

July 23, 1946.

R. S. COLLEY

2,404,567

PARTITIONED INFLATABLE SUIT

Filed Aug. 20, 1942

Fig-1

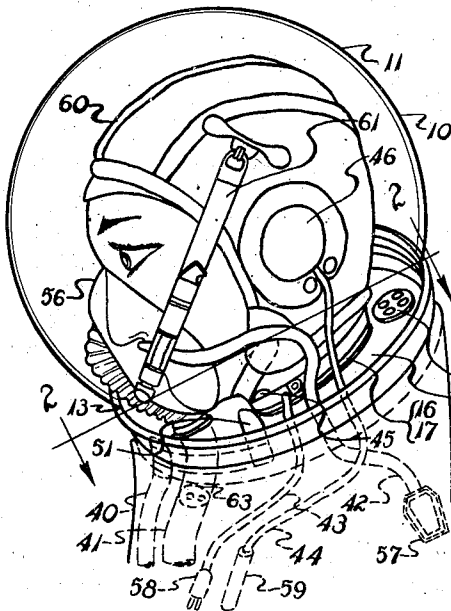


Fig-2

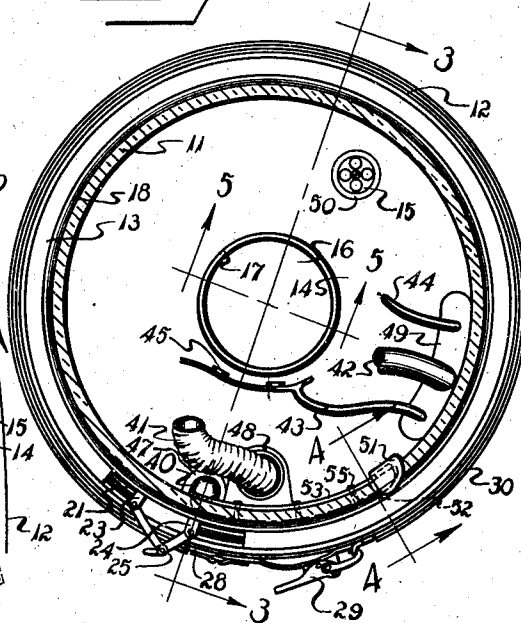


Fig-3

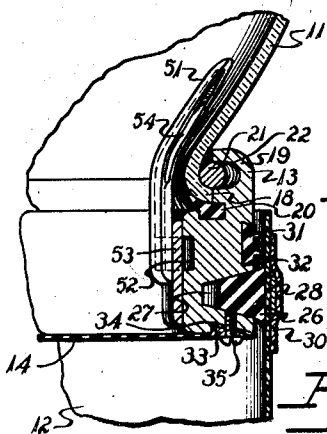
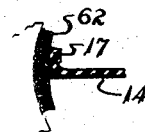
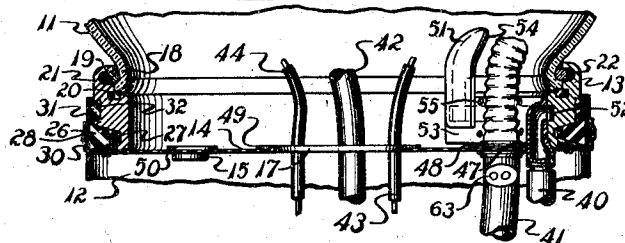


Fig-5

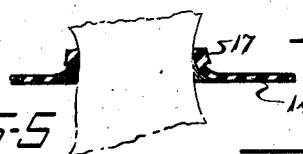


Fig-6

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UNITED STATES PATENT OFFICE

2,404,567

PARTITIONED INFLATABLE SUIT

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Application August 20, 1942, Serial No. 455,511

10 Claims. (Cl. 128—144)

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This invention relates to partitioned hollow structures and especially to partitioned inflatable suits.

