United States Patent [19]

Eber

[11] **3,715,896**

[45] **Feb. 13, 1973**

[54] **ABSORPTION REFRIGERATION APPARATUS OF THE INERT GAS TYPE**

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[73] Assignee: **Aktiebolaget Electrolux,** Stockholm, Sweden

[22] Filed: **May 7, 1971**

[21] Appl. No.: **141,294**

[52] **U.S. Cl.**.....**62/490**
[51] **Int. Cl.**.....**F25b 15/10**
[58] **Field of Search**.....62/490, 491, 492, 493

[56] **References Cited**

UNITED STATES PATENTS

2,255,414	9/1941	Coons	62/490 X
2,691,281	10/1954	Phillips	62/494

FOREIGN PATENTS OR APPLICATIONS

995,541	6/1965	Great Britain	62/492
983,273	6/1951	France	62/492

Primary Examiner—Meyer Perlin
Assistant Examiner—P. D. Ferguson
Attorney—Edmund A. Fenander

[57] **ABSTRACT**

In absorption refrigeration apparatus of the inert gas type all of the parts are formed of piping and are of the same diameter except the pump pipe and vent pipe connecting the outlet end of the condenser to the inert gas circuit. These particular pipes also can be formed of the same size piping employed to form all of the other parts of the apparatus by deforming them so that they are non-circular in cross-section and will carry out their intended function during operation of the apparatus.

7 Claims, 8 Drawing Figures

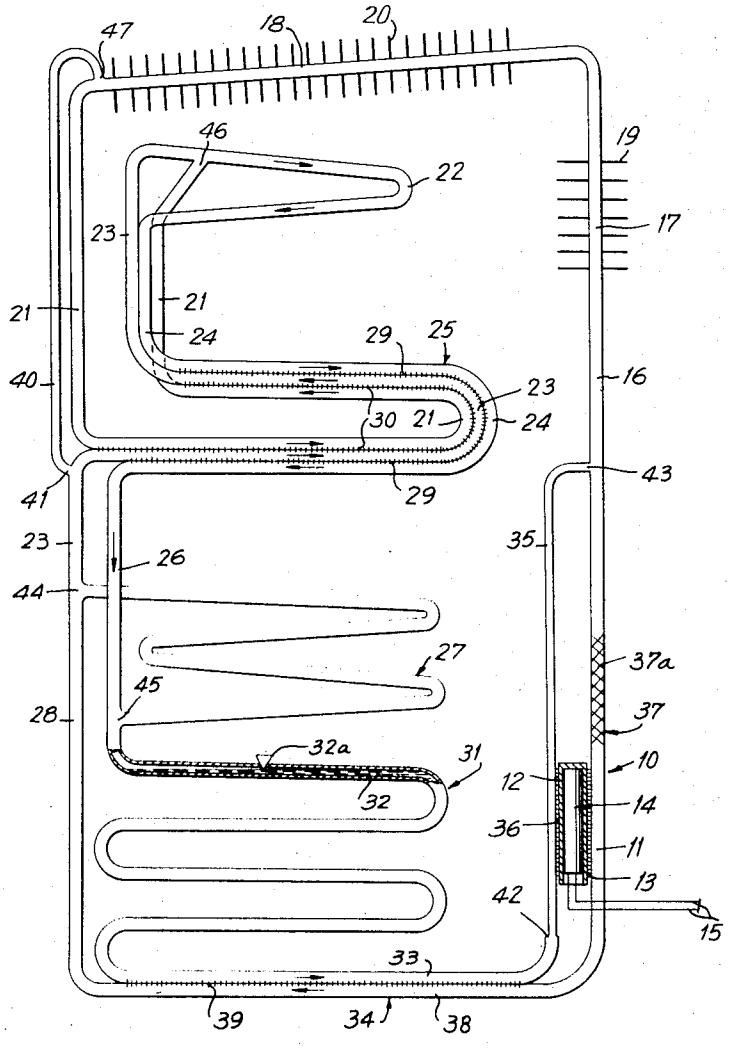
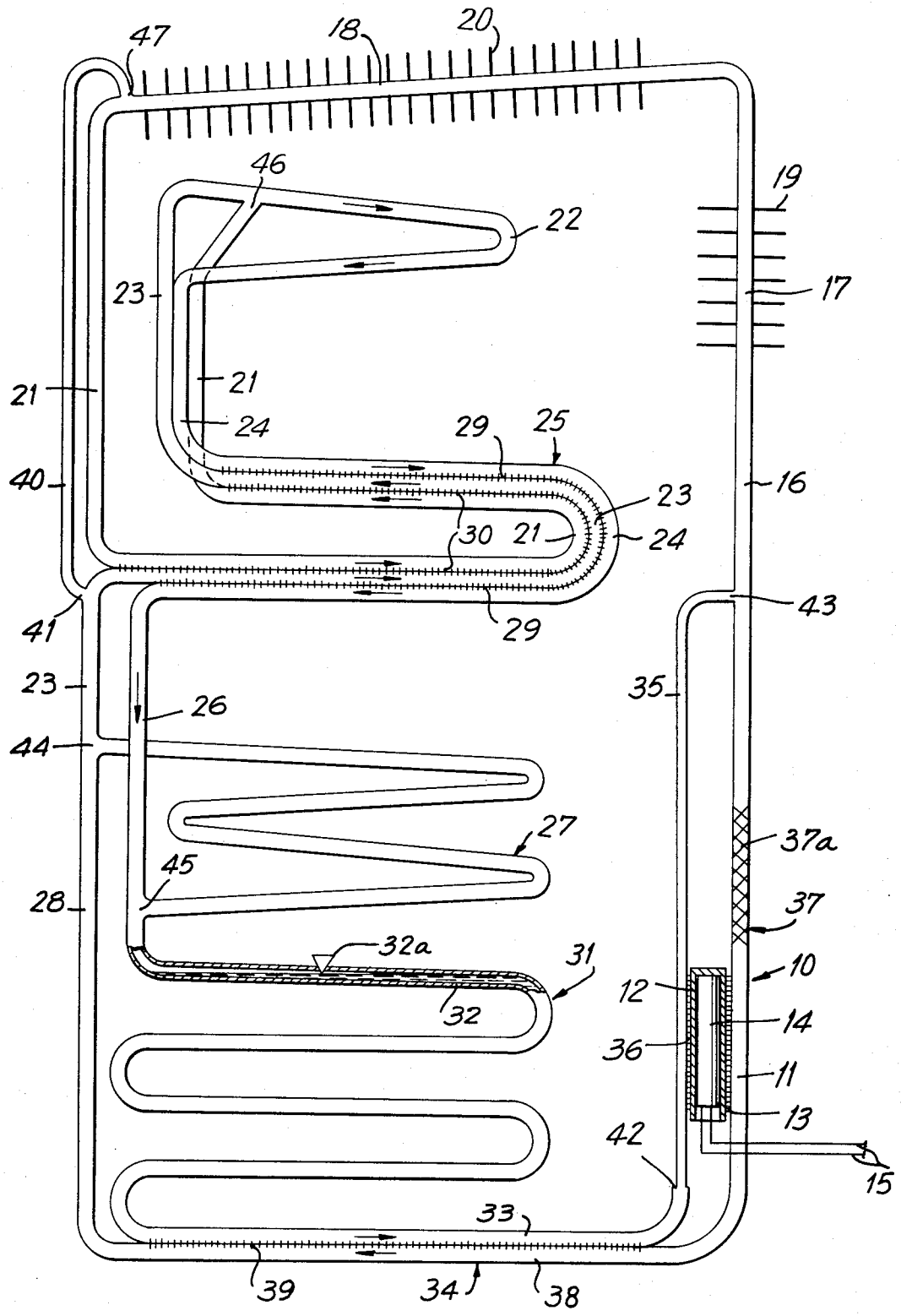


