United States Patent [19]

Benteler et al.

[11] **3,833,053**

[45] **Sept. 3, 1974**

[54] **INSTALLATION FOR THE CONDITIONING OF AIR**

[75] Inventors: **Erich Benteler,** Heepen; **Wilhelm Schirp,** Bergneustadt-Hackenberg; **Heinz Menne,** Schloss Neuhaus; **Otto Eckhardt,** Bielefeld; **Wilhelm Mowe,** Bad Salzuflen-Schotmar, all of Germany

[73] Assignee: **Benteler-Werke Aktiengesellschaft,** Bielefeld, Germany

[22] Filed: **July 10, 1972**

[21] Appl. No.: **271,342**

[30] **Foreign Application Priority Data**

July 10, 1971 Germany 2134619

[52] **U.S. Cl.** **165/60,** 165/96, 165/137, 165/122, 55/222, 55/269, 261/152, 261/157

[51] **Int. Cl.** **F24f 3/14**

[58] **Field of Search** 261/30, 26, 152, 157; 55/222, 269; 165/60, 137, 96; 237/78

[56] **References Cited**

UNITED STATES PATENTS

1,849,061	3/1932	Anderson	55/222
2,186,145	1/1940	Perham	261/30
2,723,616	11/1955	Hubbard	165/96
3,012,762	12/1961	Norris	165/137
3,052,105	9/1962	Bowman et al.	55/222

FOREIGN PATENTS OR APPLICATIONS

1,357,085	2/1964	France	165/60
937,830	9/1963	Great Britain	165/60
620,595	3/1961	Italy	165/60

Primary Examiner—Bernard Nozick
Attorney, Agent, or Firm—Michael S. Striker

[57] **ABSTRACT**

A first housing is provided, together with a similarly dimensioned second housing. Heat exchange elements are provided in the first housing for the purpose of conditioning the ambient air, and a humidifying arrangement is provided in the interior of the second housing and occupies a substantial portion of this interior.