Use of an inflatable suit equipped with a headpiece having a transparent wall portion or window structure is affected adversely by fogging of the window during flight in the region of the stratosphere. This phenomenon results from the fact that the air within the inflatable suit contains an appreciable quantity of water vapor which condenses and usually also freezes upon the inner surface of the transparent wall portion or window of the headpiece. The resultant obscuration of the vision of the wearer is undesirable, and constitutes a definite hazard.

Objects of the invention are to provide for dividing one part of a hollow structure from another, while providing for transmitting fluid, or electrical energy, or both from one part to another; and to provide for admitting a member through an opening in a partition in substantially sealing relation.

Further objects are to provide means for joining a pair of hollow structures while substantially isolating the space within each of the respective structures, yet permitting the transmission of fluid from one structure to the other; to provide means for separating the spaces while embracing an element therein in substantially sealing relation; and to provide for simplicity of construction, ease of manufacture, and effectiveness of operation.

Specific objects of my invention are to provide for dividing an inflatable suit into upper and lower portions, while permitting the passage of fluid, or electrical energy, or both from one portion to the other; to provide for admitting a portion of the body of the wearer through a diaphragm in substantially sealing relation and without discomfort to the wearer; to provide for substantially isolating the space within the torso portion of the suit from the space within the headpiece, while admitting the head of the wearer into the headpiece; and to provide for preventing fogging of the headpiece.

These and other objects and advantages of the invention will be apparent from the following description:

In the accompanying drawing, which forms a part of this specification, and in which like numerals are employed to designate like parts throughout the same,

Fig. 1 is a view in perspective of the upper part of an inflatable suit including a headpiece and

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torso portion constructed in accordance with and embodying the invention.

Fig. 2 is a view taken along line 2—2 of Fig. 1, parts being in section and broken away.

Fig. 3 is a view taken along line 3—3 of Fig. 2,

Fig. 4 is a view taken along line 4—4 of Fig. 2,

Fig. 5 is a view taken along line 5—5 of Fig. 2, broken lines indicating the neck of the wearer, and

Fig. 6 is a view like Fig. 5 but showing a modified construction.

In the embodiment of the invention as illustrated in the drawing, obscuration of the vision of the wearer of an inflatable suit 10 including a headpiece 11 is prevented effectively and conveniently with a minimum of discomfort to the wearer. As shown in Fig. 1, the headpiece 11 and a torso portion 12 of the suit 10 are secured to a ring structure 13 in a manner hereinafter described, and a partition or diaphragm 14 is secured to the ring structure 13. Suitable conduits and conductors in apertures in the diaphragm 14 permit conducting fluids, such as air and oxygen, and electrical energy from the torso portion 12 to the headpiece 11. A check valve 15 is provided for maintaining the pressure within the headpiece 11 substantially equivalent to the pressure within the torso portion 12 of the suit and is in the open position so long as such a pressure condition prevails. In the partition 14 an opening 16 having a reinforced margin 17 permits admitting the head of the wearer therethrough; and the partition is so constructed and arranged that the margin 17 is in substantially sealing relation with the neck of the wearer, as shown in Figs. 1, 5 and 6, as hereinafter more fully described.

The headpiece 11 is made, preferably although not necessarily, globular in form and may be made of a suitable transparent plastic, such as a methyl methacrylate resin, or glass material having the desired physical and optical properties. As shown in Figs. 3 and 4, the opening in the headpiece 11 is bounded by an outwardly curved flange portion 18, which is adapted to seat against a metal ring 19 while being in contact with a lip-sealing element 20, and which is held in position by a clamping ring 21, thereby providing for a fluid-tight joint.

Preferably, the ring 19 is made of aluminum or magnesium alloy for light weight; and the lip-sealing element 20 is made of a suitable resilient rubber-like or other material; and the clamping ring 21 may be made of stainless steel. The clamping ring is divided and is radially extensible and contractible within the confines of an annu-

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lar groove 22 in the metal ring 19. Ends 23 and 24 of the ring 21 as shown in Fig. 2, are interconnected by a toggle fastener 25, which is illustrated in the released position for purposes of clarity, the clamping ring 21, however, being shown in the locked condition.

