April 27, 1954 P. SCHLUMBOHM 2,676,468

REFRIGERATING APPARATUS

Filed Sept. 28, 1951

Fig 1

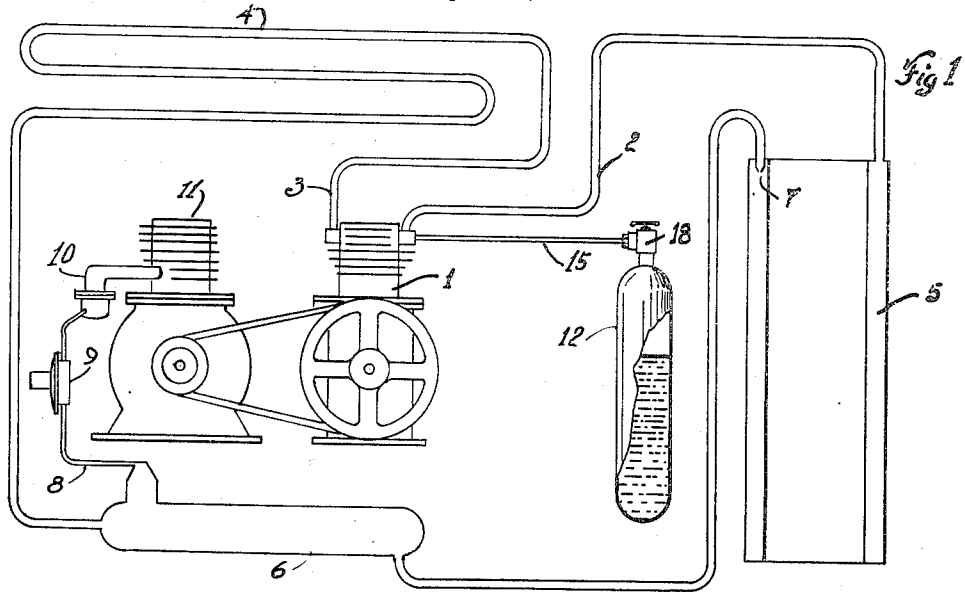
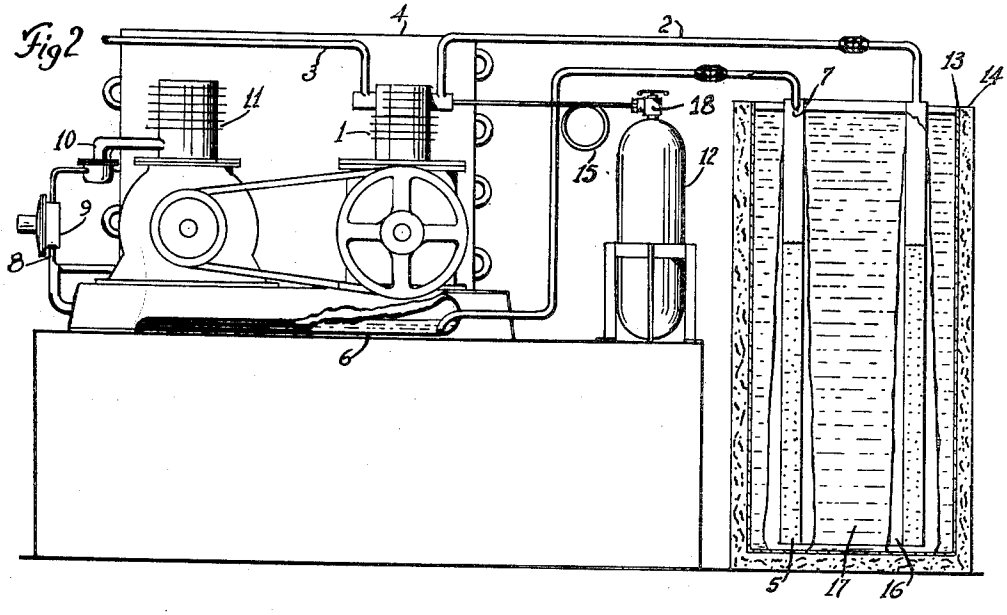


Fig 2



Inventor

Peter Schlumbohm

Patented Apr. 27, 1954

2,676,468

UNITED STATES PATENT OFFICE

2,676,468

REFRIGERATING APPARATUS

Peter Schlumbohm, New York, N. Y.

