Sept. 11, 1934. F. J. KURTH ET AL 1,973,490

AIR OR GAS DISTRIBUTING DEVICE

Original Filed Oct. 28, 1932

Fig. 1

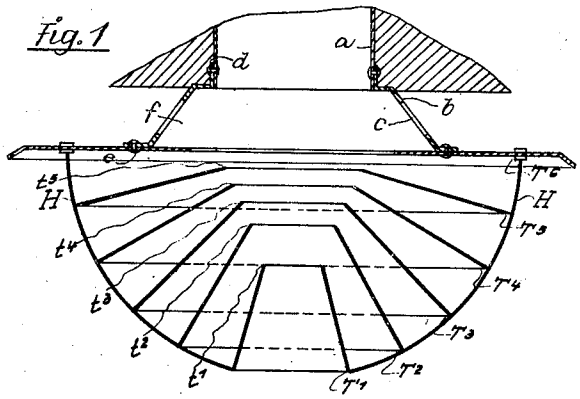


Fig. 2

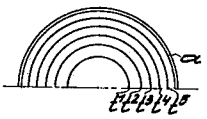


Fig. 3

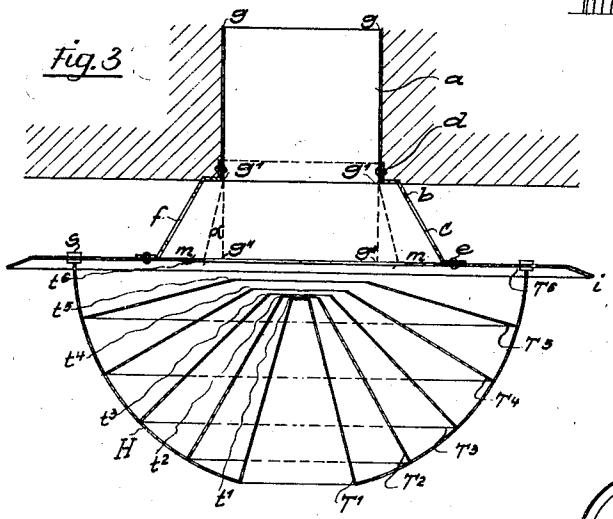


Fig. 4



Fig. 5

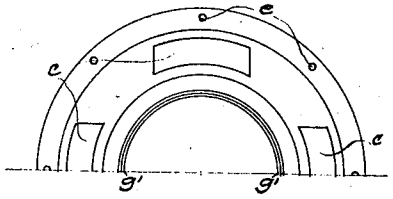
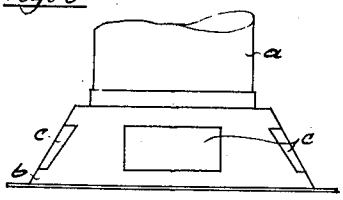


Fig. 6



Inventors:
Franz Josef Kurth
and Jost Sassenberg
By Alfred Thum Atty.

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AIR OR GAS DISTRIBUTING DEVICE

Franz Josef Kurth, London, England, and Jost Sassenberg, Cologne, Germany; said Sassenberg assignor to said Kurth

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8 Claims. (Cl. 98—40)

This invention relates to improvements in air or gas distributing devices.

Different kinds of devices are known for introducing air into a room without causing a draught and are intended to distribute the incoming air in all directions and simultaneously to reduce the energy of flow of the air current in order to prevent occupants of the room from experiencing any sensation of draught. The uniform distribution is secured by deflecting the current of incoming air or by dividing it into separate currents.

Among known air or gas distributing devices is one comprising a number of funnel-like members arranged one within another, but a uniform, draught-free distribution of the incoming air is not thereby necessarily ensured.

One object of the present invention is to provide a device of the character mentioned embodying a construction whereby a uniform distribution and a predetermined reduction in the velocity of the incoming air is obtained.

A perfectly uniform distribution of the incoming current of air is desirable in cases where the air distributor can be arranged at a sufficient height, or where the temperature of the incoming air corresponds approximately with that of the air in the room. If these two factors are not present it may often be desirable, for instance in the case of the ventilation of rooms with low ceilings such as ship's cabins or vehicles and/or when a certain temperature difference exists between the incoming air and the air of the room, to distribute the incoming air not uniformly but non-uniformly to avoid any sensation of draught.