The wall of the torso portion 12, which may be made of woven fabric impregnated or coated with a suitable rubber-like or other suitable impervious material, is attached to the metal ring 19 in the manner shown in Figs. 3 and 4. An annular element 26, which is trapezoidal in section and which may be made of a resilient rubber-like material, preferably covered or otherwise suitably reinforced as by fabric, is disposed in a similarly shaped annular groove 27 in the outer face of the ring 19. A divided clamping band 28, which may be made, for example, of steel strip stock and which is equipped with a pivotally mounted toggle fastener structure 29, is disposed adjacent the annular element 26 and is incased in a fabric sheath 30, which is secured to the exterior surface of the torso wall 12 as by a suitable adhesive, or by sewing, or both.

When the toggle fastener structure 29 is in the closed position, as shown in Fig. 2, the clamping band 28 presses the wall of the torso portion 12 against the annular element 26 and presses the latter inwardly into the groove 27. Also the band 28 maintains the upper part of the wall 12 in contact with a lip-sealing member 31 disposed and secured in an undercut circumferential groove 32 in the ring 19.

For separating the space within the torso portion 12 from the space within the headpiece 11, the partition or diaphragm 14 of stretchable rubber-like material or other suitable material is attached to and supported by the metal ring 19 at the lower face thereof, as shown especially in Figs. 3 and 4. Preferably, the partition 14 is a thin rubber sheet, circular in form, with a plurality of spaced-apart apertures in the rim portion for admitting screw fasteners 35, and has an opening 16 with a reinforced or beaded margin 17, which is adapted to fit snugly and conform to the neck contour, yet not tightly enough to cause discomfort to the wearer. A metal band 33, wedge-shaped in section, which registers with a similarly shaped recess 34 in the ring 19, retains the partition 14 under a slightly stressed condition by a clamping action, when secured in place by screw fasteners 35 extending through corresponding spaced-apart apertures in the band 33 and partition 14 and engaging with similarly spaced-apart threaded openings in the ring 19. It is to be understood that other means for attaching the partition 14 to the ring 19 may be utilized without departing from the scope of the invention.

Referring to Figs. 1, 2 and 3, a plurality of apertures in the partition 14 are provided at the inner face of the metal ring 19 for an air intake conduit 40, an oxygen conduit 41, an exhaled air conduit 42, and electrical conductors 43 and 44, for a throat microphone 45 and ear-phones 46. Suitable reinforcement, 47 to 49 inclusive, such as rubber-coated fabric cemented in place, may be provided for maintaining a substantially tight fit between the respective conduits 40, 41 and 42 and conductors 43 and 44 and the partition 14; likewise a fabric reinforcement 50 may be provided for facilitating mounting the check valve 51.

It is desirable for convenience to extend the air intake conduit 40 and the oxygen conduit 41 through the diaphragm 14 at the central front of

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the torso portion 12, as shown in Fig. 1. However, it is also desirable to position a jet member 51 to one side of the central front, preferably to the left, in order to direct intake air under pressure adjacent the inner surface of the headpiece 11 in the region of approximately forward visual observation.

Accordingly, a channel 52 in the ring 19, which is covered by a suitable metal plate 53 secured to the ring by screw fasteners 55, and which is in communication with the conduit 40 and the jet member 51, is provided for conducting air to the jet member 51. The air flowing out of an elongated orifice 54 of the jet member 51 flows in a thin sheet form over the surface of the headpiece in front of the face of the wearer thus preventing moisture condensation upon said surface, the moisture being, primarily, that which is evaporated from the exposed portion of the face and, secondarily, that which is contained in the intake air.

To maintain the water vapor content of the air within the headpiece 11 at a minimum, the exhaled air containing an appreciable quantity of water vapor, or a considerable part of it, is conducted from a mask 56 by the conduit 42 and exhausted into the torso portion 12 below the partitioning diaphragm 14 through a flap valve 57. The valve 57 is closed during the inhaling period and open during the exhaling period. Alternately and under certain conditions, it is feasible and may be desirable to have the oxygen conduit 41 serve also as the exhaled air conduit thereby eliminating the conduit 42 and flap valve 57, in which case a suitable check valve 53 may be provided in the conduit 41 portion extending below the partition 14. Then during the inhaling interval of breathing, this check valve 53 is in the closed position; but during the exhaling interval it is in the open position permitting the major part of the exhaled air to escape into the torso portion 12 below the partition 14.

