April 29, 1969 D. M. FRAIOLI 3,440,776

AIR DELIVERY APPARATUS FOR AIR SUPPORTED STRUCTURES

Filed Nov. 2, 1967 Sheet 1 of 3

FIG. 1

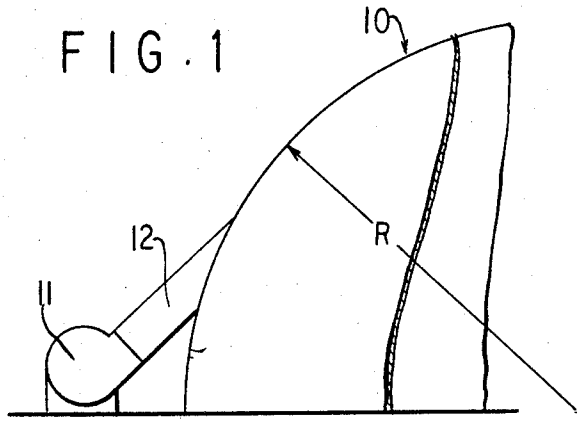


FIG. 2

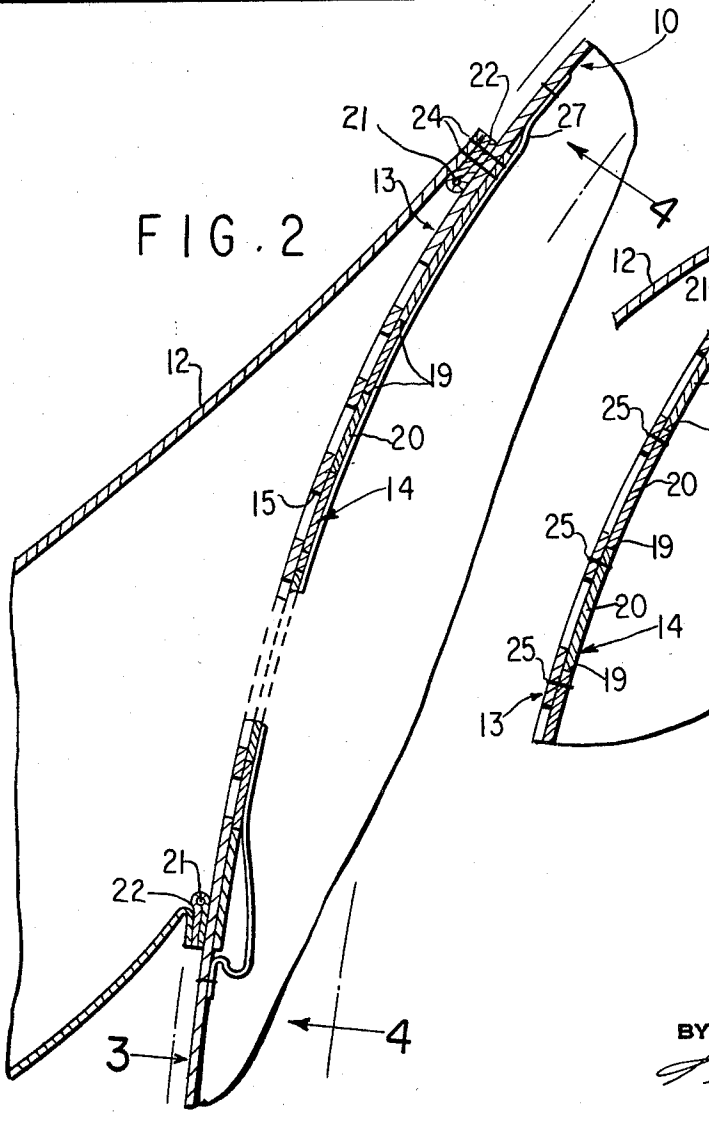
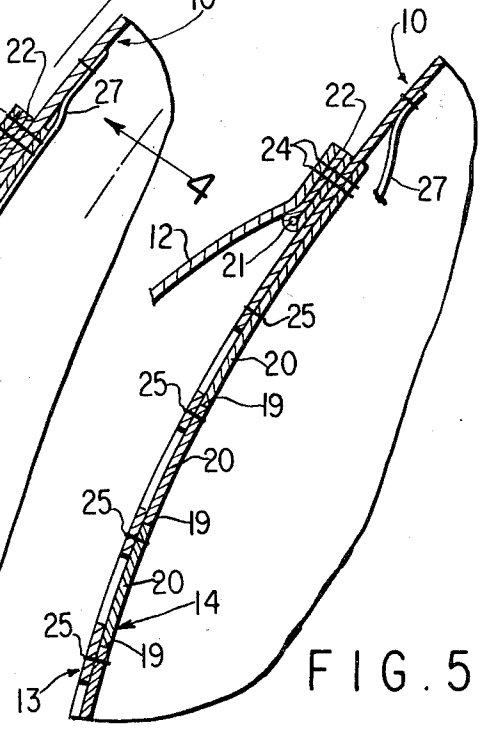


