Acceleration protective suit

[0001] This invention concerns an acceleration protective suit for the crew of high-performance aircraft. Such protective suits are available in some executions. They are classified into different type of suits - those which are supplied with air as compressed fluid, the so-called pneumatic protection suits, and suits which work based on the hydrostatic principle. The latter type either creates hydrostatic pressure directly on the person wearing the suit or it is provided with fluid veins that pass through mainly the local and instantaneous Z-axis and increase the internal pressure of the liquid column correspondingly by shortening the size of the protective suit. Together they are known simply as hydrostatic protection suits, although the fluid is not restricted to water alone.

[0002] The invention especially involves a pneumatic protective suit. Few such protective suits are already known, for example from EP 1 755 948 which is closest to the prior art, furthermore there are also a few from US 2007/0289050, JP 2008 012 958 and DE 10 2007 053 236.

[0003] In such protective suits, the parts or regions of the body that are to be protected are surrounded by the protective suit or parts of it. The parts and regions of the body that are especially subject to extreme accelerations are thereby pressurised within such protective suits via bladders or pipes impinged with compressed air or gas subject to the accelerations in the instantaneous and local Z axis, known as G_z, by which the haemostatic pressure is counteracted. This is the overall object of such a protective suit.

[0004] The costs for an effective G-protection are still considerable with traditional suits and it is this invention's intention to reduce these costs with a new suit. This protective suit should be effective under all circumstances and in all conditions without special actions from the wearer, which are the case in traditional suits, especially in the border areas. Traditional protective suits are relatively heavy, stiff and the wearer sweats easily in it, which negatively impacts his mental state. Some suits may cause foot and arm pain for the wearer. With

Patent Claims

1. Acceleration protective suit for pilots of high-performance aircraft with a covering (4) made of stretch-resistant textile material, where at least parts of covering (4) are designed with two walls and thus form compartments (6) on the inner and outer side of the covering (4), where air tubes (2) are inserted in the compartment, consisting of flexible and stretchable plastic, and these air tubes (2) can be supplied with acceleration-dependent air pressures and thus can be stretched as bladders, characterised in that the suit is equipped with at least two different types of compartments (6) with air tubes (2) for forming air bladders, namely the first type with compartments (6) acting as "spacer" (10), which has loose air tube inside the compartment, so that contour can be formed during compressed air supply with the air tube (2), which in turn differs from the compartment containing it, whereby the volume of the air tube (2) inside the compartment (6) is smaller than the inner volume of the compartment (6) and the second type with compartments (6) acting as "muscles" (9), where the compartments (6) are clung inside with tube material in their inner side, so that the compartments and air tubes always have the same contour, and in addition there is a pressure bladder (12) in the protective suit, which is located in the abdominal area of the wearer of the acceleration protective suit and to which all air tubes (9, 10) are connected, communicating freely with all air tubes in all compartments (6), whereby the pressure bladder (12) has at least one main valve (13) to which the compressed air supply of the acceleration protective suit can be connected and which is set up in such a way that it closes, if the supply air pressure and/or pressure in cockpit drops.

2. Acceleration protective suit according to claim 1, *characterised in that*, in case of compartments acting as "muscles", these compartments (6) are made of the same material like the covering (4), whereby the "muscles" (9) are restricted in their volume and in case of compartments acting as "Spacer" the inner side of the compartments (6) is made of stretchable elastic material, so that the "spacer" (10) can be stretched as part of elasticity of the compartments.

3. Acceleration protective suit according to one of the previous claims, characterised in that, the compartments (6) for the air tubes (2) meant to act as spacer have closed,

thin-walled bladders (25) at the sides positioned against the outer side of the protective suit to compensate for the reduced barometric pressure.

4. Acceleration protective suit according to one of the previous claims, *characterised in that*, the air tubes (9, 10) of the acceleration protective suit stretch over the following body parts to be covered by the protective suit: Arms, legs, thorax, spine and stomach.

