# United States Patent

**Caldwell**

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## [54] DIFFERENTIAL PRESSURE AIR IMMERSION WASHER-CONDITIONER


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[21] Appl. No.: **48,873**

**Related U.S. Application Data**

[63] Continuation of Ser. No. 745,171, July 16, 1968, abandoned.

[52] **U.S. Cl.**.....**261/30,** 261/122, 261/123, 261/124

[51] **Int. Cl.**.....**B01f 13/02**

[58] **Field of Search**.....261/77, 30, 121, 122, 123, 261/124; 55/244, 255, 256, 257



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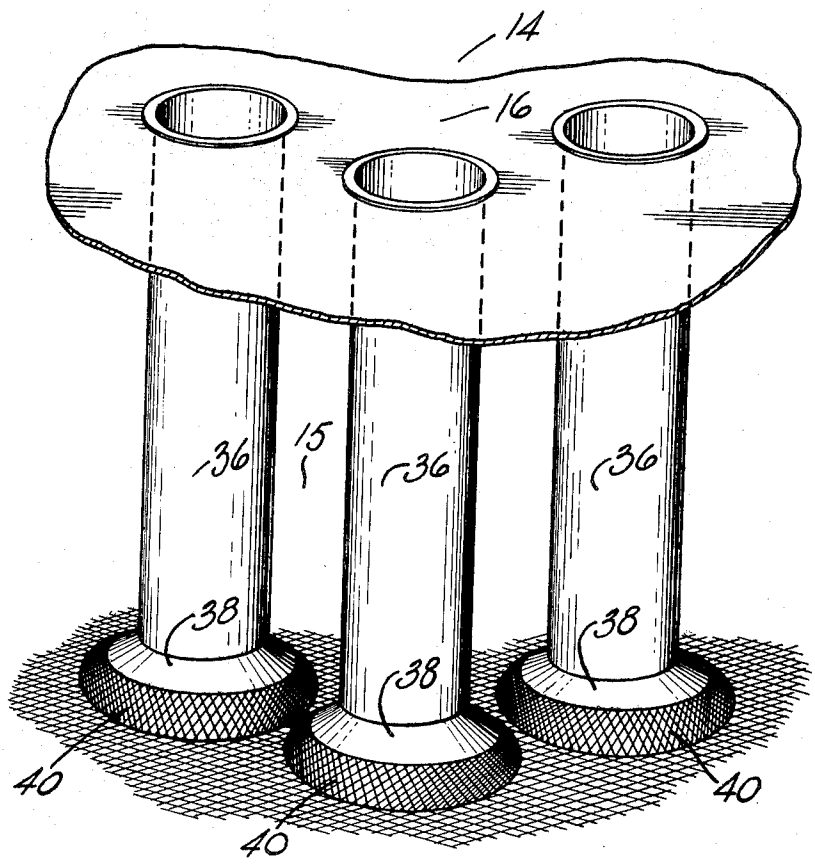
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[57] **ABSTRACT**

An air washer and conditioning unit comprising a primary pressure chamber communicating at its upper portion with the discharge of a fluid pressure pump and having a lower portion immersed in a body of liquid through which the air flowing in the chamber from the pump is expanded and then uniformly discharged and distributed up through the liquid into a secondary pressure chamber embracing the primary chamber.


