Application No. S. 77558 I/17 a)

CONSULATE GENERAL BERLIN FEE STAMP

Albert Einstein

Leo Szilard

SWORN to and subscribed before me this 2nd day of December 1927.

SERVICE No. 9376.

$ 2.-

Thomas F. Sherman
Vice Consul of the United States

4

DEC 15 1927 PATENTS

1,716

IN THE UNITED STATES PATENT OFFICE

Application of

ALBERT EINSTEIN AND
LEO SZILARD

Filed Dec. 15, 1927

REFRIGERATING APPARATUS WITHOUT
ABSORPTION OF THE COOLING AGENT.

Dec. 16, 1927

Hon. Commissioner of Patents,

Washington, D. C.

Sir:

Please enter the attached drawings for examination.

Respectfully submitted,

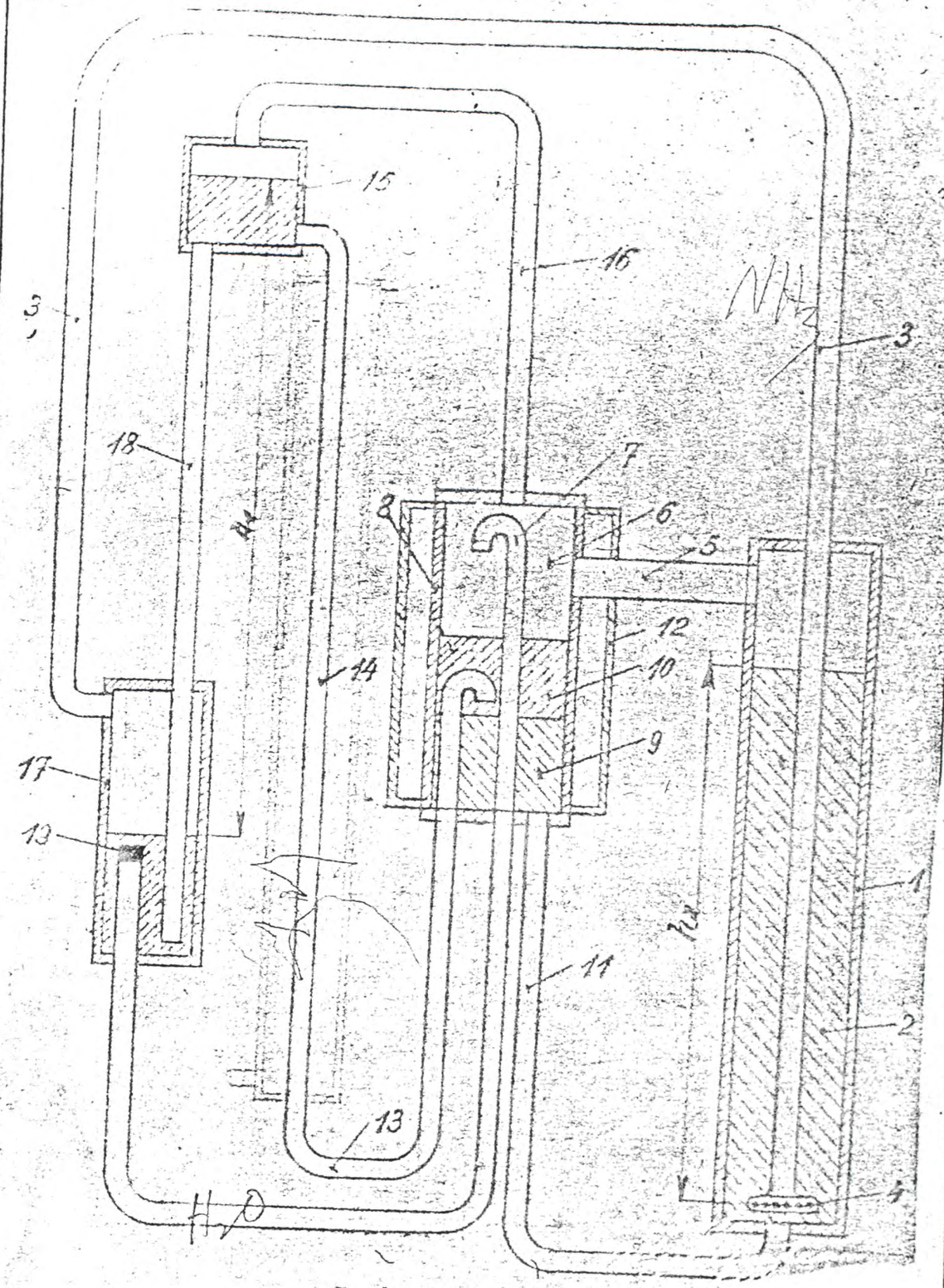
ALBERT EINSTEIN AND
LEO SZILARD

By Wm. T Hedlund
W.S.

their attorney.