5. Acceleration protective suit according to one of the previous claims, *characterised in that*, the protective suit includes an electrical fan (23) for sucking in ambient air and supplying the same to the ventilation veins (21), which are laid separately in the protective suit and ventilation veins (21) with a number of holes (22) with closing lips are placed in the compartments that act as "spacers", through which air can be supplied to the inner side of the compartments by the fan (23) over separate ventilation veins (21), where the air can be diffused by the compartment material, for cooling the body surface of the wearer of the acceleration protective suit.

6. Acceleration protective suit according to one of the previous claims 1 to 4, *characterised in that*, the protective suit includes an electrical fan (23) for sucking in ambient air and supplying the same to the ventilation veins (21), which are laid separately in the protective suit and ventilation veins (21) with a number of holes (22) with closing lips are integrated in the compartments that act as "muscles", through which air can supplied to the inner side of the compartments by the fan (23) over separate ventilation veins, where the air can be diffused by the compartment material, for cooling the body surface of the wearer of the acceleration protective suit.

7. Acceleration protective suit according to one of the previous claim, *characterised in that*, the protective suit includes an electrical fan (23), for sucking in ambient air and supplying the same to the ventilation veins (21) that are laid separately in the protective suit, and that ventilation veins (21) with a number of holes (22) with closing lips are placed in the compartments acting as "spacers" along air tubes, whereby air can be delivered into the inner side of the compartment via the ventilation veins (21) when there is increased air pressure, whereby air can be diffused by the compartment material for cooling the body surface of the wearer of the protective suit. Likewise there are ventilation veins (21) with a number of holes (22) with closing lips in the compartments acting as "muscles" along the air tubes, which are integrated opposite to the inner side of the compartments, where air can be delivered

via ventilation veins when there is increased air pressure and which can be diffused by the adjacent compartment material for cooling the body surface of the wearer of the protective suit.

8. Acceleration protective suit according to one of the previous claims, *characterised in that*, at least 40% of the compartments located on the surface of the compartment sides of the acceleration protective suit adjacent to the body are considered as compartments acting as "spacers" and at least 40% are compartments acting as "muscles".

9. Acceleration protective suit according to one of the previous claims, *characterised in that*, half of the compartments located on the surface of the compartment sides of the acceleration protective suit adjacent to the body are considered as compartments acting as "spacers" and half are compartments acting as "muscles".

10. Acceleration protective suit according to one the previous claims, *characterised in that*, the pressure bladder (12) is the supplier of compressed air to the air pockets (16) and also has a device to which the air bladder (12) is connected and with which a clocked pumping of air pockets (16) can be achieved.

11. Acceleration protective suit according to claim 10, *characterised in that*, the device for clocked pumping of air pockets (16) connected to the pressure bladder (12) interacts with compartments of the first type, where the compartments stretch from the feet up to the throat section and which has veins partially filled with water and multiple air pockets, which are fixed on the inside in the water veins and can be filled with compressed air sequentially from bottom to top, so that water can be pushed from bottom to top and which builds a rhythmically increasing and, in the case of sequential or total venting of the air pockets, decreasing pressure in the acceleration protective suit, for relieving circulation or for increasing of the electrolyte level of the heart of the wearer.

12. Acceleration protective suit according to one of the previous claim, *characterised in that*, the air supply of the ventilation veins (21) are supplied by the bladder (12).

13. Acceleration protective suit according to one of the previous claim, *characterised in that*, the pressure bladder (12) connects downstream to another check valve and upstream to ventilation veins (21), which closes if there is a sudden pressure loss in the supply line of the aircraft and/or in the cockpit atmosphere.

