June 13, 1939. L. E. SEELEY 2,161,834

AIR CONDITIONING APPARATUS

Filed Dec. 9, 1936

Fig. 1.

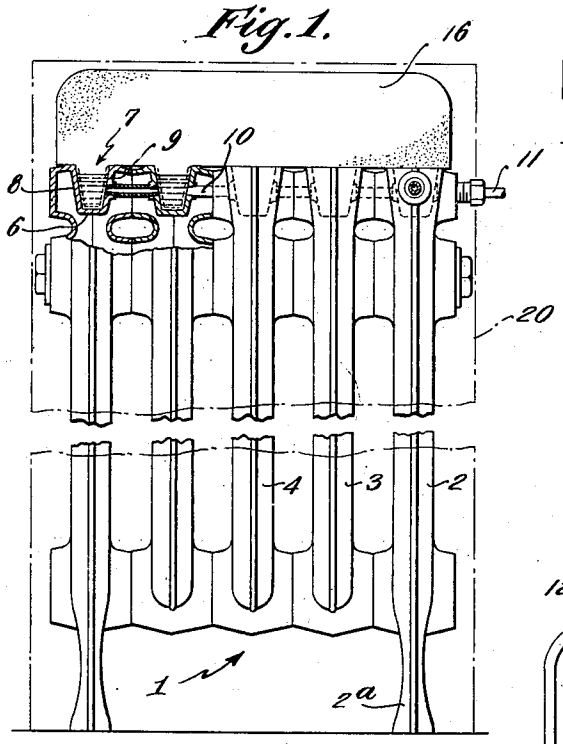


Fig. 7.

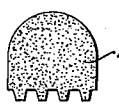


Fig. 6.

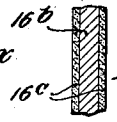


Fig. 3.

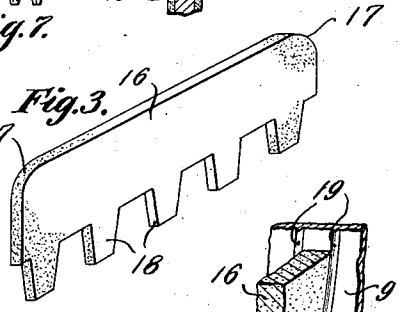


Fig. 4.

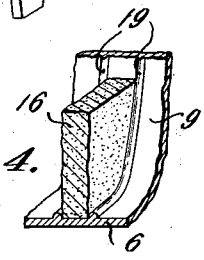
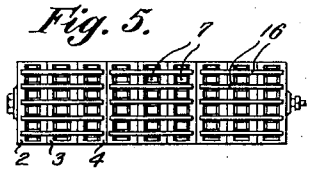
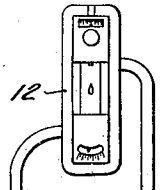


Fig. 5.





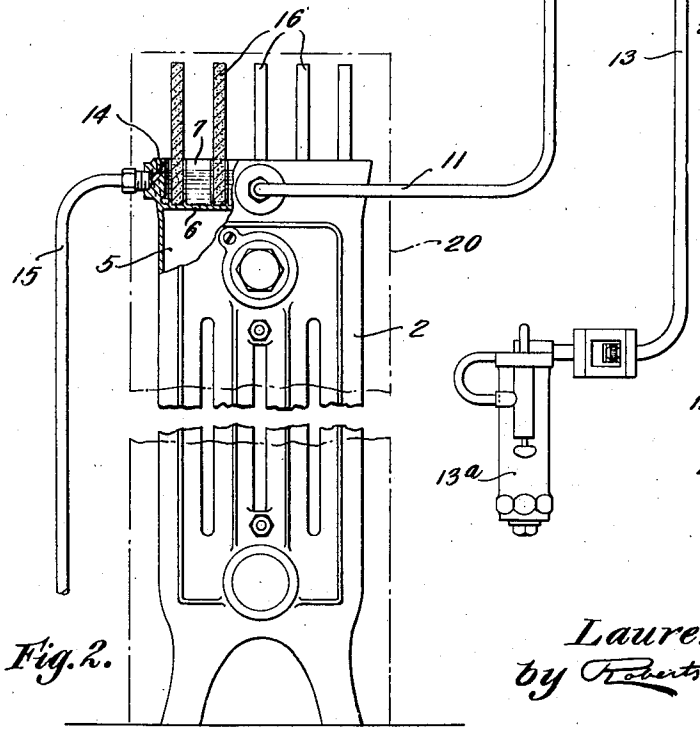


Fig. 8.

