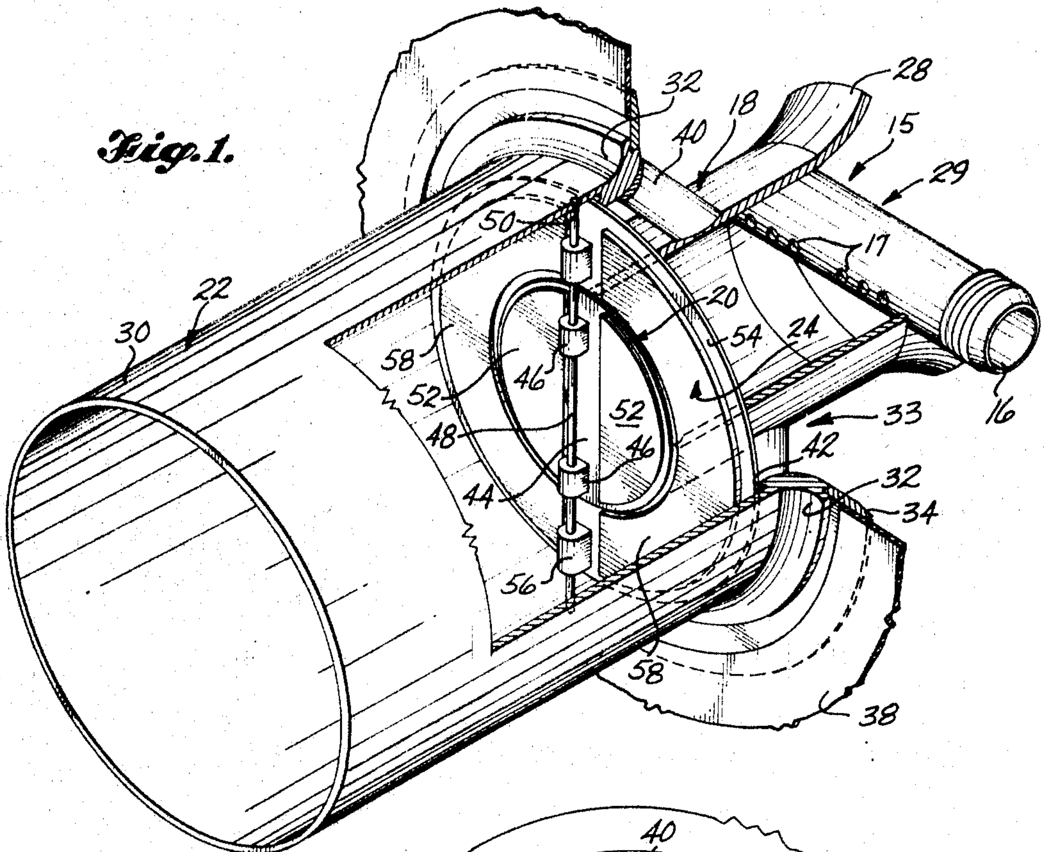
Aug. 12, 1969 C. J. GREEN ET AL 3,460,746

TWO-STAGE INFLATION ASPIRATOR

Filed Oct. 27, 1967 5 Sheets-Sheet 1

Fig. 1.



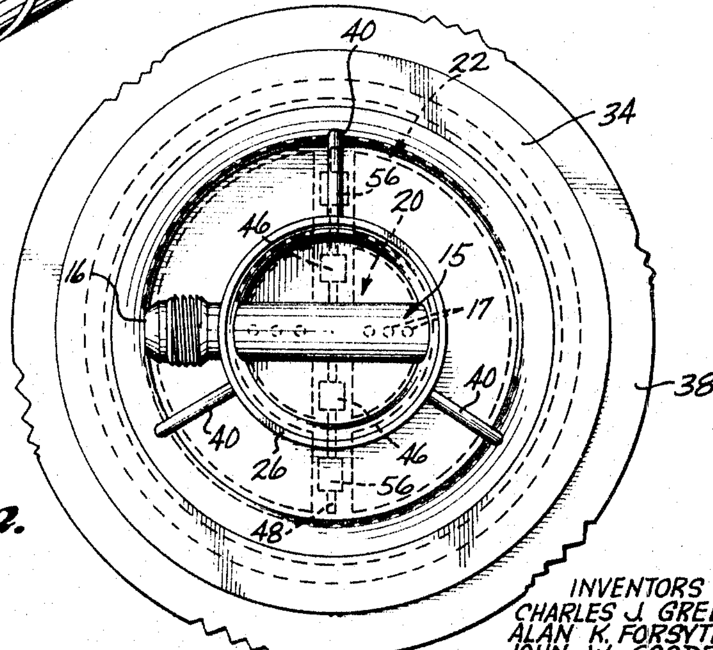


Fig. 2.

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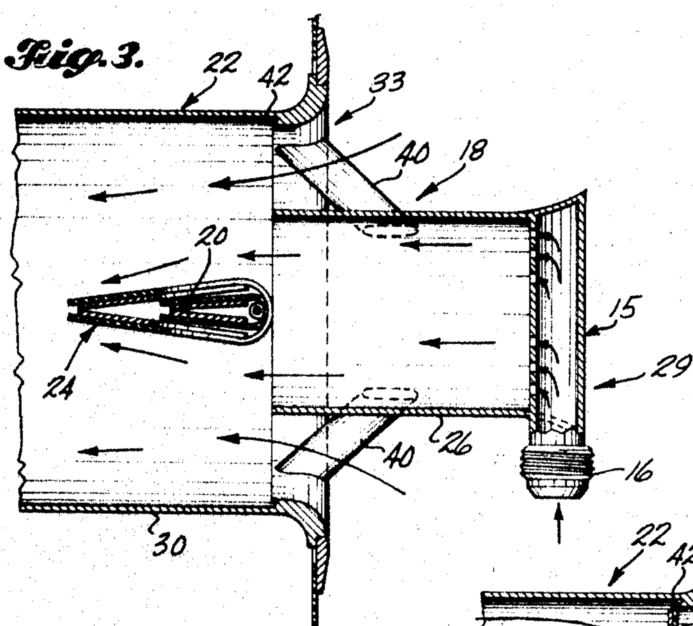
Fig. 3.



