Sept. 29, 1959 F. B. JEWETT, JR 2,906,125

SAMPLING DEVICE

Filed Aug. 15, 1956

FIG. 1

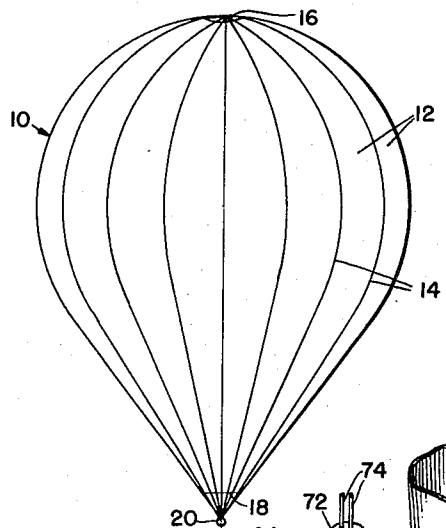


FIG. 2

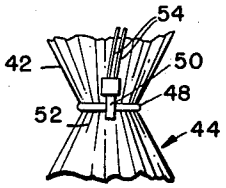
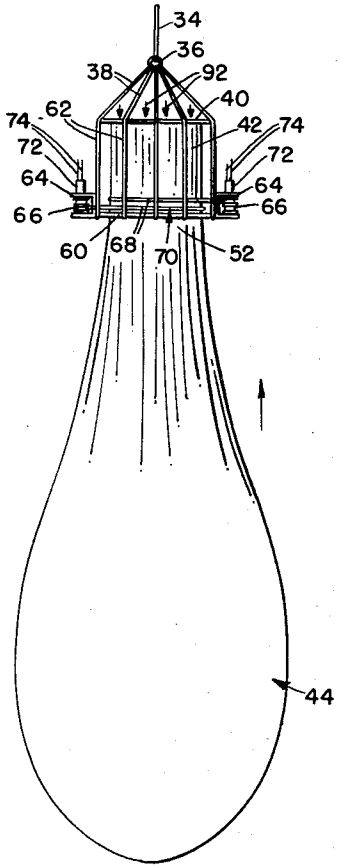


FIG. 3



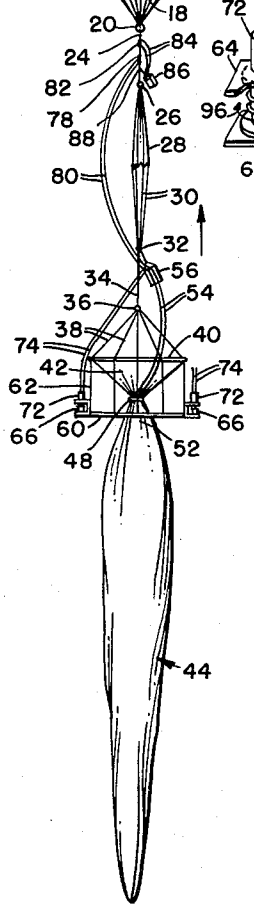


FIG. 4

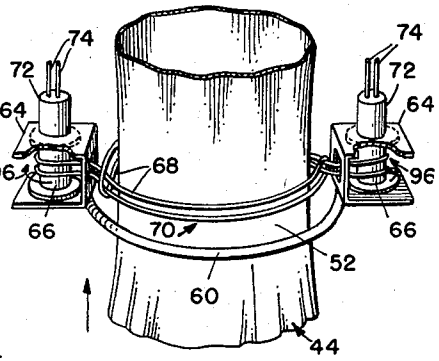
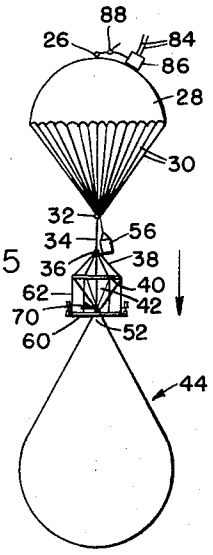


FIG. 5



INVENTOR:
FRANK B. JEWETT, JR.

BY *W R Maltby*
Louis Sheldon
ATTORNEYS

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SAMPLING DEVICE

Frank B. Jewett, Jr., New Canaan, Conn., assignor, by mesne assignments, to the United States of America as represented by the Secretary of the Navy

Application August 15, 1956, Serial No. 604,289

12 Claims. (Cl. 73—421.5)

The present invention relates to collection of high altitude air samples.