FIG. 5



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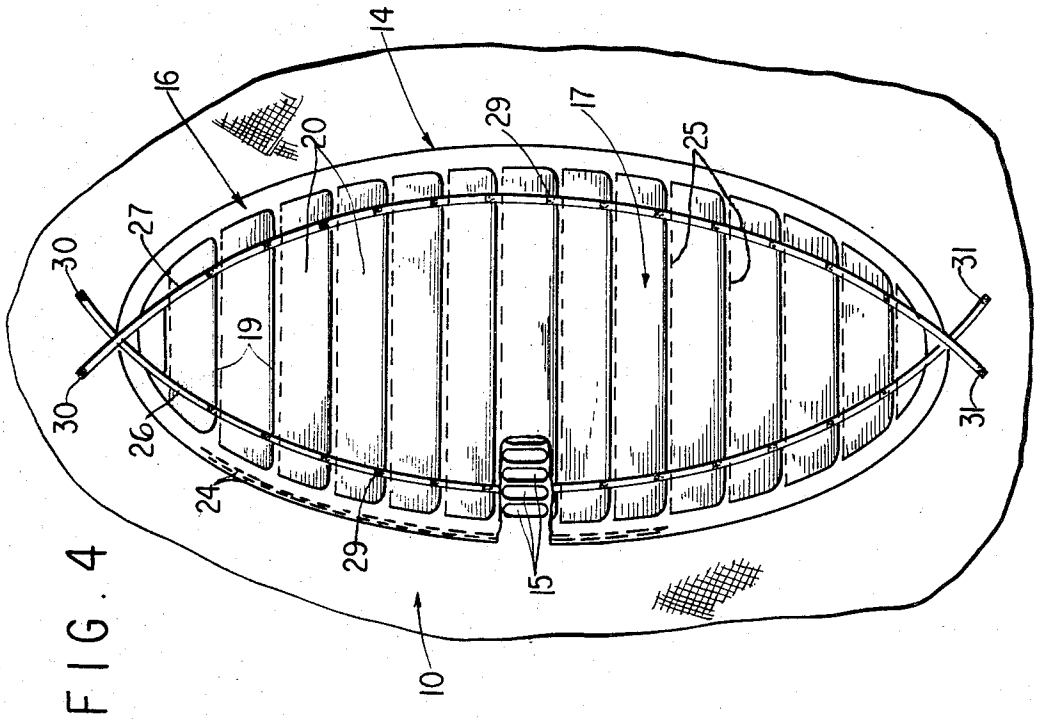