18 Claims, 6 Drawing Figures

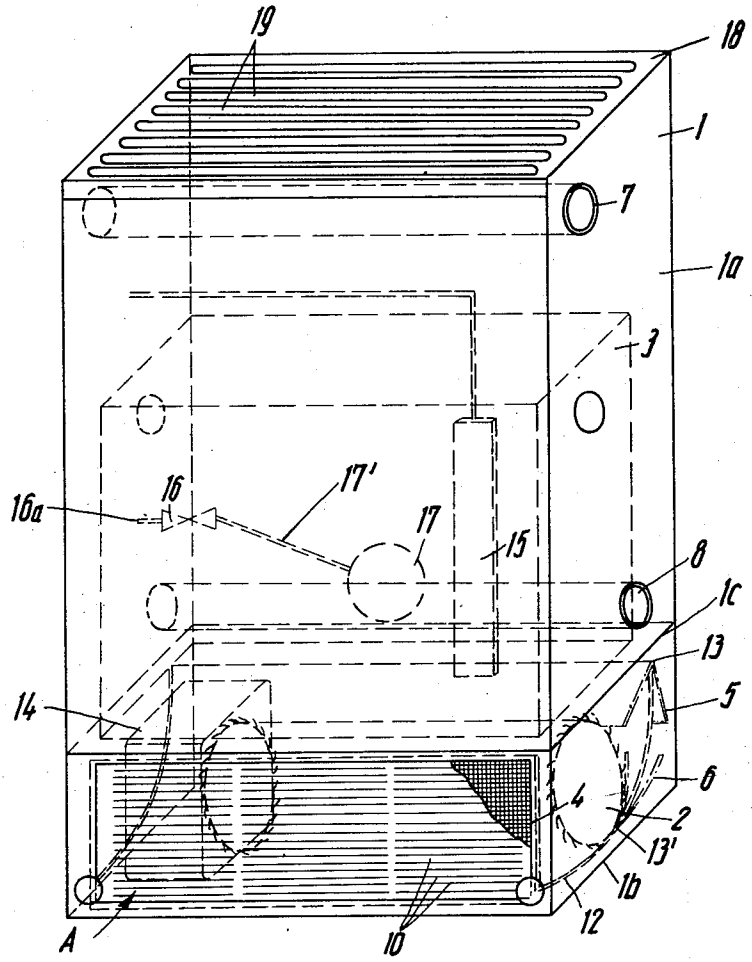


Fig.1

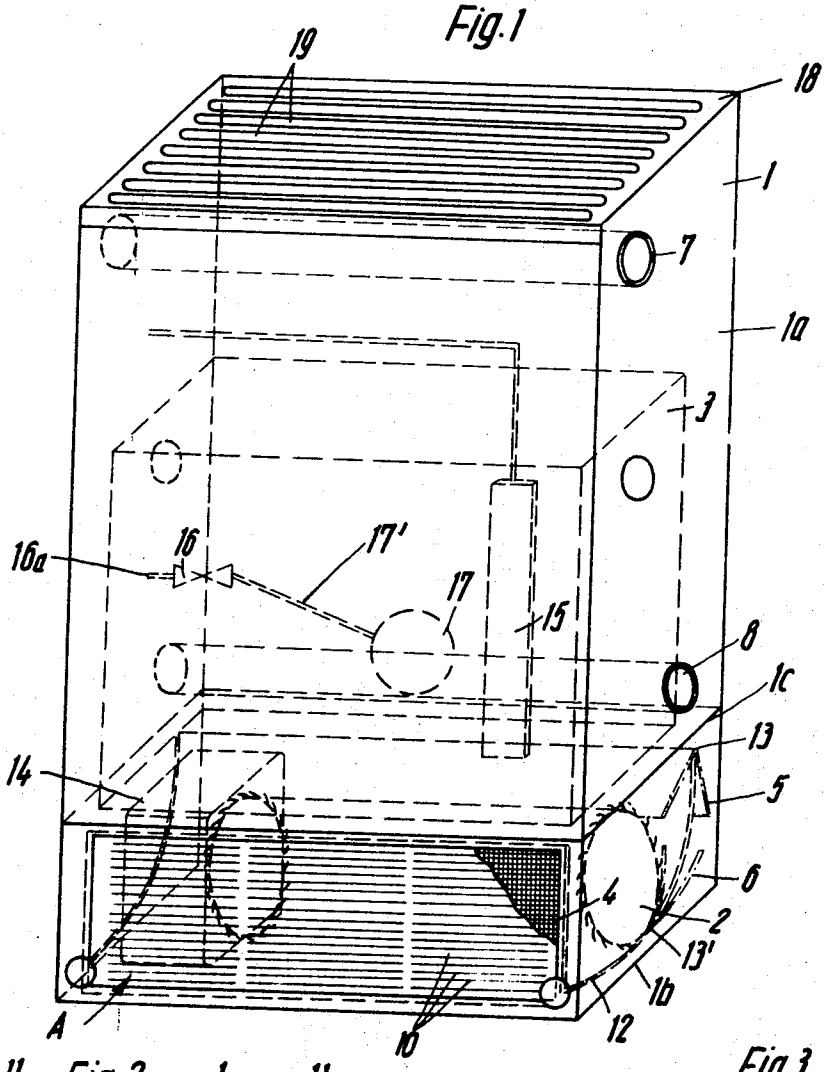


Fig.2

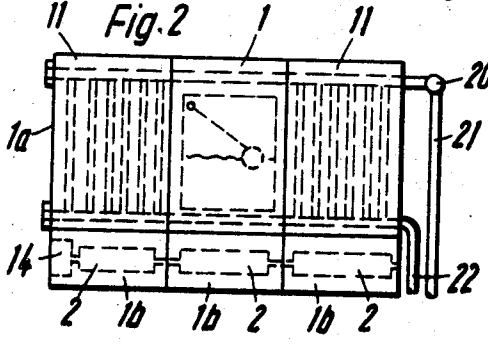
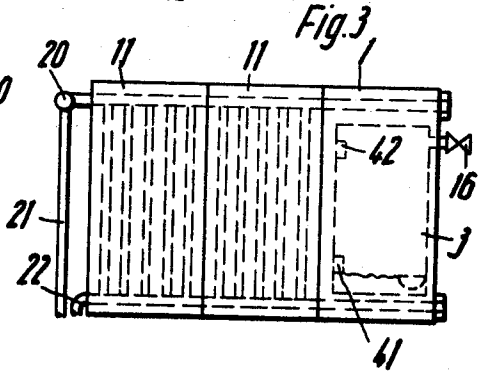