240566

Fig. 1

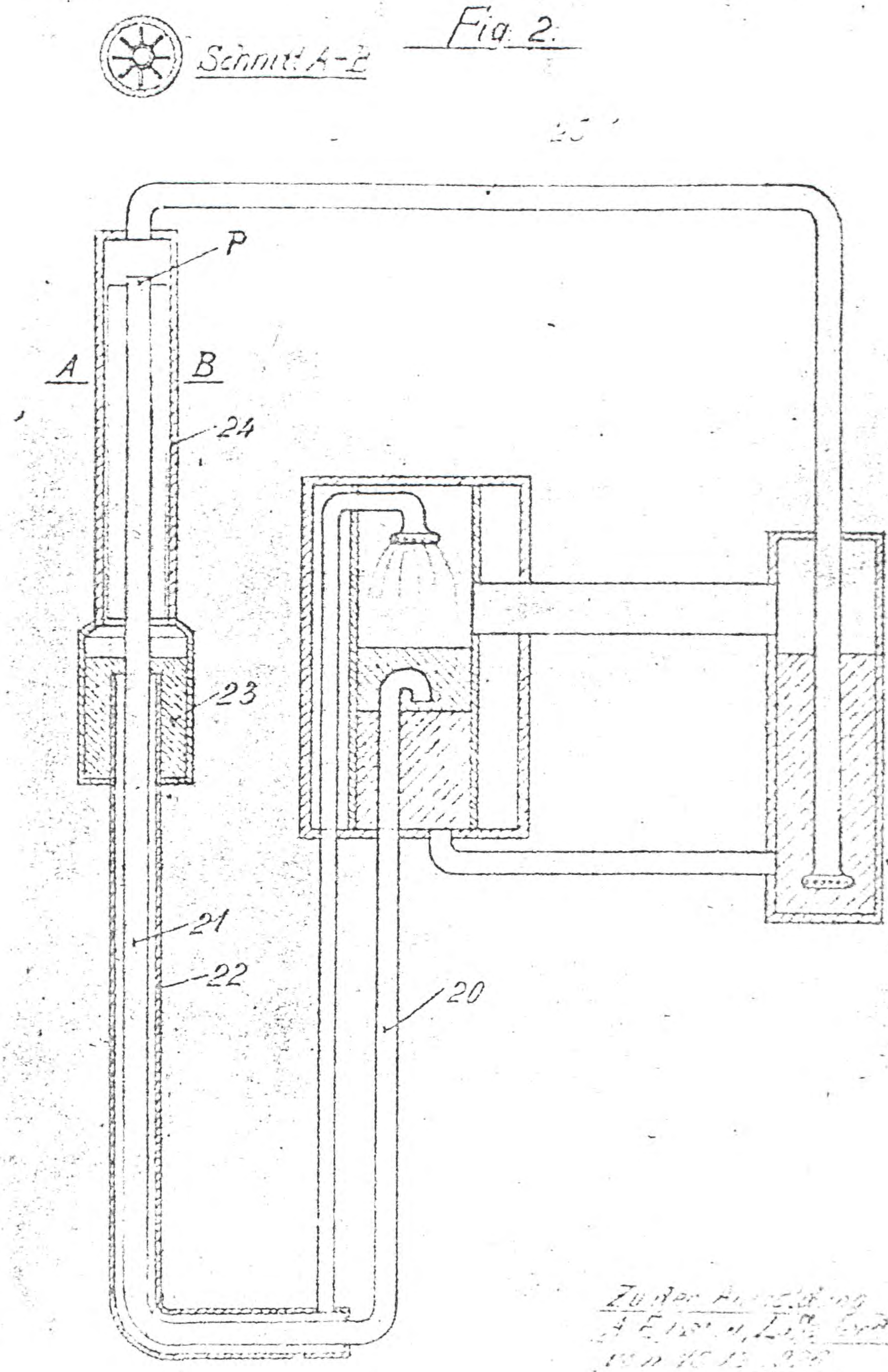


Zu der Anmeldung A. Ey
vom 18. 12. 1928

INVENTORS
Albert Einstein
Leo Szilard
BY Wm T Healy
ATTORNEY.

240566

Fig. 2.



Zu der Anmeldung

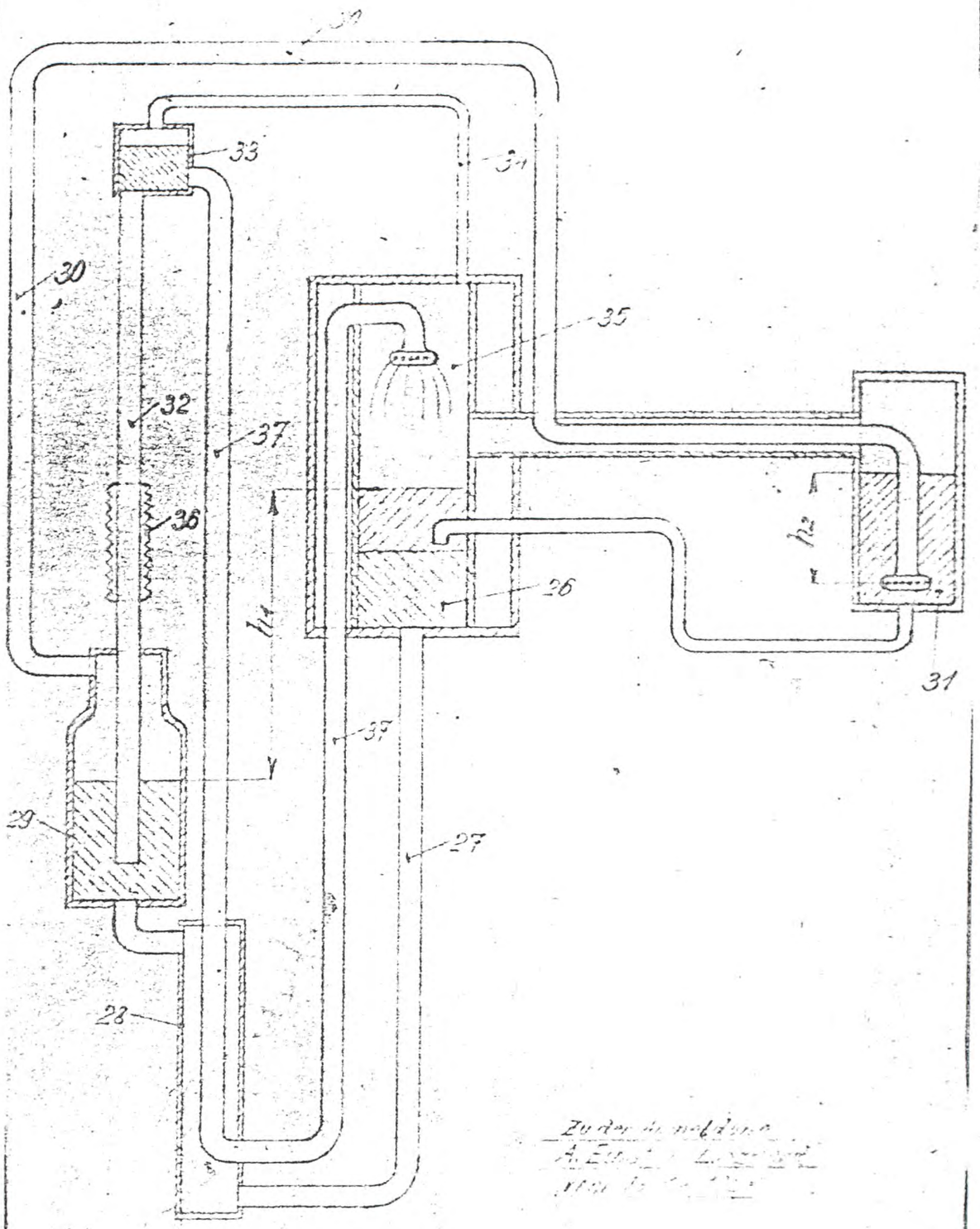
INVENTOR.

BY

ATTORNEY.

240566

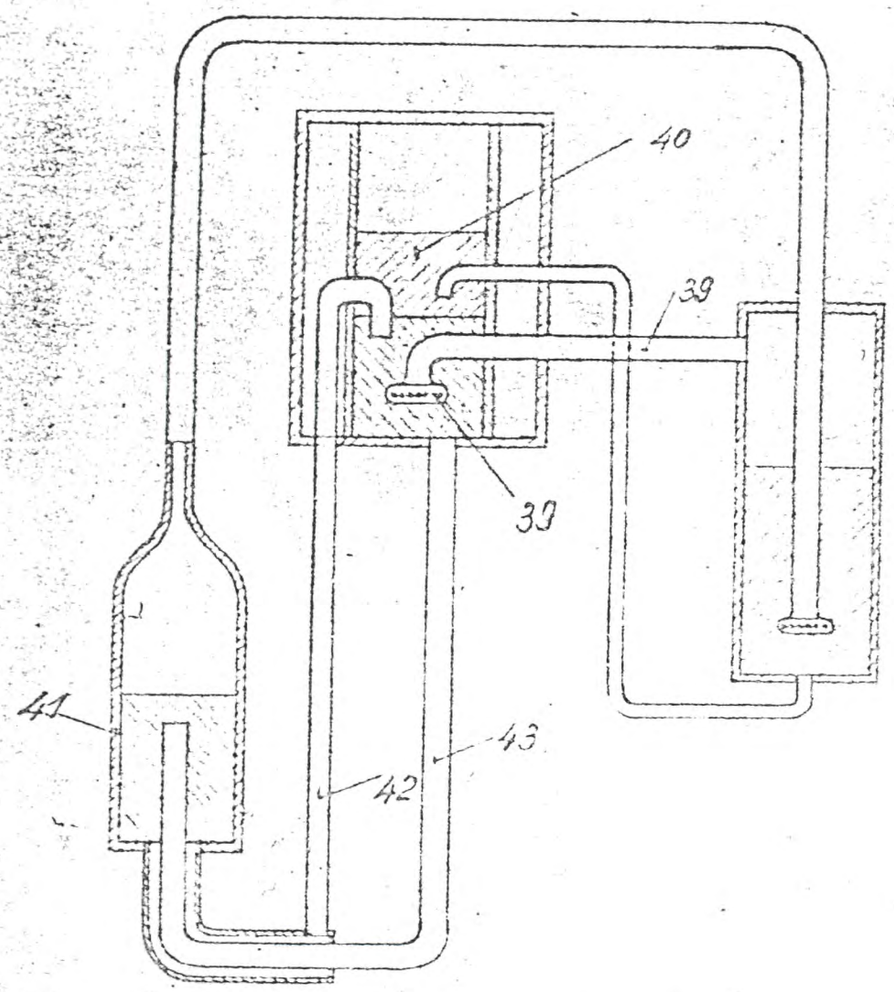
Fig. 3.