FIG. 4

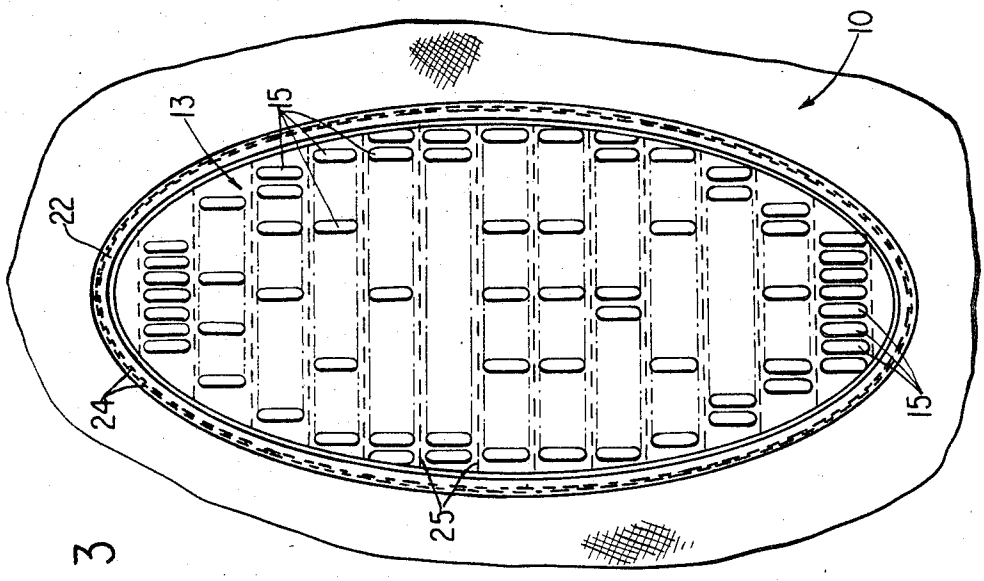


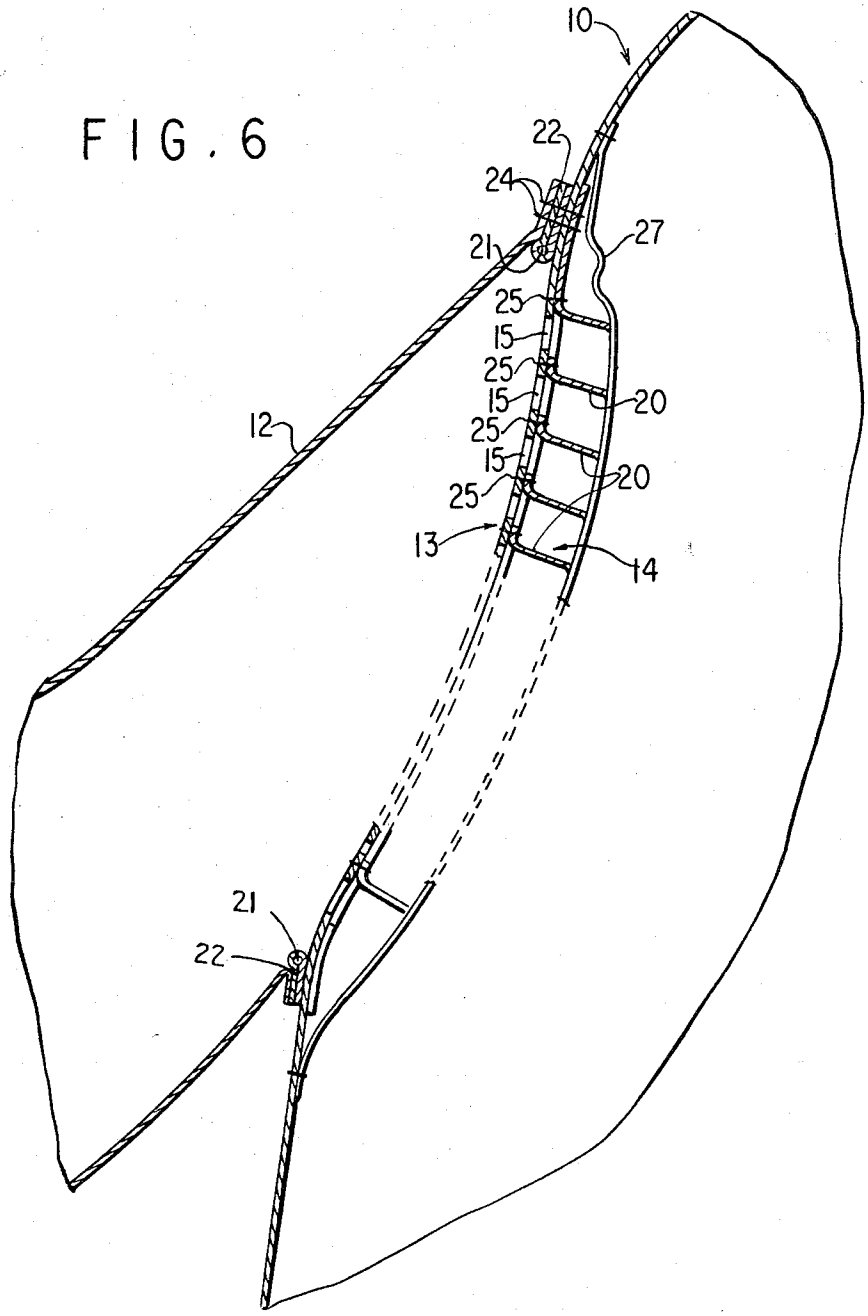
FIG. 3

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FIG. 6



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AIR DELIVERY APPARATUS FOR AIR SUPPORTED STRUCTURES

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Int. Cl. E04b 1/34; F16l 5/00
U.S. Cl. 52—2 6 Claims

ABSTRACT OF THE DISCLOSURE

Air delivery apparatus for an air supported structure wherein a cylindrical air delivery tube intersects the wall of the structure at an angle including an elliptical perforated air inlet zone in the structure for restricting the air flow into the structure to increase the useful life of the fabric air delivery tube and also including a fabric louvered panel sewn to the inner surface of the inlet zone to prevent loss of air from the structure when air delivery through the fabric tube is terminated.

BACKGROUND OF THE INVENTION

Field of the invention

The present invention relates to air supported structures of the type formed of a shell of flexible sheet material supported by above atmospheric pressure within the structure wherein the pressurizing air is delivered to the interior of the structure through a tube of flexible material.

Description of the prior art

Air supported structures of the foregoing type are generally made in the form of hemispheres, or horizontally oriented semi-cylinders, or a combination of these shapes. The walls of such structures are generally vertical where they meet the ground and arch upwardly and inwardly from there. Structures of this type are normally inflated by means of an electrically driven blower positioned on the ground outside of the structure and connected to the structure through an air delivery tube. Two blowers and air delivery tubes are normally provided. Both of these are used to initially inflate the structure and to maintain the pressure in the building during periods when the doors of the building are in use. When the doors of the building are locked, for example during the night, one blower is used to maintain the internal pressure while the second serves as a standby in case of trouble.

In the earlier structures, the air delivery tube was normally of light gauge metal and was positioned parallel with the ground so that it entered an opening in the lower portion of the structure and the air flow was directed along the ground within the structure. This arrangement was found to be unsatisfactory. The drafts created caused discomfort to personnel working in the structure and care had to be taken not to block the opening when storing goods within the structure.

It then became become practice to extend the air delivery tube upwardly at angle of about 45 degrees with the horizontal so that the air entered the structure at a higher portion thereof and was directed toward the ceiling of the structure. This arrangement requires the use of a longer delivery tube which must be supported at one end by the fabric shell of the structure. Because of the weight factor, it became common practice to use fabric air delivery tubes.

The fabric used for the delivery tubes was the same as that used for the shell of the structure, that is, nylon coated with a plastic such as vinyl resin or neoprene. Although the structures had a useful life of ten years or more, the air delivery tubes deteriorated in one year.