Application September 28, 1951, Serial No. 248,785

6 Claims. (Cl. 62—106)

1

The present invention relates to a method of refrigeration and to refrigeration apparatus for using the method. More specifically, the invention refers to a refrigerating system of the compression type, in which the motor fuel serves the dual purpose of being fuel for the motor which drives the compressor, as well as being refrigerant in the compression cycle.

The invention is illustrated in Figure 1 and Figure 2 of the accompanying drawings. Figure 1 is a diagrammatic illustration, whereas Figure 2 embodies the technical structure of an operative unit shown in side view and partly in vertical section. The reference numbers of Figure 1 apply also to Figure 2. The aim of the invention is to create a small portable icemaker.

Following the invention, the fuel/refrigerant is applied in a small package, dimensioned to be sufficient for just one batch of icemaking. The consequences of this step will be clearer after I have explained the function of the system. The system is especially designed for using liquefied petroleum gases such as propane, butane, or mixtures of them, as fuel/refrigerant.

As shown in Figure 1 and Figure 2, the propane compressor 1 is driven by a propane combustion engine 11. The propane cycle includes the high side with its tube 3 leading from the compressor 1 to the condenser 4, the receiver tank 6 and the expansion nozzle 7. The low side comprises the evaporator 5 and the suction line 2.

The high side is purged by a purging line 8 which connects the receiver tank 6 with the carburetor 10 of the propane engine 11. A pressure-reducing valve 9 is interposed in this purging line 8.

The low side, preferably near the intake of the compressor 1, is connected by tube 15 with a steel bottle 12 which contains the fuel. The pressure bottle 12 is either of the type in which a hand valve opens the bottle so that tube 15 connects the interior of the bottle 12 with the space of the refrigerant circuit, or the bottle may be closed by a plug and screwed into a connector 18 of the needle-piercing type, attached to pipe 15 (in the same manner as carbon dioxide bulbs are inserted into soda water bottle attachments to pierce the plug), to establish communication between the space of the bottle 12 and the tube 15.

After having established this communication between the space of the fuel bottle 12 and the space of the refrigerant circuit, the low side and high side will be filled with vapor of the fuel to the extent of the pressure of the bottle 12 and the air which was in the space of the refrigerant circuit will constitute only a small percentage in this fuel/air mixture. By pressing the starter button of the usual automotive starting equipment of the propane motor 11, the motor will take in fuel vapor through valve 9 into its carburetor 10 and will start driving the compressor 1.

2

The compressor will suck propane vapor from the bottle 12 and compress it on the high side. The liquefied propane will be collected in the receiver tank 6. The expansion valve 7 is designed to offer sufficient flow-resistance to build up the pressure on the high side to effect the liquefication of the propane. In its simplest form, the expansion valve 7 may be of the capillary type.

The evaporator 5 is preferably designed with a large surface, for example, in the shape of a double-walled hollow cylinder, as shown in the drawings. The evaporator 5 is immersed in a bucket 13 which is insulated by insulating means 14 and filled with water 17. Under the influence of refrigerant evaporating in the evaporator 5, ice 16 is formed on the outside surface of the evaporator 5.

Following the invention, the liquid capacity of the steel bottle 12 for holding liquid fuel/refrigerant, is chosen to be smaller than the capacity of the interior of the evaporator 5 to hold liquid refrigerant. This step of the invention facilitates the equipment considerably and offers a simple operation with a flooded evaporator.

After a short while the entire liquid contents of the steel bottle 12 will have been transferred first as vapor into the condenser 4, and then as liquid into the receiver tank 6 and into the evaporator 5. During the subsequent period of operation the motor runs by drawing refrigerant vapors and non-condensible gas from the vapor space of the high side. After a pre-determined time, the motor has used up the entire refrigerant as fuel. Meanwhile, however, due to the evaporation of the refrigerant in the evaporator 5, a layer of ice has been formed on the outside walls of the evaporator 5. After there is no liquid of the refrigerant existent any more in the space of the refrigerant circuit, there will be hot condenser gas passing from the high side through the expansion valve 7 into the space of the evaporator 5. This will cause the ice-covered walls of the evaporator 5 to get warm and to melt the layer of ice in contact with them.