INVENTORS
Albert Sunstein
BY Leo Arland
Wm. T. Hedlund
ATTORNEY.

240566

Fig. 4.



Zu der Anmeldung
A. Einstein u. L. Szilard
Vom 16. 12. 26.

INVENTORY
Albert Einstein
Leo Szilard
BY Wm. F. Hedlund
ATTORNEY.

Dec. 16, 1927

Hon. Commissioner of Patents
Washington, D. C.

Sir:

Permission is requested by the undersigned to withdraw the blue prints in the application of Albert Einstein and Leo Szilard, for "Refrigerating Apparatus without Absorption of the Cooling Agent, deposited in the Patent Office Dec. 15, 1927

Very respectfully,
Wm. T. Hedlund
per N. Spencer

Received Dec 16, 1927
W. Spencer

IN THE UNITED STATES PATENT OFFICE

IN RE APPLICATION OF)
)
ALBERT EINSTEIN and)
LEO SZILARD) DIV. 44
)
SERIAL NO. 240,566)
)
FILED DECEMBER 16, 1927.)
)
REFRIGERATING APPARATUS)
WITHOUT ABSORPTION OF)
THE COOLING AGENT)

February 2, 1928.

Hon. Commissioner of Patents,
Washington, D.C.

Sir:

Kindly amend the above identified application as follows:

Change the title to read - REFRIGERATION -

IN THE SPECIFICATION

Page 2, (note numbering at bottom), line 4, correct the spelling of "vapor", (both occurrences). Lines 5 and 6, correct the spelling of "vapor". Line 7, correct the spelling of "vapors". Line 15, place a comma before "which". Line 16, place commas before and after "is"and after "way". Same line, correct the spelling of "simplest". Line 23, place a comma after "remainder". Same line, place a comma before "is". Line 24, place a comma after "manner". Same line, correct the spelling of "vapor". Last line, cancel "it is in no way the question of" and substitute - a system operating in this manner does not constitute -.

Page 3, line 2, correct the spelling of "vapor". Line 3, place a comma after "cold". Line 15, after "except" insert - for -. Same line, correct the spelling of "differences". Line 17, place a comma after "ammonia". After line 22, insert the following:

- In the accompanying drawings which show apparati for carrying out the invention:

Fig. 1 shows one form of apparatus according to the invention;

Fig. 2 shows a modified form of apparatus;

Fig. 3 shows still another apparatus wherein different fluids are used than those of Figs. 1 and 2;

Fig. 4 is a modified form of the apparatus of Fig. 3; and

Fig. 5 is a section taken on the line 5-5 of Fig. 2. -

Line 23, place a comma after "shows" and a comma after "example". Last line, place a comma after "bubbles".

Page 4, line 1, place a comma after "manner". Line 2, place a comma after "completely". Same line, correct the spelling of "vapor". Line 3, shift the word "then" to before the word "flows". Line 5, cancel "through" and substitute - from -. Line 16, correct the spelling of "vapor". Line 23, cancel "swims" and substitute - floats -. Line 24, cancel "communicates with that in" and substitute - flows to -. Same line cancel "by". Line 25, cancel "means of" and substitute - through -. Line 29, before "so" insert - as by means of heating jacket 45 -.

Page 5, line 16, cancel "1" occurring after "column" and substitute - h -. Line 24, remove the comma after "flow". Line 27, cancel "pressed" and substitute - forced -. Same line, cancel "The" and substitute - Since -. Same line, place a comma after "water". Line 28, cancel "entering" and substitute - , should enter -. Line 30, cancel "/not shown in fig. 1/" and substitute - as indicated at 46 -.

Page 6, line 2, correct the spelling of "vapor". Line 10, correct the spelling of "vapor". Line 14, cancel "being" and substitute - to be -. Same line, before "and" in-

sert - (centigrade) -. Line 15, cancel "being" and substitute - to be - (both occurrences). Line 17, correct the spelling of "vapor". Same line, after "atm." insert - (atmospheres) -. Line 20, before "same" insert - the -.

Page 7, line 1, correct the spelling of "vapor". Line 6, change "6,5" to - 6.5 -. Same line, change "1,54" to - 1.54 -. Line 14, cancel "in a gaseous state". Line 15, after "agent" insert - in a gaseous state -. Line 26, after "condenser" insert - ,passing through conduit -. Same line, change "rised" to - raised -. Line 27, cancel "point" and substitute - level -. Line 29, cancel "From" and substitute - After leaving -. Same line, insert a comma after "22". Line 30, place a comma after "water". Same line, place a comma after "ammonia". Same line, cancel "over" and substitute - past -. Same line, cancel "of" and substitute - on -.

Page 8, line 1, insert a comma after "24". Same line, cancel "section A-B" and substitute - Fig. 5, -. Line 3, cancel "any" and substitute - some -. Line 6, correct the spelling of "vapor". Line 12, correct the spelling of "vapor". Line 18, cancel "Contrary" and substitute - In distinction -. Same line, place a comma after "above". Line 19, shift the word "is" to after "embodiment". Line 21 insert - indicated at - after "ammonia". Line 28, replace the diagonal lines by parentheses.

Page 9, line 3, change "rised" to - raised -. Line 12, cancel "above" and substitute - through -. Line 16, after "passing" insert - through -. Same line, after "jacket" insert - 12 -. Line 18, after "cooler" insert - or rectifier -. Line 20, replace the diagonal lines by parentheses. Line 23, cancel "Contrary" and substitute - In distinction -. Line 24, correct the spelling of "vapor".

At the end of the specification add the words:

- What we claim is: -.

IN THE CLAIMS

Cancel the claims and substitute the following:

1. Method of refrigerating which comprises evaporating a condensable cooling agent in the presence of a non-condensable gas; absorbing the non-condensable gas in absorption liquid and separating the cooling agent; condensing the cooling agent; heating the absorption liquid to separate therefrom the non-condensable gas; and again evaporating the cooling agent in the presence of the non-condensable gas.