Another disadvantage of air delivery apparatus used in the past was that air within the structure could flow out through a non-operating blower unless manually operated doors at the outlet of the blowers were closed. In the past, it had been found that the need for closing these manually operated doors wes frequently forgotten when locking the building for the night. As a result the air within the building would rush out through the non-operating blower at a rate greater than could be handled by the one operating blower. Thus, in the morning the building would be completely deflated.

The manually operated blower doors have still another disadvantage. In the event an electrical power interruption occurred, causing the blowers to stop functioning, the air in the building would rush out through the now non-operating blowers and allow the structure to collapse in a very short time. Even if personnel were on hand to close the blower doors, a great deal of the internal pressure would be lost before this operation could be completed, and the building could collapse before repairs could be made or an auxiliary power source could be brought into operation.

Still another disadvantage of air delivery apparatus used in the past was that the air inlet openings were completely unobstructed and rubbish such as coffee containers and soda cans were frequently tossed into these openings. This rubbish rolled down the air delivery tube into the blower and in time interferred with or prevented operation of the blower.

SUMMARY

Accordingly, an object of the present invention is to provide air delivery apparatus for air supported structures which is not subject to the foregoing difficulty.

Another object is to provide such apparatus which extends the useful life of a fabric air delivery tube.

Another object is to provide such apparatus which minimizes air loss from the structure.

Another object is to provide such apparatus which is protected against clogging and damage.

Another object is to provide such apparatus which directs a quite diffused flow of air into the structure.

Other and further objects of the invention will be obvious upon an understanding of the illustrative embodiment about to be described, or will be indicated in the appended claims, and various advantages not referred to herein will occur to one skilled in the art upon employment of the invention in practice.

In accordance with the present invention the foregoing objects are generally accomplished by providing improved air delivery apparatus for an air supported structure including a generally arcuate shell formed of flexible sheet material and supported by above atmospheric air pressure within the structure, the air delivery apparatus comprising in combination means in the shell providing an inlet zone for admitting pressurized air, air pump means positioned outside of the shell, an air delivery tube of a flexible sheet material capable of being adversely effected by vibration during use extending from the air pump means to the inlet zone and terminating at the shell, the outer periphery of the inlet zone being defined by the intersection of the tube and the shell with the tube meeting the shell at an angle so that the inlet zone is of substantially larger area than the cross-sectional area of the tube, the inlet zone being provided with a plurality of perforations having a total area smaller than the area of the zone to an extent whereby vibration of the tube is prevented.

BRIEF DESCRIPTION OF THE DRAWINGS

A preferred embodiment of the invention has been chosen for the purpose of illustration and description, and

is shown in the accompanying drawings, forming a part of the specification, wherein:

FIG. 1 is a partial exterior end view of an air supported structure showing a blower and fabric duct for pressurizing the interior of the structure.

FIG. 2 is a longitudinal sectional view of the portion of the air delivery apparatus present at the junction of the fabric duct and the structure, illustrating the condition of that portion of the apparatus when the blower is not operating.

FIG. 3 is a view taken along the line 3—3 on FIG. 2 illustrating the perforated inlet zone at the junction of the duct and the structure.

FIG. 4 is a view taken along the line 4—4 on FIG. 2 illustrating the louvered panel at the junction of the duct and the structure.

FIG. 5 is an enlargement view of a portion of FIG. 2 illustrating the manner in which the perforated inlet zone and the louvered panel are stitched together.

FIG. 6 is a view similar to FIG. 2 illustrating the condition of the portion of the junction of the duct and the structure when the blower is operating.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings in detail, there is shown a generally semi-cylindrical structure having generally hemispherical ends and being formed of a thin fabric shell **10** having a radius R and supported by air pressure in the interior of the structure, and an air supply system for maintaining the air pressure within the structure at a value in excess of the ambient atmospheric pressure. The shell is made of plastic coated nylon fabric.