It is frequently desirable to ascertain various facts concerning high altitude air, and it is accordingly an object of the invention to provide apparatus which may be carried aloft and at a predetermined high altitude collect a large sample of air at that altitude and return the sample to earth without mixing it with unwanted air.

It is an additional object to provide mechanism adapted to obtain and bring intact to the ground a sample of air collected at an altitude above the range of the ordinary airplane.

Another object is to provide a simple, reliable, foolproof, light-weight apparatus including a high altitude balloon having a range far above the range of the ordinary airplane for capturing and bringing to earth intact a sample of air from such higher altitudes.

A further object is to provide a device which will carry a container to a predetermined altitude, automatically open the container so as to enable it to collect air, and automatically seal the container after the air is collected.

A still further object of the invention is to provide a mechanism which will carry aloft a deflated bag, automatically open the bag mouth at a predetermined altitude so that, with continued ascent with the mouth foremost, a sample of air is rammed into the bag, close the mouth to trap the sample, and bring the bag intact to earth.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawing wherein:

Fig. 1 is an elevational view of an air sampling assembly embodying features of the invention;

Fig. 2 is an enlarged fragmentary elevational view showing a releasable container closure;

Fig. 3 is an enlarged elevational view of the container as it is being filled with a sample of high altitude air, and mechanism for closing the container after the sample is collected.

Fig. 4 is a further enlarged detailed perspective view of the mechanism for closing the container after the air sample has been collected;

Fig. 5 is an elevational view showing the container gravitating after an air sample has been collected.

Referring now more particularly to the drawing, disclosing an illustrative embodiment of the invention, there is shown at **10** a balloon envelope which may be formed of gores **12** seamed together and covered at the seams by tapes **14**. The envelope **10** may be closed at the top as by a cap **16**, and the tapes **14** extend below the envelope bottom **18** and are connected to a balloon load ring **20**.

A balloon load line **24** suspended from the ring **20** is connected to an eye **26** secured to the top of a parachute **28** whose shroud lines **30** are connected to a parachute load ring **32**. A load line **34** suspended from the ring **32** is connected to an eye **36** from which load strings **38**

diverge and suspend a rim **40** to which is suitably secured the edge of the mouth **42** of an air sampling bag **44**, so that the rim defines the entrance to the bag.

A collar **48** passing through a squib **50** tightly clasps and closes the neck **52** of the bag **44** to impart a funnel shape to the mouth **42** (Figs. 1 and 2), the neck forming the upper end of a compartment of the bag. The squib **50** is connected by leads **54** to electric circuit constituents (not shown) contained in a housing **56** suspended from the parachute load ring **32**.

A collar **60** encircling the neck **52** of the sampling bag **44** is suspended from the rim **40** by means of lines **62**. Opposed brackets **64** carried by the collar **60** support winches **66** to which are anchored linked cords **68** which form a collapsible loop **70** adapted to serve as a tourniquet about the neck **52**, as will appear. The winches **66** are driven by motors **72** connected by leads **74** to electric circuit constituents (not shown) contained in the housing **56**.

The balloon load line **24** passes through a main flight termination squib **78** connected by leads **80** to electric circuit constituents (not shown) contained in the housing **56**.

The balloon load line **24** also passes through an auxiliary or safety flight termination squib **82** above the squib **78** and connected by leads **84** to electric circuit constituents (not shown) contained in a box **86** suspended as at **88** from a point on the line above the parachute eye **26**.

Fig. 1 shows the assembly as it appears in soaring flight toward the predetermined altitude at which collection of the desired air sample is to commence, the bag **44** being deflated and collapsed. When that altitude is reached, a suitable pressure-sensitive switch, in circuit with batteries and the squib **50**, closes, firing the squib, which severs the band **48**. Said altitude is substantially lower than the maximum altitude of which the loaded towing balloon **10** is capable, so that at severance of the band **48** soaring continues. At the release of the band **48**, and pursuant to and by reason of continued rapid ascent of the balloon, air is rammed as indicated by the arrows **92** into the mouth and through the neck and into the bag and proceeds to readily and rapidly expand and fill the bag.

When a predetermined higher altitude, at which filling of the bag has been precalculated to be substantially complete, is attained, another suitable pressure-sensitive switch, in circuit with the batteries and the motors **72**, closes so that the motors turn the winches **66** in the directions indicated by the arrows **96** to collapse the tourniquet loop **70** until the neck **52** is closed, trapping and sealing the sample of air in the bag **44**, which then has the appearance substantially as shown in Fig. 5.

