Sept. 12, 1939. B. F. RANDEL 2,172,408

AIR CONDITIONING APPARATUS

Filed Dec. 7, 1937 2 Sheets-Sheet 1

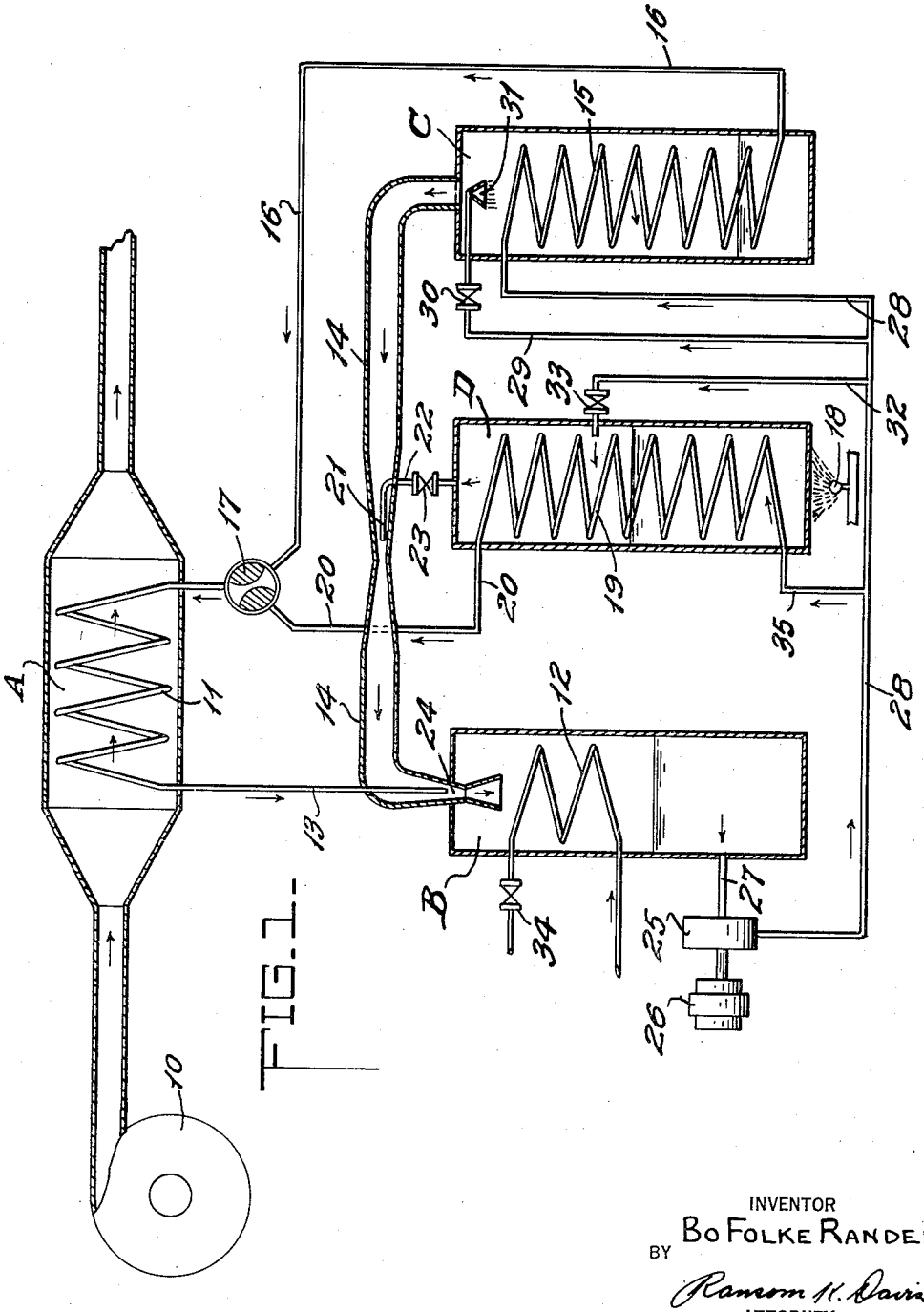

FIG. 1.

