

April 16, 1940.

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2,197,492

AIR CONDITIONING SYSTEM

Filed Aug. 16, 1937

2 Sheets-Sheet 1

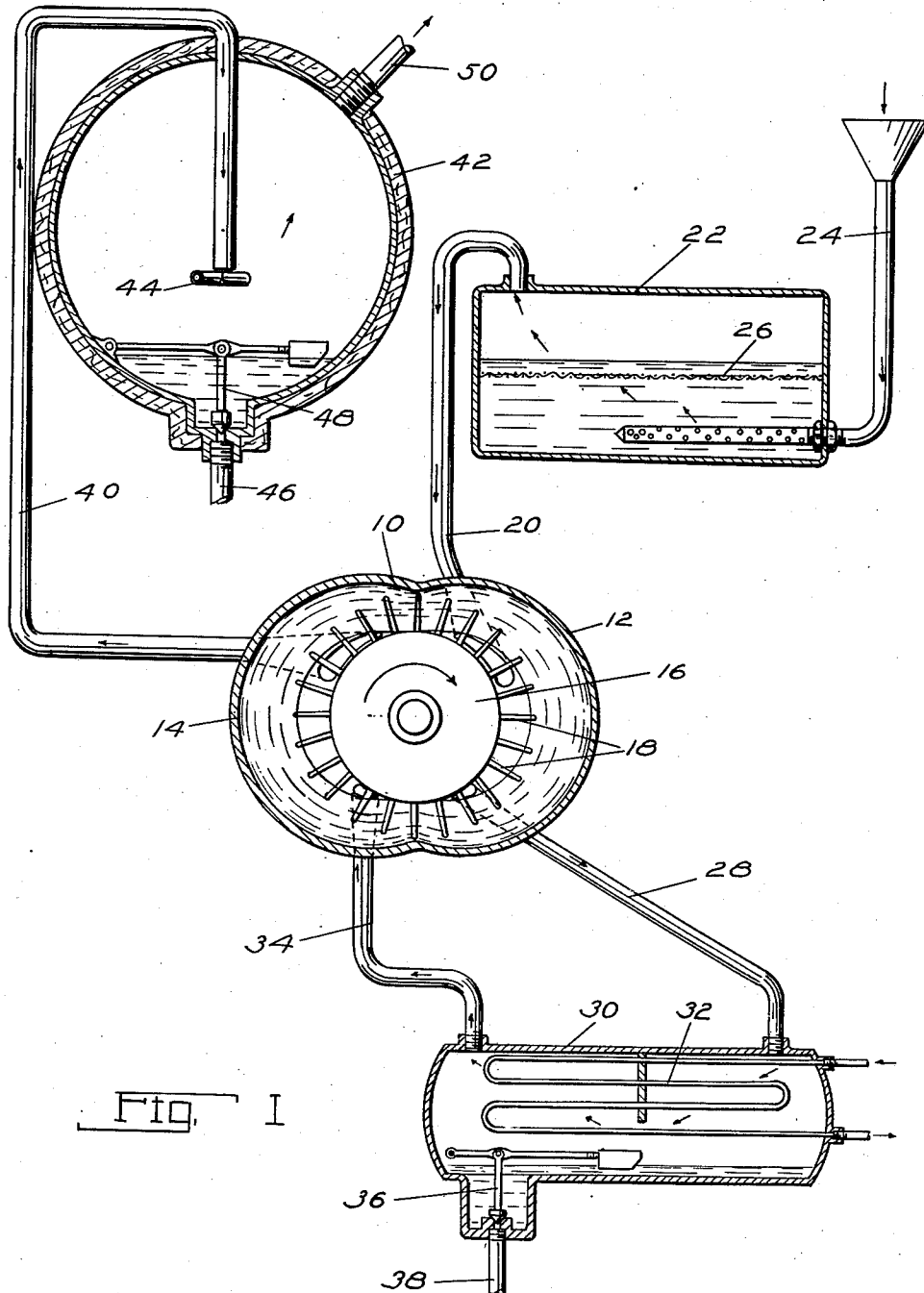


Fig. 1

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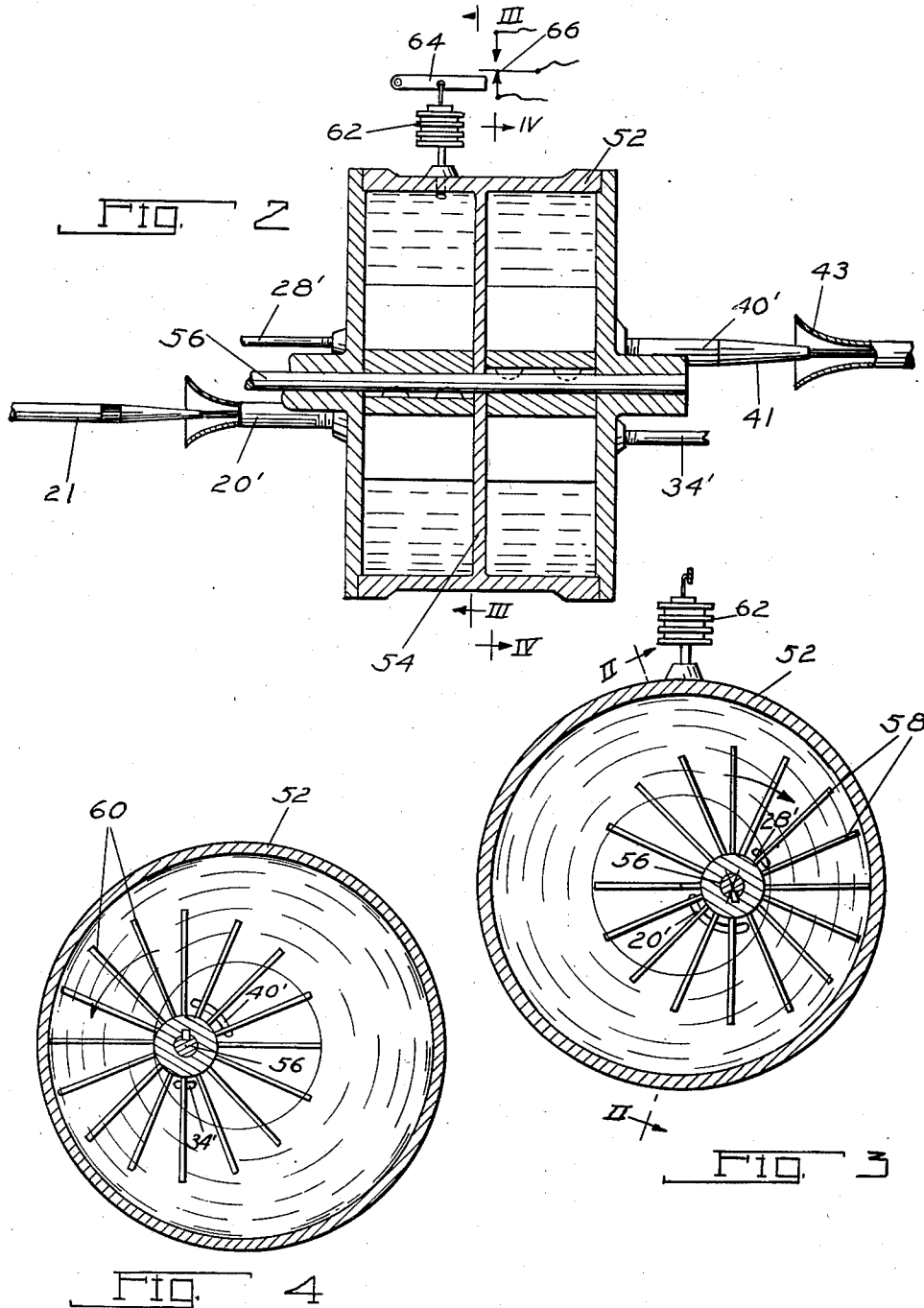
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AIR CONDITIONING SYSTEM

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Application August 16, 1937, Serial No. 159,310

6 Claims. (Cl. 62-136)

This invention relates to air conditioning systems and more particularly to systems for cooling and dehumidifying the air in an enclosure without the use of a separate refrigerant.

One of the objects of the invention is to provide a simple and compact system in which air is first compressed, then cooled and finally gradually expanded. As a result of this cycle the temperature will be materially reduced and it will give up moisture to lower its humidity.

Another object of the invention relates to washing and precooling the air prior to compression thereof.

Another object is to provide an air conditioning system in which any entrained water or other particles are removed from the air prior to its discharge.

Other objects and advantages of the invention including novel subcombinations and particular constructions will be apparent from the following description when read in connection with the accompanying drawings, in which:

Figure 1 is a diagrammatic view with parts in section of a system embodying the invention;

Figure 2 is a longitudinal section on line II-II of Figure 3 of a modified compressor and expander unit for use in the system of Figure 1; and

Figures 3 and 4 are sections on the lines III-III and IV-IV respectively of Figure 2.