FIG. 1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37a
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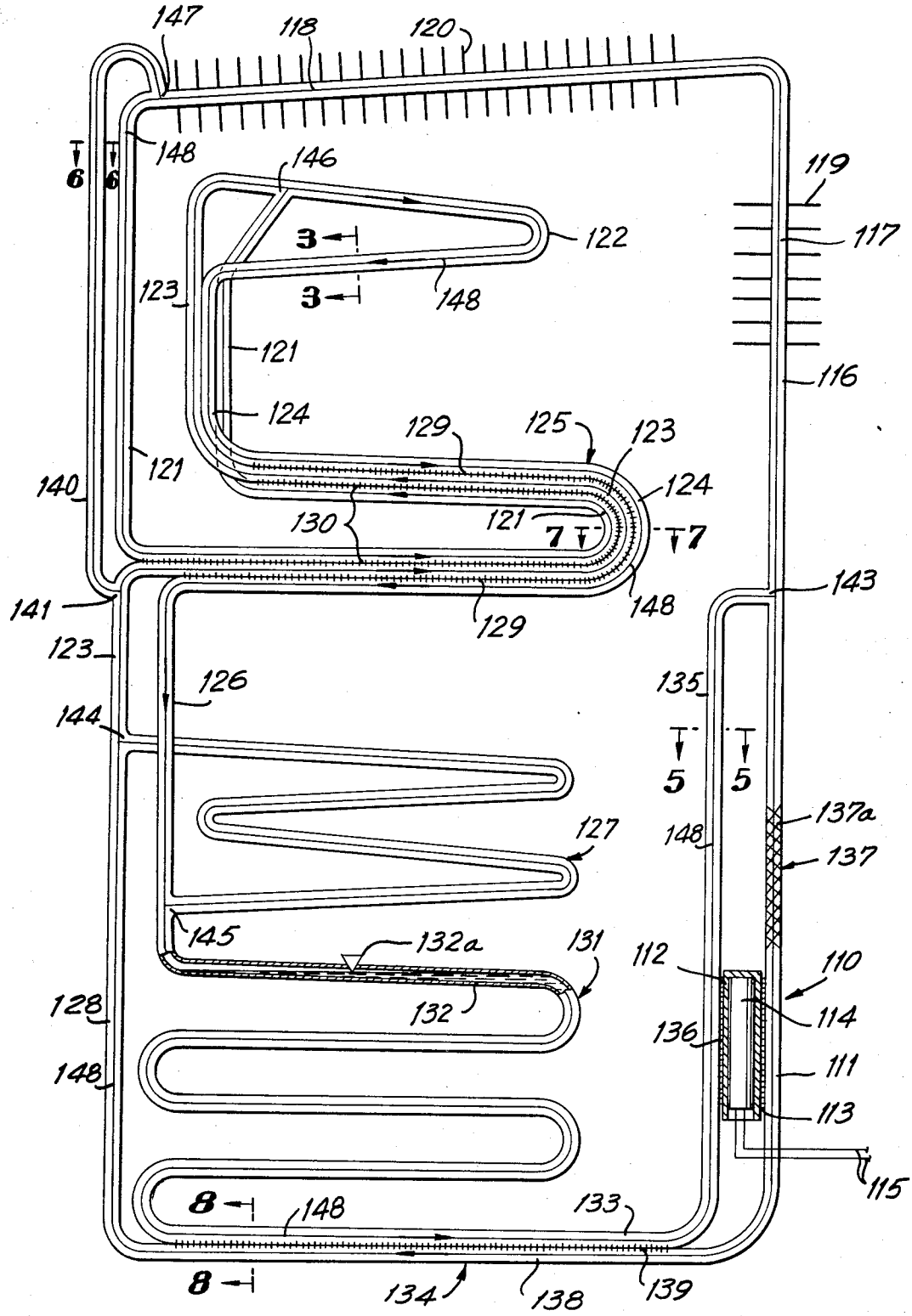
FIG. 2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137a
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FIG. 3