Such an alternative arrangement is permissible, when the volumetric capacity of the conduit 41 is less than the maximum permissible volume of exhaled air, which may be mixed with oxygen and rebreathed without harmful physiological effects; and is practicable when suitable controls are provided to regulate the flow of oxygen according to the demand of the wearer of the suit.

In the operation of the invention, the wearer, clothed in suitable undergarments, dons the lower portion of the suit 10 including the torso portion 12. Then he positions the ring structure 13 including the partition 14 adjacent the torso 12 by registering his head with the opening 16 in the partition and pulling the ring structure downwardly until the margin 17 of the opening 16 is in contact with his neck, the margin being slightly upwardly curved, as shown in Figs. 1 and 5. The stretchable material of the partition 14 permits the margin 17 of the opening 16 to conform readily to the changes in contour of the head and to embrace the neck in substantially sealing relation without harmful constriction and discomfort to the wearer. The torso portion 12 and the ring structure 13 are joined in the way hereinabove described; and the clamping band 28 and toggle fastener structure 29 are placed in the closed position, securely uniting the suit and the ring in a fluid-tight manner.

The lower ends of the air intake conduit 40 and the oxygen conduit 41 are connected to suitable connector structures (not shown), which are interconnected through the wall of the torso por-

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tion with sources of supply of pressurized air and oxygen. The lower portion of the conduit 42 and the flap valve 57 are disposed below the partition 14 and, preferably, adjacent the back of the wearer. The microphone 45 and the earphones 46 are connected by plug members 58 and 59 to an exterior communication hookup (not shown).

The wearer next dons the helmet 60 including the earphones 46, and secures the microphone 45 in contact with his neck by a suitable strap and fastener means. The upper ends of the oxygen conduit 41 and the exhaled air conduit 42 above the partition 14 are connected to the mask 56, and then the mask is positioned over the nose and mouth of the wearer, as shown in Fig. 1, by means of straps 61 attached to the helmet 60. The conduits 41 and 42 and the conductors 43 and 44 are in a slack condition to permit turning movement of the head of the wearer.

As a final step, the wearer places the headpiece over his head and positions it in contact with the ring structure 13, as described previously. Then the toggle fastener 25 is placed in the locked position, which causes the clamping ring 21 to engage the flange 18 of the headpiece 11, thus uniting effectively the headpiece and the ring structure in a fluid-tight manner.

Oxygen is supplied to the wearer in accordance with his requirements as determined by the altitude of flight and his energy expenditure; and it flows upwardly in the conduit 41 to the mask 56 during the inhaling period, the flap valve 57 being closed. Suitable valve means in the aforesaid connector structure for the conduit 41 functions to shut off the oxygen supply at the beginning of the exhaling period, while the flap valve 57 in the conduit 42 opens coincidentally to exhaust a considerable part of the exhaled air into the torso portion 12 below the partition 14, any remaining part being retained in the conduits 41 and 42, and being re-breathed subsequently. In this way the exhaled air, which contains an appreciable proportion of water vapor, is prevented by the partition 14 from diffusing into the atmosphere within the headpiece 11; consequently one of the two major causes of fogging is eliminated effectively.

Air under pressure and, preferably, of low relative humidity is admitted into the conduit 40 and flows upwardly therein through the diaphragm 14 to the channel 52 in the ring 19, and then flows to and out of the jet member 51 into the space in the headpiece 11 above the diaphragm. The elongated orifice 54 of the jet member 51 directs a wide, thin stream of air generally in the direction along the wall of the headpiece in front of the face of the wearer, effectively preventing fogging at this portion of the headpiece.