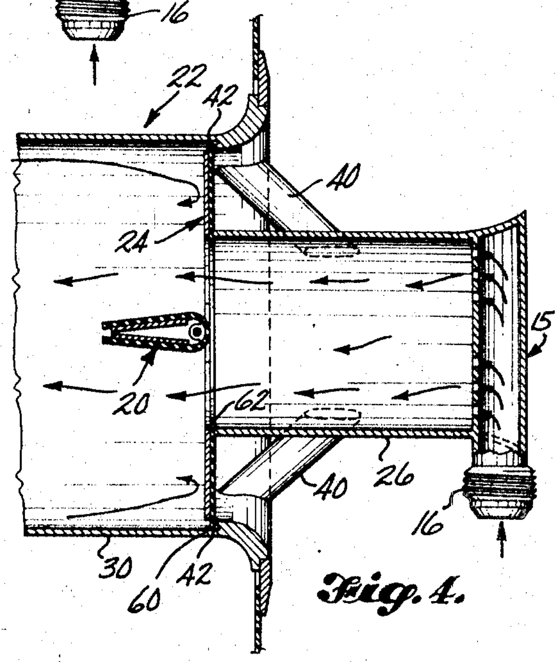


Fig. 4.

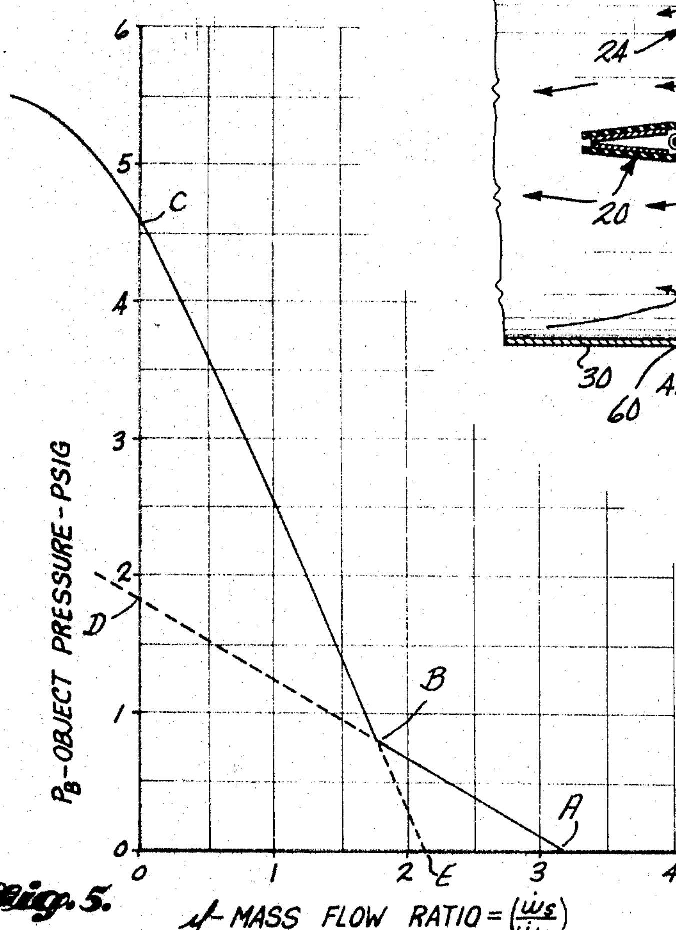


Fig. 5.

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TWO-STAGE INFLATION ASPIRATOR

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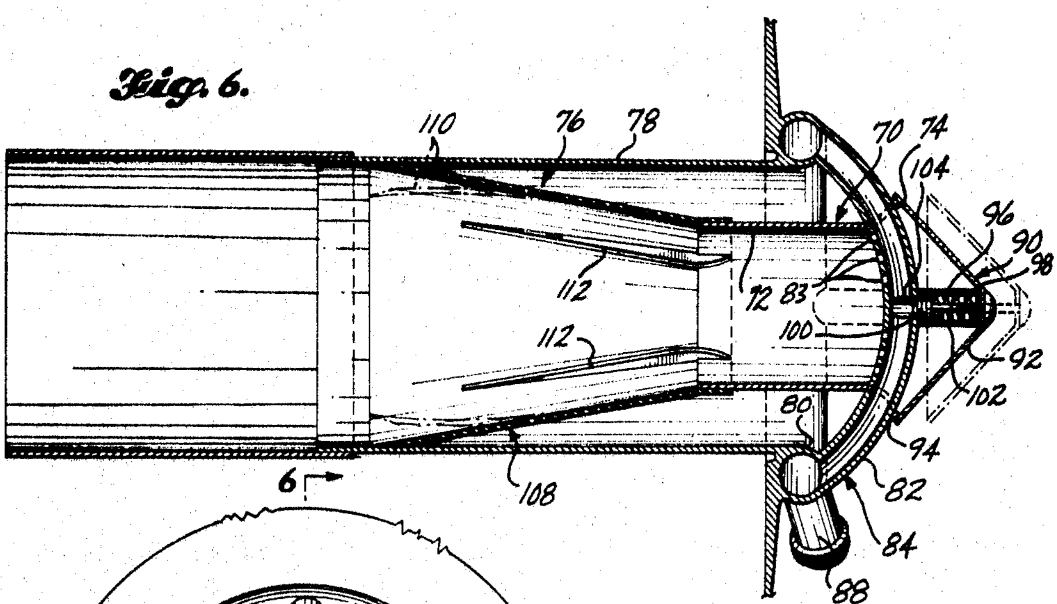
Fig. 6.



