

DESCRIPTION

THIN AIR JACK

TECHNICAL FIELD

[0001] The present invention relates to a thin air jack used for lifting, for example, heavy objects such as automobiles, to be repaired, inspected, etc., or lifting desired portions of collapsed buildings or the like to save the buried people at the time of earthquakes, typhoons, accidents or the like, and particularly to a thin air jack which is highly safe and capable of being inserted into even an extremely narrow opening in an automobile or the like to lift the automobile or other heavy objects, and is excellent in handleability and operability to which air can be supplied with bicycle pumps, compressors and the like.

BACKGROUND ART

[0002] Generally, hydraulic jacks, mechanical jacks and the like are conventionally used as jacks for lifting heavy objects such as automobiles.

These jacks have had the problems that they are all large in height when retracted, so that they cannot be inserted into narrow openings, and that they are heavy and have poor handleability.

[0003] To this end, an air jack apparatus having a bag structure for solving the problems mentioned above was developed, and is disclosed in Japanese Unexamined Patent Publication No. 2000-247587 (refer to Reference 1).

[0004] That is, the air jack apparatus 20 is provided with, as shown in Figs. 12 to 14, a rectangular rubber tube 21, an enclosure body 22 which is formed in a rectangular shaped with nylon woven fabric or aramid woven fabric and accommodates the rubber tube 21, and an air joint 23 which supplies air to the rubber tube 21, a pair of opposing sides of the rubber tube 21 and the enclosure body 22 are nipped by metal plates 24, screws 25 and nuts 26, respectively, while another pair of opposing sides of the rubber tube 21 and enclosure body 22 are folded inwardly in a V-shape, respectively.

[0005] Moreover, between the rubber tube 21 and enclosure body 22 and on the surface of the enclosure body 22, two sets of metallic reinforcement plates 27 are placed in a manner of nipping the enclosure body 22, respectively. These two sets of the metallic reinforcement plates 27 are coupled by rivets 28.

[0006] Furthermore, to the metallic reinforcement plates 27 on the surface side of the enclosure body 22, the rubber plates 29 are stuck, respectively, and on the upper rubber plate 29 among these rubber plates 29, a recessed groove 31

into which a lower frame 30 of the automobile bodywork is inserted is formed.

[0007] In addition, when the air jack apparatus 20 is placed at the lower surface of the heavy object to be lifted and then compressed air is injected from the air joint 23 into the rubber tube 21, the rubber tube 21 is expanded, which also expands the enclosure body 22, so that the heavy object can be lifted.

[0008] Since this air jack apparatus 20 uses the rubber tube 21 and the enclosure body 22 made of woven fabric, its appearance shape can be thin as a whole, and can be inserted into narrow openings to lift heavy objects.

[0009] However, the air jack apparatus 20 accommodates the rubber tube 21 within the enclosure body 22 made of woven fabric, and therefore the frictional resistance between the enclosure body 22 and the rubber tube 21 becomes extremely large. Therefore, when the rubber tube 21 is inflated in a state that a load is applied on the enclosure body 22 and the rubber tube 21, the rubber tube 21 is not inflated uniformly, and a large load is applied on a part of the rubber tube 21 so that the rubber tube 21 may rupture, resulting in poor safety.

[0010] Moreover, in the air jack apparatus 20, an excessive amount of compressed air may be put into the rubber tube 21 when the rubber tube 21 is inflated. In the worst

case, there is the possibility that the rubber tube 21 ruptures.

[0011] Furthermore, in the air jack apparatus 20, both end portions of the rubber tubes 21 and enclosure body 22 are nipped by the metal plates 24, and the metallic reinforcement plate 27 and rubber plate 29 are attached to a central portion of the enclosure body 22 on the surface side thereof. Therefore, its thickness cannot be extremely small, and its smallest thickness is about 6 cm. As a result, there had been the problem that it cannot be inserted into or used for an extremely narrow opening.

[0012] Furthermore, in the air jack apparatus 20, the rubber tube 21 needs to be inflated, and, for example, it is difficult to inflate the rubber tube 21 with a manual bicycle pump. The air jack apparatus 20 therefore requires an air compressor when used, which is disadvantageous in terms of handleability and operability.

CITATION LIST

PATENT LITERATURE

[0013]

Patent document 1: Japanese Laid-Open Patent Publication No. 2000-247587

SUMMARY OF INVENTION

TECHNICAL PROBLEM

[0014] The present invention has been made in view of such problems, and its object is to provide a thin air jack which is highly safe and capable of being inserted into even an extremely narrow opening in an automobile or the like to lift the automobile or other heavy objects, to which air can be supplied with bicycle pumps, compressors and the like, and which is excellent in handleability and operability.