**2 Claims, 4 Drawing Figures**



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SHEET 1 OF 2

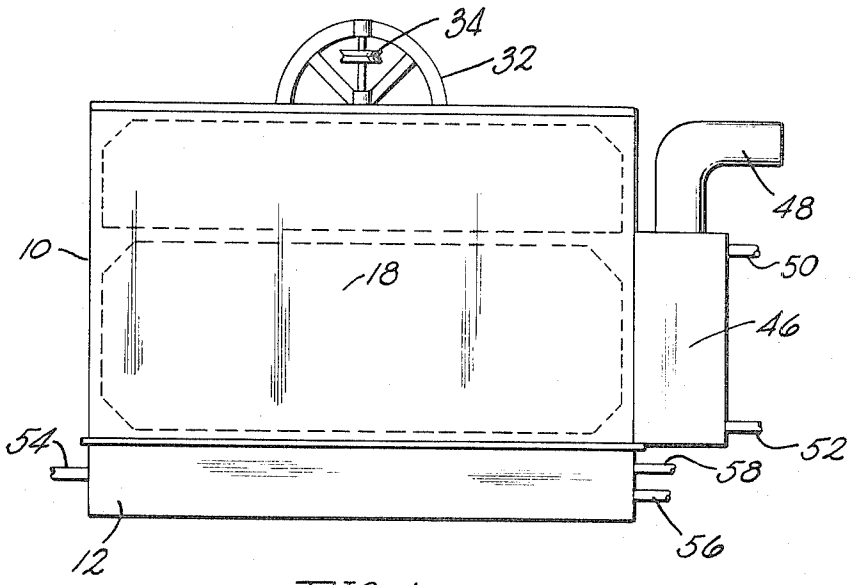



FIG. 1

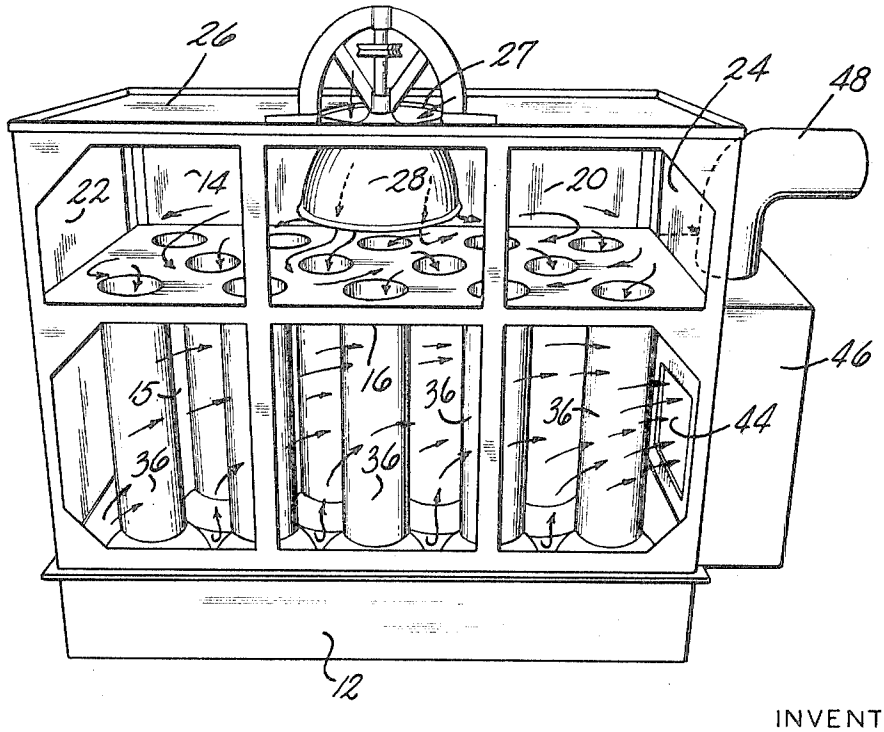



FIG. 2

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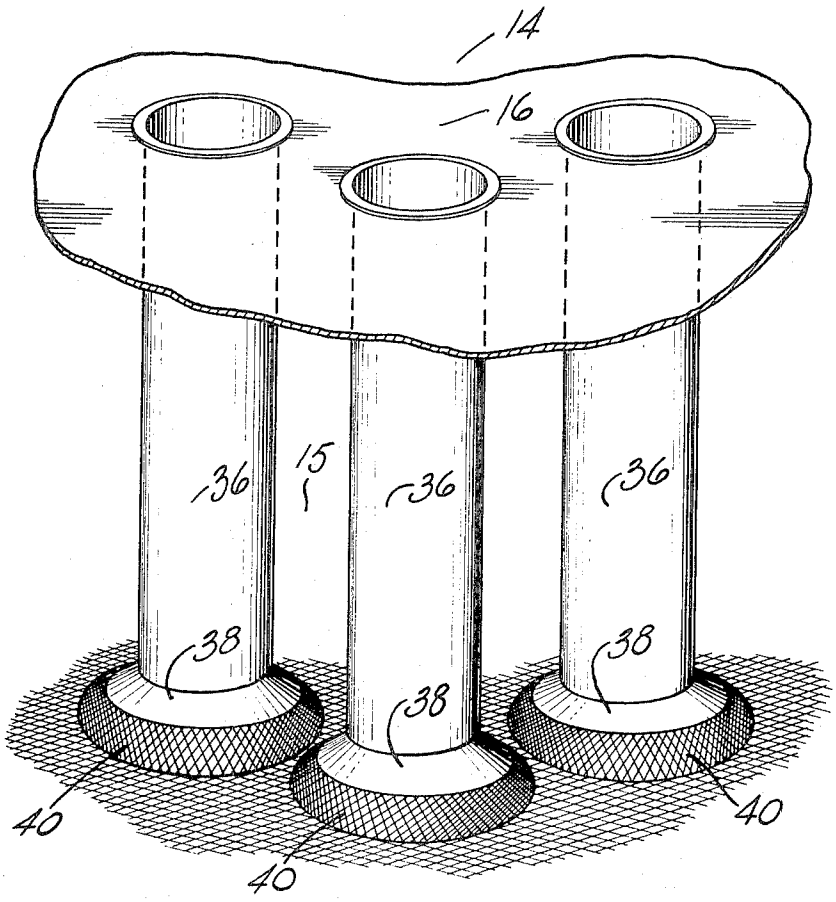