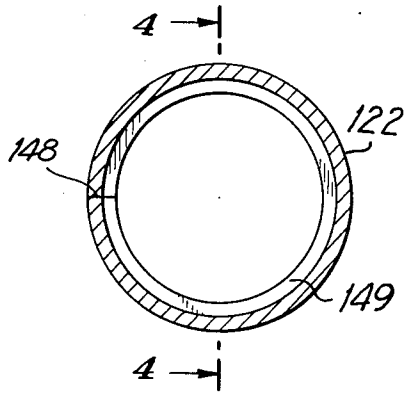


FIG. 4

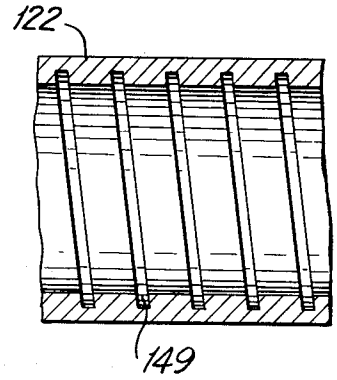


FIG. 5

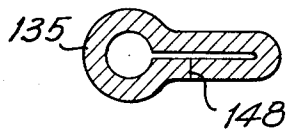


FIG. 6

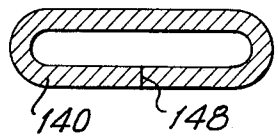


FIG. 7

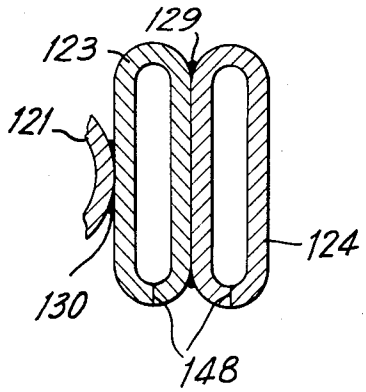
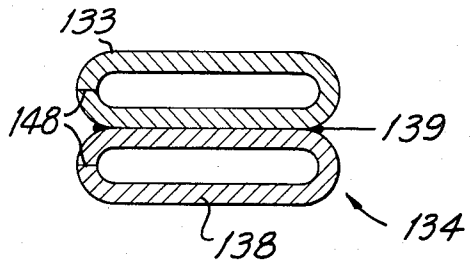


FIG. 8



ABSORPTION REFRIGERATION APPARATUS OF THE INERT GAS TYPE

BACKGROUND OF THE INVENTION

This invention relates to absorption refrigeration apparatus of the inert gas type. Absorption refrigeration apparatus of this type contains an inert gas or pressure equalizing fluid and includes a generator or boiler, a condenser, an evaporator and an absorber which are interconnected for circulation of a refrigerant, absorption liquid and inert gas.

