Dec. 13, 1966 E. W. GOUGH 3,291,203

SYSTEM FOR HEATING AND COOLING CHAMBERS

Filed March 6, 1964 3 Sheets-Sheet 1

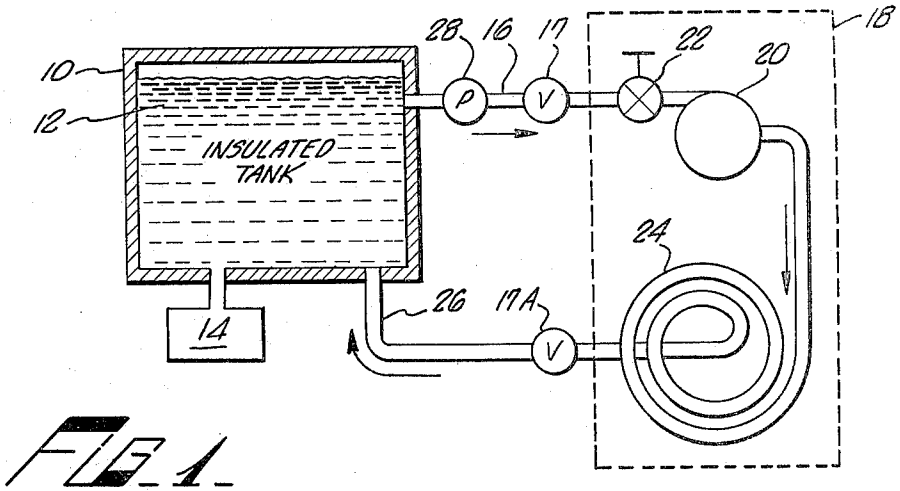
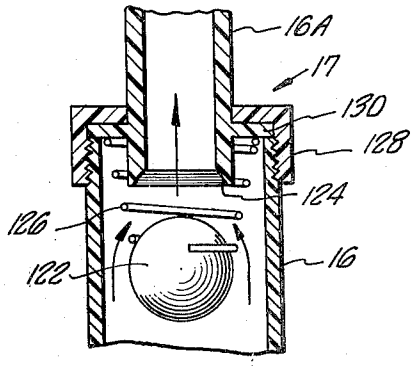