2. Method of refrigerating which comprises introducing a liquid cooling agent into the presence of a non-condensable gas, thus evaporating the cooling agent and forming a mixture of gases, introducing a liquid into the presence of the mixture into which the cooling agent is less soluble than the non-condensable gas thus separating the cooling agent; condensing the cooling agent; separating the non-condensable gas from the liquid; and again introducing the liquid cooling agent into the presence of the non-condensable gas.

3. Method of refrigerating which comprises introducing a liquid cooling agent into the presence of a non-condensable gas, thus evaporating the cooling agent and forming a mixture of gases, introducing a liquid into the presence of the mixture in which the cooling agent is less soluble than the non-condensable gas thus separating the cooling agent; condensing the cooling agent; separating the non-condensable gas from the liquid; cooling the non-condensable gas; and again introducing the liquid cooling agent into the presence of the non-condensable gas.

4. Method of refrigerating which comprises heating a solution of non-condensable gas in an absorption liquid and thus separating out the gas and producing a pressure of gas; forcing the gas through a body of liquid cooling agent under the

influence of gas pressure produced, thus evaporating the cooling agent and producing a gas mixture; introducing the gas mixture thus formed into the presence of the absorption liquid, thus separating out the cooling agent as a gas; condensing the cooling agent; again heating the absorption liquid; and again forcing the gas produced by the last-mentioned heating through the body of liquid cooling agent.

5. Method of refrigerating which comprises heating a solution of a non-condensable gas in an absorption liquid, thus separating out the gas; forcing the gas into contact with a liquid cooling agent, thus evaporating the cooling agent and producing a gas mixture; forcing the gas mixture through a body of said absorption liquid, thus absorbing the non-condensable gas in the absorption liquid and separating out the cooling agent; condensing the cooling agent; again heating the absorption liquid; and again forcing the gas produced into contact with the liquid cooling agent.

6. That improvement in the art of refrigeration which consists in bringing a mixture of gaseous fluids into contact with a medium having a greater affinity to one of the fluids of the mixture than another so that one fluid is absorbed and another is liberated, liquefying the liberated fluid, expelling the absorbed fluid from said medium in vapor form and introducing the last-mentioned fluid in gaseous form into the presence of the liquefied fluid.

7. Method of refrigerating which comprises evaporating liquid butane in the presence of ammonia to absorb heat and thus forming a gaseous mixture of ammonia and butane, conveying the gaseous mixture into the presence of water at such condition that the butane condenses on being deprived of ammonia in gaseous mixture therewith due to the introduction of water into the presence of the ammonia, separating the aqua-

ammonia from the condensed butane, returning the condensed butane to the presence of the ammonia gas, separating the ammonia and water by heat, returning the water to the gaseous mixture of ammonia and butane and returning the ammonia to the presence of the liquid butane.

8. Method of refrigerating which comprises evaporating a liquid cooling agent having a given chemical component in the presence of an auxiliary agent having the same chemical component to absorb heat and thus forming a gaseous mixture, conveying the gaseous mixture into the presence of a third substance having the same chemical component and serving to deprive the gaseous phase of the cooling agent of the gaseous phase of the auxiliary agent and at such condition of temperature and pressure that the cooling agent condenses in the presence of the other substances, returning the condensed cooling agent to the presence of the auxiliary agent, separating the auxiliary agent and the third substance from the condensed cooling agent, separating the auxiliary agent from the third substance, returning the auxiliary agent into the presence of the liquid cooling agent and returning the third substance into the presence of the gaseous mixture.

9. A cooperating group of fluids for refrigeration comprising butane, ammonia and water.

10. Method of refrigerating which comprises evaporating a liquid cooling agent having a given chemical component in the presence of a gaseous auxiliary agent having a common chemical component with the cooling agent to absorb heat and thus forming a gaseous mixture of the cooling agent and the auxiliary agent, conducting the gaseous mixture thus formed into the presence of a third substance having a common chemical component with both the cooling agent and the auxiliary agent and serving to deprive the gaseous phase of the cooling agent of the

gaseous phase of the auxiliary agent ~~and at such condition of temperature and pressure that the cooling agent condenses~~, separating the fluid consisting of the auxiliary agent and the third substance thus formed from the cooling agent, condensing the cooling agent returning the cooling agent to the presence of the auxiliary agent, separating the auxiliary agent from the third substance so that the auxiliary agent is in gaseous form, conducting the gaseous auxiliary agent into the presence of the liquid cooling agent and conducting the third substance into the presence of gaseous mixture.

11. Method of refrigerating which comprises evaporating a first hydrogen compound in liquid form in the presence of a second hydrogen compound to absorb heat and thus forming a gaseous mixture, conveying the gaseous mixture into the presence of a third hydrogen compound serving to deprive the gaseous phase of the said first hydrogen compound of the gaseous phase of the said second hydrogen compound and at such condition of temperature and pressure that the said first hydrogen compound condenses in the presence of the other hydrogen compounds, separating the fluid consisting of said second hydrogen compound and the third hydrogen compound thus brought together from the condensed first hydrogen compound, returning the condensed first hydrogen compound to the presence of the second hydrogen compound, separating the second hydrogen compound from the third hydrogen compound, returning the second hydrogen compound into the presence of the first hydrogen compound and returning the third hydrogen compound into the presence of the gaseous mixture of first and second hydrogen compounds.

12. Method of refrigerating which comprises evaporating a first hydrogen compound in liquid form in the presence of a second hydrogen compound in gaseous form thus absorbing heat and forming a gaseous mixture of hydrogen compounds, con-

veying the gaseous mixture into the presence of a third hydrogen compound serving to deprive the gaseous phase of the said first hydrogen compound of the gaseous phase of the said second hydrogen compound ~~and at such condition of temperature and pressure that the said first hydrogen compound condenses in the presence of the other hydrogen compounds~~, separating the said second hydrogen compound and the third hydrogen compound thus brought together from the ~~condensed~~ condensing the first hydrogen compound, first hydrogen compound, returning the condensed first hydrogen compound to the presence of the said second hydrogen compound in gaseous form, separating the second hydrogen compound from the third hydrogen compound so as to form a gas of the second hydrogen compound, returning the said second hydrogen compound thus separated in gaseous form into the presence of the first hydrogen compound in liquid form and returning the third hydrogen compound into the presence of the gaseous mixture of the first and second hydrogen compounds.

IN THE DRAWINGS

Enter the new drawings on Bristol Board herewith submitted in lieu of the drawings now on file.

RESPECTFULLY SUBMITTED,

ALBERT EINSTEIN and LEO SZILARD,

By Wm. F. Hedlund
Their Attorney

Div. 44 Room 253 260 Paper No. 3

Address only "The Commissioner of Patents, Washington, D. C." and not any official by name

Sm/mw

DEPARTMENT OF COMMERCE
UNITED STATES PATENT OFFICE
WASHINGTON

All communications respecting this application should give the serial number, date of filing, and name of the applicant

Please find below a communication from the EXAMINER in charge of this application. June 29, 1928.

Thomas E. Robertson
Commissioner of Patents.