FIG. 3

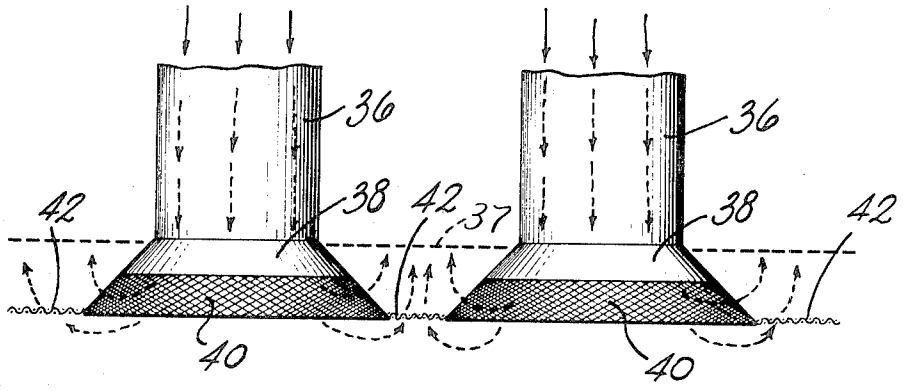



FIG. 4

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# DIFFERENTIAL PRESSURE AIR IMMERSION WASHER-CONDITIONER

This is a continuation of application Ser. No. 745,171, filed July 16, 1968 and now abandoned.

## BACKGROUND OF THE INVENTION

It has been the practice in the past to wash and condition air by treating it in the primary pressure chamber with sprayed or agitated liquid. All known attempts to force the air up through a liquid surface have not been successful due to channelling and carry over liquid which prevents adequate heat transfer between the air and the liquid and cleansing of the air.

## SUMMARY OF THE INVENTION

In its preferred form, the invention comprises a pressure compartment divided into upper and lower pressure chambers, one or more fluid pumps discharging into the upper and lower pressure chambers, one or more fluid pumps discharging into the upper pressure chamber and providing a flow of air under pressure downwardly through a plurality of ducts which may be considered an extension of the upper or primary pressure chamber.

The lower ends of the ducts extend into a pan of liquid disposed in the secondary pressure chamber, the level of the liquid in the pan submerging the expanded lower ends of the ducts. Preferably, the expansion of the lower ends of the ducts takes the form of an imperforate conical portion merging into a perforated terminal portion disposing a perforated surface between the expanded imperforate discharge end of the ducts and the surface of the liquid.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevational view of an apparatus embodying the principles of the invention,

FIG. 2 is a perspective view of FIG. 1 with the front side panels shown removed,

FIG. 3 is an enlarged fragmentary perspective view of the air tubes and associated skirt and screen components, and

FIG. 4 is an enlarged fragmentary side elevational view of the lower portion of the tube shown in FIG. 3.

Referring to the drawings, the apparatus **10**, as shown in FIG. 1, is of rectangular form having a lower water pan portion **12**, an upper primary pressure chamber portion **14** and an intermediate secondary pressure chamber portion **14** and an intermediate secondary pressure chamber portion **15**. A partition **16** separates the chamber portions **12** and **14** which are enclosed by a front panel **18** (shown removed in FIG. 2), a back panel **20**, side panels **22** and **24**, and a top panel **26**.

Top panel **26** has a suitable opening to receive the inlet **27** of fluid pump **28** shown with a vertical driven shaft **30** supported in the outboard bearing bracket **32**. A pulley **34** is shown on shaft **30** for receiving a driven belt from a suitable motor, not shown. The fluid pump **28** is preferably of the construction shown in my copending application Ser. No. 662,615, filed Aug. 23, 1967.

