

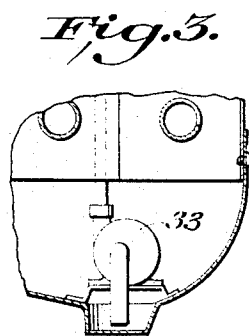
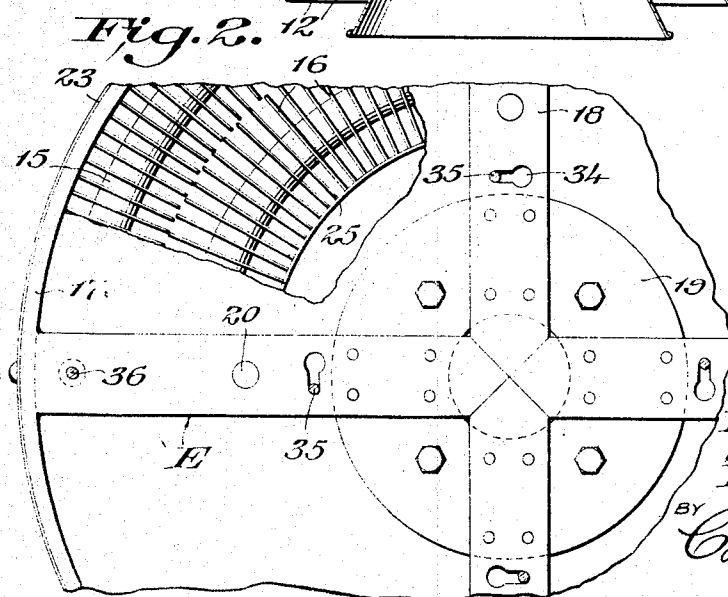
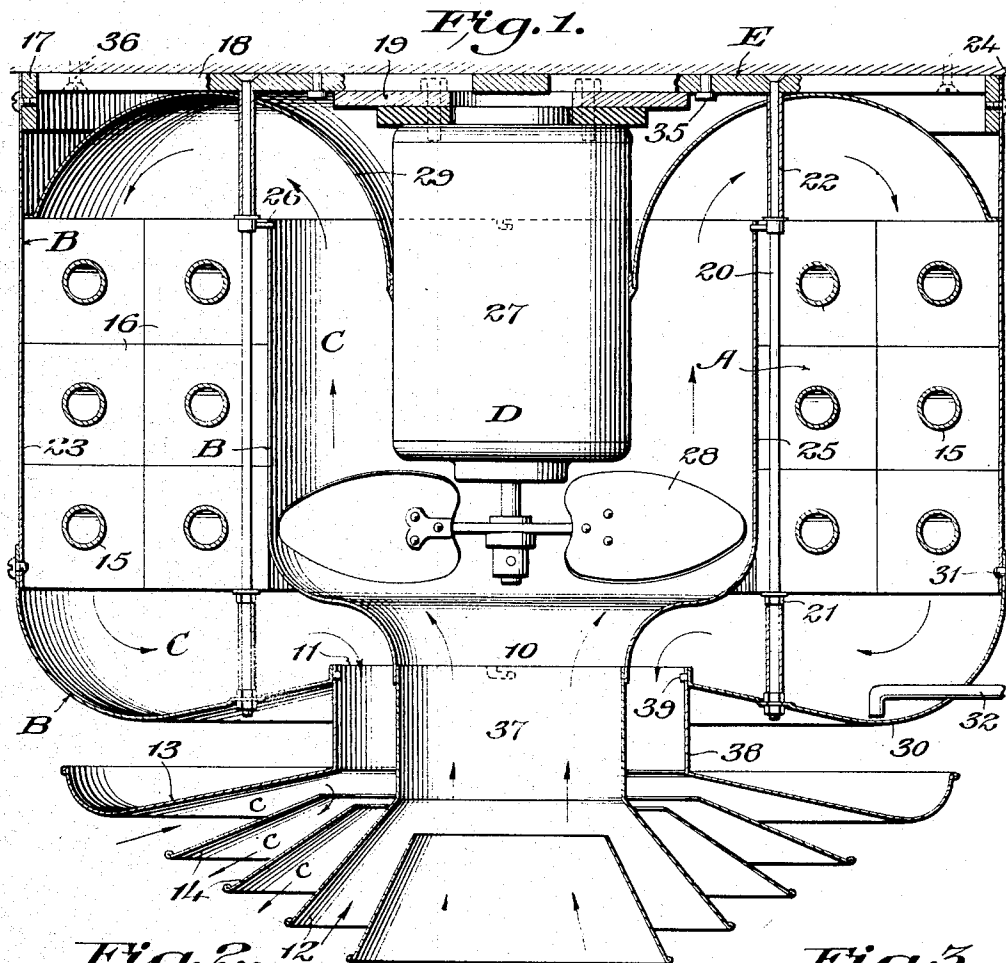
May 4, 1943.

F. HONERKAMP ET AL
HEAT EXCHANGE APPARATUS.

2,318,393

Filed Feb. 29, 1940

4 Sheets-Sheet 1



Inventors
F. Honerkamp,
V. F. Self,
F. J. Kurth,

BY
Carroll Bailey
Attorney

May 4, 1943.