Fig.3



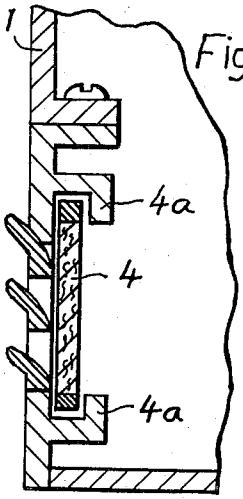


Fig. 1a

Fig. 4

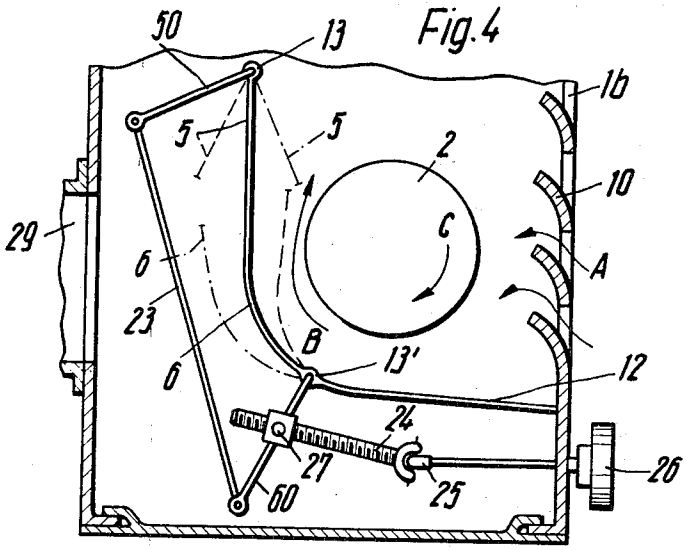
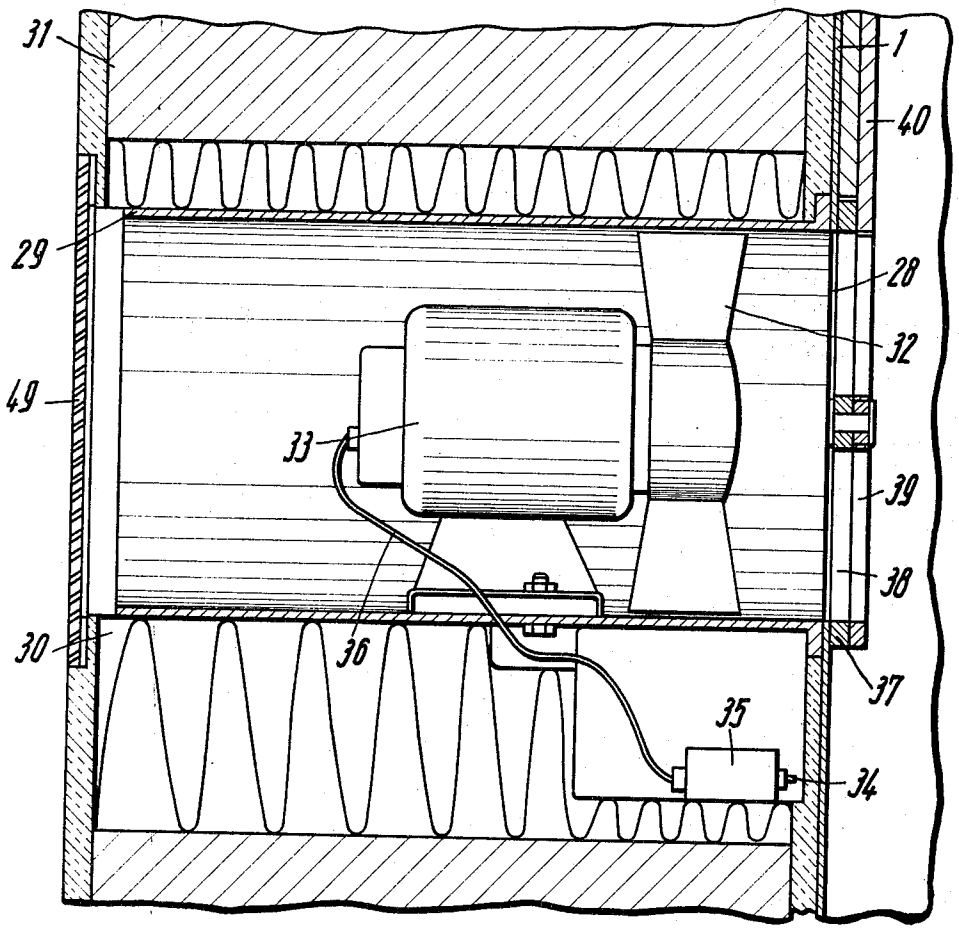


Fig. 5



INSTALLATION FOR THE CONDITIONING OF AIR

BACKGROUND OF THE INVENTION

The present invention relates generally to installations for the conditioning of air, and more particularly to an installation capable of heating and/or cooling the ambient air.

