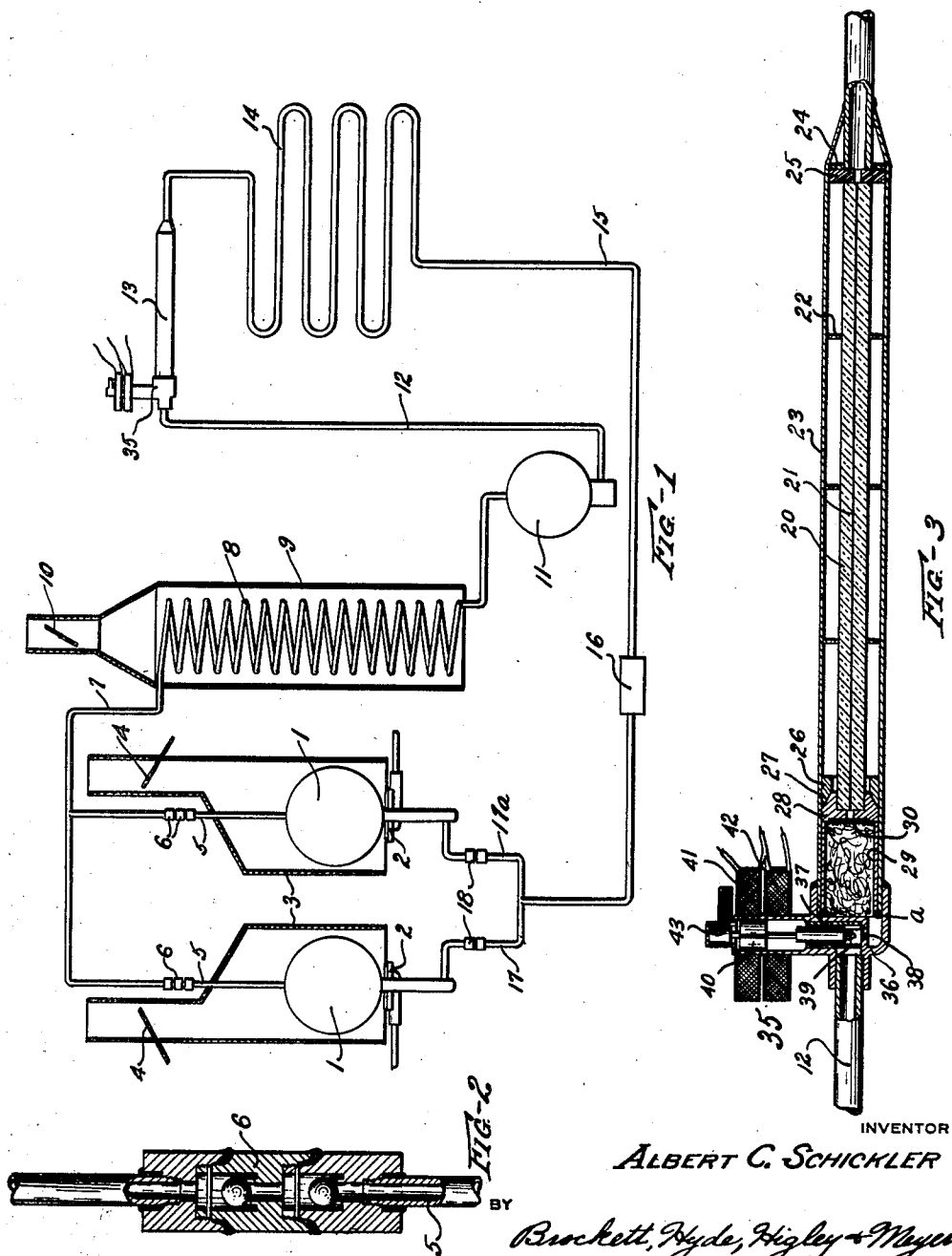


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A. C. SCHICKLER
REFRIGERATING APPARATUS
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INVENTOR
ALBERT C. SCHICKLER

BY
Brockett, Hyde, Higley & Meyer

ATTORNEYS

UNITED STATES PATENT OFFICE

ALBERT C. SCHICKLER, OF CLEVELAND, OHIO, ASSIGNOR TO EDMUND E. ALLYNE, OF CLEVELAND, OHIO

REFRIGERATING APPARATUS

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This invention relates to refrigerating apparatus of the absorption type in which a suitable refrigerant, such as ammonia, is alternately driven off from and absorbed in a suitable absorbing agent, such as water. The invention has more particular reference to a duplex absorption system including two boilers or generators which are alternately used as boiler and absorber, so as to maintain refrigeration without interruption, as will more fully appear hereafter.