INVENTOR
BO FOLKE RANDEL.
BY
Ransom N. Davis
ATTORNEY

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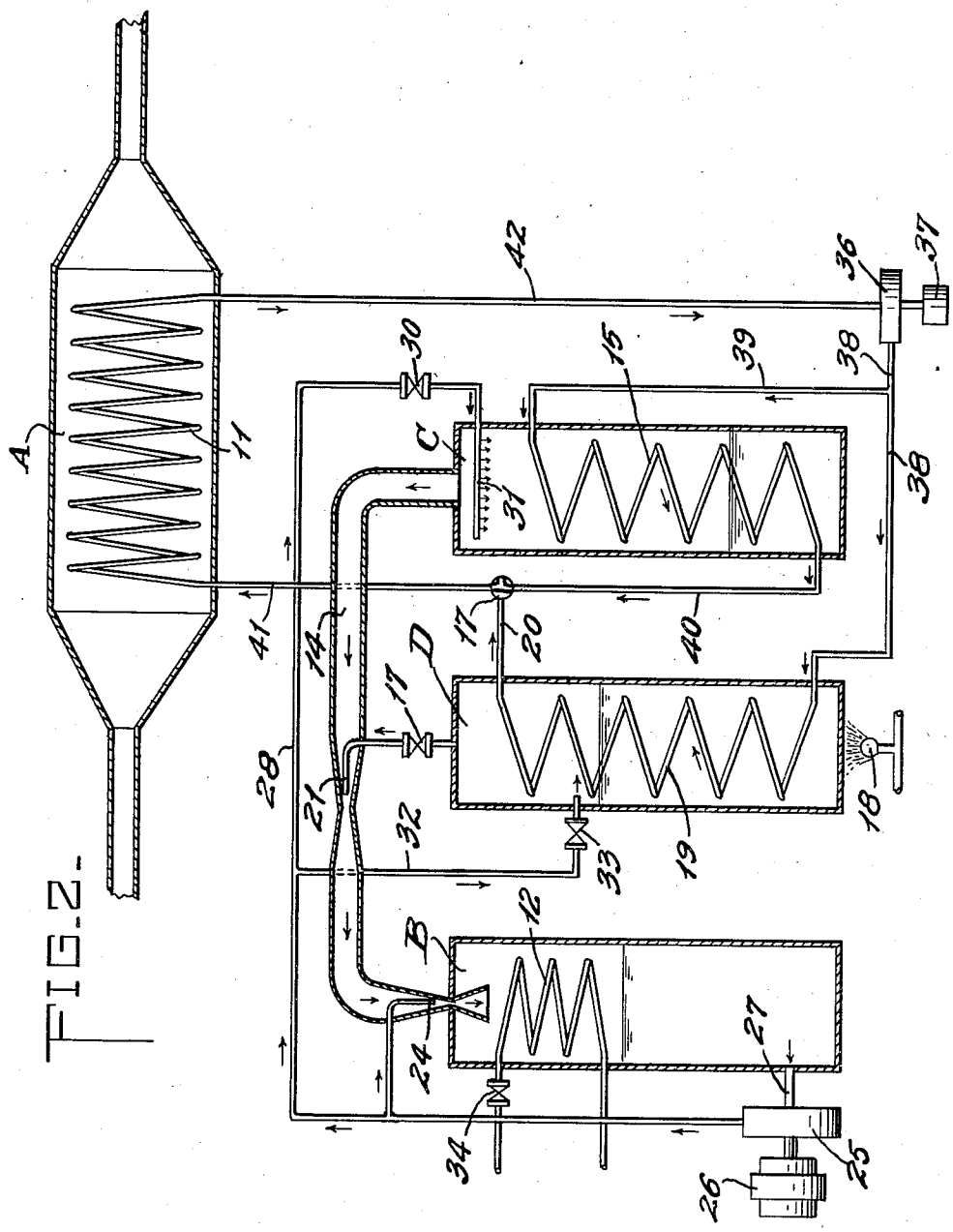

FIG. 2.