Acceleration protective suit

[0001] This invention concerns an acceleration protective suit for the crew of high-performance aircraft. Such protective suits are available in some executions. They are classified into different type of suits - those which are supplied with air as compressed fluid, the so-called pneumatic protection suits, and suits which work based on the hydrostatic principle. The latter type either creates hydrostatic pressure directly on the person wearing the suit or it is provided with fluid veins that pass through mainly the local and instantaneous Z-axis and increase the internal pressure of the liquid column correspondingly by shortening the size of the protective suit. Together they are known simply as hydrostatic protection suits, although the fluid is not restricted to water alone.

[0002] The invention especially involves a pneumatic protective suit. Few such protective suits are already known, for example from EP 1 755 948 which is closest to the prior art, furthermore there are also a few from US 2007/0289050, JP 2008 012 958 and DE 10 2007 053 236. Document WO 03/020586 A1 discloses a protective suit made of low-stretch material with double-walled compartments or bags. In the compartments, there are flexible plastic pipes laid. The air pipes are loadable with acceleration-dependent air pressures and thus stretchable as bubbles.

[0003] In such protective suits, the parts or regions of the body that are to be protected are surrounded by the protective suit or parts of it. The parts and regions of the body that are especially subject to extreme accelerations are thereby pressurised within such protective suits via bladders or pipes impinged with compressed air or gas subject to the accelerations in the instantaneous and local Z axis, known as G_z, by which the haemostatic pressure is counteracted. This is the overall object of such a protective suit.

[0004] The costs for an effective G-protection are still considerable with traditional suits and it is this invention's intention to reduce these costs with a new suit. This protective suit should be effective under all circumstances and in all conditions without special actions from the wearer, which are the case in traditional suits, especially in the border areas. Traditional protective suits are relatively heavy, stiff and the wearer sweats easily in it, which negatively impacts his mental state. Some suits may cause foot and arm pain for the wearer. With

Patent Claims

1. Acceleration protective suit for pilots of high-performance aircraft with a covering (4) made of stretch-resistant textile material, where at least parts of covering (4) are designed with two walls and thus form compartments (6) on the inner and outer side of the covering (4), where air tubes (2) are inserted in the compartment, consisting of flexible and stretchable plastic, and these air tubes (2) can be supplied with acceleration-dependent air pressures and thus can be stretched as bladders, characterised in that the suit is equipped with at least two different types of compartments (6) with air tubes (2) for forming air bladders, namely the first type with compartments (6) acting as "spacer" (10), which on the side faced toward the body of the wearer are made of an elastic textile fabric or knitted fabric while the opposite side of the compartment (6) is made of an inelastic matetrial, and which has loose air tube inside the compartment, so that contour can be formed during compressed air supply with the air tube (2), which in turn differs from the compartment containing it, whereby the volume of the air tube (2) inside the compartment (6) is smaller than the inner volume of the compartment (6) and the second type with compartments (6) acting as "muscles" (9), where the compartments (6) are clung inside with tube material in their inner side, so that the compartments and air tubes always have the same contour, and in addition there is a pressure bladder (12) in the protective suit, which is located in the abdominal area of the wearer of the acceleration protective suit and to which all air tubes (9, 10) are connected, communicating freely with all air tubes in all compartments (6), whereby the pressure bladder (12) has at least one main valve (13) to which the compressed air supply of the acceleration protective suit can be connected and which is set up in such a way that it closes, if the supply air pressure and/or pressure in cockpit drops.

2. Acceleration protective suit according to claim 1, *characterised in that*, in case of compartments acting as "muscles", these compartments (6) are made of the same material like the covering (4), whereby the "muscles" (9) are restricted in their volume and in case of compartments acting as "Spacer" the inner side of the compartments (6) is made of stretchable elastic material, so that the "spacer" (10) can be stretched as part of elasticity of the compartments.

3. Acceleration protective suit according to one of the previous claims, characterised in that, the compartments (6) for the air tubes (2) meant to act as spacer have closed, thin-walled bladders (25) at the sides positioned against the outer side of the protective suit to compensate for the reduced barometric pressure.