After a short while the motor will have used up the remaining refrigerant vapors as fuel and will stop running. This will be a good evidence that the batch process is over and that the ice can be harvested. The evaporator 5 is simply lifted out

of the water bucket 13 and the ice is fished out of the water.

I visualize a great application of this small engine as a portatble unit for vacation trips and in warm climates.

The structure of the invention has furthermore the great advantage of basing the use of propane on small bulb-type containers. These containers may even be of the non-returnable type when closed by a plug like the carbon dioxide bulbs. Also such small bulbs would be eligible for shipments by railway express without any great handicaps. Altogether, a small batch container would be without any great danger in handling. The danger point has been the greatest handicap in popularizing propane refrigerating systems.

While I visualize the most popular application of this invention to be the type of equipment as described above, I consider the invention also to have the broader scope that would apply to the general method of thawing off the ice from the walls of the evaporator by consuming the liquid refrigerant as fuel for a motor which drives the compressor. This general method would not be limited to small charges of refrigerant. Having now described the nature of my invention, and having given examples of the manner in which it may be performed, I claim as my invention:

1. The method of manufacturing a batch of ice comprising utilizing a predetermined quantity of fuel as a refrigerant, compressing, condensing and evaporating said fuel to effect refrigeration, removing heat from a predetermined quantity of water to be frozen by associating said water to be frozen with said evaporation step, simultaneously withdrawing said fuel and burning same to convert the energy of said fuel into a driving force to motivate the fuel as a refrigerant through said compression, condensation and evaporating steps, continuing to burn said fuel until all the liquid is consumed and then causing said driving force thus created to circulate heated gaseous fuel to harvest the ice formed by partially thawing until all of the fuel is consumed and the ice completely harvested, whereby the method will automatically cease when the ice is completely harvested.

2. The method of batch-manufacturing a predetermined amount of ice by means of a combustion-engine driven refrigeration compression-cycle apparatus of the type in which the engine draws its fuel from the purging line of the refrigerant condenser and in which the refrigerant-fuel evaporator-compressor-condenser circuit apparatus is connected to a supply container filled with refrigerant-fuel, comprising the step of limiting the liquid amount of the supply to the amount of fuel which is required to run the motor just long enough to produce the predetermined amount of ice, to the effect that the motor will have consumed the entire amount of liquid refrigerant by the time the ice has been frozen; comprising the step of subsequently running the motor on the vapor which fills the refrigerating apparatus after the liquid phase is no longer existent, whereby the motor will continue to drive the compressor, not with a refrigerating effect in the evaporator, but rather with a heating effect in the evaporator, and comprising the step of utilizing this heating effect to thaw off the ice from the walls of the evaporator element, the motor coming to a stop due to lack of fuel after the time element required for this thawing step.

3. A batch ice maker comprising a compressor, condenser, evaporator system, a supply container for refrigerant connected with the suction side of said compressor, an engine for burning refrigerant connected with said condenser, said engine being associated in driving relation with said compressor, the volume of said container being less than the volume of said evaporator, whereby said engine will continuously burn the refrigerant, the container will be exhausted prior to cessation of the refrigeration cycle and whereby the refrigeration cycle will automatically convert into a heating cycle and will thereafter automatically cease operation.

4. Combustion-engine drvien refrigerating compression-cycle apparatus of the type in which the engine draws its fuel from the purging line of the refrigerant condenser and in which the refrigerant-fuel evaporator-compressor-condenser circuit apparatus is connected to a supply container filled with refrigerant-fuel, characterized by a supply container which has a smaller liquid capacity than the evaporator of said circuit.

5. Refrigerating apparatus as claimed in claim 4 comprising an evaporator in the shape of a double walled cylinder open at both ends, in which the space between the double walls is the space for the refrigerant.

6. Batch ice maker, including the equipment as claimed in claim 4, comprising a heat-insulated bucket for holding the water to be frozen together with the evaporator-element immersed in said water.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
1,168,015	Lawrence	Jan. 11, 1916
2,082,850	Schlumbohm	June 8, 1937
2,195,387	Schlumbohm	Mar. 26, 1940
2,410,334	Brace	Oct. 29, 1946
2,429,851	Swann	Oct. 28, 1947