INVENTOR
BO FOLKE RANDEL.
BY Ransom & Davis
ATTORNEY

Patented Sept. 12, 1939 2,172,408

UNITED STATES PATENT OFFICE

2,172,408

AIR CONDITIONING APPARATUS

Bo Folke Randel, San Diego, Calif.

Application December 7, 1937, Serial No. 178,441

1 Claim. (Cl. 257—9)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

This invention relates to apparatus for air conditioning and it has a particular relation to heating and/or cooling the air of a building or other space.

The principal object of the present invention is the provision of new and improved means for heating and cooling the ventilating air of a building, that is simple in construction and operation and which embodies but few moving parts.

With these and other objects in view, as well as other advantages that may be incident to the use of the improvements, the invention consists in the parts and combinations thereof hereinafter set forth and claimed, and with the understanding that the several necessary elements constituting the same may be varied in proportion and arrangement without departing from the nature and scope of the invention, as defined in the appended claim.

In order to make the invention more clearly understood, there are shown in the accompanying drawings, means for carrying the invention into practical use, without limiting the improvements in their useful application to the particular construction, which, for the purpose of explanation, have been made the subject of illustration.

In the accompanying drawings:

Fig. 1 is a diagrammatic view of an air conditioning apparatus constructed in accordance with the invention; and

Fig. 2 is a similar view of another form of air conditioning apparatus.

Referring to the drawings, and particularly to Fig. 1 thereof, an air conditioning apparatus embodying the present invention is shown as comprising in its essentials a chamber A through which air to be conditioned is caused to flow by a fan 10 and containing a temperature controlling coil 11; a condenser B containing a cooling coil 12 and communicating with the temperature controlling coil 11 through a pipe 13; an evaporator C communicating with the upper portion of the condenser B through a conduit 14, and containing a cooling coil 15 which communicates with the temperature controlling coil 11 through a pipe 16 and two-way valve 17; and a boiler D which is heated by a suitable burner 18 and containing a heating coil 19 which also communicates with the temperature controlling coil 11 through a pipe 20 and the two-way valve 17. The pressure in the evaporator C is reduced in order to hasten evaporation and resulting cooling by a steam injector 21 located in the conduit 14 and communicating through a pipe 22 and valve 23 with the boiler D. The pressure in the condenser is increased in order to accelerate condensation by a liquid ejector 24 also located in the conduit 14 and which communicates with the pipe 13 leading to the temperature controlling coil 11.

When the apparatus is employed for cooling purposes the two-way valve 17 is turned to the position shown in Fig. 1 in which position a pump 25 driven by a motor 26 withdraws water from the lower portion of the condenser B through a pipe 27 and forces it through a pipe 28 into the cooling coil 15 in the evaporator C and thence through the pipe 16, two-way valve 17, temperature controlling coil 11, pipe 13, and liquid ejector 24 into the upper portion of the condenser B. The cooling water thus injected back into the condenser enters the same in the form of a spray which entrains steam from the ejector 21 and vaporized water from the evaporator entrained by the steam and not only partially liquefies the same but projects it over the cooling coil 12.

Some of the water withdrawn from the condensers by the pump 25 passes from the pipe 28 through a branch pipe 29, expansion valve 30, and spray nozzle 31 into the upper portion of the evaporator C, thus not only facilitating vaporization in the evaporator but assisting in the cooling of the coil 15 and replacing the water lost through evaporation. Also, part of the water withdrawn from the condenser B, passes from the pipe 28 through a branch pipe 32 and regulating valve 33 into the boiler D in order to compensate for the water generated into steam.