GPO 11—8623

Applicant: Albert Einstein et al

Ser. No. 240,566
Filed Dec. 16, 1927
For REFRIGERATION

Wm. T. Hedlund,
51 East 42nd Street,
New York, N. Y.

MAILED
JUN 29 1928

Responsive to amendments of February 3, 1928.

In view of Rule 93 and Order 2750, action on claims 1-6 inclusive is suspended for six-months to determine whether an interference will be declared unless those claims are canceled. At the end of the six-months applicant should call up the case for action.

It is noted that applicant elects modifications of Fig. 3 and 4 in that but one is specifically claimed.

Claim 9 contains subject matter examinable in Class 252-5, and must be divided out of this application.

Claim 7 is probaly allowable.

Claims 8 and 10; and 11 and 12 are duplicates in legal effect.

Sm

C. E. Shoffner
Examiner.

IN THE UNITED STATES PATENT OFFICE 19960

IN RE APPLICATION OF)
)
ALBERT EINSTEIN and)
LEO SZILARD)
) Div. 44
SERIAL NO. 240,566)
) Room 253
FILED DECEMBER 16, 1927.)
)
REFRIGERATION)

Dec. 18, 1928.

Hon. Commissioner of Patents,
Washington, D.C.

Sir:

In response to the official communication of June 29, 1928, the above identified application is herewith amended as follows:

IN THE CLAIMS

Cancel claims 1 to 6 inclusive.

Cancel claim 9

Claim 10, cancel from and including "and" in line 10 to and including "condenses" in line 11. Line 13, before "returning" insert - condensing the cooling agent -.

Claim 12, cancel from and including "and" (first occurrence) in line 8 to and including "compounds" in line 10. Line 12, cancel "condensed". Same line, before "returning" insert - condensing the first hydrogen compound -.

Add the following claims:

13. That improvement in the art of refrigeration which consists in evaporating a condensable hydrocarbon in the presence of a non-condensable gas inert with respect to the hydrocarbon, conducting the mixture of gases thus formed into the presence of an absorption liquid capable of dissolving the inert gas but in which the hydrocarbon is substantially insoluble to dissolve the inert gas and liberate the hydrocarbon, condensing

the hydrocarbon, heating the absorption liquid to expell the inert gas therefrom and again evaporating the hydrocarbon in the presence of the inert gas.

14. That improvement in the art of refrigeration which consists in evaporating a condensable aliphatic hydrocarbon in the presence of a non-condensable gas inert with respect to the hydrocarbon, conducting the mixture of gases thus formed into the presence of an absorption liquid capable of dissolving the inert gas but in which the hydrocarbon is substantially insoluble to dissolve the inert gas and liberate the hydrocarbon, condensing the hydrocarbon, heating the absorption liquid to expell the inert gas therefrom and again evaporating the hydrocarbon in the presence of the inert gas.

15. That improvement in the art of refrigeration which consists in evaporating a condensable hydrocarbon in the presence of a non-condensable gas comprising hydrogen and inert with respect to the hydrocarbon, conducting the mixture of gases thus formed into the presence of water, the hydrocarbon being insoluble in the water and the inert gas being soluble therein, thereby dissolving the inert gas and liberating the hydrocarbon, condensing the hydrocarbon, heating the water containing the inert gas to expell the inert gas therefrom and again evaporating the hydrocarbon in the presence of the inert gas.

16. That improvement in the art of refrigeration which consists in evaporating a condensable aliphatic hydrocarbon in the presence of a non-condensable gas comprising hydrogen and inert with respect to the hydrocarbon, conducting the mixture of gases thus formed into the presence of water, the hydrocarbon being insoluble in the water and the inert gas being soluble therein, thereby dissolving the inert gas and liberating the hydrocarbon, condensing the hydrocarbon, heating the water

containing the inert gas to expell the inert gas therefrom and again evaporating the hydrocarbon in the presence of the inert gas.

14. Refrigerating apparatus comprising a generator, a condenser arranged at a higher level than the generator, an evaporator, a container arranged at a higher level than the condenser, said generator containing an inert gas dissolved in absorption liquid and adapted to expell the inert gas from solution, a conduit for conducting the inert gas from the generator to the evaporator, a conduit for conducting liquid refrigerant from the condenser to the evaporator, a conduit for conducting mixed vapor of refrigerant and inert gas from the evaporator to the condenser in heat exchange relation with inert gas passing into the evaporator, a conduit for conducting rich absorption liquid from the condenser to the generator by gravity, a conduit for conducting weak absorption liquid from said container to said condenser by gravity, a conduit extending upwardly from said generator to said container and means to heat the last-mentioned conduit to lift liquid from the generator to the container.

RESPECTFULLY SUBMITTED,

ALBERT EINSTEIN and LEO SZILARD,

By Wm. J. Hedlund
Their Attorney

REMARKS

The cancellation of claims 1 to 6 obviates the necessity for considering an interference.

Claim 9 has been cancelled, the right being reserved to reinsert the claim in a divisional application.

As between claims 8 and 10, claim 8 has been elected. Claim 10 has been amended so that it is thought to be of different legal effect from claim 8 and allowable. Claim 8 specifies that the cooling agent condenses "in the presence of the other substances". Claim 10 is not so limited.

Similarly, as between claims 11 and 12 claim 11 is elected. Claim 12 has been amended in similar manner to claim 10 and it is thought that this claim is of different legal effect from claim 11 and allowable.

New claims are submitted herewith and, inasmuch as no art is cited against claims 7 to 12, it is thought that these claims are allowable.

Will the Examiner please indicate whether the words "but one" appearing in line 8 of the office action should be - butane -?

Reconsideration and allowance of the application are respectfully requested.

RESPECTFULLY SUBMITTED,

Wm. S. Vedlund

Attorney for
Albert Einstein and Leo Szilard

Div. 44 Room 253

Address only
"The Commissioner of Patents,
Washington, D. C."
and not any official by name

Sm/S

DEPARTMENT OF COMMERCE
UNITED STATES PATENT OFFICE
WASHINGTON

Paper No. 5

All communications respecting this application should give the serial number, date of filing, and name of the applicant

Please find below a communication from the EXAMINER in charge of this application.

Thomas E. Robertson
Commissioner of Patents.

July 24, 1929.

Applicant: Albert Einstein et al.

Ser. No. 240,566
Filed Dec. 16, 1927
For Refrigeration

OPO 11—3623

Wm. T. Hedlund,
51 East 42nd St.,
New York, N. Y.

MAILED
JUL 24 1929

In response to amendment filed December 19, 1928.

Reference made of record:

Von Platen 1,685,764 Sept. 25, 1928 (62-179)

1. The claims are all rejected on the above reference, the modification shown in Figure 2 of the patent being almost identical with applicant's device.

Sm

Examiner.

IN THE UNITED STATES PATENT OFFICE

10964

IN RE APPLICATION OF
ALBERT EINSTEIN and
LEO SZILARD
SERIAL NO. 240,566
FILED DECEMBER 16, 1927.
REFRIGERATION

Div. 44
Room 253

January 20th, 1930.

Hon. Commissioner of Patents,
Washington, D. C.