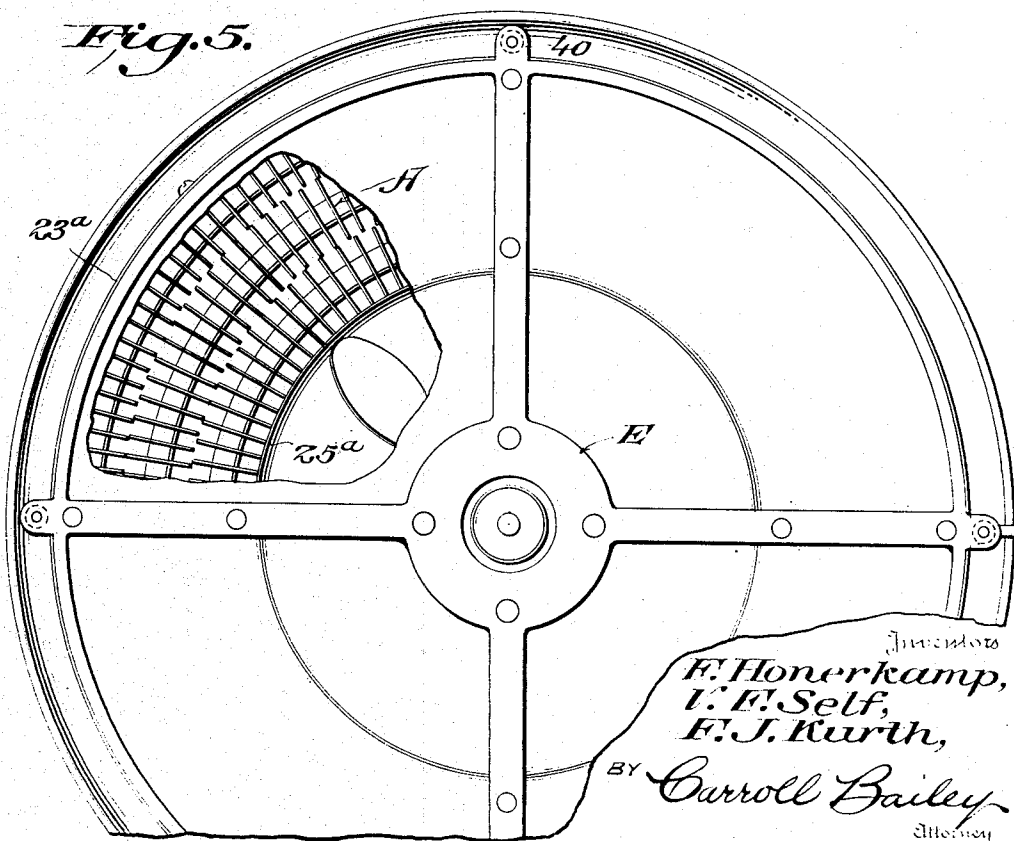
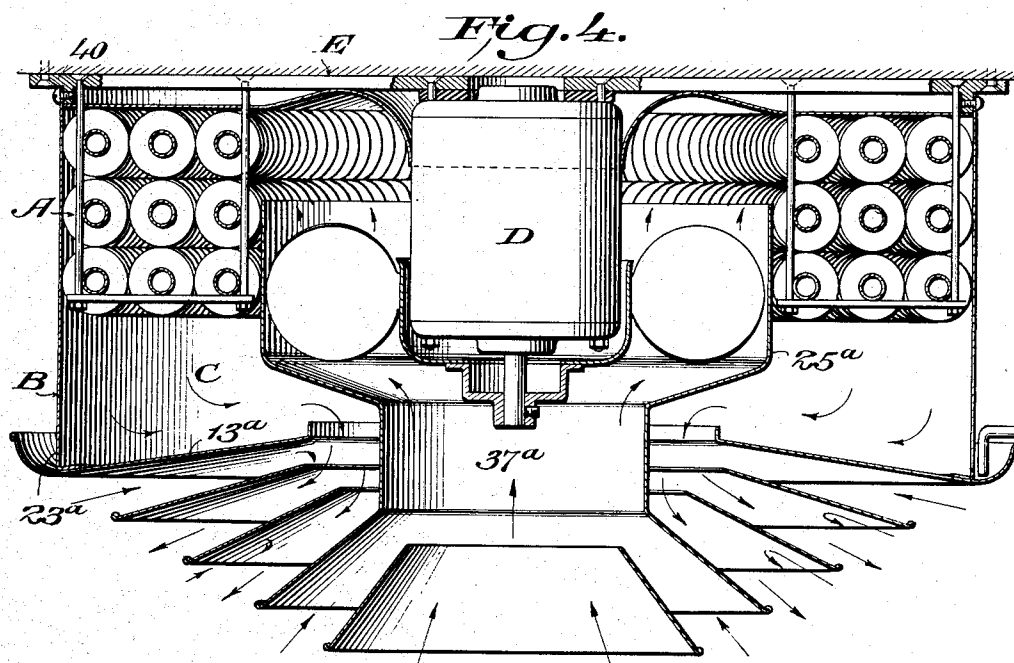
F. HONERKAMP ET AL

2,318,393

HEAT EXCHANGE APPARATUS

Filed Feb. 29, 1940

4 Sheets-Sheet 2



Inventors
F. Honerkamp,
I. E. Self,
E. J. Kurth,
BY *Carroll Bailey*
Attorney

May 4, 1943.