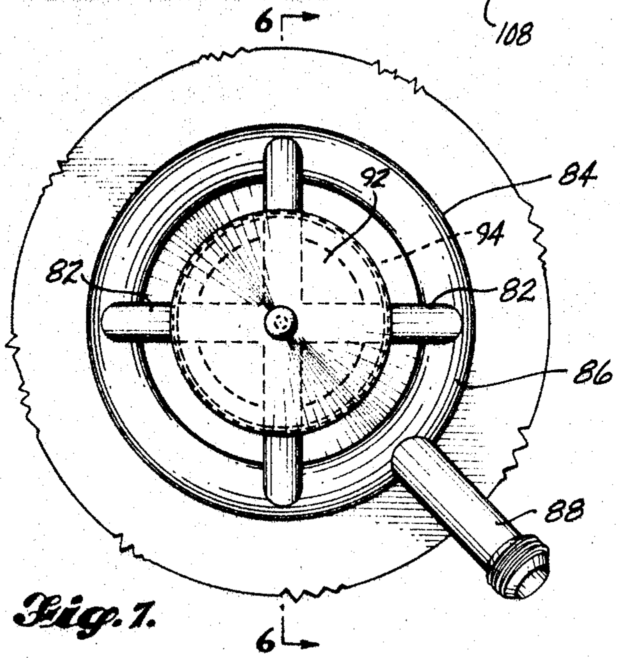


Fig. 7.

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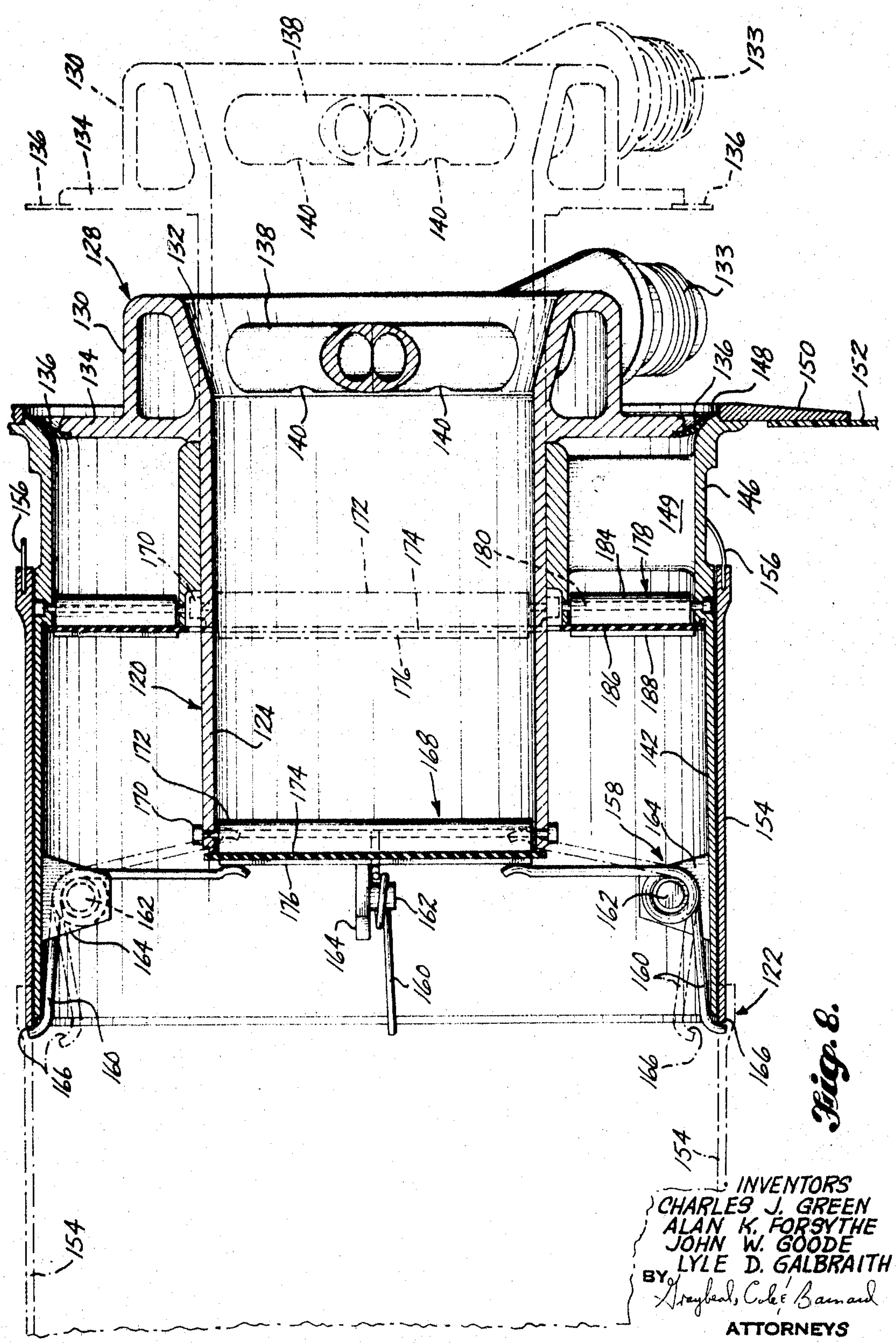

Fig. 8.

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Fig. 9A.