The balloon continues to ascend, and at a somewhat higher elevation a third pressure-sensitive switch, in circuit with the batteries and the lower flight termination squib **78**, closes, firing the squib, which severs the balloon load line **24**, whereupon the assembly thus released from the balloon commences to descend and the parachute **28** opens and allows the assembly below the point of severance to gravitate gently so that the equipment will not be damaged on landing.

In the event of failure of the main squib **78** to fire, another suitable pressure-sensitive switch, in circuit with batteries and the safety squib **82**, closes at a somewhat higher altitude, firing the safety squib **82** to sever the balloon load line **24**.

Inasmuch as the balloon load line is severed, whether by the squib **78** or the squib **82**, above the place of suspension of the box **86**, said box and its contents will be salvaged. If the main squib **78** fires, the wiring **84** will be pulled loose or broken pursuant to the resulting relative move-

ment of the balloon and the remainder of the equipment. If desired, this wrenching can be eliminated by passing the wires **84** through the squib **78** so that said wires as well as the load line **24** will be severed when the squib **78** fires.

Instead of relying on a pressure-sensitive switch to start the tourniquet motors **72**, a timer, started by the switch controlling the band-severing squib **50**, may be employed. This timer, after a predetermined period sufficient to permit the bag **44** to substantially fill with the air sample, would close a switch to start the motors **72**. However the motors **72** may be started, they may be continuously energized so as to hold the tournique **70** taut. However, if desired, the motor-controlling switch could be opened when constriction of the bag neck **52** is completed, and suitable braking or ratchet mechanism (not shown) on the winches could be employed to prevent relaxation of the tourniquet.

Instead of relying on a pressure-sensitive switch to control firing of the main flight termination squib **78**, a timer may be employed. This timer could be started pursuant to closing of the motor starting switch and could be set to close a switch at a predetermined subsequent time, to fire the squib **78**.

Likewise, the firing of the safety squib **82** could be timer-controlled instead of altitude-controlled.

It will be understood that the bag **44** may be brought to the ground by other means. For example, the squibs **78** and **82** could be dispensed with and means (not shown) provided to deflate the balloon envelope **10** so that it will descend with the load. The latter method may be desired particularly where the load is heavy, to afford a more gentle descent and thus avoid damage to the apparatus upon landing.

The balloon and sampling bag may be formed of various types of materials which are light in weight yet will withstand the low temperatures at high altitudes and resist rupture on landing. Polyethylene is an example of a suitable material.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

I claim:

1. Apparatus for capturing a sample of high altitude atmosphere, comprising a high altitude balloon, a load line suspended from the balloon, a squib about the line, a parachute suspended from the line below the squib, a deflated bag suspended from the parachute and arranged with its mouth uppermost, means holding the edge of the mouth agape, a collar closing the bag below said edge, a squib through which the collar passes, a ring surrounding and in non-constricting relation to the neck of the bag, a tourniquet carried by the ring and comprising an undrawn noose about the bag, means for firing the second squib at a predetermined high altitude so as to sever the collar, allowing the sample to rush into and inflate the bag with continued ascent, means for operating the tourniquet at a higher altitude to draw the noose so as to close the bag when the bag is inflated, and means for firing the first squib so as to sever the balloon load line and allow the parachute to float the inflated bag to the ground.

2. Apparatus for capturing a sample of high altitude atmosphere, comprising a high altitude balloon, a parachute suspended from the balloon, a deflated bag suspended from the parachute with the mouth of the bag uppermost, means closing the deflated bag at the neck thereof, means holding the edge of the mouth agape, means operative at a predetermined high altitude to open the bag at the neck thereof so that with continued ascent the sample rushes into and proceeds to inflate the bag, means operative at a predetermined higher altitude to reclose the bag at the neck thereof when the bag is inflated, and means for releasing the parachute from the balloon when the bag is reclosed.

3. In an apparatus for capturing a sample of high altitude atmosphere, a deflated bag adapted to be carried aloft, means holding the top of the bag agape, and releasable means closing the bag in proximity to the top to impart a divergent shape to the upper portion of the bag, whereby, when the closing means is released, the sample will have a free corridor to enter and inflate the bag as the bag continues to ascend.

4. In an apparatus for capturing a sample of high altitude atmosphere, a deflated bag adapted to be carried aloft and having a flared end portion releasably closed at the apex and adapted to face the direction of ascent, means for opening the apex at a predetermined high altitude to enable the sample to be rammed rapidly into and inflate the bag with continued ascent of the bag, and means operative at a higher altitude for trapping the sample in the bag.