SOLUTION TO PROBLEM

[0015] To achieve the above objects, a first invention of the present invention includes an airtight body which is formed in the shape of a bag having a sealed structure with a film, an air supply hose whose base end portion is inserted into the airtight body in an airtight manner and which is provided with a connector with a check valve connected to an air supply source at its tip portion, a valve attachment hose whose base end portion is inserted into the airtight body in an airtight manner and which is provided with a safety valve at its tip portion, a cover body which is formed in the shape of a bag with a synthetic resin material having low frictional resistance and which accommodates the airtight body in a state that the tip portions of the air supply hose and valve attachment hose protrude outwardly, respectively, an interior body which is formed with a woven fabric made of

synthetic fiber in the shape of a bag and which accommodates the airtight body and cover body in a state that the tip portions of the air supply hose and valve attachment hose protrude outwardly, respectively, and a cylindrical exterior body formed by turning a hose having the same structure as a fire hose inside out or a cylindrical exterior body prepared by applying a painting onto a cylindrical fabric, and is characterized in that the exterior body accommodates the airtight body, cover body and interior body in a state that the tip portions of at least the connector with check valve and the safety valve protrude from one end portion of the exterior body outwardly, and is formed in the shape of a flat bag in a state that both end portions are closed.

[0016] A second invention of the present invention is characterized in that it includes an airtight body which is formed in the shape of a bag having a sealed structure with a film, an air supply hose whose base end portion is inserted into the airtight body in an airtight manner and which has a branch joint provided at its tip portion, a connector with check valve and a safety valve connected to the air supply source connected to the branch joint, respectively, a cover body which is formed in the shape of a bag with a synthetic resin material having low frictional resistance and which accommodates the airtight body in a state that the tip portion of the air supply hose protrudes outwardly, an

interior body which is formed with a woven fabric made of synthetic fiber in the shape of a bag and which accommodates the airtight body and cover body in a state that the tip portion of the air supply hose protrudes outwardly, and a cylindrical exterior body formed by turning a hose having the same structure as a fire hose inside out or a cylindrical exterior body prepared by applying a painting onto a cylindrical fabric, the exterior body accommodates the airtight body, cover body and interior body in a state that the tip portions of at least the connector with check valve and the safety valve protrude from one end of the exterior body outwardly and is formed in the shape of a flat bag in a state that both end portions are closed.

[0017] A third invention of the present invention is characterized in that, in the first invention, the airtight body is formed to have a sealed structure with a multilayer film or single-layer film having excellent gas barrier property in the shape of a rectangular bag, has hose attachment cylindrical parts into which the base end portions of the air supply hose and valve attachment hose are inserted, respectively, on its opposing two sides in an inclined attitude, and the air supply hose and valve attachment hose have their base end portions inserted into the hose attachment cylindrical parts of the airtight body, respectively, and part or all of the outer circumferential

surfaces of the hose attachment cylindrical parts is fastened in an airtight manner by fastening means to prevent falling off.

[0018] A fourth invention of the present invention is characterized in that, in the second invention, the airtight body is formed to have a sealed structure in the shape of a rectangular bag with a multilayer film or single-layer film having excellent gas barrier property, has a hose attachment cylindrical part into which the base end portion of the air supply hose is inserted on one of its sides in an inclined attitude, and the air supply hose has its base end portion inserted into the hose attachment cylindrical part of the airtight body, and part or all of the outer circumferential surfaces of the hose attachment cylindrical parts is fastened in an airtight manner by fastening means to prevent falling off.

[0019] A fifth invention of the present invention is characterized in that, in the third or fourth invention, the multilayer film is made of a nylon multilayer film, and the single-layer film is made of a thermoplastic polyurethane film.

[0020] A sixth invention of the present invention is characterized in that, in the third invention, the hose attachment cylindrical parts of the airtight body and the base end portions of the air supply hose and valve attachment

hose are positioned to the inside of the airtight body, and the tip portions of the air supply hose and valve attachment hose are positioned on the outside of the airtight body.

[0021] A seventh invention of the present invention is characterized in that, in the fourth invention, the hose attachment cylindrical part of the airtight body and the base end portion of the air supply hose are positioned on the inside of the airtight body, and the tip portion of the air supply hose is positioned on the outside of the airtight body.

[0022] An eighth invention of the present invention is characterized in that, in the third or fourth invention, opposing two sides of the airtight body with no hose attachment cylindrical part provided are folded inwardly, respectively.

[0023] The ninth invention of the present invention is characterized in that, in the third invention, the insertion lengths of the air supply hose and valve attachment hose into the hose attachment cylindrical parts of the airtight body are set to be a few centimeters or longer, respectively.