FIG. 1

FIG. 4



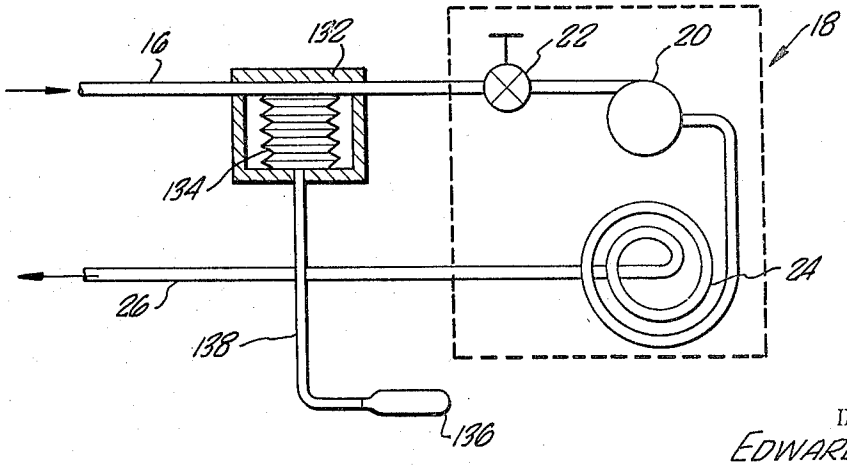


FIG. 5

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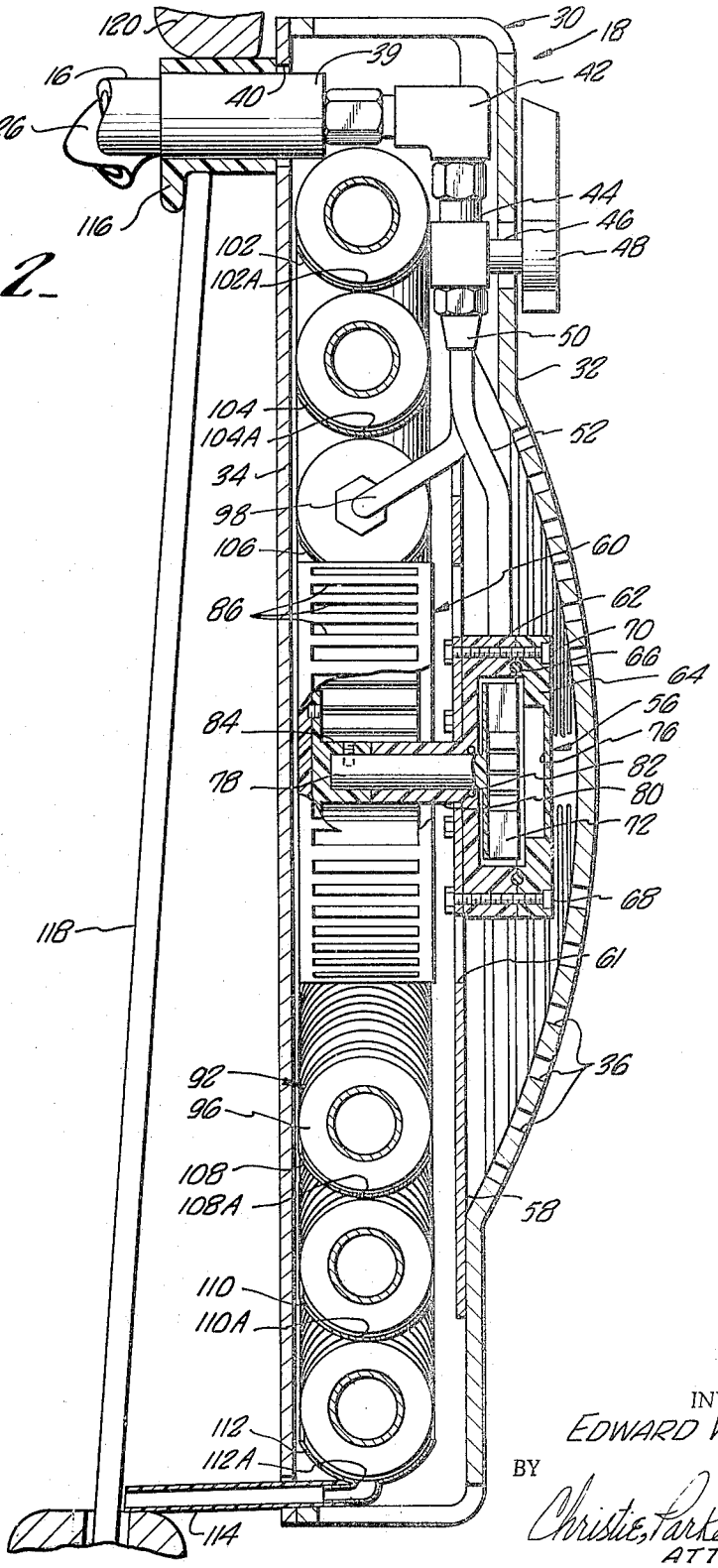
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SYSTEM FOR HEATING AND COOLING CHAMBERS

