

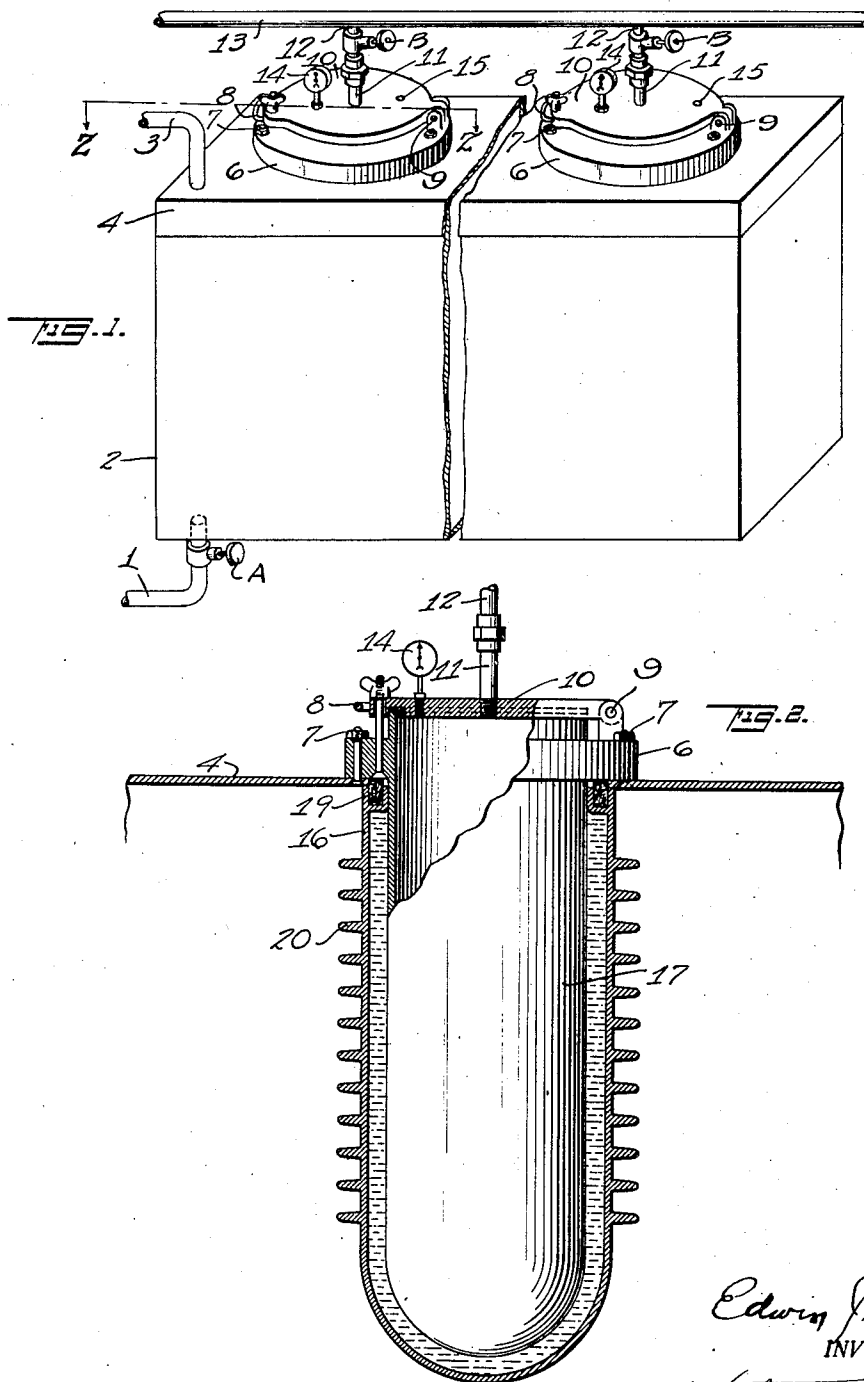
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DEVICE FOR SOLIDIFYING LIQUIDS AND GASES

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## UNITED STATES PATENT OFFICE

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## DEVICE FOR SOLIDIFYING LIQUIDS AND GASES

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It is an object of my invention to produce a device of this type which will be inexpensive to manufacture and highly efficient in operation.

5 It is my further object to produce a device of this type which will be readily adapted to existing machinery and methods of solidifying liquids and gases. I am familiar with the conventional process of producing solidified liquids and gases, particularly solidified  
10 carbon dioxide gas, and the like.