Various types of such installations are already known. They usually are provided with conduits for the circulation of a heat-exchange fluid, that is either a hot or cold liquid or the like, and they usually are provided one supply conduit and one return flow conduit, with the two being located at different levels and being connected by more or less vertically oriented conduits. It is also known to arrange these conduit systems in essentially box-shaped casing or covers, usually spot-welded to the conduit system and provided with slits or similar apertures for air.

A further development of this type of unit is provided in addition with a ventilating means, usually arranged in a bottom portion of the casing and most frequently constructed as radial-flow blowers. The purpose here is to provide for a significantly improved heating of the ambient air due to the movement of the ambient air by the blower as opposed to ordinary air movement by convection.

The most frequently used approach in such systems is to provide each unit as a separate entity, and to connect as many of the units as are necessary for obtaining a desired heating and/or cooling effect, that is as many as are necessary to heat and/or cool a given room area. The cases or housings of these units are usually placed close together or into abutment, being connected with one another by screws or similar connecting means, and the conduits in the individual units are connected with one another for circulation of the heat exchange fluid therein.

The problem with this state of the prior art is that if such a system is used for heating purposes, it is not possible to properly humidify the ambient air. All known systems of this type irrespective of whether they are provided for heating or cooling purposes, whether they operate by convection or are provided with a blower, can be utilized in conjunction with humidification of the ambient air only by providing a receptacle which is filled with water and placed or hung on a respective one of these units. This is of course aesthetically displeasing, aside from the fact that it is not as effective as is desired. As a consequence, the usual pattern of use in such instances is that the receptacle is filled and placed in position only at such times as the heated air is so dry as to become bothersome to the user or users of the room in question. At other times the receptacle is not employed, thus circumventing the main consideration behind the humidification of heated air, namely to obtain an even humidity at all times irrespective of the amount of heating and irrespective of the conditions of the air outside the room in question.

SUMMARY OF THE INVENTION

It is, accordingly, a general object of the present invention to overcome the disadvantages of the prior art.

More particularly it is an object of the present invention to provide an installation for the conditioning of air which is not possessed of the aforementioned disadvantages.

Still more particularly it is an object of the invention to provide such an installation which is capable of providing humidification of the ambient air in such a manner as to maintain the humidity at a certain level at all times.

Another object of the invention is to provide such an installation which provides for the desired humidification of the air, and which is either free from or at least requires only minimum maintenance and at the same time serves to remove pollutants from the ambient air.

In pursuance of these objects, and of others as will become apparent hereafter, one feature of the invention resides, in an installation for the conditioning of air, in a combination which briefly stated comprises a first housing and a similarly dimensioned second housing. Heat exchange means is provided in the first housing for conditioning the ambient air, and humidifying means is provided in and occupies a substantial portion of the interior of the second housing.

Thus, the second housing can be used in effect as a component or module in the construction of an installation for the conditioning of air. If it is assumed, for instance, that two of the first housings with their associated heat exchange means are required for providing the desired amount of heating and/or cooling of a given space, then the second housing with the humidifying means according to the present invention can be combined with them in the manner of a module, to thereby provide the desired humidifying action. Similarly, of course, the invention provides for considerable freedom of a combination, that is if for instance two of the first housings with their associated heat exchange means are provided, then the second housing with the humidifying means may be located between the two first housings, at one end of a row composed of the three housings, at the other end, or in any desired relationship.

According to a further concept of the invention the second housing may be composed of two sections, one of which is provided with the humidifying means and in the other of which a blower means is provided. The two sections may be so constructed that they can be releasably connected and that the section provided with the humidifier means can be employed by itself in conjunction with one or more first housings. This makes it possible to first provide the section having the humidifying means and, if it is found later to be necessary to provide in addition the section having the blower means, or if for instance financial consideration dictate that the section provided with the blower means be acquired only later, the section with the blower means can then be connected with the section having the humidifying means. Of course, if a blower means is not provided, that is if it is either completely omitted or if it is omitted for the time being to be acquired later, then the humidification effect will be less, because it will be based exclusively upon evaporation due to convection.