F. HONERKAMP ET AL

2,318,393

HEAT EXCHANGE APPARATUS

Filed Feb. 29, 1940

4 Sheets-Sheet 3

Fig. 6.

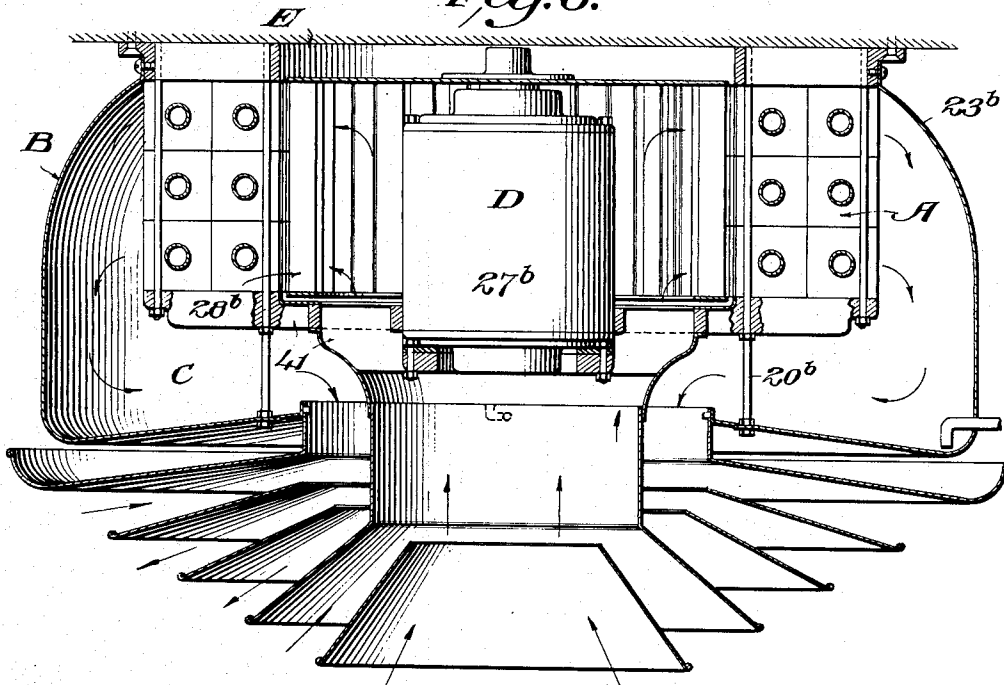
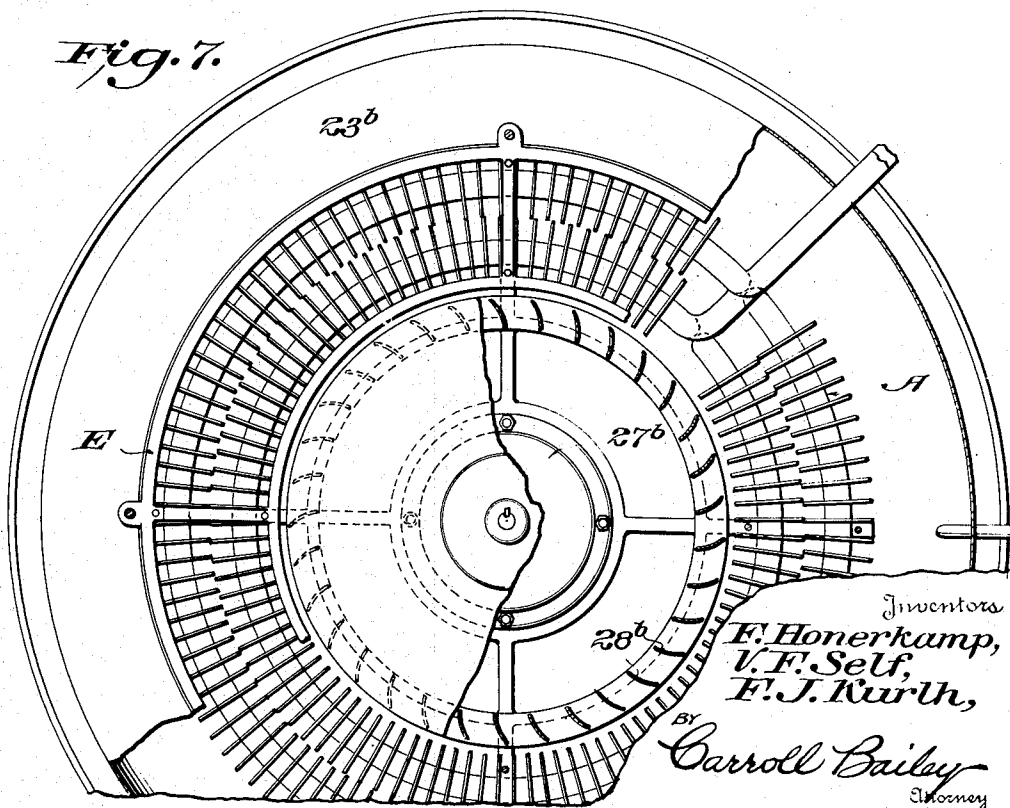


Fig. 7.



Inventors
F. Honerkamp,
V. F. Self,
F. J. Kurlh,

BY
Carroll Bailey
Attorney

May 4, 1943.