Methods heretofore employed in such processes are highly inefficient, inasmuch as the solidified substance is obtained out of and  
15 as a part of the energy source supply which creates it. To be more specific in the manufacture of solidified carbon dioxide gas it is conventional to permit such liquefied gas to escape freely in a confined chamber where  
20 a portion of the liquefied gas precipitates as a solid by absorption of heat in its own liquid and the unprecipitated portion is then reconverted back into the system.

It is my object to accomplish solidification by separating the energy source supply  
25 from the product supply; that is to say by setting up two cycles, first a primary or energy cycle the gas or liquid in which is always self-contained and separated from my secondary or product cycle, which latter cycle  
30 I use exclusively as a supply circuit of solidified liquid or gas as the case may be. It must be understood, of course, that the original source supply both for my primary and  
35 secondary cycle may be the same.

It will appear that I accomplish the further object of facilitating the recovery of my final product inasmuch as I have the same  
40 collected in container units which lend themselves to handling and the like. This is more readily seen when it is appreciated that in the process as heretofore used the gas precipitated is in the form of crystals or snow which have to be physically removed from  
45 the precipitating chamber and thereafter compressed and placed into suitable containers which obviously involves considerable loss.

It is a further object of my invention to  
50 provide a suitable structure to permit of the

removal of the final container or finished product from the position in which the gas or liquid is solidified and it is also my object to accomplish the foregoing at the same time  
utilizing a method which will give positive  
55 contact between the finished product container and the chamber of expansion.

Other objects will more fully appear from the following description and drawing:

Fig. 1 shows a diagrammatic sketch, partly  
60 in section, of my device assembled and Fig. 2 shows a sectional elevation of the container head along the plane Z—Z.

Referring now to Fig. 1, 1 is the high pressure feed line leading from a conventional  
65 condenser receiver of the ordinary type used for carbon dioxide or similar gases which will give sufficiently cold temperatures on expansion to perform the work required in each  
particular case. For example in the case of  
70 an expansion chamber where it is required to solidify carbon dioxide gas it will be necessary to reach temperatures as low as approximately 115 to 120 degrees Fahrenheit (below  
zero). A designates the expansion valve on  
75 this line. This leads directly into the primary circuit expansion chamber section designated 2. This chamber 2 is solidly constructed and adapted to withstand pressures  
up to 200 to 500 pounds per square inch. The  
80 top 4 of this chamber, which is a portion of my primary circuit, contains a circular or other cut out portion centrally disposed therein and surrounding the periphery of such cut  
out portion is a small buffer ring 19, fastened  
85 to the inner portion 16 of a vertically disposed additional section of said chamber as shown. This vertically hung portion has the  
general shape of the secondary container 17  
90 into which the finished product is introduced and accumulated. The outer section of the  
vertically disposed portion 16 is provided with vein-like or fin portions 20 the better to  
provide contact for the expanding refrigerating  
gases flowing in the chamber 2. The  
95 gases are withdrawn from chamber 2 through the suction line 3 leading to the compressor and thus back into the primary energy source  
circuit. It must be understood that the lead  
100 pipe 3 leading to the compressor may first be

brought into contact with the supply lead 1 in a conventional manner so that the temperature of the gases in 3, which in the case of carbon dioxide are approximately minus 115° Fahrenheit, will be utilized to cool the liquid flowing in lead 1 and thereby utilize all the units available in the system to the best advantage. It will appear that any gas refrigerant expanded into the chamber 2 from the line 1 will readily cool the veins or fins 20 of the vertically disposed portion 16. It must also be understood that I may construct a plurality of portions 16 all connected to a common feed 1 and free to be effected by the expanded gases from the feed 1 but in each case having the central disposed cut out portion in the top. Having thus described my primary energy source circuit I will now refer to the secondary circuit which gives me my finished product supply.

This circuit consists of a high pressure feed line 13 adapted to feed one or more of my cans or containers 17, each being connected through a lead pipe 12 having a valve B adapted to sustain pressures of 900 to 1,000 pounds per square inch of liquid or gas such as carbon dioxide or the like which I may, of course, obtain from the same basic source as used in my primary energy circuit. Of course some of the liquids or gases used may be under much higher pressures but a preferred embodiment of my system utilizes carbon dioxide gas at such pressure, or less. This lead pipe 12 is connected through a suitable union to cover the head lead 11 firmly attached to the cover 10 of an inner final container 17, the container 17 having a shoulder 6 adapted to be firmly clamped by bolts or other clamps 7 to the cover 4 of the primary chamber, also tightly down against the cushion or buffer ring 19 constructed of felt or other suitable material. The container 17 may also be equipped with handles 8 or other suitable provision for lifting and may be hinged at 9 to cover 10 or otherwise firmly attached thereto. The cover 10 is provided also with a pressure gauge 14 and air vent valve 15.