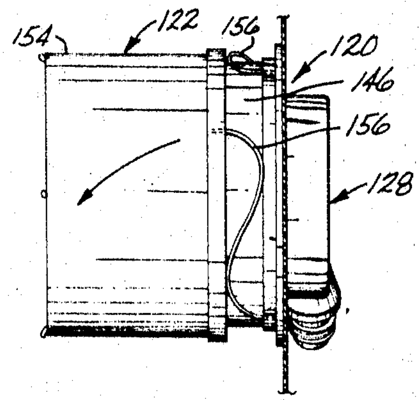


Fig. 9B.

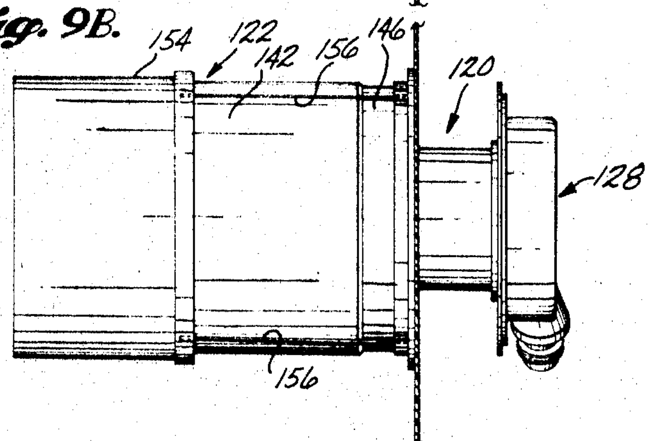
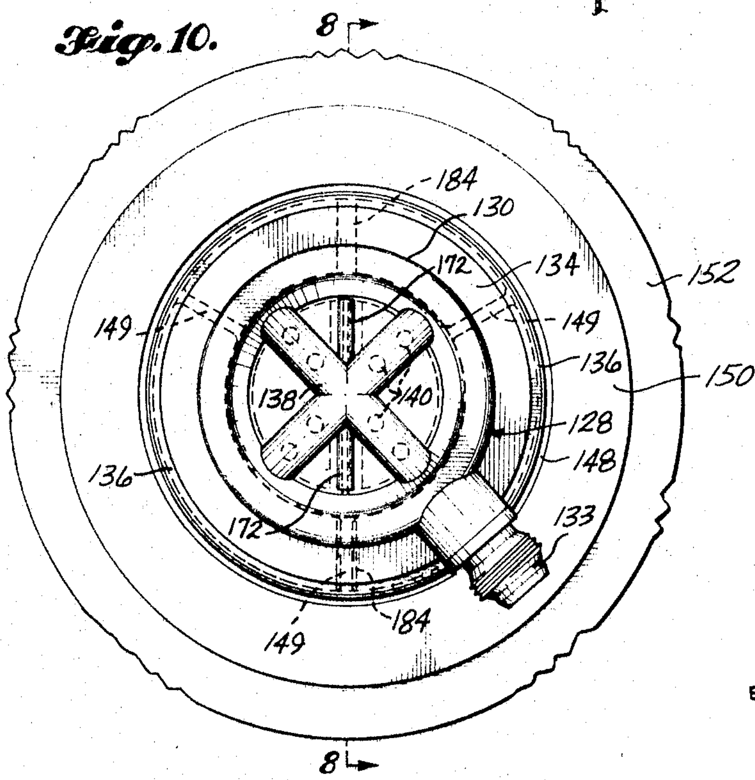


Fig. 10.



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United States Patent Office

3,460,746
Patented Aug. 12, 1969

3,460,746

TWO-STAGE INFLATION ASPIRATOR

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Filed Oct. 27, 1967, Ser. No. 678,565
Int. Cl. F04f *5/22, 5/48;* **F16k** *15/20*
U.S. Cl. 230—104 **20 Claims**

ABSTRACT OF THE DISCLOSURE

A first stage ambient air aspirator discharges into a second stage ambient air aspirator which in turn discharges into an inflatable object. A separate valve is provided for each stage. The back pressure in the object operates to automatically close the second stage valve when the back pressure in the object exceeds the pressure of the second stage aspirated air stream. Inflation is completed by the first stage alone. The two valves prevent deflation through the asiprator when inflation has been completed.

BACKGROUND OF THE INVENTION

Field of the invention

This invention relates to inflation aspirators, and more particularly to multistage aspirators adapted for rapid inflation of various inflatable objects; such as escape chutes, rafts, and the like.

DESCRIPTION OF THE PRIOR ART

A rapid inflation rate is a requirement of many inflatable devices, particularly those used with emergency objects, such as escape chutes and rafts.

Prior art aspirating devices aiming towards rapid inflation of inflatable objects have generally taken one of two forms. The first form is exemplified by the aspirator shown in the patent to Neigel, 2,859,908. An aspirating gas is introduced as a high velocity stream into a venturi nozzle adapted to discharge into the object being inflated. The upstream end of the nozzle is open to the surrounding air and the high velocity gas stream creates a suction to draw or aspirate ambient air into the stream for the purpose of increasing its volume. When the object is sufficiently inflated, and delivery of the aspirating gas has ceased, a check valve in the nozzle is closed by back pressure to prevent deflation.

A second form of inflation aspirator is shown in the patent to Crawford et al., 2,772,829. It is adapted for use in installations wherein the combined stream of aspirating gas and aspirated air, although of a high volume, is of an insufficient pressure to fully inflate the object. A check valve is provided to be closed by back pressure when the pressure in the object being inflated reaches the pressure of the air and gas stream. Aspiration of ambient air is stopped. However, the gas flow is continued and it, by itself being of a higher pressure than the gases in the object, continues to inflate the object.