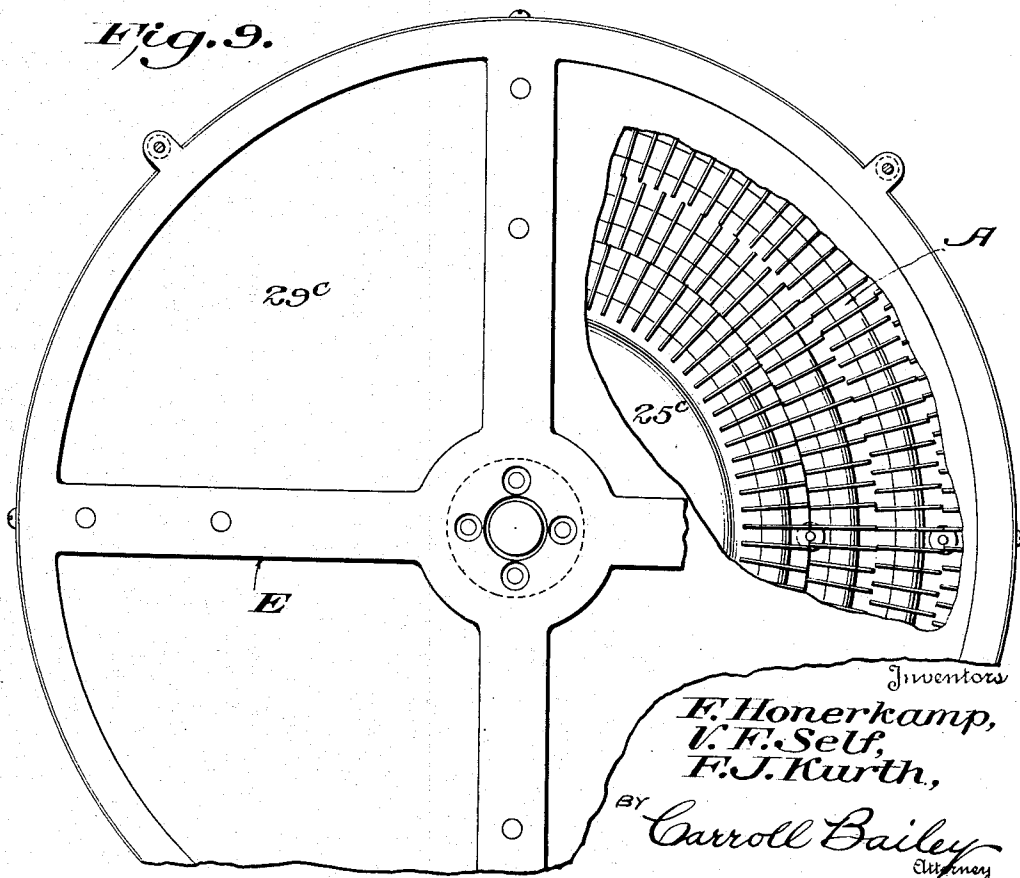
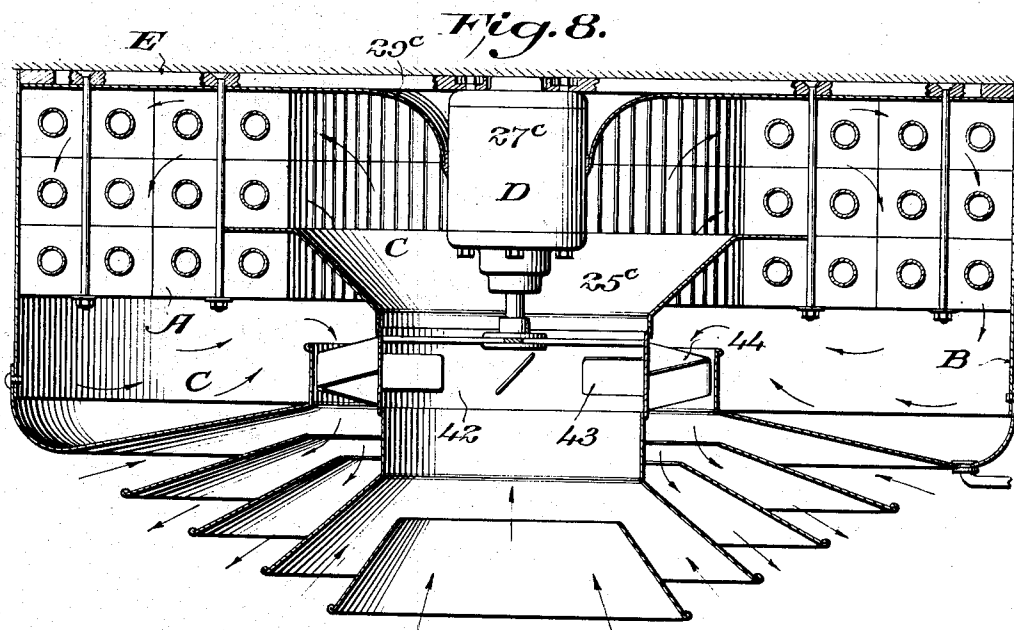
F. HONERKAMP ET AL

2,318,393

HEAT EXCHANGE APPARATUS

Filed Feb. 29, 1940

4 Sheets-Sheet 4



Inventors
F. Honerkamp,
V. F. Self,
F. J. Kurth,
BY *Carroll Bailey*
Attorney

UNITED STATES PATENT OFFICE

2,318,393

HEAT EXCHANGE APPARATUS

Friedrich Honerkamp, Vester F. Self, and Franz J. Kurth, New York, N. Y., assignors to Anemostat Corporation of America, a corporation of Delaware

Application February 29, 1940, Serial No. 321,556

8 Claims. (Cl. 62—129)

This invention relates to heat exchange apparatus and has particular reference to a device to be suspended from the ceiling of a room or other enclosure, or to be otherwise suitably mounted, and which is effective to circulate the air of the room or other enclosure through cooling or heating means comprising part of the device, thereby to impart to the air a desired temperature.