After flowing beyond the region of the face, the air diffuses and circulates to a limited extent within the headpiece 11, after which it is discharged therefrom through the check valve 15 into the space in the torso 12 below the diaphragm 14. Moisture, which is evaporated from the surface of the exposed parts of the head, is carried away by the incoming air and rapidly exhausted through the check valve 15 into the torso 12. Exhaled air and pressurized air are exhausted from the lower portion 12 below the diaphragm 14 by a suitable pressure responsive means (not shown) in the wall of the suit. The air circulation plus rapid moisture disposal prevents fogging of the remaining surface of the headpiece.

Since the air circulates to a limited extent within the headpiece, an objectionable cool draft

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may be caused upon the neck of the wearer, especially the back part. Under such conditions, a collar 62 of sheepskin, for example, may be disposed between the margin 17 of the diaphragm 14 and the neck, as shown in Fig. 6, the wool fibres of the sheepskin being adjacent the skin of the wearer. This arrangement permits freedom of head movement, and gives an adequate sealing between the neck and the margin 17, and provides desirable protection against the drafts of air.

It will be apparent from the hereinabove description that my invention provides for substantially confining and isolating the water vapor from two principal sources from the space within the headpiece. These two sources are evaporation of moisture from the torso and limbs of the wearer, and moisture contained in the exhaled air. Then, too, the water vapor due to evaporation of moisture from the exposed portions of the head, and the water vapor contained in the intake air under pressure, both of which are comparatively small in quantity, are removed expeditiously from the headpiece and discharged into the torso portion below the partitioning diaphragm. All of which, in combination with the jet action and air circulation previously described, prevent fogging of the headpiece in an effective manner.

Variations may be made without departing from the scope of the invention as it is defined in the following claims:

I claim:

1. In an inflatable suit including a headpiece and a torso portion, the combination of a ring structure uniting said headpiece and said torso portion, a flexible diaphragm supported by said ring and having a plurality of spaced-apart apertures, one of which has a margin adapted to embrace the neck of the wearer in substantially sealing relation, a fluid conduit in another of said apertures, and jet means in still another of said apertures adjacent said ring structure for discharging fluid within said headpiece.

2. In an inflatable suit including a headpiece and a torso portion, in combination, a ring structure uniting said headpiece and said torso portion, a flexible partition of rubber-like material supported by said ring structure and having a plurality of spaced-apart apertures, one of which has a margin adapted to embrace the neck of the wearer in substantially sealing relation, a fluid conduit in another of said apertures, jet means in still another of said apertures for discharging fluid within said headpiece, pressure responsive means for exhausting fluid from the headpiece into the torso portion of the suit, and an electrical conductor in still another of said apertures.

3. In an inflatable suit including a headpiece and a torso portion, in combination, a ring structure having an inner and an outer face, a flexible partition including rubber-like material secured to said ring structure and having an aperture for receiving the neck of the wearer in substantially sealing relation therewith, means for securing said torso portion to said ring structure at one of said faces, and means for securing said headpiece to said ring structure at the other said face including means for detaching the said headpiece while leaving fully intact the attachment of said partition and said torso portion to said ring structure.

4. In an inflatable suit including a headpiece and a torso portion, in combination, a ring struc-

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ture having an inner and an outer face, a flexible partition including rubber-like material secured to said ring structure and having an aperture for receiving the neck of the wearer in substantially sealing relation therewith, means for securing said headpiece to said ring structure at said inner face and for securing said torso portion to said ring structure at said outer face, the securing means including means for detaching each said headpiece and said torso portion independently of one another from said ring structure while leaving fully intact the attachment of said partition to said ring structure.

5. In an inflatable suit including a headpiece and a torso portion, in combination, a ring structure having an inner and an outer face, means for independently and detachably engaging said headpiece in a fluid-tight manner with said ring structure at one of said faces, means for independently and detachably engaging said torso portion in a fluid-tight manner with said ring structure at the other of said faces, a partition supported by and secured to said ring structure for substantially isolating the space within said headpiece from the space within said torso portion and said partition having an opening therein which has a margin adapted to embrace the neck of the wearer in substantially sealing relation, the attachment of said partition to said ring structure remaining fully intact during the independent detachment of each said headpiece and torso portion from said ring structure, and conduit means extending through and beyond each face of said partition and being adapted for permitting continuity of free flow in either direction with respect to said partition.