4. Acceleration protective suit according to one of the previous claims, *characterised in that*, the muscles (9) and spacers (10) of the acceleration protective suit stretch over the following body parts to be covered by the protective suit: Arms, legs, thorax, spine and stomach.

5. Acceleration protective suit according to one of the previous claims, *characterised in that*, the protective suit includes an electrical fan (23) for sucking in ambient air and supplying the same to the ventilation veins (21), which are laid separately in the protective suit and ventilation veins (21) with a number of holes (22) with closing lips are placed in the compartments that act as "spacers", through which air can be supplied to the inner side of the compartments by the fan (23) over separate ventilation veins (21), where the air can be diffused by the compartment material, for cooling the body surface of the wearer of the acceleration protective suit.

6. Acceleration protective suit according to one of the previous claims 1 to 4, *characterised in that*, the protective suit includes an electrical fan (23) for sucking in ambient air and supplying the same to the ventilation veins (21), which are laid separately in the protective suit and ventilation veins (21) with a number of holes (22) with closing lips are integrated in the compartments that act as "muscles", through which air can supplied to the inner side of the compartments by the fan (23) over separate ventilation veins, where the air can be diffused by the compartment material, for cooling the body surface of the wearer of the acceleration protective suit.

7. Acceleration protective suit according to one of claims 1 to 4, *characterised in that*, the protective suit includes an electrical fan (23), for sucking in ambient air and supplying the same to the ventilation veins (21) that are laid separately in the protective suit, and that ventilation veins (21) with a number of holes (22) with closing lips are placed in the compartments acting as "spacers" along air tubes, whereby air can be delivered into the inner side of the compartment via the ventilation veins (21) when there is increased air pressure, whereby air can be diffused by the compartment material for cooling the body surface of the wearer of the protective suit. Likewise there are ventilation veins (21) with a number of holes (22) with closing lips in the compartments acting as "muscles" along the air tubes, which are integrated opposite to the inner side of the compartments, where air can be delivered via ventilation veins when there is increased air pressure and which can be diffused by the adjacent compartment material for cooling the body surface of the wearer of the protective suit.

8. Acceleration protective suit according to one of the previous claims, *characterised in that*, at least 40% of the compartments located on the surface of the compartment sides of the acceleration protective suit adjacent to the body are considered as compartments acting as "spacers" and at least 40% are compartments acting as "muscles".

9. Acceleration protective suit according to one of the previous claims, *characterised in that*, half of the compartments located on the surface of the compartment sides of the acceleration protective suit adjacent to the body are considered as compartments acting as "spacers" and half are compartments acting as "muscles".

10. Acceleration protective suit according to one the previous claims, *characterised in that*, the pressure bladder (12) is the supplier of compressed air to the air pockets (16) and also has a device to which the air bladder (12) is connected and with which a clocked pumping of air pockets (16) can be achieved.

11. Acceleration protective suit according to claim 10, *characterised in that*, the device for clocked pumping of air pockets (16) connected to the pressure bladder (12) interacts with compartments of the first type, where the compartments stretch from the feet up to the throat section and which has veins partially filled with water and multiple air pockets, which are fixed on the inside in the water veins and can be filled with compressed air sequentially from bottom to top, so that water can be pushed from bottom to top and which builds a rhythmically increasing and, in the case of sequential or total venting of the air pockets, decreasing pressure in the acceleration protective suit, for relieving circulation or for increasing of the electrolyte level of the heart of the wearer.

12. Acceleration protective suit according to one of the previous claim, *characterised in that*, the air supply of the ventilation veins (21) are supplied by the bladder (12).

13. Acceleration protective suit according to one of the previous claim, *characterised in that*, the pressure bladder (12) connects downstream to another check valve and upstream to ventilation veins (21), which closes if there is a sudden pressure loss in the supply line of the aircraft and/or in the cockpit atmosphere.