One special object of the invention is to provide a simple, practical device of the character mentioned in which both the inlet and the outlet for the air are disposed at the bottom or front of the device, whereby the device may be mounted closely adjacent to a ceiling or other wall and yet is operable to effect a thorough circulation of the room or other enclosure air.

Another special object of the invention is to provide a device of the character mentioned in which the air inlet and outlet ends thereof are disposed one in surrounding relationship to the other, and in which the air outlet end is equipped with means to diffuse the cooled or heated air and to produce an air aspirating action, whereby the air not only is thoroughly circulated, but is delivered from the device practically without producing any sensation of draft, even though the circulation is quite rapid.

Another special object of the invention is to provide a device of the character mentioned embodying an advantageous compact arrangement of the air cooling or heating and air circulating elements thereof relative to each other, and in particular to dispose the cooling or heating element so that practically all portions thereof are effective to cool or heat the circulated air.

Another special object of the invention is to provide a device of the character mentioned in which the parts thereof are readily separable for convenience in packing, transportation and installation and for cleaning or repairs.

With the foregoing and other objects in view, which will become more fully apparent as the nature of the invention is better understood, the same consists in the novel features of construction and in the novel combination and arrangement of parts as will be hereinafter more fully described, illustrated in the accompanying drawings and defined in the appended claims.

In the accompanying drawings, wherein like characters of reference denote corresponding parts in related views—

Figure 1 is a central, longitudinal section through a device constructed in accordance with one practical embodiment of the invention.

Figure 2 is a plan view, partly broken away to

disclose the underlying structure, of the device illustrated in Fig. 1.

Figure 3 is a detail sectional view illustrating pump means for removing condensate from the device.

Figures 4 and 5 are views similar to Figs. 1 and 2, respectively, illustrating an alternative embodiment of the invention.

Figures 6 and 7 are views similar to Figs. 1 and 2, respectively, illustrating another alternative embodiment of the invention; and

Figures 8 and 9 are views similar to Figs. 1 and 2, respectively, illustrating still another alternative embodiment of the invention.

Referring to the drawings in detail, it will be observed that the present device, according to each of the illustrated embodiments thereof, comprises a heat exchange element of hollow, annular form, designated generally as A, casing means, designated generally as B, defining an air passageway C wherein said element A is disposed, whereby air circulated through said passageway is subjected to temperature change by said element A, and means, designated generally as D, for circulating air through said passageway C.

It will further be observed that, according to each of the illustrated embodiments of the invention, the passageway C has inlet and outlet ends 10 and 11, both disposed at the same end of the device in axial alinement with the heat exchange element A, and that, in each instance, the outlet end 11 is disposed in surrounding relationship to the inlet end 10.

Moreover, it will be observed that, according to each of the illustrated embodiments of the invention, there is provided, as an extension of the wall separating the inlet and outlet end portions of the passageway C, a flaring member 12, and, as an extension of the wall defining the outer side of the outlet end of said passageway, a flaring member 13; also, that between said flaring members 12 and 13 there are provided other flaring members 14 of hollow, open-ended form which are spaced from each other and from the members 12 and 13 and thus provide a plurality of flaring passageways c through which air discharged from the device passes and thereby is diffused. In this connection it is pointed out that the rear ends of the members 14 may be disposed relative to each other and to the outer side of the outlet end 11 of the passageway C to cause some of the discharged air to flow through each of said flaring passageways c. Preferably, however, the rear end of the larger or outermost member 14 is disposed outwardly

of the outer side of the outlet end 11 of the passageway C whereby the discharged air passes across the rear end or mouth of the outermost passageway c and thereby creates a decided suction effect or aspirating action in said outermost passageway C. In any event, a certain amount of aspiration will occur in each of the passageways c due to the tendency of the delivered air to hug the walls defining the inner sides of said passageways. Thus there is effected in the immediate vicinity of the device a thorough intermixture of the delivered air with the room or other enclosure air into which the delivered air is delivered. This, combined with the diffusion of the air effectively avoids the production of any sensation of draft to occupants of the room or other enclosure even though there may be a decided temperature differential between the delivered air and the room or other enclosure air and even though the means D may circulate the air at a relatively high velocity. Moreover, it is apparent that by having the air outlet of the device in surrounding relationship to the air inlet of the device at the same end of the device, a very thorough circulation of the room or other enclosure air results. Moreover, this has the added advantage of permitting the device to be mounted with its other end closely adjacent to, or in a recess in, a ceiling or other wall, which is an important consideration in many instances.