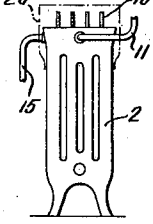


Fig. 9.

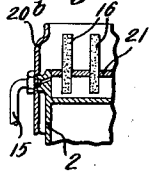


Fig. 10.

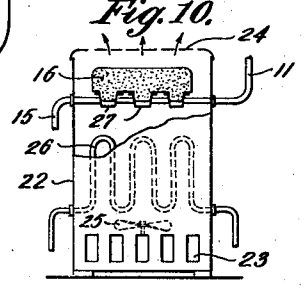


Fig. 2.

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Patented June 13, 1939

2,161,834

UNITED STATES PATENT OFFICE

2,161,834

AIR CONDITIONING APPARATUS

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Application December 9, 1936, Serial No. 114,933

4 Claims. (Cl. 257—138)

This invention pertains to air conditioning apparatus of the kind wherein an appliance or unit, comprising a heat exchanger and moisture evolving means, is designed to be installed within or substantially within the space wherein the air is to be conditioned, for example the room of a dwelling house, apartment or the like, such an appliance or unit being quite distinct in type and mode of operation from apparatus which delivers the conditioned air to the room through ducts from a more or less remote central conditioning apparatus.

Typical of heat exchangers desirable for use in appliances such as above described, are the various types of so-called "radiator", to wit those known as tubular, column, or sectional radiators, wall radiators, panel radiators, window type radiators, pipe coil radiators, fan type radiators, unit heaters, etc. most of which act primarily by convection and/or conduction, rather than actual radiation, to change the temperature of the ambient air, but it is to be understood that the present invention is applicable generally to heat exchangers of any of these various kinds, as well as others not specifically enumerated. However, as an illustrative embodiment of the invention, it has been chosen to show and describe it herein in detail as comprising a sectional heat exchanger so enclosed in an air guiding or directing casing that the temperature of the ambient air is changed almost wholly by convection and/or conduction by direct contact with the surfaces of the heat exchanger rather than by true radiation, such appliance being hereinafter referred to for convenience as an enclosed radiator or convector.

The principal object of the present invention is to provide air moistening means so associated with a heat exchanger as to form a conditioning appliance or unit, as described, and wherein the air moistening means is of high efficiency for evaporating and diffusing a fluid, for example water, into the stream of air flowing through the appliance, and so designed as to afford substantial uniformity of operation without requiring the attention of the occupant of the room, but at the same time of a design such that it will not be offensive to the eye or tend to collect dust or dirt.

A further object is to provide evaporative means for use in such a conditioning appliance or unit such that the effective evaporative area may readily be varied in extent or character to suit substantially any condition which may be met with in service. It is a further object of the invention to provide moisture evolving means of a novel character which, while highly effective for its intended purpose, is very durable and may readily be cleaned without detriment to its usefulness.

Other objects and advantages of the invention will hereinafter be pointed out in the following more detailed description wherein reference is made to the accompanying drawing in which:

Fig. 1 is a fragmentary front elevation partly in section, and with the outer casing indicated in broken lines, of a heating and moistening appliance or unit embodying the present invention;

Fig. 2 is a fragmentary end elevation of the appliance of Fig. 1 illustrating automatic means for supplying fluid for evaporation by the heat exchanger;

Fig. 3 is a perspective view illustrating a desirable form of evaporative plate useful in the practice of the invention;

Fig. 4 is a fragmentary perspective sectional view showing one desirable means of holding the evaporative element in assembled relation to the heat exchanger proper;

Fig. 5 is a diagrammatic plan view to small scale, showing a possible arrangement of evaporative plates in association with a long sectional heat exchanger;

Fig. 6 is a fragmentary section showing one possible form of evaporative plate;

Fig. 7 is a front elevation, to small scale, of a plate of a different shape;

Fig. 8 is a view, generally similar to Fig. 2, but to smaller scale and illustrative of another embodiment of the invention;

Fig. 9 is a fragmentary sectional view illustrating the upper part of an appliance like that of Fig. 2, but showing a modified arrangement for holding the evaporative plates in position; and

Fig. 10 is a diagrammatic view illustrative of a more general embodiment of the invention.