Air to be conditioned is drawn through the inlet **27** by the fluid pump **28** to pressurize the primary pressure chamber portion **14** in the order of 4–6 inches of water gauge and the air is then forced downwardly through a series of air tubes **36** having their upper ends disposed in the partition **16**. It will be understood that all the air drawn into the chamber portion **14** is discharged downwardly through tubes **36** into the secondary chamber **15**.

As shown, the lower ends of the tubes **36** extend into the water pan portion **12** and, in practice, are submerged below the water level maintained therein and indicated at **37**. Each tube **36**, in its preferred form, has a solid flared skirt **38** in its lower end to expand the air flowing downwardly through the tubes **36**. As an extension of each skirt **38** there is preferably provided a flared perforated skirt **40**. The spaces between the perforated skirts of each air tube **36**, as well as the spaces between the sides of the water pan portion **12** and such skirts, are filled in with perforated sheet material **42**, the material **42** being expanded sheet metal, or other suitable perforated material.



As a result of this arrangement all the air being discharged downwardly through the tubes **36** is first expanded in the lower end of each tube in the solid flared skirt portion **38** and then uniformly discharged and distributed upwardly through the water in the pan portion **12** in the form of air bubbles which pressurize the secondary chamber **15** in the order of 2–4 inches of water gauge.

The conditioned air in the chamber **15** is discharged through a suitable opening **44** into the air box **46** where it may be heated or otherwise treated before being distributed through the air supply outlet **48**. A hot water supply and return to coils located in the box **46** being indicated at **50** and **52**, respectively. Chilled water supply and return for maintaining the desired temperature condition of the water in the pan portion **12** are indicated at **54** and **56**, respectively. An overflow connection **58** is provided to remove dirt and dust and other foreign matter which may be separated from the air.

## OPERATION

The air to be washed and otherwise conditioned is drawn into the apparatus **10** through the air inlet **27** by the fluid pump **28** to pressurize the primary pressure chamber **14** and to uniformly distribute the air downwardly through the plurality of tubes **36**. After being expanded in the imperforate skirts **38**, the air is uniformly broken up and distributed by the screening material embracing the skirts **38** to pass upwardly in the form of air bubbles. An exchange of heat takes place between the air bubbles and the chilled water in the pan **12**. Also, turning the air through 180° as it flows between the primary and secondary pressure chambers results in the deposit of dust, dirt and other foreign matter in the water of the pan **12**.

In practice, the pressure of the washed and chilled air in the secondary chamber **15** is utilized as the sole means of distributing the air through the air box **46** and supply outlet **48** to the space to be heated or cooled. Some or all of the air from the heated or cooled space may be returned to the inlet **27** of the fluid pump **28** through return ducts, corridors and other well-known return structure.

I claim:

1. An air washer and conditioning apparatus for treating air being recirculated in a space to be heated or cooled comprising a cabinet, a partition for dividing said cabinet into an upper primary pressure chamber having an air inlet connected with said space and a lower secondary pressure chamber having a discharge connected with said space, said last chamber including a liquid pan portion to receive a body of liquid, air tubes extending between said chambers and disposed in said partition with their upper inlet ends communicating with said primary pressure chamber and their lower ends communicating with said last chamber within said pan portion and below the level of the liquid body to be carried therein, the lower end of said tubes having downwardly and outwardly flared imperforate skirt portions constituted as a direct and streamline extension of the walls of said tubes to provide each tube with a terminal expansion portion located beneath the liquid level into which the pressurized air flowing downwardly in each tube directly enters and is expanded before being discharged into the liquid body, and a perforated skirt portion constituted as a downwardly and outwardly flared extension of said imperforate skirt portion of each tube whereby the pressurized air being conducted by each tube between said primary and secondary chambers is first expanded into said first skirt portion and then broken up by the perforate structure of said second skirt portion to be discharged upwardly through the liquid level in the form of air bubbles to pressurize said secondary chamber, said tubes as well as their flared imperforate and perforate skirt portions all opening downwardly into said pan portion as a continuous, unobstructed, open-end passage.

2. An air washer and conditioning apparatus as defined in claim 1, the air flow communication between the lower ends of said tubes and said imperforate skirt portion being direct and obstruction free.

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