In any of the different forms of the invention the cooling, or heating, element A may be of any suitable or desired specific form, provided, of course, that it is of a form such that, when interposed in the passageway C, it permits the passage of air therethrough whereby the air is cooled, or heated, as may be desired. In the present instance said element A, according to each of the different illustrated forms of the invention, is comprised by a plurality of coils 15 of pipe provided with numerous heat conducting flanges 16, and it is assumed that a cooling, or heating, medium is circulated through said coils from any remote source whereby the air passing over or around the coils 15 and between the flanges 16 is cooled, or heated, as the case may be.

According to the specific embodiment of the invention illustrated in Figs. 1 and 2, there is provided a frame element E upon which the different parts of the device are mounted and through the instrumentality of which the device as an entirety may be mounted upon a ceiling, wall or other suitable support.

The frame element E may be a cast member or may be built up from separate parts welded, riveted or otherwise suitably fastened together. In any event, said element comprises a ring 17 of an external diameter approximately equal to the external diameter of the heat exchange element A, and radial arms 18 connecting said ring with a central disk 19.

The heat exchange element A is disposed below the frame element E with its top suitably spaced downwardly from said frame element and is rigidly suspended from said frame element in any suitable manner, as for example, by means of rods or bolts 20 depending from the frame-element arms 18. These rods or bolts may extend, for example, between the flanges 16 of the element A and may have nuts 21 thereon cooperating with the bottom of the element A to hold the latter against downward movement relative to said frame element E, while to hold the element A spaced downwardly from the frame element E said rods or bolts 20 may have sleeves 22

thereon interposed between the arms 18 and the top of said element A.

Disposed around the outside of the heat exchange element A is a casing member 23 which may extend, as shown, from the bottom of said heat exchange element upwardly around the ring 17 and which may be removably fastened in place in any suitable manner, as for example, by means of screws 24 extending therethrough into said ring 17. Another casing member 25 in the form of a sleeve is disposed interiorly of the heat exchange element A and cooperates with the casing member 23 to define that part of the passageway C in which said heat exchange element A is disposed. The casing member 25 is open at its upper and lower ends and at its lower end, which preferably is constricted and disposed suitably below the bottom of the heat exchange element A, defines the inlet end 10 of the passageway C. At its upper end said member 25 is disposed flush, or substantially flush, with the top of the heat exchange element A. Moreover, said member 25 preferably is removably mounted within the heat exchange element A, as for example, by having bayonet slot connections at its upper end with pins 26 extending inwardly from the suspension rods or bolts 20 whereby it may be withdrawn from said heat exchange element to afford access to the air circulating means D which is disposed interiorly of said member 25 upwardly of its constricted lower end.

The air circulating means D comprises an electric motor 27 mounted upon and depending from the disk 19 of the frame element E and fan blades 28 carried by the shaft of said motor at the lower end thereof and disposed in the sleeve member 25 upwardly of its constricted lower end.

A casing member 29 in the form of a ring of arched cross section surrounds the motor 27 and extends from said motor first upwardly and outwardly over the heat exchange element A in spaced relationship to the top thereof and then downwardly and outwardly approximately to the upper, outer corner thereof. Said casing member 29 thus cooperates with the motor 27 to define the upper part of the passageway C which leads from the inlet portion of said passageway, defined by the sleeve 25, to the top of that portion of said passageway which is occupied by the heat exchange element A. The member 29 may be secured in place in any suitable manner, as for example, by being confined between the arms 18 of the frame element E and an annular shoulder on the motor 27.

Below the heat exchange element A is a casing member 30 in the form of a ring-like pan which defines the outlet end portion of the passageway C. This casing member 30 may be formed as an integral part of the casing member 23, but preferably is separate therefrom and detachably connected therewith, its outer marginal portion being engaged over the lower end portion of said member 23 for example and screws 31 extending through its outer marginal portion into the lower end portion of the member 23 being employed, for example, to detachably fasten it in place. Alternatively, or additionally, said casing member 30 may be fastened in place upon the lower end portions of the rods or bolts 20.

Being of ring-like form, the casing member 30 has a central opening. This opening is of greater diameter than the constricted lower end portion of the sleeve 25 and the said constricted lower end portion of said sleeve extends into said opening. Thus, the outlet end 11 of the passageway

C is defined by the constricted lower end portion of the sleeve 25 and the edge of the member 30 defining the central opening therein. Thus, too, the outlet end of the passageway C is disposed in surrounding relationship to the inlet end of said passageway C at the same end of the device; i. e., at the lower end thereof, which, as aforesaid, permits the device to be mounted with its other or upper end against or close to a ceiling or other wall or other support.

The casing member 30 preferably is of dished form so as to act as a collection pan for condensate removed from the air by the heat exchange element A, and any suitable means may be provided for removing condensate from said pan. For example, a tube 32 may be provided, as illustrated in Fig. 1, for gravity flow of condensate from said pan, or, as illustrated in Fig. 3, a small pump 33, driven by a small motor or in any other suitable manner, may be provided for power extraction of condensate from said pan.

The device as an entirety may be suspended from a ceiling or mounted against a wall or other support in any suitable manner. For example, the arms 18 may be provided with key-hole slots 34 to accommodate headed studs 35 projecting from a ceiling, wall or other support, whereby the device may be mounted and dismounted by endwise and rotary movements thereof. Alternatively, or additionally, screws 36 may extend through openings in the arms 18 into a ceiling, wall or other support, access to said screws being had by dropping the casing member 23 relative to the heat exchange element A.