Referring to Figs. 1 to 6 of the drawing, which more specifically illustrates the invention, by way of example, as embodied in a heating and moistening appliance comprising a sectional heat exchanger enclosed in an outer casing through which air flows in an upward direction in intimate contact with the surfaces of the heat exchanger sections, the numeral 1 designates a sectional heater of conventional form provided with spaces and channels for the circulation of a circulating medium such as water, steam or gas. This heat exchanger or "radiator", as usual, is made up of a plurality of sections 2, 3, 4, etc.,

suitably coupled together as by means of tapered nipples or the like, the end sections being furnished with legs 2a whereby the heat exchanger or radiator proper is supported at a suitable distance from the floor. The fluid space 5 (Fig. 2) within each radiator section is closed at its top by means of a wall 6 integral with the side walls of the section, such top wall member 6 being shaped to provide the bottom of a depression 7 elongate in the direction of the front-to-rear depth of the radiator and preferably extending substantially from the front to the rear of the section, such recess or cavity constituting an evaporating pan and preferably having downwardly sloping side walls 8 and 9 (Fig. 1) integral with the wall 6. Preferably the cavities or evaporating pans 7 of the several sections are connected together so that collectively they may be considered as constituting a single large pan. If desired, they may be connected by means of small pipes running from one section to the next or by means of a header extending lengthwise of the radiator, but preferably as shown in Fig. 1, they are connected by nipples 10 of small diameter which enter suitable tapered sockets in the walls 8 and 9.

It is preferred to provide automatic means for supplying fluid to the evaporating pans of the radiator, although it is obvious that the fluid might be supplied otherwise if preferred. As illustrated in Fig. 2, for example, a small pipe 11 is connected to a fitting tapped into one of the end sections 2 of the radiator and is designed to conduct water to the evaporating pan 7 of such endmost section. The pipe 11 leads from a suitable regulator 12 which may, for example, be located at a convenient point on the wall of the room and which comprises either an automatic control, responsive to moisture conditions in the room, or a regulable manually actuated valve designed to permit a predetermined quantity of fluid per unit of time to flow through the pipe 11 and into the evaporating pan of the end section 2. The water or other fluid thus permitted in regulated amount to enter the pipe 11 may be supplied through a pipe 13 leading, for example, from a secondary controller 13a, including, if desired, a filter or other device and which receives a constant supply of fluid from a suitable source, for example, a supply pipe (not shown) forming a part of a city water system. Preferably an overflow is provided, for example, a small passage 14 (Fig. 2) leading from the upper part of the evaporating pan 7 and into the entrance to an overflow pipe 15, tapped into the radiator section and leading to any desired point of discharge.

In accordance with the present invention, the evaporative surface is greatly increased over that provided by the free surface of the fluid in the pans 7 by the use of evaporating plates 16. These plates, as shown in Fig. 2, are preferably although not necessarily disposed in substantially vertical, spaced parallel relation and project up to a predetermined distance above the tops of the radiator sections. Each of these plates, as illustrated in Fig. 3, is preferably of more or less rectangular contour, preferably having the smoothly rounded upper corners 17 and being provided with a plurality of integral downwardly projecting legs 18 at its lower edge. Preferably these legs 18 are of truncated downwardly tapering contour, each leg being adapted to fit between the sloping side walls 8 and 9 of one of the evaporating pans. In order to hold these plates in proper operative position the inner surface of each pan 7 may, if desired, be provided with pairs of integral outstanding parallel ribs 19 or equivalent means, the ribs of each pair being adapted to engage opposite sides of the legs 18 of one of the evaporating plates, thereby to hold the plate upright although permitting ready removal of the plate merely by lifting it from the radiator.

Preferably these plates are of some relatively stiff material so that the plates will remain substantially flat and upright for a long time, even though subjected to heat and moisture. These plates 16 may be of a moisture-absorbent material throughout, as illustrated in Figs. 3 and 4, or if preferred (as illustrated at 16a, Fig. 6) may consist of a tough, nonbreakable material 16b such, for example, as sheet metal which is not moisture-absorbent itself but which is provided with moisture-absorbent covering or surface layers 16c, for example sheet asbestos.