Filed March 6, 1964 3 Sheets-Sheet 2

FIG 2



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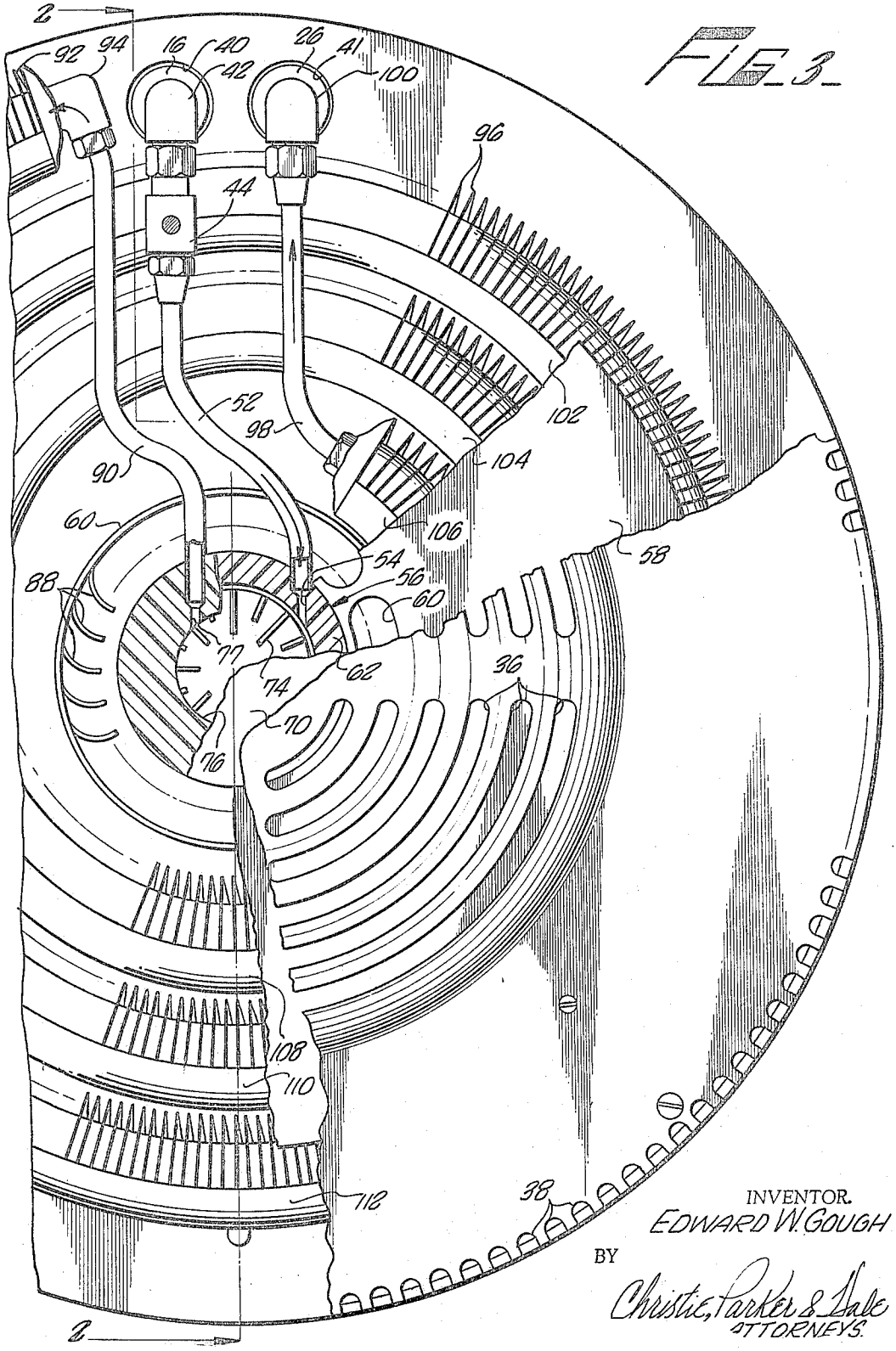
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SYSTEM FOR HEATING AND COOLING CHAMBERS

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FIG. 3



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SYSTEM FOR HEATING AND COOLING CHAMBERS

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8 Claims. (Cl. 165—85)

This invention relates to a system to heat or cool chambers from a central unit.

The invention is useful in heating or cooling motor vehicles, hotels, motels, and the like, and particularly useful in conditioning motor vehicles in drive-in theaters, and the invention is described with respect to that use.

The modern day drive-in theater has had difficulty in attracting customers during periods of uncomfortably warm or cold weather in selected portions of the country. Attempts have been made to at least provide individual heating units for automobiles, and to date, these heating units have not been widely accepted as being a solution to the problem. Most generally a resistance heating unit in combination with a fan have been used, which at best is only a partial answer to the problem. These heating units have posed a problem in safety, especially during wet weather, since the electrical leads must be necessarily trailed from an outlet to each automobile, and the constant electrical hazard has been troublesome.

Air conditioning has not been available for drive-in theaters due to the difficulty and the expense of providing conventional air conditioning units for each vehicle. The result has been a marked drop in attendance to drive-in theaters during periods of extereme heat in those parts of the country where daytime temperatures do not drop substantially after sundown.

Central systems for heating and cooling units such as office buildings and large hotels have proven to be quite economical and satisfactory when the number of units is quite appreciable. These known central conditioning units are quite immense, requiring an extremely large amount of capital and equipment for the initial installation. Prior to the present invention, central heating or cooling has not been adapted to relatively small numbers of units in the category of small hotels, motels, hospitals and the like.

The present invention combines the advantages of central heating and cooling and extends them to consumers that have a need for portable units and a low cost central system with minimum cost and minimum installation. One of the more attractive advantages of the present invention is the lack of electrical connections in and around the individual conditioning units which are installed in such things as automobiles for drive-ins, or in individual motel or hospital rooms.