S i r:

In response to the official letter of July 24th, 1929, the above identified application is herewith amended as follows:

IN THE SPECIFICATION

Page 4, line 4, change "permanently" to --continuously--.

Page 7, line 29, change reference character "22" to --21--.

Page 8, line 9, cancel "while binding" and substitute --, which evaporation requires the absorption of--; line 30, change "h_2" to --h_1--.

IN THE CLAIMS

Cancel claims 7 and 8.

Cancel claims 10 through 16, both inclusive.

Add the following claims:

~~17.~~ 18. Refrigerating apparatus comprising a generator, a condenser arranged at a higher level than the generator, an evaporator, a container arranged at a higher level than the condenser, said generator containing an inert gas dissolved in absorption liquid and adapted to expel the inert gas from solu-

tion, a conduit for conducting the inert gas from the generator to the evaporator, a conduit for conducting liquid refrigerant from the condenser to the evaporator, a conduit for conducting mixed vapor of refrigerant and inert gas from the evaporator to the condenser in heat exchange relation with inert gas passing into the evaporator, a conduit for conducting rich absorption liquid from the condenser to the generator by gravity, a conduit for conducting weak absorption liquid from said container to said condenser by gravity, a conduit extending upwardly from said generator to said container, means to heat the last-mentioned conduit to lift liquid from the generator to the container and a vent conduit connecting the upper part of said container with said condenser.

30 10. Refrigerating apparatus comprising a generator, a condenser arranged at a higher level than the generator, an evaporator, a container arranged at a higher level than the condenser, said generator containing ammonia dissolved in water and adapted to expel the ammonia from solution, a conduit for conducting the ammonia gas from the generator to the evaporator, a conduit for conducting liquid butane from the condenser to the evaporator, a conduit for conducting mixed vapor of butane and ammonia from the evaporator to the condenser in heat exchange relation with ammonia gas passing into the evaporator, a conduit for conducting strong solution of ammonia in water from the condenser to the generator by gravity, a conduit for conducting weak solution of ammonia in water from said container to said condenser by gravity, a conduit extending upwardly from said generator to said container and means to heat the last-mentioned conduit to lift liquid from the generator to the container.

40 20. Refrigerating apparatus comprising a generator, a condenser arranged at a higher level than the generator, an evaporator, a container arranged at a higher level than the condens-

er, said generator containing ammonia dissolved in water and adapted to expel the ammonia from solution, a conduit for conducting the ammonia gas from the generator to the evaporator, a conduit for conducting liquid butane from the condenser to the evaporator, a conduit for conducting mixed vapor of butane and ammonia from the evaporator to the condenser in heat exchange relation with ammonia gas passing into the evaporator, a conduit for conducting strong solution of ammonia in water from the condenser to the generator by gravity, a conduit for conducting weak solution of ammonia in water from said container to said condenser by gravity, a conduit extending upwardly from said generator to said container, means to heat the last-mentioned conduit to lift liquid from the generator to the container and a vent conduit connecting the upper part of said container with said condenser.

50 ~~21.~~ Method of refrigerating which comprises evaporating a liquid cooling agent in the presence of an inert gas to absorb heat and thus forming a gaseous mixture of cooling agent and inert gas, conveying the gaseous mixture into the presence of an absorption liquid at such condition that the cooling agent condenses on being deprived of inert gas in gaseous mixture therewith due to the introduction of absorption liquid into the presence of the inert gas, separating the solution of inert gas in absorption medium from the condensed cooling agent, returning the condensed cooling agent to the presence of the inert gas, separating the inert gas and absorption liquid by heat, circulating the absorption liquid by means of a separate source of heat to the presence of the gaseous mixture of cooling agent and inert gas and returning the inert gas to the presence of the liquid cooling agent.

22. Method of refrigerating which comprises evaporating a liquid cooling agent in the presence of an inert gas to absorb heat and thus forming a gaseous mixture of cooling agent and inert gas, conveying the gaseous mixture into the presence of an

absorption liquid at such condition that the cooling agent condenses on being deprived of inert gas in gaseous mixture therewith due to the introduction of absorption liquid into the presence of the inert gas, separating the solution of inert gas in absorption medium from the condensed cooling agent, returning the condensed cooling agent to the presence of the inert gas, separating the inert gas and absorption liquid by heat, returning the absorption liquid and regulating the flow thereof to the gaseous mixture of cooling agent and inert gas and returning the inert gas to the presence of the liquid cooling agent.

23. Method of refrigerating which comprises evaporating liquid butane in the presence of ammonia to absorb heat and thus forming a gaseous mixture of ammonia and butane, conveying the gaseous mixture into the presence of water at such condition that the butane condenses on being deprived of ammonia in gaseous mixture therewith due to the introduction of water into the presence of the ammonia, separating the aqua-ammonia from the condensed butane, returning the condensed butane to the presence of the ammonia gas, separating the ammonia and water by heat, circulating the water by means of a separate source of heat to the presence of the gaseous mixture of ammonia and butane and returning the ammonia to the presence of the liquid butane.

24. Method of refrigerating which comprises evaporating liquid butane in the presence of ammonia to absorb heat and thus forming a gaseous mixture of ammonia and butane, conveying the gaseous mixture into the presence of water at such condition that the butane condenses on being deprived of ammonia in gaseous mixture therewith due to the introduction of water into the presence of the ammonia, separating the aqua-ammonia from the condensed butane, returning the condensed butane to the presence of the ammonia gas, separating the ammonia and water by heat, returning the water and regulating the flow thereof to the gaseous mix-

ture of ammonia and butane and returning the ammonia to the presence of the liquid butane.

RESPECTFULLY SUBMITTED,

ALBERT EINSTEIN and
LEO SZILARD

By Wm. J. Hedlund
Their Attorney.

REMARKS

Claims 7, 8 and 10 through 16 have been cancelled.

It is submitted that claim 17 differentiates from the patent to von Platen as it includes structure not shown in the reference. The means for causing circulation of the absorption liquid in the two devices are different. In von Platen circulation is caused by heating strong solution on its way to the generator while in applicants' elected species, shown in Fig. 3, circulation is caused by heating weak solution after it has left the generator. The structure for accomplishing this circulation is set out in claim 17 and includes the container and "a conduit extending upwardly from said generator to said container and means to heat the last-mentioned conduit". This structure finds no counterpart whatsoever in the reference and therefore it is thought the claim is allowable.

Claim 18 is similar to claim 17 but includes the vent conduit connecting the container with the condenser and thus further differentiates from the reference.

Claims 19 and 20 are similar to claims 17 and 18 respectively but are limited to the use of butane, ammonia and water, a combination of agents not disclosed in the reference. These claims are hence thought to be allowable.

Claim 21 is for a method including the step of causing circulation of absorption liquid by heating it after the inert gas has been expelled therefrom. Claim 22 differs in scope from claim 21 in that it calls for a method including the step of regulating the flow of absorption medium from the generator to the absorber. This of course may be done by varying the heat supplied by elements 36 in Fig. 3. Such a method is not disclosed in von Platen.

Claims 23 and 24 are similar to claims 21 and 22, respectively, but are limited to butane, ammonia and water, which

combination, as previously stated is not disclosed in the reference. All the claims now submitted are drawn to new and useful subject matter not anticipated in the art cited and hence are thought to be allowable.