DESCRIPTION OF THE PRIOR ART

Many kinds of absorption refrigeration apparatus of the inert gas type are in use. They embody different engineering designs and vary in construction. But they all have one common feature and that is the drawback of being relatively expensive to build. This accounts for the fact that in recent years refrigerators operated by inert gas type absorption refrigeration apparatus have had a smaller share of the refrigerator market than refrigerators operated by compressor-type refrigeration apparatus. And this is true in spite of the fact that in certain respects inert gas type absorption refrigeration apparatus possess desirable operating advantages.

The reason that it is costly to produce inert gas absorption refrigeration apparatus is based upon the belief that it is necessary to fabricate such apparatus from a number of parts or components which have different functions and are formed of pipes having different dimensions. It has been a basic requirement in fabricating an absorption refrigeration apparatus from parts of this kind to perform an unduly large number of welding operations to unite the parts. The components or parts of the refrigerating apparatus are manufactured separately and are fabricated into sub-assemblies before the complete absorption refrigeration unit is fabricated into a single unitary structure by many welding operations.

When absorption refrigeration apparatus is built in this way it imposes upon a manufacturer the duty to clean the interiors of all of the parts or components of the apparatus very carefully before they are assembled into a single unitary structure. It also has been proposed to use welded pipes in place of drawn pipes. However, the use of welded pipes has not reduced objectionable high production costs because it is expensive to shift welding machines from manufacturing pipes of one size to pipes of different sizes.

SUMMARY OF THE INVENTION

It is an object of my invention to reduce materially the cost of manufacturing absorption refrigeration apparatus of the inert gas type. I accomplish this by forming all of the parts or components of such apparatus of piping. Further, more than ninety percent of the parts or components are formed of piping having the same diameter.

All of the parts can be formed of piping having the same diameter except the pump pipe and vent pipe connecting the outlet end of the condenser to the inert gas circuit. These particular pipes, when deformed so that they are non-circular in cross-section and will carry out their intended function during operation of the apparatus, also can be formed of the same size piping employed to form all of the other parts of the refrigeration apparatus.

In this way it is possible to effect substantial savings in manufacturing costs because the requirement for transporting pipes and storing shaped pipe components between manufacturing areas and storage areas for the components is eliminated entirely. The storing and handling of apparatus parts or components which are all formed of piping materially simplifies manufacturing procedures. Moreover, it is possible to use the same equipment and tools to bend the pipes almost at all places. It also is an advantage, when the production is very large, to provide a pipe welding machine in the production plant because such a machine can operate continuously without any need to be shifted to produce pipes having different dimensions.

BRIEF DESCRIPTION OF THE DRAWING

In the drawing, FIG. 1 more or less diagrammatically illustrates absorption refrigeration apparatus of the inert gas type embodying my invention:

FIG. 2 is a view similar to FIG. 1 illustrating another embodiment of the invention;

FIG. 3 is a sectional view taken at line 3—3 of FIG. 2;

FIG. 4 is a sectional view taken at line 4—4 of FIG. 3; and

FIGS. 5, 6, 7 and 8 are sectional views taken at lines 5—5, 6—6, 7—7 and 8—8, respectively, of FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawing, I have shown my invention embodied in absorption refrigeration apparatus of a uniform pressure type in which an inert pressure equalizing gas is employed. Refrigeration apparatus of this type comprises a generator or boiler **10** which includes an upright pipe **11** containing a refrigerant, such as ammonia, in solution in a body of absorption liquid, such as water. Heat is supplied to the pipe **11** from a heating tube **12** thermally connected therewith at **13**, as by welding, for example. The heating tube may be heated by an electrical heating element **14**, for example, which is disposed within the tube and connected by conductors **15** to a suitable source of electrical energy.

The heat supplied to boiler pipe **11** and absorption solution therein expels refrigerant vapor out of solution and such vapor passes upward from the boiler through a vapor supply line or pipe **16** and an air-cooled rectifier **17** into an air-cooled condenser **18**. The rectifier **17** and condenser **18** are provided with fins or heat dissipating members **19** and **20**, respectively.

Absorption liquid vapor accompanying refrigerant vapor is condensed and removed from the latter in the rectifier **17** by surrounding cool air which flows in physical contact therewith and the fins **19**. Absorption liquid vapor condensed in the rectifier **17** drains back to the boiler **10**.

Refrigerant vapor is condensed and liquefied in the condenser **18** by surrounding cool air which flows in physical contact therewith and the fins **20**, and the liquefied refrigerant flows therefrom through a pipe **21** into a cooling element or evaporator **22** in which it evaporates and diffuses into an inert pressure equalizing gas, such as hydrogen, which enters through a pipe **23**. Due to evaporation of refrigerant fluid into inert

gas in cooling element 22, a refrigerating effect is produced with consequent absorption of heat from the surroundings.