In accordance with my present invention, I have provided a central source of heating or cooling fluid directed to individual conditioning units that may be temporarily or permanently installed within chambers. The invention extends to the method of heating or cooling a chamber by pumping a pressurized working fluid, that has been heated or cooled to a conditioning unit where the pressurized fluid then serves the dual purpose of providing the thermal energy to be exchanged and driving an air moving device which moves air over the heat exchanger and distributes the conditioned air about the chamber.

In terms of structure, the invention includes individual conditioning units which have coils therein in the form of heat exchangers. A turbine mounted in proximity to the coils is driven by the heated or cooled pressurized fluid, and in turn drives a blower which directs forced air over the coils to be heated or cooled and thereafter distributed about the chamber to be conditioned.

Further, my invention encompasses a central system for heating and cooling a series of chambers. The system includes a storage vessel of fluid which is heated or cooled, and pressurized into a series of conduits that are connected to the individual conditioning units described above. The units are portable and may be installed at will in any type of chamber. The flow of fluid to the conditioning unit may be regulated by a manually adjusted flow regulating means at each remote unit and also may be controlled by an automatic regulating means including a temperature sensitive element disposed remote from the unit to thereby automatically regulate the heated air flow.

It is to be understood that the term "fluid" as used herein extends to liquids and gases, and any combination of the two in any state. The term includes fluids from the field of cryogenics and extends into superheated gases.

While the present invention is especially adaptable for heating and cooling systems in new and existing drive-in theaters, it is to be understood that the invention extends to installations in residences, motels, hotels, hospitals, and the like.

Other advantages and features of the invention will be more fully understood from the following detailed description and the accompanying drawings in which:

FIG. 1 is a schematic illustration of the present invention illustrating a central storage of heated or cooled fluid and one of a plurality of conditioning units;

FIG. 2 is a front elevation of an individual conditioning unit constructed according to the present invention and illustrated partially in cross-section taken along lines 2—2 of FIG. 3;

FIG. 3 is a cross-sectional view of the conditioning unit illustrated in FIG. 2, the section taken along lines 3—3 of FIG. 2;

FIG. 4 is a typical cross-sectional view of a valve used in the present invention; and

FIG. 5 is a schematic illustration of the conditioning unit constructed according to the present invention controlled by thermostatic device.

Referring to FIG. 1, an insulated tank 10 is filled with a fluid 12 and is operatively engaged to a means 14 for varying the amount of heat or cold retained by the fluid 12. An inlet conduit 16 extends from tank 10 and is connected to an individual conditioning unit 18 disposed remotely from tank 10. An individual conditioning unit 18 is illustrated, however, in practicing my invention, it is contemplated that a plurality of individual units 18 will be connected to a single centrally located tank 10.

The conditioning unit 18 includes a fluid operated turbine 20 connected to inlet conduit 16 and a flow regulating device such as a valve 22 disposed up stream from the turbine 20. Thus valve 22 may be closed and turbine 20 will not be constantly subjected to line pressure. A heat exchange coil 24 is connected in series with turbine 20, and outlet conduit 26 leads back to the tank 10. While inlet conduit 16 and outlet conduit 26 indicate separate lines run from the centrally located tank 10, it is a matter of choice to provide a series of branch plumbing lines of varying capacity into an installation such as a drive-in theater. This plumbing can be arranged for convenience sake such that individual lines need not connect each conditioning unit with the fluid source.

A pump 28, disposed in proximity to tank 10, gives the fluid 12 a hydraulic head such that upon reaching the individual units 18 normally some distance away from tank 10, a pressure in the vicinity of 50 pounds per square inch is available to drive turbine 20.

The present invention extends to both heating and cooling installations, and thus means 14 connected to tank 10 influences the temperature of fluid 12. For ex-

ample, a gas fired hot water boiler having fluid **12** contained therein would be used for a heating system and could be thermostatically operated such that the entire volume of fluid **12** in the tank **10** is kept at a particular temperature such as 200° F. It is contemplated that the capacity of tank **10** is considerably greater than the immediate requirements of the total number of individual units **18** used in the central conditioning system. Thus the fluid **12** may be heated during an off peak period such as during the late evening hours or early morning hours, or in the case of a drive-in theater, during the off peak morning and afternoon hours.