SUMMARY OF THE INVENTION

This invention is directed to the technique of using an aspirator to inflate an object by filling the object at a more rapid rate than in either of the foregoing devices while still providing a high pressure fluid for inflating the object to a desired pressure. To accomplish this, a two-stage aspirator in employed. The aspirating fluid for the first stage is obtained from a high pressure source and the stream of aspirating fluid and

aspirated air leaving the first stage nozzle is used as the aspirating fluid for the second stage nozzle. In this manner a high volume, low pressure fluid stream is used to inflate the object up to a desired pressure level less than the final pressure. When this lower level is reached the second stage of the aspirator is valved shut and inflation is completed by the effluent of the first stage nozzle only.

As another feature of this invention, a telescopic aspirator is used which may be stored very compactly in a nonactive condition within the inflatable object during storage of said object in a folded condition. When activated, however, the nozzles of both stages are automatically extended to produce a more efficient nozzle shape and thus provide better flow characteristics for more rapid inflation of the object and better mixing of the gas and air.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is an isometric view of one form of an aspirator embodying the invention, with parts broken away for clarity of illustration of the two valves and the primary fluid injector;

FIG. 2 is an end elevational view of the aspirator shown by FIG. 1;

FIG. 3 is a fragmentary horizontal sectional view of the aspirator shown by FIGS. 1 and 2, showing both stages active;

FIG. 4 is a fragmentary horizontal section of such aspirator with only the first stage active;

FIG. 5 is a graphical illustration showing the pressure-flow characteristics of such aspirator;

FIG. 6 is a longitudinal sectional view taken along the line **6—6** of FIG. 7, illustrating another form of two stage aspirator embodying the invention;

FIG. 7 is a fragmentary plan of the aspirator form shown in FIG. 6;

FIG. 8 is an enlarged, longitudinal sectional view of another modified form of the invention, taken substantially along the line **8—8** of FIG. 10;

FIGS. 9A and 9B are schematic operational elevations of the FIG. 8 form of aspiration; and

FIG. 10 is an end elevational view of such latter form of aspirator.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In general, the embodiment shown in FIGS. 1–4 includes an inlet manifold **15** which is connected to a source of high pressure fluid by a pipe **16**. Preferably the source is a cool gas generator such as, for example, the type disclosed in the patent to Heberstreit et al., 3,122,181. Other gas sources, such as compressed air, may also be suitable in some installations.

The fluid is discharged through a plurality of orifices **17** into a first stage nozzle **18**, the downstream end of which is initially closed by an inner or circular check valve **20**. A second stage nozzle **22** is positioned downstream of the first stage nozzle and has an air intake opening closed by an outer or annular check valve **24**. As is best shown in FIGS. 3 and 4, the gas streams formed by the orifices entrain air into the first stage nozzle from which the mixture of gas and air is discharged as a combined fluid stream into the second stage nozzle and becomes the aspirating fluid for the second stage. Inflation takes place at a rapid rate due to the high volume of air discharged from the second stage. When the pressure builds up in the object to a predetermined level, the outer check valve is closed by back pressure and the object is further inflated by the first stage nozzle alone. When the object is substantially fully inflated, gas flow is ceased and the back pressure in the object closes the inner check valve thus preventing deflation.

The first stage nozzle **18** has a cylindrical throat **26** formed integrally with a smoothly rounded, diverging flange **28** that defines an air inlet **29**. The inlet manifold **15** extends diametrically across the air inlet and is secured to the flange to provide structural strength. The orifices **17** are aligned diametrically on the downstream side of the manifold.

The second stage nozzle **22** includes a cylindrical throat **30** integrally formed with a rounded, outwardly diverging inlet flange **32** that defines a second air inlet **33**. An annular mounting ring **34** is secured to an inlet flange and is secured to the fabric **38**, or the like, of an object to be inflated, such as an airplane escape chute, for example. The second stage nozzle is connected to the first stage nozzle by three equidistantly spaced struts **40** that are secured, as by welding, to the second stage inlet flange and the outside surface of the first stage nozzle throat **26**. The inlet flange **32** is provided with an inwardly directed peripheral lip **42** that serves as a valve seat in a manner to be hereinafter described.

The inner check valve **20** is best shown in FIG. 1 and includes a circular resilient plate member or flap **44** of neoprene, rubber, or other flexible material and is of a diameter slightly greater than the inside diameter of the throat **26**. A pair of centrally bored bosses **46** are bonded or otherwise secured to the downstream surface of the resilient plate **44** and are aligned along its vertical diameter. The bosses receive a pin **48** which is secured in spaced holes **50**, by any suitable means, in the throat **30** of the second stage nozzle **22**. The pin serves as a support about which the side segments of the resilient plate **44** may pivot. A pair of semi-circular strengthening members **52** are secured, as by bonding, to each side of the downstream surface of the resilient plate **44**. These members **52** are preferably of aluminum or any other suitable relatively rigid material. Each member **52** extends radially outwardly almost to the peripheral edge of the resilient plate **44**. In effect, the check valve amounts to two resilient, hinged rigid flaps with a peripheral sealing edge.

The outer check valve **24**, which closes off the second air inlet **33**, includes an annular resilient, flexible plate **54** of the same flexible material as the circular plate **44**. A pair of centrally bored bosses **56** are bonded to the downstream surface of the annular plate **54**. The bosses are diametrically aligned and receive the pin **48**. A pair of semi-annular strenghtening members **58** are secured, as by bonding, to the downstream surface of the annular plate **54** and extend almost to the inner and outer edges of the annular plate **54**. These members **58** function in the identical manner as the members **52**. The upstream outer peripheral edge **60** (FIG. 4) of the annular plate **54** abuts against the lip **42** of the inlet flange **32**. The inner edge **62** of the annular plate **54** extends radially inwardly beyond the inner circumferential surface of the throat **26** of the first stage nozzle **18** and serves as a seat for the inner valve **20**. As is best shown in the operational views of FIGS. 3 and 4, when air is being aspirated in both stages, the annular circular plates are folded downstream. As the object is filled a back pressure is developed, and eventually it closes the annular plate **54** and the second stage of the aspirator ceases to operate. Inflation is then completed by the primary aspirator alone. Following completion of the inflation the inner circular plate **44** is also closed by back pressure and it and the annular valve **24** function as check valves to hold the fluid in the object.