Preferably the flaring members 12, 13, 14 are suitably connected together as a unit for unitary connection with and detachment from the device. To this end the flaring members 12 and 13 may have neck portions 37 and 38, respectively, to fit the constricted lower end of the sleeve 25 and the central opening in the casing member 30, respectively, and either or both of said neck portions may have, for example, bayonet slots at its upper end for cooperation with pins 39 carried by either the sleeve 25 or the member 30, or by both said sleeve and said member, to removably mount said unit in place.

When the air circulating means D is operating, air is drawn into the constricted lower or forward end of the sleeve 25 from the area directly below or in front of the device, passes upwardly or inwardly through the sleeve 25, then laterally outwardly to the top of the heat exchange element A, then downwardly or forwardly through said heat exchange element, then laterally inwardly to the outlet end 11 of the passageway C and finally is delivered from the device through the diffusing and aspirating means comprised by the flaring members 12, 13, 14, all in the manner indicated by the arrows and with the advantageous results heretofore mentioned.

According to the embodiment of the invention illustrated in Figs. 4 and 5 of the drawings the construction and mode of operation of the device is generally the same as in the first described form of the invention. However, as distinguished from the first described form of the invention, the sleeve 25^a of the Figs. 4 and 5 embodiment of the invention and which corresponds to the sleeve 25 of the first described form of the invention, has its upper end disposed below the top of the heat exchange element A to permit the air to pass laterally outwardly through the top portion of said heat exchange element. This permits the

top of the heat exchange element to be disposed closely adjacent to the frame element E with consequent reduction in the over-all length of the device as compared with the first described form of the invention. Another material difference between the Figs. 4 and 5 embodiment of the invention and the first described embodiment thereof is that the flaring member 13^a of the Figs. 4 and 5 embodiment of the invention, corresponding to the flaring member 13 of the first described embodiment of the invention, is utilized for the purpose of the casing member 30 of the first described embodiment of the invention. In other words, the Figs. 4 and 5 embodiment of the invention represents, as compared with the first described embodiment of the invention, elimination of the member 30 of the first described embodiment of the invention and in substituting therefor the flaring member 13^a. This results in a simplified structure as compared with the first described embodiment in that the member 13^a serves a dual purpose and, furthermore, contributes to obtaining an advantageous short, over-all length of the device.

As in the first described embodiment of the invention, the air diffusing and aspirating members of the Figs. 4 and 5 embodiment of the invention may be connected together as a unit for unitary attachment to and removal from the device in any desired manner. For example, the outermost member 13^a may be suitably attached to the bottom of the member 23^a corresponding to the member 23 of the first described embodiment of the invention. Moreover, Fig. 4 illustrates that the sleeve 25^a corresponding to the sleeve 25 of the first described embodiment of the invention may be formed as an integral part of, or may be fixed to, the neck 37^a corresponding to the neck 37 of the first described embodiment of the invention.

Figures 4 and 5 further illustrates that the frame element E may have apertured ears 40 disposed outwardly with respect to the casing member 23^a so that the device may be mounted by means of screws or other fasteners readily accessible at the outside of the device.

According to the embodiment of the invention illustrated in Figs. 6 and 7 of the drawings the general construction and mode of operation of the device is substantially the same as in the first described embodiments of the invention. However, as distinguished from the first described embodiments of the invention, the heat exchange element A of the Figs. 6 and 7 embodiment, instead of being closed, or partly closed, at its inner side, is entirely open and the air circulating means is of the centrifugal type comprising an annular series of blades 20^b which extend longitudinally of the device at the inner, open side of the heat exchange element A. Moreover, the casing member 23^b, corresponding to the casing members 23, 23^a of the first described embodiments of the invention, is spaced outwardly from the heat exchange element A so that the flow of air is primarily laterally outward through said heat exchange element rather than primarily downwardly therethrough as in the first described embodiments of the invention.

In the Figs. 6 and 7 embodiment of the invention, the rods 20^b, corresponding to the rods 20 of the first described embodiment of the invention, support, below the heat exchange element A, a suitable frame 41 upon which said heat exchange element rests and upon which is mount-

ed the motor 27^b for driving the centrifugal fan 28^b.

According to the embodiment of the invention illustrated in Figs. 8 and 9 of the drawings the general construction and mode of operation of the device again is substantially the same as in the previously described embodiments of the invention. However, as distinguished from the previously described embodiments of the invention, the air circulating means of the Figs. 8 and 9 embodiment of the invention comprises what may be termed a "dual" fan consisting of a ring-like portion 42 forming part of the air inlet neck of the device and having internal and external fan blades 43 and 44, respectively, the former of which are disposed in the inlet portion of the passageway C and the latter of which are disposed in the outlet portion of said passageway. In other respects the Figs. 8 and 9 embodiment of the invention may be in accordance with any of the previously illustrated and described embodiments of the invention.

As specifically illustrated in Fig. 8, the member 25^c corresponding to the members 25, 25^a and 25^b of the previously described embodiments of the invention, has its upper end disposed below the top of the heat exchange element A so that the path of the air flow is laterally outward through the top portion of said heat exchange element. Moreover, the member 29^c corresponding to the member 29 of Fig. 1 is disposed in substantially the same manner as the member 29 of the Fig. 1 construction so that the motor 27 is subjected to cooling by air circulated through the device.