A sensation of draught disturbs the feeling of comfort of the occupants of a room. The feeling of comfort also is disturbed if air which is cooler by a few degrees than that of a room is supplied thereto, even though perfectly uniformly, at a velocity of flow which would be imperceptible if the temperature of the incoming air and of the air in the room were the same, that is to say at a velocity such that it does not in itself constitute a draught. The air issuing from the distributor forms as it were around the distributor a layer of air which is increased by the continuously incoming air. When this air layer attains a certain size it sinks to the floor, being cooler and hence heavier than the air in the room. According to the magnitude of the temperature difference between the incoming air and the air in the room, this sinking of the cooler air takes place at a lower or a higher velocity. In the case of a low velocity and high rooms, the feeling of comfort is not disturbed because the incoming cooler and heavier air has sufficient time to mix with the air in the room. Disturbance of the feeling of comfort, however, occurs immediately in the case of low rooms and high velocities of fall of the cooler air and is then perceived as a draught.

In this case, a non-uniform, draught-free distribution of the incoming air is desirable, and another object of the invention is to provide a device embodying a construction whereby such a distribution of the incoming air can be obtained.

Also, according to the invention, mixing of the room air and of the incoming air takes place between the mouth of the inlet pipe and the distributor or within the distributor itself, in order to prevent the aforementioned disturbance of the feeling of comfort.

In the following description of the invention, the uniform distribution of the incoming air will be explained first. With this object in view the said air current is divided according to the invention into a number of concentric separate currents which are quantitatively equal to one another. If this division of the incoming air is effected by means of an air distributor of the type and arranged relatively to the air inlet in the manner hereinbefore described and the concentric separate currents are to be quantitatively absolutely equal to one another, the quantitatively equal division of the air flowing out of the air inlet conduit must take place where the current is divided into separate currents, that is to say, at the place where the air meets the inner ends of the funnel-like members. Accordingly, the inner ends of the funnel-like members are, according to one feature of the invention, of such dimensions and so arranged as to insure that substantially equal volumes of air are distributed through the passageways between the different members. This result is obtained due, on the one hand, by making the inner ends of the funnel-like members of such diameters that in the projection thereof upon a plane at right angles to the axis of said members the annular spaces formed therebetween are all equal in area, and, on the other hand, by so spacing the members axially that the planes of their inner ends are spaced progressively decreasing distances apart towards the inner end of the device.

With approximately the same temperature of the incoming air and of the air in the room, the sensation of draught does not occur if the velocity of the incoming air is reduced to below one meter air speed per second. It will be appreciated that

the velocity of the air leaving a distributor of the type set forth is determined by three factors namely the velocity of the air in the inlet conduit, the cross-sectional area of that conduit and the total area of the outlets from the distributor which distributor may be approximately spherical, hemispherical or a segment of a sphere in shape. According to another feature of the invention the aforesaid factors are such that the velocity of the air leaving the distributor is less than one meter per second.

If the air to be introduced is cooler than the air in the room, a sensation of draught may occur despite uniform distribution of the incoming air and a reduction of its velocity to below one meter per second. This can be prevented by distributing the incoming air non-uniformly. If the greater part of the incoming air is distributed towards the sides of the room and flows out from the inlet laterally and obliquely downwards it has to travel a greater distance before reaching the floor or the height of a person's head than if it is introduced into a room directly downwards, thus ensuring sufficient time for it to enter into such admixture with the air in the room as to be no longer perceived as a draught.

Accordingly the invention also includes a method of introducing a current of air flowing out of an air inlet conduit into a room in a draught-free manner, wherein the said air current is divided into a number of concentric separate currents which decrease quantitatively from the outer to the inner of said currents. In this case the inner edges of the funnel-like members of a distributor of the type set forth are of such dimensions and so arranged that, according to another feature of the invention, in the projection of said edges upon a plane at right angles to the axis of the distributor, the annular spaces formed therebetween are of different areas which diminish from the outer to the inner annular space. The areas of these spaces will depend upon the result which it is desired to obtain. For instance they may be such that the outer and largest annular space receives about 45 per cent of the incoming air, the next space about 25 per cent, the third about 15 per cent, the fourth about 10 per cent, the fifth about 4 per cent, and the sixth about 1 per cent, or even in certain cases as hereinafter explained no air at all.

The foregoing numerical relationship is given by way of example only and will vary according to the number of funnel-like members, which need not be six, and according to the shape of the distributor. If, for instance, only five funnel-like members are provided, the proportions may be about 60 per cent, 22 per cent, 12 per cent, 5 per cent and 1 per cent.

In order to prevent the occurrence of the sensation of draught in the case of incoming air which is cooler than the air in the room, the invention also contemplates mixing the incoming air and the room air between the mouth of the inlet conduit and an air distributor located in front of said mouth. This is effected according to the invention by disposing between the mouth of the inlet conduit and the distributor a connecting member having the form of a truncated hollow cone which projects wholly or partly into the room. The smaller end of the truncated cone is adjacent to the inlet conduit and is of larger diameter than the mouth of that conduit. Experience has shown that the air flowing out of a pipe or conduit always flows out as a conical stream the periphery of which is at an angle of about 15° with the axis of the pipe. Consequently a suction effect is produced in the space between the boundary of the outflowing air and the conical wall of the connecting member because as hereinbefore stated the smaller end of the connecting member is larger than the outlet of the conduit and the air issuing from the inlet conduit produces an injector effect. The conical wall of the connecting member is provided with one or more openings to permit the room air to flow through the said openings into the space aforesaid in the connecting member. This room air is carried along by and with the air issuing from the inlet conduit and is supplied to the distributor. The quantity of room air supplied to the distributor in this way, which air, due to its high temperature, increases the temperature of the incoming air after admixture therewith, is determined by the size of the openings provided in the connecting member and by the velocity of the air flowing out of the inlet conduit. If desired, means may be provided for adjusting the effective size of said openings.

In order to prevent air issuing from the distributor and particularly that of the outer air current from flowing back into the connecting member through the openings aforesaid therein, a deflector is provided to direct at least the said outer air current downwardly.

According to another feature of the invention, mixing of the incoming air and of the room air is effected within an air distributor located in front of the air inlet conduit. This method is carried out, according to the invention, by making the diameter of the inner end of the innermost funnel-like member so small that none of the air flowing out of the inlet conduit flows through that funnel-like member but flows laterally past it. Consequently air is drawn into said funnel-like member from the room and mixes within the distributor with the incoming air leaving the inlet conduit. This effect is enhanced if the inner end of the innermost funnel-like member is lower than that of the next adjacent funnel-like member as the innermost funnel-like member then has an injector effect.

For a more complete understanding of the invention two examples will now be described with reference to the accompanying drawing, in which:—

Figure 1 is a vertical section through a distributor of the type set forth whereby the incoming air current is divided into concentric quantitatively equal separate currents,

Figure 2 is a section through the inlet conduit of Figure 1 showing the inner ends of the funnel-like members,

Figure 3 is a vertical section through a distributor of the type set forth whereby the incoming air current is divided into concentric quantitatively unequal separate currents and a mixing of the incoming air with the room air is effected,

Figure 4 is a section through the inlet conduit of Figure 3 showing the inner ends of the funnel-like members,

Figure 5 is a plan of the connecting member shown in Figure 3, and

Figure 6 is an elevation of the connecting member.

Like reference characters indicate like parts throughout the drawing.

Referring first to Figures 1 and 2 an air inlet conduit *a* leads to an air distributor of the type set forth comprising five funnel-like members T^1 to T^5, and a flat annular plate T^6 dis-

posed with their axes in a common straight line. The air current issuing from the conduit *a* first strikes the inner edges t^1 to t^5 of the funnel-like members T^1 to T^5, and is there divided into concentric separate currents. As hereinbefore stated the inner edges of the said funnel-like members are of such diameters that in their projection upon a plane at right angles to the axis of the distributor the angular spaces formed thereby are equal in area. Moreover, the inner ends of said members are disposed in planes the distances between which progressively decrease towards the inner end of the device by amounts such that, taking into consideration the differences in diameters of the inner ends of the members and the fact that the velocity of the air stream decreases as it approaches the outer end of the device, substantially equal volumes of air pass into and through the passageways between the different members. Consequently, the concentric separate air currents are quantitatively equal.

The funnel-like members T^1 to T^5 are connected together by fixing bars H which are screwed or otherwise secured at S to the annular plate T^6.

The edge t^5 of the funnel-like member T^5 is also of such dimensions and so arranged relatively to the central opening in the annular ring T^6 that the air current passing between the member T^5 and the plate T^6 is quantitatively equal to the currents flowing through the other annular spaces in the distributor.

In the construction shown in Figures 3–6 inclusive, a connecting member *b* in the form of a hollow truncated cone is provided between the inlet conduit *a* and the air distributor. The said member is connected at *d* to the inlet conduit *a* and at *e* to the annular plate T^6 which is extended and bent downwardly at its outer edge to provide a deflector *i* for the purpose hereinbefore explained. Openings *c* are provided in the conical wall of the connecting member *b*. The inner end of the said conical wall is larger in diameter than the outlet of the inlet conduit *a*, and as the air flows out of said conduit a vacuum tends to form in the space *f* between the air current and said conical wall.

The air flowing out of the inlet conduit *a* does not flow in a continuous cylindrical stream from *g* through *g'* to *g''* but after leaving the inlet conduit flows out in a conical stream the periphery of which makes an angle of about 15° denoted by α with the bounding wall of the cylindrical part *g* to *g'* of the stream. Since, due to irregularities at *g'*, variations of several degrees are possible, it is preferable not to make the central opening in the annular plate T^6 of the same diameter as that of the conical air stream where it meets said annular plate as indicated at *l* but to make it of larger diameter as shown at *m*, in order that the air distributor may receive the whole of the incoming air current and to avoid the formation of eddies in the space *f*. The air flowing into the space *f* through the openings *c* mixes with the air issuing from the inlet conduit *a* and is supplied mixed with the said incoming air to the air distributor.

Experiments have shown that when the diameter of the opening in the smaller end of the innermost member T' is reduced to or is made less than a predetermined maximum, the air does not flow outwardly through said member. On the contrary, the air flowing around the outside of said member creates a suction effect therethrough with the result that air is drawn through said member in a direction counter to and mixed with the incoming air. In a device of the general form and of approximately the proportions shown, it has been ascertained that the greatest area the opening in the smaller end of the outermost member T' may have in order that a suction effect is created therethrough is approximately six per cent of the area of the air conduit *a*. However, this percentage may vary with the form and the size of the device. In any event, it is an established fact that a current of air flowing outwardly through the device creates a suction effect or an inward flow of air through the outermost member T' when the diameter of the opening in the smaller end of said member is reduced to or below a predetermined maximum. It has also been ascertained in this connection that the best effect is obtained when the inner end of the innermost member T' is disposed approximately in the plane of the inner end of the next adjacent member or, as aforesaid, slightly below the plane of the inner end of said next adjacent member.

The invention is not restricted to the precise constructional details described as changes can be made therein without departing from the invention.

Having fully described our invention, what we claim as new, and desire to secure by Letters Patent, is—

1. A device of the character described comprising a series of successively larger outwardly flaring truncated hollow members open at their ends and all having their smaller ends facing the inner end of the device, said members being disposed in nested spaced relationship to provide a series of outwardly flaring air or gas passages therebetween, the inner ends of the successively larger members all being disposed in planes the distances between which progressively decrease toward the inner end of the device, and the diameters of the inner ends of the successively larger members progressively increasing.

2. In combination, an air or gas distributor comprising a series of outwardly flaring truncated hollow members open at their ends and all having their smaller ends facing the inner end of the distributor, said members being disposed to provide a series of outwardly flaring air or gas passages therebetween, and a hollow substantially frustro-conical casing at the inner end of said distributor having its larger end facing outwardly, said casing providing a chamber into which air or gas is to be introduced axially through the smaller inner end thereof, said casing being disposed with its larger open end in air or gas discharging relationship into the inner ends of the passageways of the distributor, the side wall of said casing being apertured so that air or gas flowing through the casing draws air or gas surrounding the casing into the same for admixture with the air or gas flowing therethrough.

3. In combination, an air or gas distributor comprising a series of outwardly flaring truncated hollow members open at their ends and all having their smaller inner ends facing the inner end of the distributor, said members being disposed to provide a series of outwardly flaring air or gas passages therebetween, the inner ends of said members being of progressively increasing diameter toward the inner end of the distributor, and a hollow substantially frustro-conical casing at the inner end of said distributor having its larger end facing outwardly, said casing pro-

viding a chamber into which air or gas is to be introduced axially through the smaller inner end thereof, said casing being disposed with its larger open end in air or gas discharging relationship into the inner ends of the passageways of the distributor, the opening in the outer larger end of said casing being of greater diameter than the opening in the inner end of the formation whose inner end is of the greatest diameter, and the side wall of said casing being apertured so that air or gas flowing through the casing draws air or gas surrounding the casing into the same for admixture with the air or gas flowing therethrough.

4. In combination, an air or gas distributor comprising a series of outwardly flaring truncated hollow members open at their ends and all having their smaller inner ends facing the inner end of the distributor, said members being disposed to provide a series of outwardly flaring air or gas passages therebetween, and a hollow substantially frustro-conical casing at the inner end of said distributor having its larger end facing outwardly and providing a chamber into which air or gas is to be introduced axially through the smaller inner end thereof, said casing being disposed with its larger open end in air or gas discharging relationship into the inner ends of the passageways of the distributor, the smaller inner end of the casing being partially closed and the air or gas inlet opening therein being of less diameter than the diameter of the adjacent end portion of the casing, and the side wall of said casing being apertured so that air or gas flowing through the casing draws air or gas surrounding the casing into the same for admixture with the air or gas flowing therethrough.

5. The combination as set forth in claim 3 in which the smaller inner end of the casing is partially closed and in which the diameter of the air or gas inlet opening in said end is of less diameter than the diameter of the adjacent end portion of the casing.

6. The combination as set forth in claim 2 in which a baffle plate extends laterally outward from the inner end of the distributor.

7. The combination as set forth in claim 3 in which a baffle plate extends laterally outward from the inner end of the distributor.

8. The combination as set forth in claim 4 in which a baffle plate extends laterally outward from the inner end of the distributor.

FRANZ JOSEF KURTH.
JOST SASSENBERG.