When the apparatus is employed for heating purposes the two-way valve 17 is turned so that communication is established between the temperature controlling coil 11 and the pipe 20 leading to the heating coil 19 in the boiler D and at the same time interrupting communication between the pipe 16 and cooling coil 15. Under these conditions the expansion valve 30 is closed to prevent water from accumulating in the evaporator C and a control valve 34 is also closed to prevent the coil 12 from functioning as a cooling coil. With the parts in the positions described, the pump 25 will force water from the pipe 28 through a branch pipe 35, heating coil 19, where it is heated by the hot water and steam in the boiler D, pipe 20, valve 17, temperature control coil 11, pipe 13 and liquid injector back to the condenser B.

In Fig. 2 there is illustrated a different form of the invention in which the same essential elements are employed, the principal differences

being that the heating and cooling fluid which traverses the temperature controlling coil 11 circulates independently of the fluid in the condenser B. In this arrangement when it is desired to cool the air passing through the chamber A, the two-way valve 17 is rotated to the position shown in which a second pump 36 driven by a motor 37 will cause a fluid medium to flow in a closed circuit through a portion of pipe 38 and pipe 39, thence through the coil 15 in the evaporator C where it is cooled, thence through pipe 40, two-way valve 17, pipe 41, temperature controlling coil 11, and a pipe 42, back to the pump 36. This will cause the cooling of the coil 11 and the air flowing through the chamber A.

When it is desired to employ this apparatus for heating purposes the two-way valve 17 is turned so as to interrupt the circuit just traced and to establish communication between the pipe 20 leading to the heating coil 19 and a pipe 41 leading to the temperature controlling coil 11. Under these conditions the pump 36 cannot force the heating medium through the cooling coil 15 because the valve 17 in this position closes pipe 40. This pump will, however, force the fluid medium in a second closed circuit through the pipe 38, heating coil 19, in the boiler D where it is heated, pipe 20, valve 17, pipe 41, temperature controlling coil 11 and pipe 42 back to the pump 36. This will heat the coil 11 and the air flowing through the chamber A. The other portions of the apparatus are constructed similarly to and operate in the same manner as those previously described in connection with Fig. 1. It will be noted that in the construction just described the heating and cooling coils are connected in parallel with each other and separably in series with the coil 11 and that the fluid medium therein is separate from that in the boiler D, condenser B, and evaporator C.

From the foregoing it will be apparent that a very simple and efficient system for conditioning ventilating air is provided by the present invention and one operating quietly and with a minimum of moving parts.

Other modifications and changes in the proportions and arrangement of the parts, other than those shown, may be made by those skilled in the art, without departing from the nature and scope of the invention, as defined in the appended claim.

The invention described herein may be manufactured and/or used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

I claim:

In a system for heating and cooling the combination of a temperature controlling element; a boiler; a heating coil in said boiler for supplying heated fluid to said temperature controlling element; an evaporator; a cooling coil in said evaporator for supplying cooling fluid to said temperature controlling element; a condenser communicating with said temperature controlling element and said evaporator for receiving heating and cooling fluids therefrom; means for withdrawing fluid from said condenser and delivering the same to said boiler and the heating coil therein and also to said evaporator and the cooling coil therein; a steam ejector communicating with said boiler for reducing the pressure in said evaporator to cause the vaporization of the fluid therein and the lowering of the temperature of the cooling fluid and for causing the flow of vapor from said evaporator to said condenser; a second ejector communicating with said temperature controlling element and said condenser and arranged in series with said steam ejector, said second ejector being operable by fluid from said temperature controlling element when the same is employed for cooling purposes to liquefy the steam issuing from said steam ejector and the vapors of evaporation entrained thereby and to increase the pressure in said condenser, and also being operable by steam passing from said temperature controlling element when the same is employed for heating purposes to augment the action of said steam ejector; and means for selectively establishing communication between said heating and cooling coils and said temperature controlling element.

BO FOLKE RANDEL.