Favorable action is respectfully requested.

RESPECTFULLY SUBMITTED,

Wm. F. Hedlund

Attorney for Albert Einstein
and Leo Szilard.

Div. 44 Room 253

Address only
"The Commissioner of Patents,
Washington, D. C.,"
and not any official by name

Sm/S

DEPARTMENT OF COMMERCE
UNITED STATES PATENT OFFICE
WASHINGTON

Paper No. 7

All communications respecting this application should give the serial number, date of filing, and name of the applicant

Please find below a communication from the EXAMINER in charge of this application.

Thomas E. Robertson
Commissioner of Patents.

September 24, 1930.

GPO 11—8423

Applicant: Albert Einstein and
Leo Szilard
Ser. No. 240,566
Filed Dec. 15, 1927
For Refrigeration.

Wm. T. Hedlund,
51 East 42nd St.,
New York, N. Y.

MAILED
SEP 24 1930

In response to amendment filed January 21, 1930.

1. Claim 22 is fully met by Von Platen of record. The only doubtful step is "regulating", line 12 and this is met by a proper proportioning of pipes.

2. Claims 23 and 24 are fully met by Von Platen. On page 3 lines 32-44 the various substances are disclosed. (3) refers to ammonia, butan and glycol. To substitute water for glycol is believed too obvious to require further discussion especially in view of the fact that ammonia and water are mentioned in (1).

3. Claims 17-21 appear allowable as at present advised.

Examiner.

Ser. 9
26
30

10954

IN THE UNITED STATES PATENT OFFICE Sub Spec

~~(not sent)~~

Amt E

IN RE APPLICATION OF

ALBERT EINSTEIN and
LEO SZILARD

SERIAL NO. 240,566

FILED DECEMBER 16, 1927.

REFRIGERATION

Div. 44

Room 253

October 4th, 1930.

SUPPLEMENTAL AMENDMENT

Hon. Commissioner of Patents,
Washington, D. C.

S i r :

Kindly amend the above identified application as follows:

IN THE SPECIFICATION

Cancel the existing specification and substitute in lieu thereof the specification filed herewith. (over)

IN THE CLAIMS

Claim 18, line 5, correct the spelling of "expel".

IN THE DRAWINGS

Cancel sheets 1, 2 and 4 of the drawings on which appear Fig. 1, Figs. 2 and 5, and Fig. 4, respectively. Erase "Fig. 3" from sheet 3. It is not believed that this requires a separate letter to the draftsman.

Sht 1, 2 and 4 returned. Sht 3 retained

RESPECTFULLY SUBMITTED,

ALBERT EINSTEIN and
LEO SZILARD

By Wm. S. Hedlund
Their Attorney.

IN THE UNITED STATES PATENT OFFICE

In re APPLICATION OF

ALBERT EINSTEIN and
LEO SZILARD

SERIAL NO. 240,566

Filed DECEMBER 16, 1927.

REFRIGERATION.

Div. 44

Room 253

September 25, 1930.

Hon. Commissioner of Patents,

Washington, D.C.

S i r:

In response to the official communication dated September 24th, 1930, the above identified application is herewith amended as follows:

IN THE CLAIMS

Cancel Claims 22, 23 and 24.

The remaining claims are allowed, wherefore this application is in condition for allowance.

Respectfully submitted,

Wm. T. Hedlund,
Attorney for Albert Einstein
and Leo Szilard.

10955

REMARKS

In an oral interview had with the Examiner on or about September 26th, 1930, it was agreed that the Patent Office would accept a limitation of the specification and drawings since some of the embodiments shown are not covered by the allowed claims. Although one or more of the allowed claims reads on Fig. 1, it is believed that the invention is adequately explained by Fig. 3. Therefore the application is limited to this figure and its description. It was further agreed that the work of the Patent Office would be more simplified if a substitute specification were to be filed restricted to a description of this figure, than if the original specification were to be amended. Hence, such a substitute specification is filed herewith.

Notice of allowance is respectfully requested.

RESPECTFULLY SUBMITTED,

Wm. T. Stedlund

Attorney for Albert Einstein
and Leo Szilard.

10956

SUBSTITUTE SPECIFICATION

Our invention relates to the art of refrigeration and particularly to an apparatus and method for producing refrigeration wherein the refrigerant evaporates in the presence of an inert gas and more particularly to the type disclosed in Patent No. 1,685,764 granted September 25th, 1928, to Von Platen and Munters and our British Patent No. 282,428.

The objects and advantages of our invention will be apparent from the following description considered in connection with the accompanying drawing which shows, more or less diagrammatically, a preferred embodiment of our invention.

Referring to the drawing, reference character 1 designates an evaporator, which is ordinarily placed within a chamber to be cooled. A conduit 5 connects the upper part of evaporator 1 with the more intermediate portion of the condenser 6. A conduit 11 communicates with the bottom of evaporator 1 and extends within condenser 6 at a level below the point of communication of conduit 5 with the condenser. A cooling water jacket 12 surrounds the condenser and is adapted for the passage therethrough of water for the purpose of cooling the condenser.

A conduit 27 communicates with the bottom of condenser 6 and with the lower part of a heat exchanger jacket 28. The upper part of jacket 28 is connected to the lower part of generator 29. Generator 29 is heated in any suitable manner. A conduit 30 communicates with the upper part of generator 29 and extends within evaporator 1 to a point near the bottom thereof where it terminates in a distributor head 31. Conduit 30 extends within conduit 5 in order that the fluids passing through the respective conduits may be brought into heat exchange relationship with each other.

A conduit 32 extends upwardly from within the lower

part of generator 29 and communicates with a container 33 placed at a level above that of condenser 6. A source of heat 36 is provided for heating conduit 32 at a point above generator 29. A conduit 37 extends downwardly from container 33 and passes within heat exchanger jacket 28 and thence upwardly to within the upper part of condenser 6 where it terminates in a distributor head 35. Conduit 37 passes within cooling water jacket 12 in order that fluid passing through this conduit may be cooled. A vent conduit 34 connects the upper part of container 33 with the upper part of condenser 6.

The operation of the above described apparatus is as follows:

A suitable refrigerant, for instance butane, in liquid form is contained within evaporator 1. An inert gas, for instance ammonia, is introduced into evaporator 1 through conduit 30 and distributor head 31. The refrigerant evaporates in the evaporator in the presence of the inert gas due to the fact that the partial pressure of the refrigerant is reduced thereby and the resulting gaseous mixture passes through conduit 5 to within condenser 6. Here the mixture comes in intimate contact with an absorption liquid, for example water, which is introduced into the condenser through conduit 37 and distributor head 35. Inasmuch as the ammonia gas is very soluble in water, while the butane is quite insoluble, the ammonia gas is absorbed by the water, thus freeing the butane from the gaseous mixture. Thus the butane assumes substantially the entire pressure within the condenser, which pressure is sufficient to cause its liquefaction at the temperature maintained therein by the cooling water.

The specific gravity of liquid butane is less than that of the solution of ammonia in water and hence stratification

of the two liquids occurs, the liquid butane floating upon the ammonia solution. The latter solution is indicated by reference character 26. The liquid butane passes from condenser 6 through conduit 11 and returns to evaporator 1, where it is again evaporated and the cycle repeated.