According to still an additional concept of the invention the second housing may be provided with at least two conduits of which one is to be connected at its opposite ends with the supply conduit of the heat exchange means in the first housing or housings, whereas the other conduit is to be connected with the return-flow conduit of the heat exchange means in the first

housing or housings. This means that the second housing can be located freely wherever desired with respect to the first housing or housings, that is at one or the other side of the first housing, between two of the first housings, or in any desired location. The freedom of positioning of the second housing with reference to the first housing or housings of the installation is therefore vastly increased.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a somewhat diagrammatic perspective illustrating an embodiment of the invention, with parts broken away for clarity;

FIG. 1*a* is a fragmentary sectional detail view, showing a portion of FIG. 1;

FIG. 2 is a diagrammatic front elevation showing an installation utilizing the invention;

FIG. 3 is a view similar to FIG. 2 but showing a different installation utilizing the invention;

FIG. 4 is a vertical fragmentary section illustrating a detail of an embodiment of the invention; and

FIG. 5 is a fragmentary detailed, on an enlarged scale, illustrating another embodiment of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Discussing the drawing in detail, and firstly referring to the embodiment illustrated in FIGS. 1–3 thereof, it will be seen that the invention is here illustrated as a module or unit having a housing 1 of substantially box-shaped configuration. The configuration and dimensioning of the housing 1 is the same as that of the other housings of the installation (see for instance FIG. 2) with which it is to be combined.

In the embodiment in FIGS. 1–3 the housing 1 accommodates in its lower portion a blower 2 which may be of any desired type but which advantageously is a well-known radial-flow blower. The reason for utilizing radial-flow blowers is that they are relatively narrow and long in construction, and provide in a very small space a rather significant air-circulating capacity.

Humidifying means, here illustrated in form of a receptacle 3, is located in the upper portion of the housing 1. Air circulation openings 10 are provided in the housing 1, in the illustrated embodiment in the front panel at the lower region thereof. These air circulation openings may be in form of elongated slots or in any other desired configuration. It is advantageous to locate behind the openings 10 a removable filter, for instance in form of a filter plate 4 which is retained in a frame 4*a* (see FIG. 1*a*), so that the air which enters through the openings 10 under the aspirating effect of the blower 2, will be filtered before it reaches the latter. Such filters are already well known and may for instance be in the form of glass fiber mats or the like.

As has already been previously pointed out, the housing 1 may be of two sections, for instance the upper section 1*a* and the lower section 1*b*, with the plane of separation where the two sections meet being indicated at reference numeral 1*c*. In that instance the upper section 1*a* accommodates the humidifying means 3 and the lower section 1*b* accommodates the blower 2. The arrangement may be such that the upper section 1a with the humidifying means 3 may be used in conjunction with the other modules of the installation without the lower section 1*b* and the associated blower 2. In such a case the upper section 1*a* may be so used and the lower section 1*b* and the blower 2 be omitted permanently, or the lower section 1*b* with its blower 2 may be supplied later if a need for them is found to exist, or if financial considerations make the supplying of the lower section 1*b* and of the blower 2 possible only at a later time.

As shown in FIG. 1, a stationary guide baffle 12 may be provided in the lower section 1*b*, covering a portion of the blower 2. The baffle 12 may serve to guide and direct air. The baffle 12 may also be provided with adjustable baffles, for instance the adjustable baffles 5 and 6 which in the illustrated embodiment are pivotable about the axis 13 and 13', respectively. In the embodiment of FIG. 1 the baffles 5 and 6 regulate the supply of incoming air and the supply of outgoing air, respectively. It will be appreciated that depending upon the position of the baffles 5 and 6 the air will be moved upwardly in the interior of the housing 1 as it emerges from the blower 2, or will be ejected from the lower region of the lower section 1*b* via an appropriate outlet, for instance an outlet identical with or similar to the one identified with reference numeral 29 in FIG. 4.