The rich gas mixture of refrigerant vapor and inert gas formed in cooling element 22 flows from the lower end thereof through a pipe 24, which forms one passageway of a gas heat exchanger 25, and a pipe 26 into the lower end of an absorber coil 27. In absorber coil 27 the rich gas mixture flows countercurrent to downwardly flowing absorption liquid which enters through a pipe 28. The absorption liquid absorbs refrigerant vapor from inert gas and inert gas weak in refrigerant flows from absorber coil 27 to the upper part of the cooling element 22 in a path of flow formed by the pipe 23 which defines another passageway of the gas heat exchanger 25.

During operation of the refrigeration apparatus, heat is liberated in the absorber coil 27 due to absorption of refrigerant vapor into absorption liquid. Such heat of absorption is given up to surrounding cool air which flows in physical contact with the absorber coil, its temperature being determined by the temperature of the cooling air flowing in heat exchange relation therewith.

The circulation of gas in the gas circuit just described is due to the difference in specific weight of the columns of gas rich and weak, respectively, in refrigerant vapor. Since the column of gas rich in refrigerant vapor and flowing from cooling element 22 to the absorber coil 27 is heavier than the column of gas weak in refrigerant and flowing from the absorber coil 27 to cooling element 22, a force is produced or developed within the system for causing circulation of inert gas in the manner described.

The gas heat exchanger pipes 23 and 24 and pipe 21 are in thermal relation with one another at 29 and 30, as by welding, for example. In this way relatively cool inert gas, which is rich in refrigerant vapor and flowing from cooling element 22 through conduit section 24, functions to precool inert gas weak in refrigerant and flowing from absorber coil 27 through conduit section 23 and also precool liquid refrigerant flowing to cooling element 22 from condenser 18 through conduit section 21.

Absorption solution enriched in refrigerant flows from the lower end of absorber coil 27 into a looped pipe or coil 31 which is elongated and functions to hold a body of absorption solution 32 having a liquid surface at 32a. From the coil 31 solution enriched in refrigerant flows through a pipe 33 which forms one passageway of a liquid heat exchanger 34 and is in communication with the the lower end of a vapor-liquid lift tube or pump 35.

Liquid is raised by vapor-liquid lift action through lift tube 35 which is thermally connected to the heating tube 12 at 36, as by welding, for example. The raised liquid flows from the pump 35 into the upper part of the boiler pipe 11. Refrigerant vapor expelled out of solution in boiler pipe 11, together with refrigerant vapor entering from pump 35, flows upwardly through the pipe 16, as previously explained. The portion 37 of the boiler pipe 11 serves as a rectifier and functions to reduce the quantity of vapor of absorption liquid accompanying refrigerant vapor flowing from the boiler 10. The rectifier 37 may comprise an insert 37a which is diagrammatically illustrated and can take the form of wire netting, apertured plates, spirally wound wire or balls formed of steel.

The absorption liquid from which refrigerant has been expelled flows from the boiler 10 through a pipe 38 which is in thermal relation with the pipe 33 at 39, as by welding, and forms another passageway of the liquid heat exchanger 34. In liquid heat exchanger 34 heat is transferred from absorption solution weak in refrigerant and flowing through pipe 38 from boiler 10 to absorption solution rich in refrigerant and flowing through pipe 33 to boiler 10. The weak absorption liquid flowing from boiler 10 continues in its path of flow from pipe 38 through pipe 28 to the upper end of absorber coil 27.

The outlet end of the condenser 18 is connected by a pipe 40 to a part of the inert gas circuit, as at 41, so that any inert gas which may pass through the condenser can flow into the gas circuit. Refrigerant vapor not liquefied in the condenser 18 flows into pipe 40 to displace inert gas therefrom and force such gas into the gas circuit. The effect of forcing gas into the gas circuit in this manner is to raise the total pressure in the entire apparatus whereby an adequate condensing pressure is obtained to insure condensation of refrigerant vapor in condenser 18.

In accordance with my invention all of the parts of the refrigeration apparatus just described and shown in the drawing are formed of piping and are of the same diameter except the pump pipe 35 and pipe 40 connecting the outlet end of the condenser 18 to the gas circuit at 41. This means that more than 90 percent of the piping in the apparatus will be the same in size and have a single pipe dimension. A number of factors must be taken into consideration when selecting the diameter of the piping employed in the major portion of the apparatus.