The effect of the two-stage aspiration is best shown in FIG. 5, wherein the line ABD represents the flow rate of the combined first and second stages if no second stage shutoff valve were to be provided. This line shows that a high volume of mixed air and gas is initially introduced into the object but that pressure never exceeds 2 p.s.i.g. The lines shown in the graph of FIG. 5 actually represent a mass flow ratio rather than a flow rate. It is customary

in the art, however, to discuss gas flow in terms of rate and it also provides a clearer understanding of the invention. The ratios shown in FIG. 5 are directly related to the flow rate for a constant flow of aspirating fluid $\dot{\omega}_p$. As an example, assume the aspirating fluid source produces a supply of aspirating fluid $\dot{\omega}_p$ at a constant rate of one pound mass per second. If the second stage is being used, that is as indicated by the line ABD, the initial mass flow rate of aspirated air is at a ratio of 3.2 and thus is 3.2×1 pound mass per second yielding a total fluid flow rate of approximately 4.2 pounds mass per second. At a ratio of 1 along the same line ABD the aspirated air flow rate is also 1 pound mass per second so that the total flow rate at this ratio is 2 pounds mass per second. This convention of referring to flow rate rather than to ratio will be followed throughout the following description. In the embodiment just described, the area of the air inlets of the combined nozzle stages is approximately 4½ times the area of the air inlet of the first stage nozzle alone.

The line EBC represents the flow rate if only the single stage were to be used, as was heretofore customary. The single stage can reach a significantly greater pressure. However, the initial flow rate is substantially less than with two stages.

By the use of the check valve **24** in the second stage nozzle **22** the flow rate curve follows the solid line ABC. Thus, a high volume initial flow rate is produced up until point B where the back pressure is sufficient to close the outer check valve **24**. The curve then follows the flow rate for the single stage nozzle reaching a pressure of over 4 p.s.i.g. in the example presented. Since the first 60% of inflation is at a pressure slightly greater than atmospheric, the large volume will greatly increase the speed at which this amount of inflation is reached. For example, in the installation to which the graph relates the initial use of the second stage reduced the time of filling from 5 to 3 seconds or a percentage increase of 40%.

The aspirator shown in FIGS. 6 and 7 is in many respects similar to the above-described embodiment. It includes a first stage nozzle **70** having a cylindrical throat **72** and a smoothly curved, outwardly diverging inlet flange **74**. A second stage nozzle **76** is provided with a cylindrical throat **78** and a smoothly curved, outwardly diverging inlet flange **80**. The second stage inlet flange circumscribes the cylindrical throat of the first stage nozzle. The first stage nozzle is supported therein by four crossed tubular supports **82** having orifices **83** and which form a gas inlet manifold **84**. The tubular supports are joined at their midpoints and are joined at their ends by an annular tube **86** that is connected to a supply pipe **88**. The pipe **88** is connected to a suitable source of high pressure gas. The annular tube **86** is integrally formed on the air inlet flange **80** of the second stage nozzle to serve as a rigid support for the first stage nozzle. The outer peripheral edge of the inlet flange **82** is secured to the fabric, not shown, of the object to be inflated.

As in the embodiment shown in FIGS. 1–4, the nozzles **70** and **76** are each provided with a check valve. The first stage nozzle **70** has a check valve **90** which includes a rigid conical plate **92** that seats against a seal ring **94** mounted on the inlet flange **74**. A coil spring **96** is secured, as by welding, to the downstream surface **98** of the conical plate. The downstream end of the spring is secured in a piston **100** that is slidably mounted in a cylinder **102**. The cylinder **102** communicates with the inlet manifold **88** through a passage **104** in one of the tubular members **82**. Pressurized gas within the tubular members causes the piston to move the conical plate **92** to the right, as viewed in FIG. 6, thus opening the check valve for the admission of air. The spring is calibrated to open the plate by a force slightly greater than the back pressure exerted on the face of the plate when the object is filled. Thus, the valve also acts as a relief valve to prevent over pressurization of the object when filled.

The second stage nozzle **78** is also provided with a check valve **108** which is in the form of a truncated cone **110** of a flexible, resilient material, such as neoprene or rubber. The cone is fastened at its upstream edge to the outside surface of the cylindrical throat **72** of the first stage nozzle **70**. Four stiffening bars **112** are equidistantly spaced within the truncated cone **10** and are welded at their upstream edges to the inside surface of the cylindrical throat **72**. These stiffening bars extend downstream a substantial distance and diverge outwardly toward the inside surface of the cylindrical throat **78**. These bars **112** provide rigidity to the flexible material of the cone **110** to assist in maintaining the downstream end of the cone **110** normally biased outwardly tightly against the inside surface of the cylindrical throat **78**. However, when the downstream pressure in the second stage nozzle falls below atmospheric, the incoming air flexes the cone inwardly. When the pressure in the object increases to a superatmospheric level the downstream end of the cone is flexed outwardly to seat against the inner wall of the second stage nozzle and stop the flow of ambient air into the second stage.