Alternatively, the means **14** may be a refrigeration unit for cooling a refrigerant such as a mixture of water and an anti-freeze such as ethylene glycol. A conventional compressor and condenser unit used for large scale refrigeration systems may be used to advantage and operated during the off peak hours to cool the mixture to 10° F., for storage at this temperature within the insulated tank **10**. In the case of a drive-in theater, it is required that 3,000 B.t.u. per hour per vehicle is required to keep the occupants comfortable at temperatures of 90 to 100° F. existing exteriorly of the vehicle. This refrigeration would then amount to approximately one-quarter ton of refrigeration required per automobile, and in a standard drive-in theater having spaces for 400 automobiles, a 100 ton system may be operated constantly to store a sufficient amount of water and ethylene glycol mixture to adequately condition each vehicle within the theater. Using these approximations of capacity, the tank **10** should be large enough to contain 10,000 gallons of fluid without an extreme amount of heat loss through radiation.

Referring now to FIGS. 2 and 3, an example of an individual conditioning unit **18**, particularly adaptable for installation in an automobile vehicle, is illustrated. A support structure takes the form of a casing **30** having a circular, hollow, pancake shaped support member **32** with a flat disc **34** fixedly mounted thereon. Support member **32** has a plurality of arcuately shaped slots **36** centrally located, which acts as an intake grill. Disposed on the entire periphery of support member **32** are a series of slots **38** functioning as an outlet grill. A flow path is defined such that air may enter the grooves **36** passing through the interior of casing **30** and exit through the outlet grill through slots **38**.

Conduit **16**, having a standard fitting **39** fixedly mounted thereon, enters the casing **30** through an aperture **40** in disc **34**. Fitting **39** is threaded within a conventional L-shaped coupling **42**, which is mounted upon a conventional globe valve **44** having a stem **46** extending therefrom, terminating in a handle **48** disposed exteriorly of casing **30**. The valve **44** affords the user of the conditioning unit **18** means for regulating the fluid flow through the unit to the point of shutting it off entirely, if desired. A standard flare unit **50**, extending from valve **44**, has a length of tubing **52** mounted thereto which extends into inlet orifice **54** of a turbine **56**.

Turbine **56**, centrally mounted within casing **30**, is fixedly attached to a plate **58** that in turn is supported and mounted upon the interior of support member **32**. A plurality of apertures **61**, formed in plate **58**, are disposed about the periphery of turbine **56**, thus affording communication of air entering the arcuately shaped slots **36** to impinge upon a blower **60** which is driven by turbine **56**.

The turbine **56** includes a housing **62** with a closely fitting cap **64** disposed thereon, and an O-ring **66** positioned therebetween; the entire assembly retained in position by a plurality of screws **68**, **70** passing therethrough and extending through plate **58**. The turbine rotor **72** has a plurality of driven vanes **74** extending upwardly therefrom and shaped in such a manner that the fluid entering tube **52** is directed through orifice **54** in a direction tangent to the vanes **74**. A cavity **76**, formed in cap **64**, is centrally located over rotor **72** and has an outlet **77** formed therein. A centrally located shaft **78** extends laterally from rotor **72** and is journaled within the bearing **80** formed in the housing **62**. O-ring **82** disposed within the bearing portion **80** and abutting the shaft **78** in sealing relation therewith prevents a loss of fluid from the turbine **56**.

The blower **60** is fixedly mounted to the rotor **72** and shaft **78** by an adapter **84**, which is screwed to the blower and fixedly attached to the shaft **78**. Blower **60** comprises a cup shaped shell having a series of slots **86** formed on its periphery and a plurality of inwardly extending curved vanes **88**. Thus by this construction, rotation of rotor **72** by the impact of fluid under sufficient pressure entering orifice **54** rotates vanes **74**, shaft **78**, and blower **60**. In a preferred embodiment the turbine **56** and blower **60** are fabricated of plastic such as nylon to minimize the inertia of the moving system.