In order that the pressure drop of inert gas circulating in the inert gas circuit will be at a minimum and the body of absorption liquid 32 in the looped pipe 31 will form a liquid reservoir of sufficient size to provide an ample supply of rich absorption liquid for the boiler 10, it is desirable to select piping having an internal diameter which is as large as possible. But such an arbitrary pipe size cannot be employed in the condenser 18 for the reason that, when the internal diameter of the piping is unduly large, the refrigerant vapor in the condenser will not function to displace inert gas therefrom and such malfunction will result in unsatisfactory condensation of refrigerant vapor. Investigations which have been made indicate that good performance of the condenser is realized when its internal diameter has an upper limit of approximately 13 mm.

In order to promote good heat transfer between the cooling element or evaporator 16 and object to be cooled, it is desirable to effect good distribution of liquid refrigerant at the inner surface of the evaporator pipe which in turn will provide good gas and liquid contact surface within the evaporator. The entire inner surface of the evaporator piping can be wetted by liquid refrigerant by providing internal capillary grooves which function to raise liquid refrigerant in the piping from the bottom thereof at its opposing sides.

The capillary grooves can be formed in a flat metallic sheet which subsequently is shaped to form seamed piping, the seam of which is united by welding. The ad-

vantage of using the same size piping for all parts would be partly lost by using grooved piping and piping without internal grooves in the same system for different parts thereof. In accord with my invention I employ piping having internal grooves and of the same dimensions not only for the cooling element or evaporator but also for other parts where piping having internal grooves is not necessary in order for such parts to function properly.

In view of the foregoing, it will be evident that all parts of the refrigeration apparatus illustrated in the drawing, except the pump pipe **35** and pipe **40** connecting the outlet of the condenser **18** and the gas circuit, can be formed of piping having the same dimension to fabricate the apparatus. And it also is possible to form the pipes **35** and **40** from the same size piping employed to form all of the other parts of the refrigeration apparatus. This can be accomplished by deforming the pipes employed to form the pipes **35** and **40** to provide paths of flow for fluids therein which will enable them to function properly during operation of the apparatus, that is, carry out the intended functions of the parts. By doing this it will be evident that the weld or joint at **42** can be eliminated.

There now are six places in the refrigeration apparatus illustrated in the drawing at which three pipes communicate with one another at the same region. These include (1) the connection of pump pipe **35** to boiler pipe **11** at **43**; (2) the connection of the upper end of absorber coil **27** to the pipe **28** at **44**; (3) the connection of the lower end of the absorber coil **27** to pipe **26** at **45**; (4) the connection of the liquid refrigerant supply line **21** to the upper end of the cooling element or evaporator **22** at **46**; (5) the connection of the upper end of pipe **40** to the condenser **18** at **47**; and (6) the connection of the lower end of pipe **40** to pipe **23** at **41**. At the aforementioned six places **41** and **43** to **46**, inclusive, the welds or joints cannot be avoided even when the pipes connected to one another have the same dimensions.

In the refrigeration apparatus illustrated in the drawing it is apparent that the upper and lower ends of the absorber coil **27** are connected at **44** and **45**, respectively, to other parts of the apparatus. Also, the liquid refrigerant supply line **21** is connected to the upper end of the cooling element **22** at **46**. However, the connections of T form at **41**, **43** and **47**, in accord with my invention, can be effected in a variety of ways by joining any one of the three legs of each T-connection to the other two legs of such T-connection.

In this way it is possible to select a pipe form which is best suited for fabricating the refrigeration apparatus, such as, for example, a pipe form that requires bending of only one pipe length to the desired shape together with the small portion which extends from the connection at **44** to the connection at **42** through the looped coil **31** and liquid heat exchanger **34**. A pipe form also can be selected in which a pair of long pipes are obtained that are generally of equal length and can be bent to the desired shape when fabricating the refrigeration system.

It has been found in practice that, in fabricating the refrigeration apparatus, the same bending radius can be employed to make all of the pipe bends in the apparatus. Hence, the smallest possible number of tools and equipment is required for bending the pipes. If it is desirable for some reason to fabricate the refrigeration apparatus in such manner that a particular pipe bend has a different radius of curvature, there is nothing to prevent such a variation or modification from being adopted when fabricating the apparatus.

Heretofore, when absorption refrigeration apparatus has been fabricated from a plurality of different components, considerable work is involved to clean the internal surfaces of the pipes to remove remainders and chemicals that may be present. The demands for internal cleanliness of the component parts of the refrigeration apparatus are so great that, during fabrication of the refrigeration units, checks must be frequently made to make certain that the units are clean and free of all foreign matter when the units are charged with working media, that is, refrigerant, inert gas and absorption liquid.

In view of the foregoing, it will now be understood that the looped pipe or coil **31** receives absorption solution rich in refrigerant from the absorber coil **27** and forms a reservoir for such liquid which is supplied to the lower inlet end of the pump pipe **35**. The rich absorption liquid is supplied to the pump pipe **35** through piping **33** which forms one of the passageways of the liquid heat exchanger **34**. The liquid heat exchanger piping **33** and looped piping defining the reservoir **31** are formed by a single continuous length of piping. Further, the piping defining both of the gas heat exchanger passageways **23** and **24** of the gas heat exchanger **25** and the piping defining the reservoir **31** are formed by a single continuous length of piping.