The object of the present invention is to provide a system of this kind which can be practically completely sealed against the atmosphere, doing away with the necessity for stuffing boxes and like sealed or packed joints; in which refrigeration may be readily controlled in accordance with any desired or required conditions; and in which expansion of the condensed refrigerant to produce refrigeration takes place through or by means of a device which is of simple form and not likely to get out of order in service.

In the drawings, Fig. 1 represents a diagram of apparatus embodying the invention; Fig. 2 is a detail view of one of the check valves; and Fig. 3 is a detail sectional view through the expansion device and controller.

The apparatus shown in the drawings comprises two like boilers or generators 1, each heated by a suitable burner 2, the burner control being such that the boilers may be heated independently of each other. Each boiler may also be cooled independently of the other in any suitable manner, such as by enclosing it in a shield, indicated at 3, which is more or less of chimney form with a damper or valve 4 which may be more or less opened to promote or retard air circulation past the boiler for cooling purposes, as will be readily understood without further explanation. By heating either one of the boilers while it contains a mixture of absorbing agent and refrigerant, such as a solution of ammonia in water, the gas distilled from the boiler passes off by way of a pipe 5 and past one or more check valves 6 which seat toward the boiler, to a pipe 7, from which the gas flows through a suitable condenser including a coil 8 within a shield or hood 9

of form similar to the shields 3, and having an adjustable controlling valve or damper 10 by means of which the rate of flow of air past the coil 8 may be accelerated or retarded to vary the refrigerating effect, as will appear. In the condenser the ammonia gas or other refrigerant is condensed to liquid form, and from the condenser it flows to a receiver 11 of suitable form. Beyond the receiver the liquefied refrigerant flows by way of a pipe 12 to an expansion device, generally indicated at 13, through which it passes to the evaporator 14, which may be a suitable coil or other device located in the space or chamber or at the device to be cooled. In the evaporator the liquefied refrigerant becomes a gas and absorbs heat, and the gas thus produced is returned to the boiler system by way of the pipe 15, which includes in its length a suitable screen 16, beyond which pipe 15 communicates by way of two branch pipes 17, 17a, with the two boilers 1, each of the branch pipes 17, 17a including one or more check valves 18 seating away from the boiler.

The expansion device 13 is of special form, preferably including a restricted orifice of small size so made as to prevent its clogging under service conditions and also to compel a retarding effect upon the flow of refrigerant so as to limit refrigeration to a useful value. Ordinary restricted orifices in plates or by way of needle valves or the like are found to clog either by the collection of sediment or by the freezing action in the zone of the restricted orifice, which produces frost from any water which may be present and is thus likely to clog the orifice.

According to the present invention, my restricted orifice is formed of a suitable material which can be made in tubular form of suitable length, say six to ten inches, and with a very minute bore. Suitable non-corroding metals may be employed for the purpose, but one suitable material is glass, which can be made after the fashion of thermometer glass in the form of a rod or pencil of material thickness, but nevertheless with a very minute but uniform bore throughout its length. Fig. 3 of the drawings shows such a glass rod 20 having a minute bore 21 extend-

ing throughout its length. The glass rod is held centrally by suitable spacers 22 in a metal shell 23 of steel or the like, one end of said shield having welded or otherwise rigidly secured thereto a cross wall 24 forming a shouldered seat for a lead washer or gasket 25 against which one end of the glass rod 20 abuts. At the opposite end of the shell 23 is welded an internal ring 26 having a tapered seat 27 cooperating with a like surface of the lead washer or gasket 28, which also has a portion abutting the other end of the tube 20. In assembling these parts the glass tube is pushed into shell 23 against the washer 25; the washer 28 is laid in place in its opposite end and a cup 29, open at one end and closed at the other by a wall of screen material 30, is pushed into place within the shell 23. The cup 29 abuts the washer 28 and pressure is applied to tightly seal both ends of the glass rod against the lead gaskets, whereupon the outer exposed edges of the cup 29 and shell 23 are welded together at *a*. The screen cup may be filled with woolen, asbestos, or any other fine material useful as a filtering medium and not subject to deterioration in use.