The operation of the embodiment shown in FIGS. 6 and 7 is basically identical to that shown in the first described embodiment. When gas is introduced through the manifold **84** it creates a pressure in the cylinder **102** to open the first stage check valve **90**. Air aspirated through the inlet flange **74** of the first stage nozzle is entrained in the stream of gas and the combined fluid stream acts as an aspirating fluid for the second stage nozzle **76**. At this time the object is just beginning to inflate and both stages are active to rapidly inflate the object. When the object reaches a predetermined pressure the back pressure will close the second stage check valve **108** and further pressurizing will be by the first stage nozzle alone. Once the object is inflated and primary gas flow ceases, the first stage check valve **92** is also closed by back pressure.

The embodiment shown in FIGS. 8–10 is also similar to the embodiment shown in FIGS. 1–4; however, it includes advantageous features for compact storage. This embodiment includes a first stage nozzle **120** shown in a retracted position in FIG. 8 and a second stage nozzle **122**. The first stage nozzle includes a cylindrical throat **124** that is slidably mounted in rigid inner ring **126**. An inlet manifold **128** is integrally formed on the cylindrical throat **124** and includes an annular tube **130** having a radially inner wall **132** that diverges smoothly outwardly from the cylindrical throat to form an air inlet. A pipe **133** connects the manifold to a suitable supply of pressurized gas. The inlet manifold also includes a radially outer extension **134** that has a flexible rubber debris and moisture seal **136** attached to its outer periphery. A pair of cross tubes **138** having downstream orifices **140** communicate with the annular tube **130**.

The second stage nozzle **122** includes a cylindrical throat **142** integrally formed with a rigid outer ring **146** that diverges smoothly outwardly at its upstream end to form an inlet flange **148**. A plurality of spaced radial arms **149** support the rigid inner ring **126** centrally in the rigid outer ring. The inlet flange also serves as an entrance for aspirated air and as a seat for the debris seal **136**. An annular plate **150** is secured to the inlet flange and, at its outer peripheral edge to the fabric **152** of an inflatable object, not shown. An outer cylindrical extension **154** is slidably mounted on the cylindrical throat **142** and is shown in its retracted position in FIG. 8. The extension is biased to the left, as viewed in FIG. 8, by a plurality of spring strips **156**, best shown in the operational views 9A and 9B. A catch **158** holds the cylindrical extension in its retracted position and includes a rod **160** twisted about a pivot pin **162** mounted on a boss **164** that is secured to the inside surface of the cylindrical throat **142**. The rod has an outwardly curved tip **166** that, in its operative position, extends radially outward beyond the downstream edge of the cylindrical extension **154**. The other end of the rod, in its operative position, abuts against a downstream surface of a check valve, to be later described, fastened to the downstream end of the cylindrical throat **124** of the first stage nozzle **120**. Four such catches are provided. As can be readily seen from FIG. 8 the first stage nozzle maintains the rod in engagement with the downstream edge of the cylindrical extension. When the cylindrical throat of the first stage nozzle is moved to the right, as viewed in FIG. 8, the rod is released and the springs **156** move the cylindrical extension **154** to the left while simultaneously rotating it into the position shown in phantom lines in FIG. 8.

The first stage nozzle **120** is provided with a check valve **168** which is similar to the check valve **20** shown in the embodiment of FIGS. 1–4. The valve includes a pin **170** secured to the cylindrical throat **124** by any suitable means. The pin is received in a diametrical boss **172** secured to the upstream surface of a circular flexible plate **174**. The circular plate is made of a resilient material, such as rubber, and seats against the downstream edge of the cylindrical throat **124**. A pair of stiffening members **176**, of aluminum or the like, are bonded to the downstream surface of the flexible plate. The members are identical in shape and function to the strengthening members **52** of the check valve shown in the embodiment of FIGS. 1–4. The flexible plate acts like flaps and since the valves in the two embodiments are substantially alike both in structure and function, no further description is believed necessary.

The second stage nozzle **122** is also provided with a check valve **178** that includes a pair of diametrically opposed pins **180** secured by any suitable means in the downstream ends of the rigid inner and outer rings **126** and **147**. The pins are received in a pair of bosses **184** secured to the upstream surface of an annular flexible plate **186**. The annular plate **186** is also of a resilient material, such as rubber, and seats against the downstream edges of the rigid inner and outer rings. A pair of stiffening members **188** are bonded to the downstream surface of the annular flexible plate. The flexible plate of the check valve **178** functions like flaps in substantially the identical manner as the check valve **24** of the embodiment shown in FIGS. 1–4 and accordingly no further description is believed necessary.

In the operation of the embodiment shown in FIGS. 8–10 the two-stage aspirating technique is identical to that of the embodiment of FIGS. 1–4. The extension features of this embodiment improve the flow and mixing characteristics of the nozzles and function in the following manner. The gas emitted from the orifices **140** reactively moves the cross tubes **138** to urge them to the right, as viewed in FIG. 8, into the phantom position. The catch **158** is released and the springs **156** extend the cylindrical extension **154** to the left. After the object is inflated, the cylindrical extension and the first stage nozzle remain in their extended positions since it is no longer essential that they be in a compact form.

While the invention has been described in its preferred non-limiting forms, it is understood that changes may be made without departing from the principles of the invention. It is to be understood, therefore, that the scope of the invention is to be determined solely by the proper interpretation of the claims appended hereto.