While doubtless various materials can be used for making the plates, it has been found that an inorganic material is to be preferred, for example ceramic material such as unglazed porcelain or the like. Such a material possesses the desired rigidity and shape-retaining qualities, it is quite bibulous so that it readily takes up fluid from the evaporating pan, and diffuses such fluid by capillary action throughout its substance, but it is also very readily cleaned, since its surface is hard and visually smooth and does not readily pick up dust or other particles of appreciable size.

The radiator 1 (of generally conventional type, as above suggested, and comprising a series of spaced, substantially vertical parallel sections 2, 3, 4, etc., between which the air, as it is warmed, tends to move upwardly in substantially parallel streams) is enclosed in an outer casing 20 (Figs. 1 and 2) for example of pressed metal or the like, and which usually comprises an opening or grill at its lower part for the entrance of air and an exit opening or grill at its top. Such an enclosing casing constrains the air to flow in intimate contact with the surfaces of the radiator sections and by convection and/or conduction to take up heat by direct transfer from the metal, and then to move upwardly as a warm and moisture-absorbent current over the surfaces of the plates 16 from which it very rapidly absorbs moisture.

It is contemplated that the plates 16 may be made in various lengths corresponding to the different numbers of sections which may be assembled to form radiators, and that while each section may be furnished with means, for example the ribs 19, for holding a maximum number of the plates 16, the actual number of plates employed in any given instance may be varied to suit conditions. For example, if it be found that the number of plates employed tends to produce too pronounced a moistening of the air in a given space, one or more of the plates may readily be removed merely by lifting it from its socket, thus reducing the evaporative capacity of the conditioning apparatus. It is further to be noted that since the air current which rises between the spaced parallel radiator sections and passes between these plates is mainly in an upward direction there is little tendency for dust to accumulate upon the plates or in the evaporating pans and that if some dust eventually does gather upon the plates they may readily be cleaned merely by removing them and wiping them off. It is contemplated that the inner surface of the evap-

orating pan 7 may be given some suitable finish, for example, by the application of enamel or the like, so that such surface will be smooth and also easily cleanable. While the moistening of the air in the room has been mentioned as the principal object of the apparatus disclosed, it is contemplated that the evaporating pans and plates may be employed for other purposes, for example for the evaporation of disinfectants, perfumes or the like.

While a radiator or heat exchanger containing but five sections is here illustrated, it is to be understood that the invention is in no way limited to the number of sections, which may be as few or many as desired, and it is further contemplated that if the radiator be of great length single plates 16 need not extend the entire length of the radiator and that each plate may extend only over a limited number of sections, for example diagrammatically as illustrated in Fig. 5, in which event, successive plates longitudinally of the radiator might, for example, be arranged end to end as shown. It is further to be understood that the exact shapes and dimensions of the plates 16 are not necessarily such as here illustrated, since these plates may be made of any desired contour, height and thickness, in accordance with the requirements of the particular use and as circumstances may show to be useful, a plate of one such different contour being shown by way of example at 16^{x}, Fig. 7.

Referring to Fig. 8, a slightly modified arrangement is illustrated wherein the sectional heat exchanger or heater 2 is provided at its upper part only with an enclosing and air directing casing 20^{a}, so that the lower part of the heater may act to warm its surroundings, in part at least, by radiation, while its upper part acts more particularly by convection and/or conduction to heat the air current ascending through the casing 20^{a}. In this arrangement, as in that previously described, the heater or radiator sections are provided with an evaporating pan or pans in which are disposed the evaporative plates 16, such as above described, so arranged as to expose extended areas to the ascending current of air.

In Fig. 9 a further slight modification is illustrated wherein the heater 2, having the evaporating pan at its upper part is furnished with a cover 21 for the pan, such as to keep out dust, dirt or rubbish, such cover being furnished with slots in which are seated evaporative plates 16 preferably of the kind above described. With this arrangement most of the evaporation takes place from the exposed surfaces of the plates 16 above the cover 21, the lower parts of the plates dipping into the water in the pan so that the water is drawn upwardly into the upper parts of the plates by capillary action. In this instance the outer casing 20^{b} is shown as somewhat restricted at its upper end or outlet, thereby to insure a more rapid flow of the air over the surfaces of the plates 16.