6. In an inflatable suit including a body portion and a headpiece with a transparent portion, in combination, a ring structure uniting said body portion and said headpiece, a diaphragm secured to said ring structure and substantially isolating said body portion from said headpiece, jet means extending through an aperture in said diaphragm and including discharging means extending upwardly relative to said diaphragm in spaced-apart relation to said headpiece adjacent said transparent portion for discharging fluid across said transparent portion, and exhaust means for conducting fluid through said diaphragm from within said headpiece to said body portion and including a fluid conduit extending through and beyond said diaphragm into said body portion for discharging fluid into the space within said body portion.

7. In an inflatable suit including a body portion and a headpiece with a transparent portion, in combination, a ring structure uniting said body portion and said headpiece, a diaphragm supported by said ring structure substantially isolating said body portion from said headpiece, jet means extending through an aperture in said diaphragm and including discharging means extending upwardly relative to said diaphragm in spaced-apart relation to and generally conformingly along the wall of said headpiece adjacent said transparent portion for discharging fluid in substantially thin sheet form across said transparent portion within said headpiece, and pressure responsive means for exhausting fluid from within said headpiece into said torso portion.

8. In an inflatable suit including a headpiece and a torso portion, in combination, a ring struc-

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ture uniting said headpiece and said torso portion, a flexible partition supported by and secured to said ring structure and having a plurality of spaced-apart apertures, one of said apertures having a margin adapted to embrace the neck of the wearer in substantially sealing relation, an intake fluid conduit of substantially unrestricted bore extending through a second aperture and beyond each side of said partition and adapted for freely conducting fluid therethrough in either direction with respect to said partition, an exhaust fluid conduit of substantially unrestricted bore extending through and beyond a third aperture and adapted for freely conducting fluid in either direction with respect to said partition, said exhaust fluid conduit terminating at one end thereof within said torso portion, valve means at said end for exhausting fluid from said exhaust conduit into the space within said torso portion, and a breathing mask positionable within said headpiece and carried solely by the head of the wearer and being in communication with said fluid conduits.

9. In an inflatable suit including a headpiece and a torso portion, in combination, a ring structure uniting said headpiece and said torso portion, a flexible partition supported by said ring structure and having a plurality of spaced-apart apertures, one of said apertures having a margin adapted to embrace the neck of the wearer in substantially sealing relation and the other apertures being adjacent said ring structure and positioned within the boundaries of a circumferentially extending zone of relatively small extent as compared to that of said partition, a fluid conduit in one of said other apertures, jet means in another of said other apertures for discharging fluid within said headpiece, and an electrical conductor in still another of said other apertures.

10. In an inflatable suit including a body portion and a headpiece with a transparent portion, in combination, a ring structure having an inner and an outer face uniting said body portion and said diaphragm and having a circumferentially extending depression in said inner face, means disposed in said depression in said inner face for detachably engaging said headpiece with said ring structure at said inner face, means for detachably engaging said body portion with said ring structure at said outer face, a flexible diaphragm of rubber-like material supported by and secured to said ring structure and having a plurality of spaced-apart apertures, one of which has a margin adapted to embrace the neck of the wearer in substantially sealing relation and the other apertures being positioned within the boundaries of a circumferentially extending zone adjacent said ring structure, said zone being of relatively small extent as compared to that of said diaphragm, an intake fluid conduit in one of said other apertures, an exhaust fluid conduit in a second said other aperture, jet means in a third said other aperture for discharging fluid within said headpiece, an electrical conductor in a fourth said other aperture, pressure responsive means for exhausting fluid from the headpiece into said body portion, and a breathing mask positionable within said headpiece and carried solely by the head of the wearer and being in communication with said intake and said exhaust fluid conduit.

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