The invention is particularly adapted to condition the air in homes, offices, stores and other rooms or enclosures intended for human occupancy. For purposes of brevity of description it is intended that the terms "enclosure," "room" or "dwelling room" as used hereinafter shall be interpreted to include all such enclosures.

The system as illustrated in Figure 1 includes a compressor and expander unit of the type shown in my copending application Serial No. 752,042 including a casing 10 formed with a pair of diametrically opposed lobes 12 and 14 connected by portions of reduced radius. A rotor 16 having a series of radial vanes 18 is centrally mounted in the casing with the tips of its vanes spaced from the walls of the lobes but closely approaching the connecting portions.

The lobe 12 is provided with an air inlet 20 leading from a tank 22 which is adapted to contain a body of water or the like. An air inlet pipe 24 leads into the lower part of the tank 22 below a screen 26 and is provided with a plurality of air inlet openings below the surface of the water.

An air outlet 28 from the lobe 12 leads to a

cooling tank 30 which contains a coil 32 for circulation of water or the like to cool air in the tank. Air is discharged from the tank through a pipe 34 forming an air inlet for the lobe 14. Water condensed from the air in the tank 30 collects in the lower part thereof and is discharged past a float operated valve 36 to a suitable drain 38.

The lobe 14 is provided with an air outlet pipe 40 extending vertically downward into a separator housing 42 and terminating in a discharge head 44 having a series of spiral outlet openings. Thus the air will be given a circular motion and any entrained water or other particles will be thrown out against the sides of the housing 42 and will collect in the bottom thereof to be discharged through a drain 46 under the control of a float valve 48. The washed, cooled and dried air is discharged through a pipe 50 to the enclosure to be conditioned.

In use the tank 22 is filled with water to approximately the level indicated and the casing 10 is partially filled with water. The rotor 16 is driven in a clockwise direction by any suitable power source, not shown, such as an electric motor, and causes the water in the casing 10 to swirl around in the casing to form a layer of water sealing the ends of the blades 18. It will be noted that the spaces between the blades in the lobe 12 decrease in size from the inlet to the outlet so that air will be compressed and that the similar spaces in the lobe 14 increase in size from the inlet to the outlet so that the air may expand.

Operation of the rotor draws air into the pipe 24 to bubble up through the water in the tank 22 and through the screen 26. This washes the air and effects a preliminary cooling thereof, the washed air passing through the pipe 20 into the lobe 12 where it is compressed. As the air is compressed its temperature rises and the hot compressed air is conducted through pipe 28 to the cooler 30 where it is cooled by contact with the coil 32. Moisture condensed from the air is discharged through the drain 38 and the cool compressed air passes through the pipe 34 into the lobe 14. In its flow through this lobe the air expands, giving up energy to the rotor to assist in driving it. This feature contributes to the economy of operation of the system and at the same time provides work for the air to do while expanding to increase the cooling effect.

The cold expanded air is led from the lobe 14 through pipe 40 into the separator 42 which removes therefrom any water particles or other

foreign material and the washed, cooled and dried air is discharged to the enclosure through pipe 50. It will be apparent that if desired air from the enclosure could be recirculated through the pipe 24 or that a mixture of fresh air and air from the enclosure could be circulated.

It will be noted that the outlet port in the expansion lobe 14 is arranged beyond the center of the lobe so as not to communicate with the chamber of largest capacity. This arrangement provides for a momentary expansion of the air greater than the final expansion, which momentary expansion may be to a pressure less than atmospheric if desired. During this short interval of maximum expansion the temperature of the air may fall to a degree considerably below the freezing point of water but the water will not be frozen due to the short interval of time the minimum temperature is maintained. However, the time interval will be long enough to reduce the humidity of the air to saturation at the minimum temperature so that upon again raising the temperature of the air its humidity will be decreased. Immediately following the point of maximum expansion the air is recompressed slightly to bring its pressure to atmospheric or slightly above and to raise its temperature to approximately the freezing point of water. In this condition the air is discharged through the outlet pipe 40.

Figure 2 illustrates a modified compressor and expander unit including a cylindrical casing 52 divided substantially centrally of its length by a partition 54. A shaft 56 is journaled in the casing and extends longitudinally there-through eccentric to the casing axis. A set of compressor blades 58 are carried by the shaft on one side of the partition 54 and a similar set of expander blades 60 are raised by the shaft on the other side of the axis.