In Fig. 10 there is illustrated in a more or less diagrammatic way an appliance embodying a further modification of the invention. In this arrangement the numeral 22 designates a casing of any desired shape, size and material, preferably provided with a grill 23 or other type of air inlet near its lower part, and preferably having a cover 24 provided with a grid-like air outlet, it being understood that the casing may be furnished with any desired form of inlet and outlet for the air not necessarily of the particular kind here shown, and that the inlet and outlet may be reversed in position if desired. If desired, although it is not essential, a fan 25 or other air impelling means may be arranged within the casing so as to produce a more or less positive movement of air upwardly through the casing. In the path of the moving air is a heat exchanger 26, here shown as a coil, for example a steam coil, but intended as typical of any desired type of heat exchanger having a surface over which the air may flow and by means of which the temperature of the air may be changed by convection and/or conduction. Thus, for example, the heat exchanger may, as indicated, be a coil for the passage of any fluid such as steam, hot gas, hot water or a cooling medium such as refrigerated brine or cold gas, or such exchanger may take the form of an electrical resistance coil, a chamber for the combustion of fuel either solid, gaseous or liquid, or for holding solid refrigerant, or in fact, any device capable of changing the temperature of the air flowing over its outer surface. Within this casing and above the exchanger is disposed an evaporating pan or reservoir 27 preferably consisting of a series of spaced sections between which the air current may flow, and connected together by means of nipples or otherwise, so as to maintain a substantially uniform liquid level in the several sections. Liquid may be supplied to this pan through a pipe 11 and may overflow through a pipe 15, such pipes corresponding to those similarly numbered in the arrangement shown in Fig. 2. Preferably the pan 27 is shaped to receive evaporative plates 16, such as above described, which dip down into the pan to receive liquid therefrom by capillary action and which expose a large surface to the current of air so that the air may receive moisture before passing out through the exit openings.

All of these and such other variations and substitutions as may occur to those skilled in the art are to be regarded as falling within the scope of the present invention, as defined in the appended claims.

I claim:

1. Air conditioning apparatus of the class described in which air is warmed by means of a sectional heater whose constituent sections are designed to define evaporating pans, comprising in combination a substantially rigid plate of bibulous material, said plate having spaced integral legs projecting from one edge, each leg being received in the evaporating pan of a corresponding section, and plate-positioning means carried by each section designed to removably hold the plate in operative position.

2. Air conditioning apparatus of the class described, wherein air is warmed by means of a sectional radiator of substantially conventional type, comprising a plurality of spaced, substantially parallel sections between which the warmed air tends to flow upwardly in parallel streams, but having a depression in the top wall of each section constituting an open topped evaporating pan and including means providing an evaporative surface of variable area, characterized in that said evaporative surface consists of a plurality of thin, substantially rigid plates of bibulous material, each of a length substantially equaling the length of the radiator and disposed in substantially parallel spaced upright relation, each plate having lower edge portions which rest upon the radiator sections and at least one downwardly directed leg portion which dips into one of the

evaporating pans, and means designed and arranged removably to hold each individual plate in operative position with portions of its surface bridging the spaces between adjacent radiator sections and directly exposed to the currents of warm air rising between said sections.

3. Air conditioning apparatus of the class described, wherein air is warmed by means of a sectional radiator of substantially conventional type, comprising a plurality of spaced, substantially parallel sections between which the warmed air tends to flow upwardly in parallel streams, but having a depression in the top wall of each section constituting an open topped evaporating pan and including means providing an evaporative surface of variable area, characterized in that said evaporating surface is provided by a plurality of plates, each of predetermined size and shape and each having a fluid-absorbent surface, said plates being sufficiently rigid to be self-sustaining and each having a portion which reaches down into one at least of the evaporating pans, and means operative removably to hold each individual plate in a position such that a substantial area of the plate is disposed directly in the path of the warm air current which rises between adjacent sections of the radiator.

4. Air conditioning apparatus of the class described, wherein air is warmed by means of a sectional radiator of substantially conventional type, including spaced vertical sections but having the upper end of each section so shaped as to provide an evaporating pan elongate from front to rear of the radiator, each pan having downwardly convergent side walls and an open top, and a plurality of evaporating plates each having a fluid-absorbent surface, each plate being of such length as to extend from one radiator section to another when operatively disposed transversely of the sections, each plate having legs projecting from its lower edge portion, each such leg tapering in width and being shaped to fit between the converging side walls of one of the respective pans of the radiator.

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