As explained above, the piping defining the reservoir **31** and condenser **18** desirably have the same diameter and are formed by a single continuous length of piping. Further, the piping defining the absorber pipe coil **27** and the condenser **18** also desirably have the same diameter. Also, the piping defining the liquid refrigerant supply line **21** for the evaporator **22** and the condenser **18** desirably have the same diameter. Further, the piping defining the evaporator **22** and the and the condenser **18** also desirably have the same diameter.

The piping forming the passageways **33** and **38** of the liquid heat exchanger **34** may be deformed so that they will be non-circular in cross-section. Likewise, the piping forming the passageways **23** and **24** of the gas heat exchanger **24** may be deformed so that they will be non-circular in cross-section.

When refrigeration units are fabricated in accord with my invention, in the manner explained above, impurities within the pipes are avoided to a very great degree and at the same time the extent to which control measures are required is reduced. Further, refrigeration units or apparatus embodying my invention are relatively free from operating breakdowns, thus avoiding the need for servicing after the systems are in the field which is expensive and must ultimately be charged to the overall production costs and the final factory cost of the units or apparatus.

FIG. **2** illustrates another embodiment of the invention in which parts similar to those in FIG. **1** are referred to by the same reference numerals with **100** added thereto. In FIG. **2** all of the pipes embodied in the apparatus are of the kind having seams in which the

opposing edges at such seams are united by welding at **148**. The piping forming the cooling element or evaporator **122** is formed with capillary passages **149**, as seen in FIGS. **3** and **4**, which function to raise liquid from the bottom of the piping at opposing side walls thereof to promote distribution of liquid. As explained above, the piping providing the evaporator **122** and other parts can be formed from a flat metallic sheet which is shaped and welded at the opposing edges defining the seam.

In order to provide the same size piping for all parts of the refrigeration apparatus of FIG. **2**, piping like that employed for the evaporator **122** and having internal capillary grooves also is employed for other parts even when piping having internal grooves is not necessary for such parts to function properly.

This means that the pump pipe **135** and vent pipe **140** are also formed by piping like that used to provide the evaporator **122**. As shown in FIGS. **5** and **6**, the pump pipe **135** and vent pipe **140**, respectively, are deformed to provide paths of flow for fluids therein which will enable them to function properly during operation of the apparatus.

FIGS. **7** and **8** respectively illustrate the deformation of the pipes **123** and **124** of the gas heat exchanger **125** and the deformation of the pipes **133** and **138** of the liquid heat exchanger **134** in the refrigeration apparatus of FIG. **2**.

I claim:

1. In absorption refrigeration apparatus of the inert gas type having circuits for circulation of refrigerant, absorption liquid and inert gas, the combination of

a. a generator (**10**) comprising a first upright conduit (**11**) and a pump pipe (**35**) having its upper end connected to the upper part of said first conduit (**11**), a condenser (**18**) and an evaporator (**22**) below said condenser (**18**) comprising a first looped coil (**22**) for flowing fluid therethrough between different levels,

b. a second conduit (**16**) for conducting to said condenser (**18**) vapor expelled from absorption liquid in said generator (**10**) and a third vertically extending conduit (**21**) for conducting to said first looped coil (**22**) condensate formed in said condenser (**18**),

c. an absorber below said first looped coil (**22**) comprising a second looped coil (**27**) for flowing fluid therethrough between different levels,

d. a fourth vertically extending conduit (**23**) connecting the upper end of said second looped coil (**27**) and one end of said first looped coil (**22**) and a fifth vertically extending conduit (**24,26**) connecting the lower end of said second looped coil (**27**) and the opposite end of said first looped coil (**22**),

e. said third (**21**), fourth (**23**) and fifth (**24,26**) conduits being in thermal exchange relation (**29,30**) in a lengthwise direction,

f. a sixth conduit (**31,33**) having one end connected to the lower ends of said second looped coil (**27**) and said fifth conduit (**24,26**) and its opposite end connected to the lower end of said pump pipe (**35**),

g. a seventh conduit (**28,38**) having one end connected to the upper end of said second looped coil (**27**) and lower end of said fourth conduit (**23**) and its opposite end connected to the lower part of said first upright conduit (**11**),

h. a first part (**31**) of said sixth conduit (**31,33**) comprising a vertically extending looped coil (**31**) and a second part (**33**) thereof being in thermal exchange relation (**39**) with said seventh conduit (**28,38**) in a lengthwise direction,