The housing 1 further accommodates two transversely extending pipes 7 and 8. These are to be connected with the supply conduit and return-flow conduit, respectively, of the heat exchange system in other housings of the installation which accommodate the heat exchange portion of the installation. In other words, if the other housings (which will be discussed with respect to FIGS. 2 and 3) contain a supply pipe and a return-flow pipe for hot and/or cold water, then the pipes 7 and 8 are to be connected with these in order for instance to make it possible to accommodate the housing 1 with its associated components between two housings accommodating heat exchange means, so that the circulation and return flow of heat exchange fluid can take place from a heat-exchange housing at one side of the housing 1 through the latter to a heat-exchange housing located at the opposite side of the housing 1. It is possible to omit the pipe 8 if desired, because if the housing 1 is located only adjacent one heat-exchange housing, and not between two of them, then one end of the pipe 7 could be connected with the supply conduit and the other end of the pipe 7 could be connected with the return-flow conduit of the heat exchange housing.

FIG. 4 shows by way of example how the baffles 5 and 6 can be displaced about their pivot axes 13 and 13', respectively. In this embodiment, which may be employed in FIGS. 1–3, in the exemplary embodiment of FIG. 5 or in any other embodiment of the invention which is encompassed in the scope of the present invention, the pivot axes 13, 13' are constituted by shafts, one of which is connected with a lever 50 and the other of which is connected with a lever 60. The levers 50 and 60 are connected with one another by a connecting rod 23 which is articulated to them at its opposite ends. Displacement of the levers 50 and 60 together with the

rod **23** thus takes place in form of a parallelogram-linkage, and for effecting such displacement there is provided a threaded spindle **24** connected via a universal or cardanic joint **25** with a turnable knob **26.** The spindle **24** is mounted in a nut **27.** It will be appreciated that when the knob **26** is turned in one direction the spindle **24** shifts axially of itself due to the fact that it is threaded through the nut **27,** causing the arm **60** (on which the nut **27** is pivotably mounted) to become displaced in one direction. This results in an automatic displacement of the arm **50** via the connecting rod **23,** and effects the pivoting of the baffles **5** and **6** in mutually opposite directions, for instance from the dashed line position to the dot-dash line position shown in FIG. **4.** Turning of the knob **26** in the opposite direction will have the opposite effect, that is for instance it will result in pivoting of the baffles **5** and **6** from the dot-dash line position to the dashed line position. When they are in the dashed line position a flow of air will take place in the direction of the arrow B when the blower **2** rotates in the direction of the arrow C. This also results in an injector effect at the space between the blower **2** and the baffle **6.** Aspiration of air through the openings **10** takes place in the direction of the arrows A.

FIG. **2** shows how the embodiment according to the present invention can be utilized as part of the installation for the conditioning of air. It will be seen that here there are provided two first housings **11** each accommodating heat exchange means and these housings **11** being located at opposite lateral sides of the housing **1.** The housings **1** and **11** are of identical configuration and in the illustrated embodiment they each have an upper portion and a lower portion **1***b*, with the lower portion in each instance accommodating a blower **2.** The blowers **2** can all be coupled with one another and in this case only one of them need be connected with the diagrammatically illustrated motor **14** which then drives them all. Of course, only a single blower could be provided in the lower portion **1***b* of the housing **1.** The inlet conduit is identified with reference numeral **21,** being controlled by suitable valves **20,** and the outlet conduit with reference numeral **22.** It will be appreciated that in this instance the inlet conduit **21** is connected with one end of the pipe **7** in the housing **1,** whereas the other end of the pipe **7** in the housing **1** is connected with the portion of the inlet conduit which is located in the left-hand housing **11.** Similarly, the two portions of the outlet conduit **22** provided in the two housings **11** are connected with the opposite ends of the pipe **8** in the housing **1.**

In FIG. **3** another possibility is shown how the housing **1** and its associated components can be combined with two housings **11,** it being understood that more than two housings or only a single housing **11** can of course also be provided. In FIG. **3,** also, the separate lower housing sections accommodating the blowers **2** have been omitted, so that each housing is here of only one section. It is clearly seen that the housings **11** and **1** form a row at one end of which the housing **1** is located.

In the event that an installation exists which may for instance be composed of various of the housings **11** with the associated heat exchange means, the installation being such as to supply sufficient heating capacity for a given room and it being desired to provide the present invention in conjunction with the installation but with insufficient space being available to add the present invention, it is possible to omit one of the housings **11** with the associated heat exchange means and to replace it with the present invention. This can be done because the heating effect obtained by providing the present invention (where a blower **2** forms a part of the unit according to the invention) is greater by approximately 50 percent than the heating effect which is obtained if reliance for air circulation is placed only upon convection. Thus it is possible to eliminate one of the housings **11** with the associated heat exchange means under such circumstances and nevertheless not lose any heating capacity.