What is claimed is:

1. A two-stage aspirator comprising:

a first stage tubular nozzle defining a first stage flow passageway having an inlet for ambient air and an outlet;

means for introducing an aspirating fluid stream generally axially into said first stage flow passageway;

a larger second stage tubular nozzle having an inlet end receiving the outlet of said first stage flow passageway, and together with said first stage nozzle defining, a second stage flow passageway for ambient air which at least partially surrounds said first stage flow passageway; and

valve means for preventing any back flow through said aspirator, said valve means including a first double flap valve movable between an open position wherein the flaps are generally contiguous and aligned with the flow and a closed position wherein said flaps extend generally transversely across said first stage flow passageway, and a second double flap valve movable between an open position wherein the flaps are generally contiguous and aligned with the flow and a closed position wherein said flaps extend transversely across the [inlet of said] second stage flow passageway

2. A two-stage aspirator comprising:

a first stage tubular nozzle defining a first stage flow passageway having an inlet for ambient air and an outlet;

means for introducing an aspirating fluid stream generally axially into said first stage flow passageway;

a larger second stage tubular nozzle having an inlet end receiving the outlet of said first stage flow passageway, and together with said first stage nozzle defining a second stage flow passageway for ambient air which at least partially surrounds said first stage flow passageway; and

valve means for preventing any back flow through said aspirator, said valve means including separate check valves, each including a resilient plate member and a set of stiffening members fastened to its plate member on opposite sides of a non-stiffened center strip, and a mounting pin fastened to each center strip, whereby the non-stiffened center strip of each plate member functions as a hinge means, parmitting a pivotal folding together of the stiffened portions of each plate member.

3. The aspirator of claim **1**, wherein said first double flap valve includes a plate having a resilient central hinge portion, and means secured to said hinge portion for connecting said plate to said first stage nozzle.

4. The aspirator of claim **3**, wherein said means for introducing a stream of fluid axially into said first stage flow passageway includes a tubular member extending across the air inlet of said first stage flow passageway, said tubular member having a plurality of orifices positioned on opposite sides of said means for connecting said plate to said first stage nozzle means.

5. The aspirator of claim **1**, wherein said first and second double flap valves are generally coplanar, said second double flap valve extends about the first, and said first double flap valve has a peripheral sealing edge that seats against said second flap valve.

6. An inflation aspirator for an inflatable object comprising:

nozzle means communicating with the interior of the object, said nozzle means being movable at least partially into the object for stowage, and extendable outwardly of the object for use;

injector means for supplying a stream of aspirating fluid axially into said first nozzle means; and

second stage nozzle means arranged to receive the effluent of said first nozzle means, and to discharge into the object,

said second stage nozzle means being extendable inwardly of said object.

7. The aspirator of claim **6**, wherein said nozzle means are each provided with an air inlet and closure means.

8. The aspirator of claim **6**, further including means for biasing said second nozzle means into its extended position and catch means for holding said second nozzle means in its retracted position, said catch means being releasable in response to outward movement of the first nozzle means.

9. The aspirator of claim **7**, wherein said closure means includes an annular check valve for closing-off the inlet of said second nozzle means and a circular valve closing-off the exit of said first nozzle means.

10. The aspirator of claim **6**, wherein said first nozzle means is telescopically received in said second nozzle means.

11. A two-stage inflation aspirator for a gas confining type inflatable object comprising:

a first stage tubular nozzle defining a first stage flow passageway into said inflatable object having an inlet for ambient air and an outlet;

means for introducing an aspirating fluid stream generally axially into said first stage flow passageway;

a larger second stage tubular nozzle having an inlet end receiving the outlet of said first stage flow passageway, and together with said first stage nozzle defining a second stage flow passageway for ambient air which at least partially surrounds said first stage flow passageway; and

valve means for preventing any back flow through said aspirator, said valve means including a second stage valve for closing said second stage flow passageway only during one period of aspirator use, enabling use of the first stage passageway alone in such period.

12. The aspirator of claim **11** wherein said valve means further includes a valve for closing said first stage flow passageway alone.

13. The aspirator of claim **11** wherein said valve means further includes a first stage valve for closing said first stage flow passageway alone and wherein said first stage and second stage valves include separate check valves, each check valve including a resilient plate member.

14. The aspirator of claim **11** wherein said valve means includes a spring biased valve for closing the inlet of the first stage nozzle.

15. The aspirator of claim **11** wherein said second stage valve comprises a check valve in the form of a flexible truncated cone.

16. An inflation aspirator for a gas confining inflatable object having an outer fabric, comprising:

inlet structure including nozzle guide means secured to said fabric, tubular nozzle means slidably received in said guide means for movement relative to said fabric and communicating with the interior of the object and having a predetermined length, said nozzle means being at least partially movable into the object for substantially its entire length for stowage, and extendable outwardly of the object for a substantial portion of its length when in use; and

injector means for supplying a stream of aspirating fluid axially into said nozzle means.

17. The aspirator of claim **16**, wherein said guide means permits the nozzle to be reactively extended by the initial supply of aspirating fluid discharging from said injector means.

18. An inflation aspirator comprising an inlet tube for a gas confining type inflatable object having an ambient air inlet and a combined fluid outlet, an injector for delivering an aspirating fluid into said inlet tube of said inflatable object, and the improvement comprising:

tubular wall means dividing the interior of the inlet tube into first and second stage passageways, each having an ambient air inlet, with said injector being positioned to discharge directly into the first stage passageway, and with said first stage passageway being positioned to discharge generally axially into said inlet tube at a location bounded by said second stage passageway, so that the mixture of aspirating fluid and aspirated ambient air discharging from said first stage passageway functions as an aspirating fluid for causing second stage aspiration in the second stage passageway, and check valve means in said second stage passageway, arranged to close in response to a predetermined back pressure in the inflatable object and in that manner render the second stage of the aspirator ineffective, with inflation thereafter being completed by the first stage of the aspirator alone.

19. An inflation aspirator according to claim 18, wherein said first stage passageway is located radially inwardly of said second stage passageway and a tubular wall separates the two passageways, and said check valve is a plural leaf flap valve supported in the second stage passageway radially outwardly of said tubular wall.

20. An inflation aspirator according to claim **19**, further including a second plural leaf flap valve positioned in the first stage passageway, and arranged to close in response to back pressure when the inflatable object is sufficiently inflated.

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U.S. Cl. X.R.

103—258; 137—223; 230—95