i. certain of said aforementioned parts comprising a single continuous length of piping having the same diameter in which successive portions thereof, starting from the region (**46**) at which said third conduit (**21**) conducts condensate to said first looped coil (**22**), form said third conduit (**21**), condenser (**20**), second conduit (**16**), first upright conduit (**11**), seventh conduit (**38,28**), fourth conduit (**23**), first looped coil (**22**), fifth conduit (**24,26**) and sixth conduit (**31,33**),

j. the upper end of said second looped coil (**27**) being connected to the single length of piping at the juncture (**44**) of said fourth conduit (**23**) and sixth conduit (**28,38**) and the lower end of said second looped coil (**27**) being connected to the single length of piping at the juncture (**45**) of said fifth conduit (**24,26**) and sixth conduit (**31,33**),

k. said first and second looped coils (**22** and **27**) and fourth (**23**) and fifth (**24,26**) connecting conduits therebetween defining an inert gas circuit,

l. said second looped coil (**27**) and generator (**10**) and sixth (**31,33**) and seventh (**28,38**) connecting conduits therebetween defining an absorption liquid circuit,

m. the first part (**31**) of said sixth conduit (**31,33**), which comprises a vertically extending looped coil, receiving absorption liquid rich in refrigerant from said second looped coil (**27**) and defining an elongated path which serves as a reservoir for holding a column of liquid (**32**) therein, and

n. said pump pipe (**35**) raising liquid by vapor-liquid lift action by heating under the influence of a reaction head formed by the liquid column (**32**) in the first part (**31**) of said sixth conduit (**31,33**) and metering the flow of absorption liquid from the reservoir in said sixth conduit (**31,33**) to the upper part of said first conduit (**11**).

* * * * *

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 3,715,896
DATED : February 13, 1973
INVENTOR(S) : NICOLAS EBER

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 2, line 34, "the drawing" should read --FIG. 1--.

Column 4, line 28, "the drawing" should read --FIG. 1--.

Column 4, line 31, before "of" insert --(90%)-- .

Column 4, line 64, after "sides" and before the period "(.)" insert --, as shown in FIGS. 3 and 4 and explained hereinafter in describing the embodiment of FIG. 2-- .

column 5, line 5, before "piping" insert --such seamed-- .

column 5, line 9, after the period "(.)" insert -- Such an embodiment is shown in FIGS. 2 which is described hereinafter.--.

Column 5, lines 11 and 12, "the drawing" should read --FIG. 1-- .

Column 5, line 25, after the period "(.)" insert --This is shown in FIGS. 5 and 6 and explained hereinafter in describing the embodiment of FIG. 2.--.

Column 5, line 27, "the drawing" should read -- FIG. 1 --.

Column 5, lines 42 and 43 "the drawing" should read -- FIG. 1 --.

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 3,715,896

DATED : February 13, 1973

INVENTOR(S) : NICOLAS EBER

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 6, line 44, cancel "and the"

Column 6, line 48 after "cross-section" and before the period "(.)" insert --, as shown in FIG. 8 and explained hereinafter in describing the embodiment of FIG. 2-- .

Column 6, line 51, after "cross-section" and before the period "(.)" insert --, as shown in FIG. 7 and explained hereinafter in describing the embodiment of FIG. 2-- .

Column 6, line 67, after "having" insert --longitudinally extending-- .

Column 8, after line 55 insert claims 2 to 7, as follows:

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,715,896 Dated Feburary 13, 1973

Inventor(s) NICOLAS EBER

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

--2. Absorption refrigeration apparatus as set forth in claim 1 in which said single continuous length of piping comprises piping having a longitudinally extending seam in which the opposing edges thereof are united to one another.

3. Absorption refrigeration apparatus as set forth in claim 2 in which at least the portion of said single continuous length of piping forming said first looped coil which serves as said evaporator has internal capillary passages to promote distribution of liquid.

4. Absorption refrigeration apparatus as set forth in claim 1 in which said pump pipe comprises piping having the same diameter as said single continuous length of piping and forms a part thereof, the portion of said single continuous length of piping forming said pump pipe being deformed and non-circular in cross-section to enable it to function properly during operation of the apparatus.

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,715,896 Dated February 13, 1973

Inventor(s) NICOLAS EBER

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

5. Absorption refrigeration apparatus as set forth in claim 1 in which said fourth and fifth conduits in thermal exchange relation in a lengthwise direction and forming portions of said continuous length of piping are deformed and non-circular in cross-section.

6. Absorption refrigeration apparatus as set forth in claim 1 in which said sixth and seventh conduits in thermal exchange relation in a lengthwise direction and forming portions of said single continuous length of piping are deformed and non-circular in cross-section.

7. Absorption refrigeration apparatus as set forth in claim 1 in which at least the portion of said single continuous length of piping forming said first looped coil which serves as said evaporator has internal capillary passages to promote distribution of liquid.--

Signed and Sealed this

thirtieth Day of *March 1976*

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks