May 9, 1967 H. R. BOHANON 3,318,224

VENTILATING AND CIRCULATING AIR SYSTEM TUBE HANGER

Filed Oct. 18, 1966

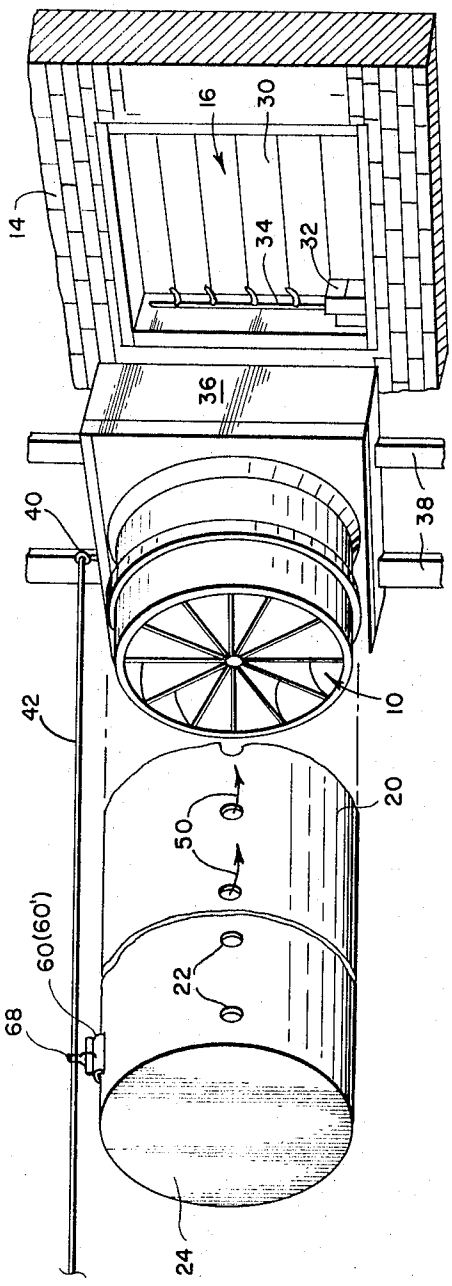

FIG. 1

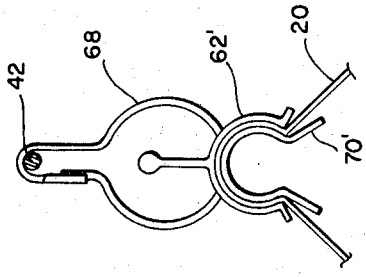

FIG. 5

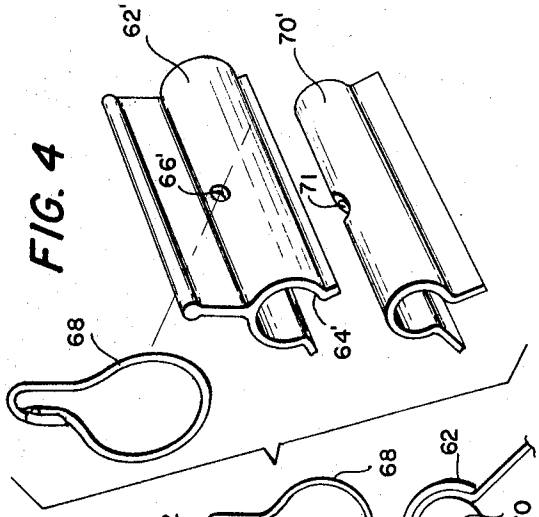

FIG. 4

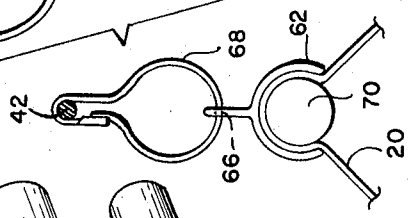

FIG. 3

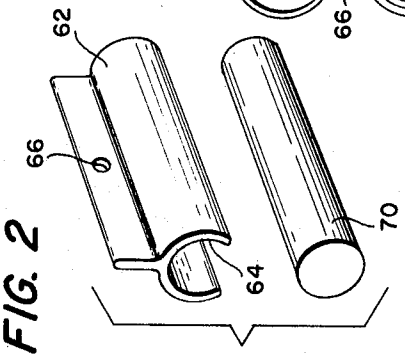

FIG. 2

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VENTILATING AND CIRCULATING AIR SYSTEM TUBE HANGER

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ABSTRACT OF THE DISCLOSURE

Clip assemblies for suspending flexible material, particularly flexible ducting.

Cross-reference to related application

The present application is a continuation-in-part of application Ser. No. 526,562, filed February 10, 1966, and entitled Ventilating and Circulating Air System.

Background of the invention

A need exists to enable flexible materials, particularly plastics, to be suspended without depending primarily on friction or the puncturing of material while minimizing stress concentration. In the present environment, it is desired to suspend a plastic air distribution tube from a wire support with the use of a simple clip assembly.

Summary of the invention

The present invention relates generally to a ventilating and circulating air system permitting small jets of air to be evenly distributed throughout an enclosed space. More particularly, the present invention concerns low cost flexible ducting and novel clip assemblies for suspending same. With the present invention, the flexible plastic ducting material may be suspended without depending primarily on friction or the puncturing of material. Also, stress concentration is minimized. More specifically, the plastic air distribution tube is suspended from a wire support with the use of clip assemblies having components which are capable of being either slid together endwise or snapped in place, while resisting sliding during use.

Description of the drawings

FIG. 1 is a perspective view of the ventilating and circulating air system illustrating in particular the flexible ducting and system for suspending same from wire support;

FIG. 2 is a perspective view of the components of a first embodiment clip assembly;

FIG. 3 is an end view of assembled first embodiment clip components;

FIG. 4 is a perspective view of the components of a second embodiment clip assembly; and

FIG. 5 is an end view of assembled second embodiment clip components.

Description of the preferred embodiments

The ventilating and circulating system of the present invention is illustrated in FIG. 1 and consists generally of a distribution fan **10** mounted inside a building and spaced a predetermined distance from wall **14** which contains air inlet shutter **1**. The discharge of distribution fan **10** is connected to a long tube **20** which contains spaced openings **22** along the entire extent thereof. End **24** of tube **20** is closed and, normally, tube **20** extends the entire lentgh of building. A ventilating fan (not shown) is mounted in another wall of the building for discharging air to the outside.

More specifically, motorized shutter **16** contains a plurality of balanced blades **30** operable by motor **32** through actuating rod **34** in conventional manner.

Distribution fan **10** is supported or suspended from the building with any conventional structure which may, for example, include a frame **36** supported by vertical members **38**. At the top of frame **36** is located a ring **40** to which wire **42** is attached for supporting tube **20** with clip assembly **60**, described in detail hereinafter. Of course, the other end of wire **42** is attached to appropriate building structure.

The actuation of the ventilating fan (not shown) and motor **32** of shutter **16** may, if desired, be controlled by either thermostat of humidistat.

During the ventilating mode of operation, both distribution fan **10** and the ventilating fan are running while shutter **16** is in open position. Thus, the ventilating fan removes air from the building and creates a slight vacuum therein. Outside air, being at a slightly higher pressure, enters into the building through shutter **16**. Since distribution fan **10** is located immediately in front of the opening defined by shutter **16**, fresh outdoor air is picked up and discharged into tube **20**. Subsequently, outdoor fresh air is discharged within the interior of the building through openings **22** in the surface of tube **20** throughout the entire length of building. The resulting small air jets **50** are well mixed with the air inside the building by turbulent mixing and a very uniform condition exists throughout. When the house temperature reaches the maximum desired, usually on a sunny day, automatic control of the ventilating fan and shutter **16** may be achieved by thermostat or humidistat control. The slight vacuum created in the house causes the fresh cool outdoor air to rush in through inlet shutter **16** and "jump the gap" right into the continuously-running distribution fan **10** and discharge uniformly through openings **22** and thoroughly mix with the warm air. When the desired temperature and/or humidity conditions have been reached, the ventilating fan and shutter **16** may be turned off and the recirculation and uniform air movement process permitted to continue.

In the circulating mode of operation, the ventilating fan is inoperative and shutter **16** is closed. Only distribution fan **10** is running to pull air from within the building through the space between distribution fan **10** and shutter **16** into the inlet of distribution fan **10**. In this manner, indoor air is discharged into distribution tube **20** and blown back into the building through the small openings **22** in the surface of tube **20**. The resultant turbulence and mixing will again promote uniform conditions within the building.

Tube **20** can be made of virtually any material, either rigid or flexible. However, cost factors dictate tube **20** be made of thin film plastic. Thus, as tube **20** is non-rigid, the air pressure from distribution fan **10** holds it in its contemplated configuration. Of course, when tube **20** is made of flexible material it hangs limp when not operative.

The number and size of openings **22** along the surface of tube **20** is also important as this determined how far each individual jet **50** will penetrate into the relatively quiet room air and thus how much area each tube will cover. Experimentation indicates that from two to three inches is the proper diameter of opening **22**. The spacing between openings **22** must be such that the total or aggregate area of opening **22** has the proper relationship to cross-section area and length of tube **20** and fan capacity. For tubes which are less than 100 diameters long, the ratio of total area to tube cross-sectional area should range from 1.0 to 1.5 for most fans. The pressure distribution in tube **20** is such that the pressure at the closed end **24** is more than the end adjacent distribu-

tion fan **10**. If this ratio is too great, there is danger that the pressure at the fan end will go below room pressure causing reverse flow through openings **22** or collapse of tube **20** when made of flexible material. On the other hand, if the total opening area is too small, it will restrict the flow of distribution fan **10** and reduce significantly the performance of the system as a whole. While the location of openings **22** is important, and varies somewhat with each application, for most instances a location within 30 degrees of the horizontal centerline of tube **20** is preferred.

As will now be apparent, when tube **20** is made of flexible plastic, fasteners for supporting the material from wire **42** must be provided which do not depend primarily on either friction or the puncturing of material. That is, friction is not reliable and a puncture within tubing **20** will start a tear reducing the material strength drastically. Finally, it is necessary that a relatively large area of tube material **20** be held in order to distribute the stresses into the material without excessive stress concentration.

The clip assemblies of the present invention meet the aforementioned objectives and hold the flexible material of tube **20** by means of the mechanics of their geometry.

In the first embodiment clip assembly **60** of FIGS. 2–3, the reference numeral **62** designates an outside piece or holder having a partially-open slot **64** along one edge thereof and an opening **66** on the other side thereof through which hook **68** passes. Of course, the other end of hook **68** is attached to wire **42**. Retainer member **70** is designed to fit within slot **64** of holder **62** with the flexible material of tube **20** wrapped around it (FIG. 3).

The first embodiment clip assembly **60** is assembled together either by sliding holder **62** and retainer **70** together axially, or by snapping these parts together, this being possible because of the resilient material of which holder **62** and retainer **70** are made. However, the pressure must not be so great as to damage tube material **20** or so small as not to adequately secure it.

For some flexible materials, axial restraint is necessary to prevent the two pieces from sliding apart during use. This can be accomplished by deforming the ends of either holder **62** or retainer **70** to prevent axial movement. Alternatively, as illustrated in the second embodiment clip assembly **60'** of FIGS. 4–5, the retainer **70'** may include a notch **71** located in the top thereof. In this embodiment, notch **66'** is located within the curvilinear walls of holder **62'**. As will now be apparent, as retainer **70'** is slid or snapped in place within slot **64'** of holder **62'** and hook **68** inserted within opening **66'** of holder **62'** and notch **71** of retainer **70'**, axial movement of the clip components is precluded.

Installation of plastic tube **20** is accomplished by inserting wire snap hooks **68** within openings **66(66')** of holders **62(62')**. Then, the plastic tubing **20** is unrolled and selected portions along top dead center inserted between holders **62(62')** and retainers **70(70')**. This is accomplished by inserting retainers **70(70')** through the punched openings in tube **20** and sliding to selected positions along top dead center. Then, holders **62(62')** are positioned flush with the ends of retainers **70(70')** and the components slid or snapped together. By holding holders **62(62')** at a slight angle to retainers **70(70')**, the components are more easily assembled. Also, by rotating retainers **70(70')** one-quarter turn such that their two edges rest on a flat work surface, holders **62(62')** are more easily snapped over retainers **70(70')**. Finally, resilient hooks **68** are inserted over wire **42**.

Disassembly is accomplished simply by removing hooks **68** from holders **62(62')** after which holders **62(62')** and retainers **70(70')** are separated.

It is recommended that clips **60(60')** be spaced approximately ten feet apart for 18 inch diameter tubing **20**, eight feet apart for 24 inch diameter tubing **20**, and six feet apart for 30 inch diameter tubing **20**.

Manifestly, variation and rearrangement of component parts may be envisioned without departing from the spirit and scope of invention, as defined in the subjoined claims.

I claim:

1. In a ventilating and circulating system including a shutter assembly mounted within a wall of a building and a fan having an intake portion located a pre-determined space from said shutter assembly, the combination with said shutter assembly and said fan of a tube assembly connected to the discharge of said fan, said tube assembly being made of non-rigid material permitting air pressure from said fan to hold said tube in its contemplated shape during use, said tube assembly further including a plurality of continually-spaced openings of predetermined size along the extent thereof, a supporting member located above said tube and at least one clip assembly suspending said tube from said supporting member.

2. A ventilating and circulating air system as in claim **1**, wherein said clip assembly includes a first holding member and a second retaining member between which is located a portion of said tube assembly, the surfaces of said retaining and holding members in contact with said tube assembly being complementary in configuration.

3. A ventilating and circulating air system as in claim **2**, wherein said surface of said holding member in contact with said tube is formed as a slot having a lower opening of width less than the width of other portions of said slot permitting said retaining member to be slid within said slot.

4. A ventilating and circulating air system as in claim **3**, wherein said clip assembly includes hook means attached at one end to said supporting member and passing at the other end through an opening in the top of said holding member.

5. A ventilating and circulating air system as in claim **4**, wherein said clip assembly includes means precluding said retaining member from sliding relative to said holding member after said tube assembly is positioned therebetween.

6. A ventilating and circulating air system as in claim **5** wherein said means precluding relative sliding is a slot located near the top of said retaining member and in juxtaposition with respect to said opening in the top of said holder such that said hook means when passing through said opening in the top of said holding member is wedged within said slot of said retaining member thus precluding sliding of said retaining member within said holding member.

7. A clip assembly for suspending a flexible material from a support, comprising:

(A) a holding member having a slotted portion with a generally concave surface, said holding member being made of a flexible material;

(B) a retaining member having a generally convex surface complementary in configuration with respect to said slotted portion of said holding member such that said retaining member can be snapped in place or slid within said slotted portion of said holding member, the flexible material being located between said concave and convex surfaces;

(C) hook means suspending said holding member from the support; and

(D) means including said hook means for precluding sliding of said retaining member within said slotted portion of said holding member after said flexible material is positioned therebetween.

8. A clip assembly for suspending a flexible material from a support, comprising:

(A) a holding member having a slotted portion with a generally concave surface and wherein the slotted portion of the holding member terminates downwardly in an opening of width less than the width

of other portions of the slot, and the holding member is of flexible material;

(B) a retaining member having a generally convex surface complementary in configuration with respect to said slotted portion of said holding member, the flexible material being located between said concave and convex surfaces, and the retaining member is of flexible material;

(C) hook means suspending said holding member from the support;

(D) means precluding sliding of said retaining member within said slotted portion of said holding member after said flexible material is positioned therebetween; and

(E) wherein said means precluding sliding of said retaining member within said slotted portion of said holding member is a slot located near the top of said retaining member and in juxtaposition with respect to an opening located in the top of said holder such that said hook means when passing through said opening in the top of said holding member is wedged within said slot of said retaining member thus precluding sliding of said retaining member within said holding member.

9. A clip assembly as in claim 7, wherein said means precluding sliding of said retaining member is formed as an integral part of said retaining member and operates in conjunction with said hook means and said holding member to provide mechanical interference.

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