The ammonia solution flows by gravity from condenser 6 through conduit 27 and heat exchanger jacket 28 to within generator 29. Here the application of heat causes the ammonia to be expelled as a gas from the solution and this ammonia gas passes through conduit 30 and distributor head 31 to within evaporator 1, where it reduces the partial pressure of the butane, wherefore the latter evaporates as previously described.

Water, containing but little ammonia in solution, passes from generator 29 into conduit 32 where it is further heated by the source of heat 36. This heating causes the formation of vapor in conduit 32 which lifts liquid through this conduit to within container 33. The liquid thus supplied to container 33 may pass by gravity through conduit 37 to condenser 6. The hot weak liquid passing through conduit 37 is brought into heat exchange relationship with the cool strong liquid passing through heat exchanger jacket 28 and an exchange of heat between the two liquids takes place. The weak liquid is further cooled by being brought into heat exchange relation with the cooling water in jacket 12 and is hence in a condition to rapidly absorb ammonia in the condenser.

Vapor entering container 33 from conduit 32 passes therefrom through vent conduit 34 to the condenser.

During the operation of the hereinbefore described apparatus, the pressure existing in the various members is uniform with the exception of slight pressure differences, sufficient

to cause flow of fluids, caused by liquid columns. The pressure existing in generator 29 must be sufficiently greater than that existing in the upper part of evaporator 1 to cause the flow of vapor to take place from distributor head 31, or, in other words, to overcome the liquid head designated by h_2. This excess pressure in the generator is balanced by the head exerted by the column of liquid equal to the differences in levels between the liquid in condenser 6 and generator 29, indicated by h_1. It is, of course, necessary that the head represented by h_2 is less than that represented by h_1 in order that flow shall take place.

While we have described a preferred embodiment for carrying out our invention, it is to be understood that modifications thereof fall within the scope of the invention, which is to be limited only by the appended claims viewed in the light of the prior art.

What we claim is:

44 Room 253 260

Address only "The Commissioner of Patents, Washington, D. C." and not any official by name

DEPARTMENT OF COMMERCE
UNITED STATES PATENT OFFICE
WASHINGTON

Sm/S

Paper No. 10

All communications respecting this application should give the serial number, date of filing, and name of the applicant

Please find below a communication from the EXAMINER in charge of this application.

Thomas E. Robertson
Commissioner of Patents.

Oct. 11, 1930.

GPO 11—8623

Wm. T. Healund,
51 East 42nd St.,
New York, N. Y.

Applicant: Albert Einstein et al.
Ser. No. 240,566
Filed Dec. 16, 1927
For Refrigeration.

MAILED
OCT 11 1930

Returned herewith find three sheets of drawings. These sheets are duplicates of the drawings as originally filed and are unnecessary in the case.

The sheet containing Fig. 3 has been retained and substituted for the informal sheet originally filed.

Sm

C. L. Shaffer
Examiner.

DRAWINGS RETURNED
OCT 13 1930
SIGNATURE ENTERED

ADDRESS ONLY
THE COMMISSIONER OF PATENTS
WASHINGTON, D. C.

Div. 44 181
S C

Serial No. 240,566

DEPARTMENT OF COMMERCE
UNITED STATES PATENT OFFICE
WASHINGTON

Oct. thirteen, 1930.

Albert Einstein et al. Assor.,

Your APPLICATION for a patent for an IMPROVEMENT in Refrigeration, filed Dec. 16, 1927 has been examined and ALLOWED with 5 claims.

The final fee, TWENTY-FIVE DOLLARS, WITH $1 ADDITIONAL FOR EACH CLAIM ALLOWED IN EXCESS OF 20, must be paid not later than SIX MONTHS from the date of this present notice of allowance. If the final fee be not paid within that period, the patent will be withheld, but the application may be renewed within one year after the date of the original notice with a renewal fee of $25 and $1 additional for each claim in excess of 20.

The office delivers patents upon the day of their date, on which date their term begins to run. The preparation of the patent for final signing and sealing will require about four weeks, and such work will not be begun until after payment of the necessary final fee.

When the final fee is paid, there should also be sent, DISTINCTLY AND PLAINLY WRITTEN, the name of the INVENTOR, TITLE OF THE INVENTION, AND SERIAL NUMBER AS ABOVE GIVEN, DATE OF ALLOWANCE (which is the date of this circular), DATE OF FILING, and, if assigned, the NAMES OF THE ASSIGNEES.

If it is desired to have the patent issue to an ASSIGNEE OR ASSIGNEES, an assignment containing a REQUEST to that effect, together with the FEE for recording the same, must be filed in this office on or before the date of payment of the final fee.

After issue of the patent, uncertified copies of the drawings and specifications may be purchased at the price of TEN CENTS EACH. The money should accompany the order. Postage stamps will not be received.

The final fee will NOT be received from other than the applicant, his assignee or attorney, or a party in interest as shown by the records of the Patent Office.

NOTICE.—WHEN THE NUMBER OF CLAIMS ALLOWED IS IN EXCESS OF 20, NO SUM LESS THAN $25 PLUS $1 ADDITIONAL FOR EACH CLAIM IN EXCESS OF TWENTY CAN BE ACCEPTED AS THE FINAL FEE.

Respectfully,

Thomas E. Robertson
Commissioner of Patents.

Wm. T. Hedlund,
51 East 42nd St.,
New York, N. Y.

011—8054

☞ IN REMITTING THE FINAL FEE GIVE THE SERIAL NUMBER AT THE HEAD OF THIS NOTICE.

☞ UNCERTIFIED CHECKS WILL NOT BE ACCEPTED.

OCT 16 30 61086 A Check — 25.0

FINAL DIVISION OCT 16 30 U.S. PATENT OFFICE

327 Gen'd

U. S. Patent Office

FINAL FEE PAID TO THE COMMISSIONER OF PATENTS

(Be careful to give correct Serial No.)

Serial No. 240,566

INVENTORS:

ALBERT EINSTEIN and LEO SZILARD

PATENT TO BE ISSUED TO

ELECTROLUX SERVEL CORPORATION

NAME OF INVENTION, AS ALLOWED:

REFRIGERATION

DATE OF PAYMENT:

Oct. 16, 1930.

NO. OF CLAIMS

5

FEE:

$ 25.00

DATE OF FILING:

Dec. 16, 1927

DATE OF CIRCULAR OF ALLOWANCE:

Oct. 13, 1930

REMARKS—

The Commissioner of Patents will please apply the accompanying fee as indicated above.

Wm. T. Hedlund

Attorney.

SEND PATENT TO

WM. T. HEDLUND
347 Madison Ave.
New York City

12.17.29

1927

CONTENTS:

1. Application ✓ papers.
2. Amdt A Feb 3, 1928
3. LETTER JUN 29 1928
4. Amdt B Dec 19, 1928
5. Rejection JUL 24 1929
6. Amdt C Jan 24, 1930
7. Rejection SEP 24 1930
8. Amdt D Sept 26, 1930
9. Sub-Specification Oct. 7, 1930
10. Letter OCT 11 1930
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