It is of course desirable that the humidifying means be totally or substantially maintenance free. To achieve this it is possible to provide a contact element **15** extending into the receptacle **3** and closing an electric circuit when the water in the receptacle **3** reaches a certain predetermined level. The circuit may then be connected with a valve **16** in known manner, the valve **16** for instance being magnetically operated and being opened in response to the closing of the circuit to admit additional water into the receptacle **3** via a pipe **16***a* with which the valve **16** is connected. The supply of water would then continue until a float **17,** acting upon the valve **16** via the arm **17'**, reaches its upper position, indicating that an upper desired water level is achieved, whereupon the valve **16** would be closed. Needless to say, the float **17** can be relied upon to control opening and closing of the valve **16** by itself, that is without the provision of the electric circuit and the contact **15.** This is well known from the art and requires no further discussion.

The housing **1** is provided in its upper or cover wall **18** with air outlet openings **19** which may be slot-shaped or otherwise configurated, so that water can readily evaporate in the receptacle **3.** Evaporation is facilitated if during the heating season hot water or steam passes through the pipes **7** and **8,** that is when these are connected with the supply and return-flow conduits of the heat exchange means in the housing or housings **11** with which the housing **1** cooperates. This of course serves to raise the temperature of the water in the receptacle **3** by some degrees, and depending upon the heating effect obtained by the heat exchange means in the housings **11,** the humidity in the ambient air is thus self-regulating. Additional heating of the housing **1,** and thus evaporation of the water in the receptacle **3** therein, takes place of course by heat transfer from the walls of the housing or housings **11** to those of the housing **1** when an instllation such as for instance shown in FIGS. **2** and **3** is chosen.

Suitable means may of course be provided to connect the housings **1** and **11** with one another, just as suitable means may be provided for connecting the housing portions **1***a* and **1***b* with one another. The arrangement of the pipes **21** and **22,** the pipes **7** and **8** and the valve **20** may be chosen otherwise than what has been illustrated without thereby departing from the scope and intent of the present invention.

Coming to the embodiment in FIG. **5** it will be seen that here the housing is again identified with reference numeral **1.** Its rear wall is provided with an opening or cutout **21** located as desired but in the illustrated embodiment located approximately two-thirds of the height of the housing above the lower end of the latter. An inlet pipe **29** extends outwardly from this opening **28,** being connected therewith by a suitable flange or

the like, and extending into an appropriately insulated opening **30** provided in the wall **31** bounding a room or the like. The outer end of the pipe **29** is closed by a grit or screen **49** which is located at the outer side of the wall **31.**

As FIG. **5** shows, a blower **32,** in this instance illustrated as an axial-flow blower or fan, is located in the interior of the pipe **29,** being operatively associated with an induction motor **33** whose direction of rotation can be reversed in known manner. The induction motor **33** is connected with a switch **35** which can be operated via knob **34,** the connection being established via a circuit **36.** The knob **34** may be located at an appropriate point of the installation, for instance at the front side of the housing **1** if desired.

The closure element **37** is provided between the housing **1** and the blower **32,** and the illustrated embodiment being constructed as a turnable element and having cutouts **38** which can be made to register with similar cutouts **39** provided in an intermediate wall **40.** Of course, other configurations can be provided for the element **37,** for instance it can be of the sliding type or the like. In any case, the embodiment in FIG. **5** omits the arrangement of the stationary and movable baffles illustrated in FIGS. **1–4** and permits a particularly ready installation in a wall of a room whose air is to be conditioned.

Returning once more to FIGS. **1** and **3** it will be seen that other possibilities exist for controlling various functions. For instance, the housing **1** or the receptacle **3** itself, may accommodate one or two level switches **41** and **42,** being operatively associated with the motor **14** for the blower **2.** In this case the arrangement would be such that the switch **41** interrupts the circuit for the motor **42** when the level of liquid in the receptacle **3** drops to a lower limit, and when the level is subsequently restored to an upper limit the circuit for the motor **14** would be automatically completed again by the switch **42.** The same possibility exists of course also with respect to the induction motor **33** in which case the circuit **36** may be connected with the switches **41** and **42.** Details of such switches are not believed to be required because the switches themselves, as well as the manner in which the act in response to the occurrence to different liquid levels and the manner in which they are connected with the respective motor, is known from the art. The switches **41** and **42** may also, in connection with a solenoid valve, control the supply of water, for instance if the valve **16** is a solenoid valve which is also known from the art.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of constructions differing from the types described above.