The air supply system normally includes two identical air delivery apparatus positioned side-by-side, only one of which is shown in the drawings. Each air delivery apparatus generally comprises a motor driven blower **11** positioned on the ground outside of the structure, a circular air delivery tube **12** connecting the blower and the structure, a perforated inlet zone **13** in the shell **10**, and a louvered panel **14** at the inlet zone **13**.

The tube **12** extends from the blower outlet upwardly at an angle of about forty-five degrees with the horizontal to join the fabric shell of the structure at an angle of about thirty degrees. The peripheral line defined by the junction of the tube **12** and the shell **10** is elliptical and defines the outer periphery of the zone **13**. The tube is made of the same plastic coated nylon fabric as the shell.

The elliptical perforated zone **13**, as best shown in FIG. 3, is provided with a large number of elongated holes or slots **15** arranged in horizontally extending rows.

The louvered panel **14** is made of the same plastic coated nylon fabric as the tube **12** and the shell **10**. As best shown in FIG. 4, the panel **14** is formed with an edge portion **16** and an elliptical inner portion **17** which is cut along generally U shaped lines **19** to produce a series of horizontally oriented flaps **20** one above another. Each of these flaps **20** is dimensioned to cover one horizontal row of the slots **15**.

Between the shell **10** and the end of the tube **12** there is provided a strain relieving cable **21** positioned within a fabric pocket **22** provided along the periphery of the inlet zone **13**. The tube **12**, the pocket **22**, the shell **10**, and the panel **14** are sewn together in a single operation by stitching along lines **24**.

The panel **14** is also sewn to the area of the zone **13** by stitching along horizontal lines **25** shown in FIGS. 3, 4, 5 and 6. The stitch lines **25** are positioned between the rows of slots **21** and form hinge lines of the flaps **20** as shown in FIG. 6.

On the inside of the structure, two strips of webbing **26, 27** extend generally vertically along the sides of the flaps **20** of the louvered panel **14**. The webbing strips are sewn to the bottom edge of each of the flaps **20** at points **29**, and the top and bottom ends of each of these strips are sewn to the shell **10** at points **30** above the panel **14** and points **31** below the panel **14** to cause all of the flaps to move in unison.

In operation, the structure is initially erected by operating both of the blowers to force air through the fabric tubes **12** into the structure. As the pressure within the structure increases, the back pressure on the blowers causes them to slow down. An equilibrium is achieved between the volume of air supplied by the blowers and the volume of air that flows out of the building through the porous fabric, as the pressure within the building reaches about one inch of water (.036 pound per square inch). Each time one of the doors of the building is used, a quantity of air is lost reducing the internal pressure within the building. The blowers then speed up, due to the reduction in back pressure, and the building is quickly brought back to the equilibrium pressure.

In the prior art structure, wherein the air delivery tube met the shell at substantially the same angle, it was discovered that the short life of the tube fabric was due to vibrations or pulsations set up in the tube when the blower was operating.

The vibrations caused the plastic coating on the threads of the nylon fabric to crack and thus expose the nylon fabric to the deteriorating effects of the ultra-violet rays of the sun. It was further discovered that the vibrations in the fabric were caused by oscillations set up in the air flow as it passed from the circular tube through the elliptical opening of substantially larger area into the interior of the structure. The oscillations in the air flow produced pressure oscillations causing the walls of the tube, particularly in the area of the junction of the tube and the shell, to pulsate in and out. After a period of time, this flexing of the tube walls fatigued the plastic coating causing it to crack.

In the air delivery apparatus of the present invention, when the blower **11** is operating the air flows from the tube **12** into the structure through the holes **15** in the perforated zone **13**. The perforated zone **13** prevents pulsations in the fabric tube **12** by restricting the rate of flow into the structure from the tube and thereby maintaining the pressure throughout the length of the tube **12** at a value greater than the pressure within the shell **10**. The holes **15** in the zone **13** have aggregate area substantially equal to that of the circular tube **12** and the perforated zone **13** acts as a restriction to the flow of air from the tube **12** into the shell, wherefore a substantial pressure is built up in the tube and maintains the walls thereof taut.