By reference to Fig. 2 it will appear that I show a liquid between the walls of the finished product container 17 and the wall of the vertically disposed portion 16 of my primary expansion chamber 2. The purpose of this liquid as I have stated in my objects is to provide first a contactor between the low temperatures developed in the expansion chamber and the product to be solidified in the finished chamber 17, and second to provide a support for the pressures developed in the finished product chamber. Were it not for the use of this liquid the walls of the finished product chamber 17 would require construction of a prohibitively heavy material and by the introduction of this liquid, preferably alcohol or some other low freezing liq-

uid, I can construct my chamber 17 of light material and yet prevent bulging because of the non-compressibility of this liquid in its confined space. Sufficient liquid is introduced into the vertically disposed portion 16 so that the displacement thereof when 17 is inserted therein is enough to cause said liquid to approach approximately to the buffer ring 19 so that every portion of the outside of 17 is in contact with said liquid thereby insuring against the expansion of 17 under the pressure of its contents before the same is solidified.

It must be understood that I may also provide other means for maintaining a complete flush condition of this liquid in the portion 16 other than by mere displacement such as a force pump connection.

The operation of my device is in general as follows:—

The finished product container 17 is placed into the chamber provided by the vertically disposed portion 16, the shoulder 6 is brought into engagement solidly with the top 4 and the ring 19 and is securely clamped in place by the through bolts 7 or other suitable clamping means and the expanded gases are permitted to be introduced through the valve A into the primary expansion chamber 2 and after suitable expansion permitted to escape through the lead pipe 3. They are, of course, drawn by the suction of the compressor for recompression through the primary system. This expansion in the case of carbon dioxide provides a temperature within the expansion chamber 2 in contact with the veins or fins 20 of portion 16 down to a possible temperature of about minus 160° Fahrenheit depending upon the suction pressure but for my purpose it will appear that temperatures down to minus 115° Fahrenheit are sufficient inasmuch as a preferred embodiment of my device contemplates a solidification in the container 17 of carbon dioxide.

After the finished product container 17 is securely fastened in place the valve B is opened and the liquid or gas to be solidified is allowed to pass through the pipes 12 and 11 and the head or cover 10 directly into container 17 and any air present in 17 is forced out through the vent hole valve 15 in the cover 10. Of course it must be understood that I may use preliminary exhaust means connected with the vent hole valve 15 to previously remove such air in container 17. At the initial stages of the introduction of the liquid or gases to be solidified the pressure on the pressure gauge 14 may register upward of 900 to 1100 pounds per square inch depending on the temperature of the liquid or gas being introduced and as the heat is absorbed by the effect of the expansion chamber surrounding the container 17 the pressure gauge will drop until at a temperature of approximately zero degree Fahrenheit in the con-

5 tainer 17, the pressure will approximate 300  
pounds per square inch and upon complete  
solidification of the gas, carbon dioxide for  
example, a temperature of minus 109° Fah-  
10 renheit will give a registration of zero on the  
pressure gauge 14. Of course the valve B  
has heretofore been closed and I am now  
ready to disconnect the pipes 11 and 12 and  
remove the container 17 containing the solidi-  
15 fied liquid. The solidified product is readily  
removed from the container 17 after opening  
the top or head 10 and the container 17 made  
available for another charge. It must be un-  
derstood, as I have previously stated, that a  
20 plurality of finished product containers such  
as 17 may be used in one general expansion  
chamber 2 and may be connected through a  
plurality of lead-in pipes 12 to the product  
supply line 13.

20 Having thus described my invention, what  
I claim and desire to secure by United States  
Letters Patent is:—

1. In a device for solidifying liquids, an  
enclosed expansion chamber adapted to re-  
25 ceive a container for solidified liquid, means  
for securing said container to said chamber,  
with means for inserting liquid into said con-  
tainer under pressure and simultaneous  
means for preventing the distortion of said  
30 container under pressure and for conducting  
the heat of the liquid in said container to said  
chamber.

2. In a device for solidifying liquids, an  
enclosed expansion chamber adapted to re-  
35 ceive a plurality of containers for solidified  
liquid, means for securing said containers to  
said chamber, with means for inserting liquid  
into said containers under pressure and si-  
multaneous means for preventing the distor-  
40 tion of said containers under pressure and  
for conducting the heat of the liquid in said  
containers to said chamber.