With this arrangement heat is applied to one of the boilers and the gas distilled therefrom passes off by way of pipes 5 and 7 to the condenser and thence to the receiver 11 beyond which it meets the retarding effect of the minute orifice 21. The check valve system confines the rise in pressure at the boiler being heated to said boiler at one end and to the expansion device at the other. Assuming damper 10 to be open so that a condensing effect is produced, some refrigerant is condensed to liquid form and the rising pressure compels the same to first collect in the receiver 11 and then pass through the orifice 21 to the evaporator where it is evaporated to produce a refrigerating effect. The gas thus produced returns by way of pipe 15 and the proper branch pipe 17 or 17*a* to the other boiler, which is now functioning as an absorber.

At the expansion device practically the entire length of the glass tube is at atmospheric temperature, because a low or refrigerating temperature is not produced except at a point beyond the outlet end of the minute bore 21. Therefore, only one end of the expansion device is subject to relatively low temperature and a tight seal of the glass tube in its place may be produced without liability of refrigerant escaping otherwise than through the minute bore or orifice.

The operation proceeds with the first boiler heated until it is practically exhausted of refrigerant, which may pile up and collect a reserve in the storage tank 11, so that refrigeration will continue for some time after the heat is turned off from the first boiler. Before the liquefied refrigerant is entirely exhausted from the receiver the heat is turned

on to the second boiler and the first boiler is cooled, whereupon the operation is reversed and a new charge of refrigerant is produced from the second boiler and condenser, while the first boiler becomes the absorber. The rate of evaporation, and hence the rate of refrigeration, may be accelerated or retarded by any suitable means which varies the flow of the refrigerant through the expansion device. This may be accomplished in several ways. For example, adjustment of the valve or damper 10 to accelerate or retard the condensing effect will result in more or less increasing or diminishing the boiler pressure effective upon the inlet end of the expansion device and hence the rate of flow of liquefied refrigerant through the same. A similar result may be produced by providing a suitable valve between the condenser and expansion device. Such a valve is indicated generally at 35. It comprises a suitable valve casing 36 integral with or welded to the conduit system and sealed against the atmosphere. In said casing is a cross wall 37 having a port 38 communicating on one side with the supply pipe 12 and on the other side with the expansion device. Flow of liquid through said port is controlled by a valve 39, the stem of which is connected to a core member 40 of magnetic material, while the valve casing may be of non-magnetic material such as Monel metal. Core 40 slides within a tubular portion of the casing and may be moved to either open or closed position by energizing one or the other of two coils 41, 42, a spring latch 43 holding the valve in either position to which it may be adjusted. This valve is always either fully open or fully closed, and does not tend to wire draw. It may be operated manually or automatically to cause or stop the flow of refrigerant in accordance with the desired refrigerating effect to be produced.

Other arrangements are also suitable for the purpose.

What I claim is:

1. In an absorption refrigerating apparatus, a generator, condenser and evaporator connected in an operative cycle, and an expansion device in said connections between the condenser and the evaporator and comprising an elongated casing sealed in the circuit, an elongated tube within said casing sealed at both ends to the circuit and provided with a minute opening extending through the same and of substantially uniform bore throughout.

2. In an absorption refrigerating apparatus, a generator, condenser and evaporator connected in an operative cycle, an expansion device in said connections between the condenser and the evaporator and comprising an elongated casing sealed in the circuit, an elongated tube within said casing sealed at both ends to the circuit and provided with

a minute opening extending through the same and of substantially uniform bore throughout, and means for varying the effectiveness of said condenser.

5 3. In an absorption refrigerating apparatus, a generator, condenser and evaporator connected in an operative cycle, an expansion device in said connections between the condenser and the evaporator and comprising an
10 elongated casing sealed in the circuit, an elongated tube within said casing sealed at both ends to the circuit and provided with a minute opening extending through the same and of substantially uniform bore
15 throughout, and means for varying the effectiveness of said condenser and comprising a casing about said condenser for a cooling medium and means for varying the cooling medium passing through said casing.

20 In testimony whereof I hereby affix my signature.

ALBERT C. SCHICKLER.

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