While the blower **11** is operating, the air flowing through the holes **15** lift the fabric flaps **20** in the louvered panel **14** as shown in FIG. 6 and air flows freely into the structure. The webbing strips **26** and **27** cause all the flaps **20** to operate in unison to eliminate any tendency which some of the flaps **20** may have to flap noisily.

When the blower **11** is not operating the pressure within the structure is greater than that in the tube **12** and the flaps **20** of the louvered panel **14** are held against the perforated panel (as shown in FIGS. 2, 4, and 5) by the pressure within the structure. The panel **14** thus automatically and effectively seals the slots in the perforated zone **13** to prevent air flow from the interior of the structure through the tube **12** and the blower **11** to the atmosphere.

The presence of the perforated zone **13** and the panel **14** also substantially eliminates the problem of rubbish being tossed into the air inlet openings from inside the structure.

When the structure is inflated, the shell **10** is tensioned. The cable **21** within the pocket **22** is positioned around the zone **13** to relieve the zone (which is weakened by the slots **15**) of the tension forces within the shell.

In a typical building wherein the radius R is thirty feet, the circular tube **12** has a diameter of about three feet, the ellipse formed by the intersection of the tube

and the shell extends about six feet along its major axis, the bottom edge of this ellipse is five feet, six inches above ground level, the perforated zone **13** is provided with 195 slots arranged in thirteen rows, the aggregate area of the holes **21** is approximately equal to the cross-sectional area of the circular tube **12**, the panel **14** is provided with thirteen flaps **20** each of which cover one row of the slots **15**.

It will be seen that the present invention provides air delivery apparatus for an air supported structure which greatly extends the useful life of the fabric air delivery tube, minimizes the loss of air from the structure, provides a quiet diffused flow into the structure, and is protected against clogging and damage.

I claim:

1. Improved air delivery apparatus for an air supported structure including a generally arcuate shell formed of flexible sheet material and supported by above atmospheric air pressure within the structure, said air delivery apparatus comprising in combination means in said shell providing an inlet zone for admitting pressurized air, air pump means positioned outside of said shell, an air delivery tube of a flexible material capable of being adversely effected by vibration during use extending from said air pump means to said inlet zone and terminating at said shell, the outer periphery of the inlet zone being defined by the intersection of said tube and said shell, said tube meeting said shell at an angle so that said inlet opening is of substantially larger area than the cross-sectional area of said tube, said inlet zone being provided with a plurality of perforations having a total area smaller than the area of said zone to an extent sufficient to cause a pressure to build up within the entire length of the tube to prevent vibration of the tube material.

2. Apparaus according to claim **1**, wherein said tube is of circular cross-section and said inlet zone is elliptical.

3. Apparatus according to claim **2**, wherein said perforations in said inlet zone have a total area about equal to the cross-sectional area of said tube, and means on said inlet zone for sealing said perforations in response to the pressure within said shell when said blower is not operating.

4. Apparatus according to claim **1**, including a fabric panel co-extensive with said inlet zone and positioned against the inner surface of said inlet zone, said panel being cut along lines to form a plurality of movable flaps for covering and sealing said perforations in response to the pressure within said shell when said blower is not operating.

5. Apparatus according to claim **4**, wherein said perforations in said inlet zone are arranged in horizontal rows and said panel is stitched to said inlet zone along lines between said rows, said cut lines in said panel being positioned so that said stitching provides hinges at the upper edge of said flaps.

6. Apparatus according to claim **5**, including at least one vertically oriented strip extending along the inner surface of said panel and attached to the lower edge of each of said flaps to cause said flaps to operate in unison.

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U.S. Cl. X.R.

137—357; 138—40