Suitable inlet and outlet pipes are connected to the ends of the casing and for the sake of convenience these pipes have been given the same reference characters primed as the corresponding pipes in Figure 1.

In this construction the washing device 22 of Figure 1 may be replaced by a water nozzle 21 discharging into the flared open end of the inlet pipe 20' to form an injector. The water discharged into the injector serves to wash the air, to compress it partially thereby raising the volumetric efficiency of the compressor, and to provide circulation of water through the apparatus.

Since it is undesirable to discharge air at a very low temperature into a room and since it is desirable to circulate large quantities of air, the outlet pipe 40' may have a reduced portion 41 discharging into an open flared portion 43 to form an air operated injector. Uncooled air picked up by the injector increases the temperature of the discharged air to the desired degree and at the same time increases the volume of air being circulated. The injector may discharge into a suitable separator such as 42 in Figure 1. If desired the injectors 20', 21 and 41, 43 may be connected to the space to be cooled to receive air therefrom.

In operation the casing 52 is partially filled with liquid which is swirled as the shaft 56 is rotated to seal the ends of the blades 58 and 60. Air will be drawn in through the pipe 20', being precompressed by the injector 21 and will be further compressed between the blades 58 and forced out through the pipe 28'. The com-

pressed air is run through a cooler such as 30 of Figure 1 and is returned through the pipe 34' to expand between the blades 60, energy given up by the expanding air acting on the blades 60 to assist in driving the shaft 56. The expanded air is discharged through the pipe 40' and the injector 41, 43 to a suitable separator and then to the space being conditioned.

Figures 2 and 3 illustrate a novel control arrangement including a syphon 62 connected to the casing 52 and operating a control lever 64 which may control a suitable two way electric switch 66. The pressure exerted on the syphon by liquid rotating in the casing is a function of the speed of the liquid which, in turn, depends on the speed of the shaft 56. The switch 66 may control the windings of an electric motor driving the shaft 56 so that below a certain speed the switch 66 will be in position to connect the starting winding of the motor in circuit while above that speed the syphon 62 will change it to include the running winding. It will be apparent that other modes of control might be employed and that this arrangement could be used equally well with the unit of Figure 1.

While one embodiment of the invention has been shown and described in detail it will be understood that changes might be made therein and it is not intended to limit the scope of the invention to the form shown nor otherwise than by the terms of the appended claims.

What is claimed is:

1. An air conditioning system comprising a cylindrical casing having a transverse partition therein dividing it into a compressor chamber and an expander chamber, a shaft extending through said casing parallel to but offset from the axis thereof, bladed rotors carried by said shaft in the compressor and expander chambers, inlet and outlet ports in the ends of said casing communicating with the chambers respectively, a connection from the outlet port of one chamber to the inlet port of the other and a cooling device in said connection.

2. Air conditioning means comprising a water sealed compressor for compressing air to be cooled, a water operated injector for supplying air and sealing water to said compressor, means for cooling the compressed air and means for expanding the cooled compressed air and for causing it to do work during expansion.

3. Air conditioning means comprising a water sealed compressor for compressing air to be cooled, a water operated injector for supplying air and sealing water to said compressor, means for cooling the compressed air, means for expanding the cooled compressed air and for causing it to do work during expansion, and injector means connected to said expanding means to mix air discharged therefrom with uncooled air.

4. Air conditioning means comprising a water sealed compressor for compressing air to be cooled, means for mixing air and water and for supplying the mixture to said compressor, means for cooling the compressed air, and means for expanding the cooled compressed air and for causing it to do work during expansion.

5. Air conditioning means comprising a casing having a transverse partition therein dividing it into a compressor chamber and an expander chamber, a shaft extending through said chambers, bladed rotors carried by the shaft in said chambers, said casing containing a liquid to seal the bladed rotors and being formed with inlet and outlet ports communicating with said cham-

bers respectively, and means connecting the outlet port of the compressor chamber to the inlet port of the expander chamber.

- 5 6. An air conditioning means comprising a casing having a transverse partition therein dividing it into a compressor chamber and an expander chamber, a shaft extending through said chambers, bladed rotors carried by the shaft

in said chambers, means to conduct mixed air and liquid into the compressor chamber, said liquid serving to seal the bladed rotors, means to conduct compressed air from the compressor chamber to the expander chamber, and means to discharge expanded air from the expander chamber. 5

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