3. In a device for solidifying liquids, an  
enclosed expansion chamber adapted to re-  
45 ceive a container for solidified liquid, means  
for securing said container to said chamber,  
a cushion ring connected with said chamber  
at engagement with the top of said container,  
with means for inserting liquid into said  
50 container under pressure and simultaneous  
means for preventing the distortion of said  
container under pressure and for conducting  
the heat of the liquid in said container to said  
chamber.

4. In a device for solidifying liquids, an  
enclosed expansion chamber adapted to re-  
ceive a plurality of containers for solidified  
liquid, means for securing said containers to  
60 said chamber, a cushion ring connected with  
said chamber at engagement with the top of  
said containers, with means for inserting liq-  
uid into said containers under pressure and  
simultaneous means for preventing, in proc-  
65 ess, the distortion of said containers under

pressure and for conducting the heat of the  
liquid in said containers to said chamber.

5. A device of the type described having an  
expansion chamber, a vertically disposed  
portion therein adapted to conform to the 70  
shape of a container to be inserted and secured  
therein, said container having a shoulder, a  
cover, a pipe connection, a pressure gauge in  
said cover, a vent in said cover, buffer ring  
between said container and said vertically 75  
disposed portion, low freezing liquid between  
said container and said vertically disposed  
portion, said liquid free to be displaced by  
the insertion of said container and to com-  
pletely surround said container between its 80  
wall and the wall of said vertically disposed  
portion, means for securing said shoulder to  
said chamber.

6. A device of the type described having an  
expansion chamber, a vertically disposed por- 85  
tion therein, equipped with a plurality of re-  
frigeration fins and adapted to conform to  
the shape of a container to be inserted and se-  
cured therein, said container having a shoul-  
der, a cover, a pipe connection, a pressure 90  
gauge in said cover, a vent in said cover, buf-  
fer ring between said container and said ver-  
tically disposed portion, low freezing liquid  
between said container and said vertically  
disposed portion, said liquid free to be dis- 95  
placed by the insertion of said container and  
to completely surround said container be-  
tween its wall and the wall of said vertically  
disposed portion, means for securing said  
shoulder to said chamber. 100

7. A device of the type described having an  
expansion chamber, a vertically disposed por-  
tion therein adapted to conform to the shape  
of a container to be inserted and secured  
therein, said container having a shoulder, a 105  
cover, a pipe connection, a pressure gauge in  
said cover, a vent valve in said cover, buffer  
ring between said container and said vertic-  
ally disposed portion, low freezing liquid be-  
tween said container and said vertically dis- 110  
posed portion, said liquid free to be displaced  
by the insertion of said container and to  
completely surround said container between  
its wall and the wall of said vertically dis- 115  
posed portion, means for securing said shoul-  
der to said chamber and a plurality of said  
containers in such an expansion chamber.

8. In a device of the type described, means  
for inserting liquid carbon dioxide under  
pressure into a container, means for placing 120  
said container into an expansion chamber  
where said liquid will be solidified with  
means, after solidification, of removing said  
container without the utilization of tempera-  
ture or pressure change in said container. 125

9. The combination with a removable solid-  
ifying chamber having relatively thin and  
smooth heat-conducting walls, of an outer  
chamber adapted to contain cooling material,  
a conducting jacket located around the solidi- 130

5 fying chamber and spaced from said solidi-  
fying chamber and adapted to withstand  
pressure, the jacket being provided with fins  
adapted to conduct heat to the cooling ma-  
terial, a heat-conducting liquid filling the  
10 space between the solidifying chamber and  
the jacket, and means to hold the solidifying  
chamber so that the liquid will transmit pres-  
sure to the jacket and support the thin walls  
of the solidifying chamber against pressure.  
15 10. The combination with a removable sol-  
idifying chamber having thin and smooth  
heat-conducting walls, of an outer chamber  
to contain cooling material, a feed pipe lead-  
ing to the outer chamber for delivering cool-  
ing material for expansion in the outer cham-  
ber, a pipe for removing expanded material,  
a conducting jacket for the solidifying cham-  
ber held spaced from the same and having  
20 walls formed to withstand pressure, a liquid  
filling the space between the solidifying  
chamber and the jacket, and means to hold  
the solidifying chamber so that the liquid will  
support the walls of the same.

25 In witness whereof, I have hereunto set my  
hand to this specification this 25th day of  
January, 1929.

EDWIN J. LOCKWOOD.

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