A tubing **90** extends within cap **64** and is in communication with the cavity **76** to thus duct all fluid from the interior of turbine **56** after it has passed through rotor **72**. A length of heat exchanger coil **92** is connected by a standard elbow fitting **94** to the tubing **90**. The heat exchanger coil **92** is arranged in a spiral array within the casing **30** between the blower **60** and the plurality of slots **38** serving as the outlet grill. Finned tubing may be used as the heat exchanger coil **92** such that thermal energy may be readily transmitted from the interior of the coil through the plurality of fins **96** in typical heat exchange fashion. An example of the coil size is ⅜ inch diameter by 6 feet in length; however, the size is partially dependent upon the capacity and the rate of heating or cooling desired for the particular installation. One feature of my invention is the disposition of the heat exchanger coils **92** between the blower **60** and the outlet grill slots **38** of the unit such that the air flow is radial and generally parallel to the flat portion of casing **30**. This air flow would then generally follow the walls of the chamber to be heated when the unit **18** is placed flat against a chamber wall.

The heat exchange coil **92** terminates in the innermost portion of the spiral array with a conventional tube fitting with tubing **98** extending radially upwardly. The outlet conduit **26** enters the aperture **41** within the disc **34** and has a standard elbow fitting **100** which is connected to tubing **98** to complete the hydraulic circuit.

During those periods in which the conditioning unit **18** is used for air conditioning, the spiral array of heat exchange coils **92** having a chilled fluid passing therethrough normally have a tendency to condense moisture from the atmosphere, and after extended operation of the unit, this condensate would drip intermittently from the casing **30**. For this reason, a series of arcuately shaped condensate gathering troughs **102**, **104**, **106**, **108**, **110**, **112** are disposed in intimate relationship with each heat exchange coil in such a manner as to collect all the condensate within the lower most trough **112**. All troughs **102–112** are arcuately shaped in cross section and mate the exterior configuration of heat exchange coils **92**. The troughs are disposed between the lower most portions of the coils **92** and cover only ¼ to ⅓ of the periphery of the coils **92**, thereby allowing the air moved by blower **60** to be unimpeded by the troughs. Each trough has at least one aperture **102A**, **104A**, **108A**, **110A**, **112A** disposed in the lower most portion such that gathered condensate naturally drip to the next succeeding trough. A length of outwardly extending closed gutter **114** is fixedly mounted to casing **30** and communicates with perforation **112A** such that all collected condensate will naturally flow exteriorly of the casing. Any suitable means may be arranged for directing the condensate to a suitable collecting basin where it may be disposed.

The conditioning unit **18** is especially adapted for installation within a motor vehicle by having an L-shaped adapter bracket **116** fixedly mounted upon the disc **34** and

rigidly supporting the inlet conduit **16** and outlet conduit **26**. Thus the bracket **116** may be hooked over the upper edge of a vehicle window **118** and with the window in its upper-most position, bracket **116** abuts an upper door frame **120**. The gutter **114** is so positioned as to abut the lower most portion of the vehicle window **118** such that condensate may naturally flow down the interior of the window and escape through the conventional perforations in the lower most portion of the vehicle door (not shown).

Referring to FIG. 1, a second valve **17** is mounted in the inlet conduit **16** and positioned upstream of the regulating valve **22**. An example of the installation in a drive-in theater includes an upstanding post (not shown) normally disposed adjacent to a motor vehicle to which the inlet and outlet conduits are connected and valve **17** is mounted in close proximity to the post. This valve **17** acts as a means for terminating fluid flow during those times when the flow drastically increases downstream of valve **17**. During those times when the inlet or outlet conduits are broken through wear, abrasion, or intentionally severed, the valve closes thus preventing loss of fluid through the inlet conduit **16**. Referring to FIG. 3, the orifice **54** in turbine **20** limits the amount of flow through the conditioning unit **18** and is of a size substantially smaller than tubing **52**, inlet conduit **16**, outlet conduit **26**, and all other conduits. Thus, with a break in the inlet conduit **16** downstream of valve **17**, the flow drastically increases since the fluid is no longer limited by the orifice **54**.

An example of valve **17** is illustrated in FIG. 4 and comprises a sealing element **122**, a valve seat **124**, and a spring **126** disposed within inlet conduit **16**. The inlet conduit **16** is fixedly attached to conduit **16A** by a standard fitting **128** with the internal tubing sizes being approximately the same to prevent a substantial drop in pressure. Sealing element **122** is normally in spaced relation with valve seat **124** such that the fluid flow passes through valve **17** under all normal conditions. A light coil spring **126** disposed within inlet conduit **16** abuts the sealing disc **130**. By breaking the inlet conduit **16** downstream of valve **17** and upstream of turbine **20**, the flow rate will drastically increase which drags sealing element **122** towards seat **124** during this increase in flow to close valve **17** and terminate flow therethrough. The fluid pressure within inlet conduit **16** upstream of valve **17** will constantly urge sealing element **122** closed until such time as the back pressure downstream of valve **17** is increased to a level which opens sealing element **122**. A similar valve **17A** is mounted in the outlet conduit **26** at a position as close as possible to the downstream extremity of heat exchanger coil **92**. Valve **17A** is exactly the same construction as valve **17** and serves the same function for the same reason.