5. In an apparatus for capturing a sample of high altitude atmosphere, a closed deflated bag adapted to be carried aloft, means for instantaneously fully opening the upper part of the bag when the bag reaches a high altitude so that the sample will be rammed rapidly into and inflate the bag with continued ascent of the bag, and means for gradually closing the inflated bag when the bag is higher than the first-mentioned altitude.

6. In an apparatus for capturing a sample of high altitude atmosphere, a closed deflated bag adapted to be carried aloft, means for opening the upper part of the bag when the bag reaches a high altitude so that the sample will be rammed rapidly into and inflate the bag with continued ascent of the bag, and means comprising a noose for gradually closing the inflated bag when the bag is higher than the first-mentioned altitude.

7. An apparatus for capturing a sample of high altitude atmosphere, comprising a high altitude balloon, a load line depending from the balloon, upper and lower squibs about the line, a parachute connected to the line below the lower squib, a deflated bag suspended from the parachute, a band embracing and closing the upper part of the bag, a squib through which said band passes, an undrawn noose about the upper part of the bag, noose drawing means, container means suspended from the balloon below the lower squib, batteries and switches disposed in said container means and wired to the respective squibs and noose drawing means, one of the switches being set to fire the band squib so as to open the bag at a predetermined high altitude, another of the switches being set to operate the noose drawing means to draw the noose tight about and thereby reclose the bag at a higher altitude, a third one of the switches being set to fire said lower squib and thereby sever the load line when the bag is reclosed, the wiring from said upper squib to the container means being adapted to be severed pursuant to such severance of the balloon load line, and a fourth one of said switches being set to fire said upper squib in the event of failure of said lower squib to fire.

8. An apparatus for capturing a sample of high altitude atmosphere, comprising a high altitude balloon, a load line depending from the balloon, a squib about the line, a parachute connected to the line below the squib, a deflated bag suspended from the parachute, a band embracing and closing the upper part of the bag, a squib through which said band passes, an undrawn noose about the upper part of the bag, noose drawing means, container means suspended from the balloon below the load line squib, and batteries and switches disposed in said container means and wired to the respective squibs and noose drawing means, one of the switches being set to fire the band squib so as to open the bag at a predetermined high altitude, another of the switches being set to operate the noose drawing means to draw the noose tight about and thereby reclose the bag at a higher altitude, and a third one of the switches being set to fire the load line squib and thereby sever the load line when the bag is reclosed.

9. In an apparatus for capturing a sample of high altitude atmosphere, a bag having a closed deflated compartment, means for carrying the bag aloft with the mouth of the bag above the compartment, a stiff rim holding the edge of the mouth agape, a stiff collar suspended from the rim and disposed about and adjacent and in non-constricting relation to the neck of the bag, a pair of oppositely disposed winches carried by the collar, motor means for the winches, a cord anchored at its ends to one of the winches, a cord anchored at its ends to the other winch, said cords being looped together, providing an undrawn noose about the neck of the bag, means operative at a high altitude for opening the upper part of the compartment so that the sample may be rammed rapidly into and inflate the compartment with continued ascent of the bag, and means including a switch for operating said motor means to draw the noose tight about the neck and close the sample-containing bag.

10. Apparatus for capturing a sample of high altitude atmosphere, comprising a high altitude balloon, a bag suspended from the balloon, the bag having a closed deflated compartment, means operative at a high altitude to open the top of the compartment so that the sample may rush into and inflate the bag with continued ascent, means for closing the inflated compartment, and means for gently floating the inflated bag to earth.

11. Apparatus for capturing a sample of high altitude atmosphere, comprising a bag having a closed collapsed compartment, means for carrying the bag aloft, a parachute between and connected to the carrying means and the bag, means for opening the top of the compartment at a high altitude to enable the sample to rapidly inflate the compartment with continued ascent, means for closing the inflated compartment at a higher altitude, and means for releasing the parachute from the carrying means to enable the bag to float gently to earth.

12. In an apparatus for capturing a sample of high altitude atmosphere, a bag having a closed neck defining an end of a deflated compartment, an undrawn noose about the neck, means for moving the bag in a high altitude atmosphere with said end facing the direction of motion, means operative while the bag is in said atmosphere to open the neck so that a sample of said atmosphere will inflate the compartment with continued movement of the bag in said atmosphere, and means for drawing the noose tight about and closing the neck before the bag with the inflated compartment leaves said atmosphere.

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