In the foregoing description it has been assumed that the device is used in a vertically disposed position with the inlet and outlet ends of the passageway C disposed downwardly. It will be understood, however, that the device may be used in a horizontal position or at any angle to the horizontal. It has also been assumed in each instance that the air is circulated in a direction such that it enters the passageway C through the end 10 thereof and leaves said passageway through the end 11 thereof. It is pointed out, however, that the air may be circulated in a direction such that it enters the passageway C through the end 11 thereof and leaves said passageway through the end 10 thereof. Moreover, while the heat exchange element A has been illustrated and described as being of annular or circular form, it is pointed out that the same may be of any other suitable shape.

Without further description it is thought that the features and advantages of the invention will be readily apparent to those skilled in the art, and it will of course be understood that changes in the form, proportion and minor details of construction may be resorted to, without departing from the spirit of the invention and scope of the appended claims.

We claim:

1. A heat exchange device comprising inner and outer annular wall means and a single thin intermediate annular wall and top wall means providing a passageway including inner and outer continuous annular portions communicating with each other at the top of the device and otherwise separated from each other throughout their lengths, said single thin intermediate wall terminating at the lower end of the device in a constricted neck defining one end of said passageway, a bottom wall extending inwardly from the lower end of said outer wall means and hav-

ing a neck disposed in surrounding relationship to and spaced from said first mentioned neck to define the other end of said passageway, heat exchange means disposed in said passageway, and means for circulating air through said passageway and through said heat exchange means.

2. A heat exchange device comprising inner and outer annular wall means and a single thin intermediate annular wall and top wall means providing a passageway including inner and outer continuous annular portions communicating with each other at the top of the device and otherwise separated from each other throughout their lengths, said single thin intermediate wall terminating at the lower end of the device in a constricted neck defining one end of said passageway, a bottom wall extending inwardly from the lower end of said outer wall means and having a central opening of larger diameter than said neck in which said neck is disposed, thereby defining the other end of said passageway, heat exchange means disposed in the outer portion of said passageway, and means disposed in the inner portion of said passageway for circulating air through said passageway and through said heat exchange means, said bottom wall also extending upwardly as well as inwardly from the lower end of said outer wall whereby it constitutes a collection pan for condensate removed by said heat exchange means from air circulated through said passageway.

3. A heat exchange device comprising inner, outer and intermediate annular wall means and top wall means providing a passageway including inner and outer continuous annular portions communicating with each other at the top of the device and otherwise separated from each other throughout their lengths, said intermediate wall means being first constricted and then flared at the lower end of the device to define one end of said passageway, a bottom wall extending inwardly from said outer wall means and having a central opening of larger diameter than the constricted portion of said intermediate wall means in which said constricted portion is disposed, said bottom wall flaring downwardly and outwardly and cooperating with the flared portion of said intermediate wall means to provide a flaring mouth at the other end of said passageway, heat exchange means disposed in said passageway, and means for circulating air through said passageway.

4. A heat exchange device comprising inner and outer annular walls and a top wall in the form of an arched annulus connecting said inner and outer walls at their upper ends, a single thin annular wall intermediate and spaced from said inner and outer annular walls and spaced downwardly at its upper end from said top wall, thereby cooperating with said inner and outer walls and said top wall to provide a passageway including inner and outer continuous annular portions communicating with each other at the top of the device and otherwise separated from each other throughout their lengths, said intermediate wall terminating at the lower end of the device in a constricted neck defining one end of said passageway, a bottom wall extending upwardly and inwardly from the lower end of said outer wall and having a central opening of larger diameter than said neck in which said neck is disposed, thereby defining the other end of said passageway, and also a collection pan to receive condensate, heat exchange means in the outer portion of said passageway, and means in the

inner portion of said passageway entirely above said neck for circulating air through said passageway and through said heat exchange means.

5. A heat exchange device as set forth in claim 3 including a plurality of open-ended hollow flaring members between the flared lower end portion of the intermediate wall means and the bottom wall and spaced from said intermediate wall means and from said bottom wall and from each other and dividing the flaring mouth at the second mentioned end of the passageway into a plurality of separate flaring mouth passageway portions for air diffusion purposes.

6. A heat exchange device comprising inner, outer and intermediate annular wall means and top wall means providing an air passageway including inner and outer continuous annular portions communicating with each other at the top of the device and otherwise separated from each other, said intermediate wall means being flared at the lower end of the device to define one end of said passageway, a bottom wall extending inwardly from said outer wall means and having a central opening of larger diameter than the portion of said intermediate wall means directly

above its flared lower end and in which said portion is disposed, said bottom wall flaring downwardly and outwardly and cooperating with the flared portion of said intermediate wall means to provide a flaring mouth at the other end of said passageway, heat exchange means disposed in said passageway, and means for circulating air through said passageway.

7. A heat exchange device as set forth in claim 6 including a plurality of open-ended hollow flaring members in the flaring air outlet mouth portion of the air passageway and spaced from the flared lower end portion of the intermediate wall means and from the bottom wall and from each other and dividing said flaring mouth portion into a plurality of separate flaring mouth passageway portions for air diffusion purposes.

8. A heat exchange device as set forth in claim 6 in which the air circulating means comprises an electric motor and a fan driven thereby and in which the inner wall means is constituted in part by said motor.

FRIEDRICH HONERKAMP.
VESTER F. SELF.
FRANZ J. KURTH.