Referring now to FIG. 5, a means for regulating the fluid flow through inlet conduit **16** may include an element which is temperature sensitive, thus regulating the amount of fluid passing into conditioning unit **18**. In installations such as motels or hospitals, manual adjustment of regulating valve **22** would be cumbersome. An example of the regulating means takes the form of a casing **132** having a flexible bellows **134** disposed therein and abutting conduit **16**. A temperature sensing bulb **136** is disposed remote from casing **132** and conditioning unit **18** in an area centrally located within the room or rooms which are heated or cooled. A capillary tube **138** connects bellows **134** with bulb **136** and a fluid, which changes its volume linearly with changes in temperature, is charged within bellows **134**, bulb **136**, and capillary tubing **138**. Thus with changes in temperature, sensed by bulb **136**, the pressure exerted upon the flexible inlet conduit **16** will vary directly in relation to temperature changes and thereby modulate the amount of fluid passing within conditioning unit **18**.

The operation of the present invention as a heating unit will now be described. It is presumed that conditioning unit **18** is disposed within the chamber to be conditioned, as for example a motor vehicle. The unit is installed interiorly in a manner as illustrated in FIG. 2, or in the case of a motel or hospital, is mounted preferably on or in close proximity to one wall of a room. Tank **10** is charged with a fluid **12** which is heated by means **14** to a temperature of 200° F. Pump **28** pressurizes fluid **12** entering inlet conduit **16**. Upon opening valve **22**, pressurized fluid enters turbine **56** and impinges on vanes **74** causing rapid rotation of the rotor **72** and blower **60**. The fluid passes through turbine **56** and enters the heat exchange coils **92** transferring thermal energy thereto, which is radiated to the fins **96**. Upon passing through the entire length of heat exchange coils **92**, the fluid re-enters tank **10** by the outlet conduit **26**. While blower **60** is rotated by turbine **56**, air is sucked in through the arcuately shaped inlet grooves **36** and is blown past the spiral array of heat exchange coils **92**. In passing over the coils, the air is heated by radiation and is directed radially out slots **38** along the inner surfaces of the chamber to be heated. This operation is continuous, and the amount of heat emitted by the unit **18**, and the speed of blower **60** may be regulated by adjusting the fluid flow through valve **44**.

The operation of conditioning unit **18** for cooling purposes is substantially the same as that described above, with the exception that means **14** is a refrigerating unit, and fluid **12** has an antifreeze added thereto to prevent icing. The passage of the fluid through unit **18** and its regulation is substantially the same as described above.

What is claimed is:

1. A heating-cooling conditioning unit for an enclosure comprising:
- a pancake shaped support structure,
- means mounted on the support structure for attaching the unit to an enclosure,
- inlet and outlet fluid conduits protruding within the support structure,
- heat exchange coils arranged in a flat spiral array with an opening centrally located in the array engaged with the inlet and outlet coils,
- a rotatively mounted fan supported by the support structure protruding within the coil opening such that air moved by the fan would be directed across the coils,
- a fluid turbine engaged with the fan and having inlet and outlet ports thereon communicating with the inlet fluid conduit,
- whereby pressurized fluid flowing through the inlet conduit will transfer thermal energy as it passes through the coils and will drive the turbine and the fan to move air across the coils to thereby condition an enclosure.

2. A heating-cooling conditioning unit as defined in claim **1** and in addition:
- deflector vanes arranged on the fan to direct air substantially parallel to the flat spiral array of heat exchange coils.

3. A heating-cooling conditioning unit as defined in claim **1** and in addition:
- a means for regulating fluid flow mounted in the inlet conduit including a temperature responsive element disposed remote from the unit.