While the invention has been illustrated and described as embodied in an installation for the conditioning of air, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims:

1. In an installation for the conditioning of air, a combination comprising a first housing having a first side wall, and spaced-apart air inlet and outlet apertures; a second housing dimensioned and contoured similar to said first housing and having a second side wall laterally adjacent to and connected in abutment with said first side wall, said second housing also having spaced-apart air inlet and outlet apertures; heat exchange means in said first housing for thermally conditioning ambient air which enters through said inlet aperture and leaves through said outlet aperture; and humidifying means in said second housing for humidifying the ambient air, including a humidifier containing water which evaporates when heated via said heat exchange means, air circulating means for circulating air over said humidifier in said second housing, a first baffle in said second housing for guiding air entering through said inlet aperture, and a second baffle in said second housing for guiding air towards said outlet aperture.

2. A combination as defined in claim **1,** wherein said second housing comprises two discrete housing portions, said humidifier being provided in one and said air circulating means being provided in the other of said housing portions.

3. A combination as defined in claim **2,** wherein said housing portions are of polygonal configuration.

4. A combination as defined in claim **1;** and further comprising filter means extending across said air inlet apertures at the interior of said second housing.

5. A combination as defined in claim **4;** and further comprising holding means for removably holding said filter means in a position extending across said air inlet apertures, so as to admit of replacement of said filter means.

6. A combination as defined in claim **1,** said second housing having an upper and a lower section accommodating said air circulating means and provided with said side wall, said air circulating means being elongated transversely of said second housing; said baffles comprising a fixed air guiding baffle extending along said air circulating means within the confines of said wall; and a pair of movable air guiding baffles provided at respective upper edges of said fixed baffle.

7. A combination as defined in claim **6,** each of said movable baffles being pivotable about a respective pivot shaft; and further comprising actuating means for effecting such pivoting.

8. A combination as defined in claim **7,** said actuating means comprising levers mounted on the respective pivot shafts for pivotable movement therewith, a coupling rod articulated to and coupling said levers, a screw spindle articulated to one of said levers, mounting means mounting said screw spindle for longitudinal displacement in response to rotation of said screw spindle, and a control member connected with said screw spindle for effecting such rotation.

9. A combination as defined in claim **8,** said movable baffles being mounted on said pivot shafts for pivoting movement in mutually opposite directions, one of said movable baffles cooperating with said stationary baffle and together with the same surrounding said air circulating means at least in part when said one movable baf-

fle is in a given angular position with reference to said stationary baffle.

10. A combination as defined in claim **6**; further comprising at least one air conduit having an outlet communicating with the interior of said second housing in said lower section thereof, at least one of said movable baffles being operative for closing said outlet.

11. A combination as defined in claim **1**, said humidifying means comprising a receptacle for water, a flow control valve adapted to be connected with a source of flowing water and operative for movement between an open and a closed position, and control means associated with said receptacle and operative for controlling movement of said control valve between said positions thereof.

12. A combination as defined in claim **11**, said air circulating means comprising a blower and an electromotor for operating said blower.

13. A combination as defined in claim **1**; further comprising filter means for filtering of incoming air, said baffles comprising first movable baffle means for controlling the flow of incoming air, and second movable baffle means for controlling the flow of outgoing air, all accommodated in the interior of said second housing.

14. A combination as defined in claim **1**; said heat exchange means comprising supply and return flow conduits; and further comprising supply conduit means and return flow conduit means provided in said second housing and adapted to be connected with the respective supply and return flow conduits of said first housing.

15. A combination as defined in claim **1**, said second housing having a front and a back; and further comprising a unit attached to said back and comprising a casing, a blower in said casing, and a direction-reversible induction motor also in said casing and associated with said blower for driving the same.

16. A combination as defined in claim **15**, wherein said casing is tubular.

17. A combination as defined in claim **16**, said back having an aperture, and said tubular casing registering with said aperture; and further comprising closure means for closing said aperture.

18. A combination as defined in claim **17**, said closure means being a rotary closure element having at least one cut-out adapted to be placed into and out of communication with said aperture in response to rotation of said closure element.

* * * * *