4. A heating-cooling conditioning unit operated by pressurized fluid comprising:
- a hollow support structure having a centrally located intake grill and an outlet grill disposed on the periphery,
- a squirrel cage blower pivotally mounted within the support structure disposed adjacent to the inlet grill and aligned with the outlet grill,
- a turbine fixedly attached to the blower and received by the support structure,
- a length of heat exchange coil arranged in a flat spiral

array and disposed within the support structure between the blower and the outlet grill,

inlet and outlet conduits protruding within the support structure and attached to the extremities of the heat exchanger coil,

the turbine having an inlet and an outlet port interposed in the inlet conduit upstream of the heat exchange coils,

the inlet conduit having a first portion connected to the turbine inlet port and a second portion to the turbine outlet port,

whereby pressurized fluid in the unit may rotate the turbine and the blower thereby directing air to be drawn within the support structure intake grill by the fan and forcing it across the heat exchange coil and out the outlet grill.

5. A conditioning unit comprising:

inlet and outlet conduits,

a turbine connected to the inlet,

a blower connected to the turbine and driven thereby,

a length of heat exchange coils disposed adjacent to the blower and connected to the inlet and outlet conduits,

and a valve means inserted in the inlet conduit upstream of the turbine and heat exchange coils for terminating fluid flow to the unit in the event of an abnormally large increase in flow of fluid such as caused by a break in one of the conduits downstream of the valve means the valve means including a sealing element therein which closes upon a preselected increase in flow through the valve means.

6. A conditioning unit especially adapted for air conditioning and to be connected to a source of refrigerated fluid comprising:

inlet and outlet fluid conduits,

heat exchange coils arranged in a flat spiral array,

a casing having the heat exchange coils arranged therein,

the casing having an inlet and an outlet for the passage of air with the coils disposed within the natural passage of air between the inlet and outlet,

a means for moving air mounted on the casing adjacent the heat exchange coils,

a turbine mounted on the air moving means and having an inlet and an outlet thereon interposed within the inlet conduit,

a plurality of channel shaped condensate collecting troughs disposed below the heat exchange coils when mounted in a normal position, and

a gutter mounted on the casing and in communication with the trough such that condensed liquids may flow from the coils through the trough and out the gutter.

7. A conditioning unit especially adapted for air conditioning and to be connected to a source of refrigerated fluid comprising:

inlet and outlet fluid conduits,

a fluid regulating valve mounted on the inlet conduit,

a length of heat exchange coil with a first and second extremities arranged in a spiral array having at least two rows of coils disposed in a preselected manner,

the first heat exchange coil extremity attached to the outlet conduit,

a turbine having inlet and outlet ports thereon,

tubing attached to the turbine inlet port and to the valve for fluid transmission therethrough,

a second tube connected to the turbine oulet port and to second extremity of the heat exchange coils,

a blower mounted on the turbine and disposed adjacent to the heat exchange coils,

a set of channel-shaped condensate collecting troughs mounted below the heat exchange coils,

the troughs having perforations therein for directing condensate fluid from one trough to the succeeding troughs with the lower most trough being formed with a single perforation therein, and

a gutter extending to a preselected position in spaced relation to the heat exchange coils and having a port disposed proximate to the perforation in the lowermost trough adjacent to the spiral array of heat exchange coils.

8. A heating or cooling conditioning unit comprising:

a substantially flat pancake shaped hollow casing having a plurality of centrally disposed intake grooves and a series of slots formed on the periphery of the casing acting as an outlet, an inlet and an outlet conduit extending within the casing, a turbine centrally located within the casing,

the turbine including a rotor rotatably mounted therein and having formed thereon a plurality of radially disposed vanes extending therefrom,

the turbine having a passageway therein disposed in such a manner so as to be tangent to at least one of the rotor vanes during a portion of the rotor revolution,

the turbine having a second passageway formed therein in communication with the rotor for ducting fluid exteriorly of the turbine,

a blower fixedly mounted to the turbine rotor and having inwardly curved, arcuately shaped vanes disposed thereon for centrifugally moving air from the casing inlet to the casing outlet,

tubing connected between the first turbine passageway and the inlet conduit,

a manually operable valve interposed within the tubing and having a stem extending exteriorly of the casing,

a length of heat exchange coil arranged in a spiral fashion within the casing in proximity of the blower and arranged in such a manner so as to receive the majority of the air moved by the blower which passes through the casing inlet and is directed through the casing outlet,

the heat exchange coil having a plurality of fins formed thereon extending radially from the coil with adjacent fins being in spaced relation to each other,

one extremity of the heat exchange coil connected to the outlet conduit, and

a second extremity of the heat exchange coil being connected to the second passageway formed in the turbine.

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