[0024] The tenth invention of the present invention is characterized in that, in the fourth invention, the insertion length of the air supply hose into the hose attachment cylindrical part of the airtight body is a few centimeters or longer, respectively.

[0025] The eleventh invention of the present invention is characterized in that, in the third invention, adhesive layers are interposed between outer circumferential surfaces of the base end portions of the air supply hose and valve attachment hose and an inner circumferential surface of the hose attachment cylindrical parts of the airtight body, respectively.

[0026] A twelfth invention of the present invention is characterized in that, in the fourth invention, adhesive layers are interposed between an outer circumferential surface of the base end portion of the air supply hose and an inner circumferential surface of the hose attachment cylindrical part of the airtight body, respectively.

[0027] A thirteenth invention of the present invention is characterized in that, in the first invention or second invention, a reinforcing piece made of a tape or cloth or resin sheet is affixed onto part or all of both sides of the outer circumferential edge of the airtight body.

[0028] A fourteenth invention of the present invention is characterized in that, in the first or second invention, the connector with check valve is a onetouch joint type coupler with check valve.

[0029] A fifteenth invention of the present invention is characterized in that, in the first invention, the cover body is formed in the shape of a rectangular bag having at least

one of the sides being open with a synthetic resin tube or synthetic resin sheet, and withdrawal holes for pulling out the tip portion sides of the air supply hose and valve attachment hose to the outside, respectively, are formed on the sides neighboring the open side.

[0030] A sixteenth invention of the present invention is characterized in that, in the second invention, the cover body is formed in the shape of a rectangular bag having at least one of the sides being open with a synthetic resin tube or synthetic resin sheet, and a withdrawal hole for pulling out the tip portion side of the air supply hose to the outside is formed on the side neighboring the open side.

[0031] A seventeenth invention of the present invention is characterized in that, in the first or second invention, the interior body is formed of a band-shaped woven fabric made of synthetic fiber, and has such a structure that both end portions of the airtight body are retained by the inner face of the interior body by overlaying both end portions of the band-shaped woven fabric and attaching by sewing or adhering the overlapping portion, and accommodating the airtight body and cover body in the inside of the interior body.

[0032] An eighteenth invention of the present invention is characterized in that, in the first invention, the exterior body is formed by turning inside out a hose having the same structure as a fire hose made by forming a lining layer made

of a thermoplastic polyurethane elastomer on the inner circumferential surface of a jacket woven cylindrically with warps made of synthetic fiber and wefts made of synthetic fiber, or formed of a cylindrical fabric having a painting thereon, and is formed in the shape of a flat bag by closing the openings in both end portions of the fire hose or the cylindrical fabric by at least one of metal fittings, welding and attaching by sewing in a state that the tip portions of at least the connector with check valve and the safety valve protrude to the outside from the openings of the base end portion of the exterior body.

[0033] The nineteenth invention of the present invention is characterized in that, in the second invention, the exterior body is formed by turning inside out a hose having the same structure as a fire hose made by forming a lining layer made of a thermoplastic polyurethane elastomer on the inner circumferential surface of a jacket woven cylindrically with warps made of synthetic fiber and wefts made of synthetic fiber, or formed of a cylindrical fabric having a painting thereon, and is formed in the shape of a flat bag by closing the openings in both end portions of the fire hose or cylindrical fabric by at least one of metal fittings, welding and attachment by sewing in a state that the tip portions of at least the connector with check valve and the safety valve protrude to the outside from the opening of the base end

portion of the exterior body.

[0034] The twentieth invention of the present inventions characterized in that, in the first or second invention, part of the air supply hose and part of the exterior body are fixed by a caulking process with a metal ring.

ADVANTAGEOUS EFFECTS OF INVENTION

[0035] In the thin air jack of the present invention, the airtight body formed in the shape of a bag with a film is accommodated in the cover body formed in the shape of a bag from a synthetic resin material, and these are further sequentially accommodated in the interior body made of synthetic fiber and the exterior body having the same structure as a fire hose or the cylindrical exterior body prepared by applying a painting onto a cylindrical fabric. Therefore, the frictional resistance between the airtight body and the interior body is significantly reduced by the cover body, and as a result, the airtight body uniformly inflates when the airtight body inflates in a state that a load is applied on the thin air jack, and a load is not applied partially on the airtight body, and rupturing of the airtight body can be prevented, providing excellent safety.

[0036] In the thin air jack of the present invention, the valve attachment hose on which the safety valve is provided is attached to the airtight body. Therefore, even if an

excessive amount of compressed air is injected into the airtight body when the airtight body is inflated, excessive compressed air is discharged from the safety valve, and therefore the airtight body is free of ruptures, and has higher safety.

[0037] In the thin air jack of the present invention, the airtight body is formed of a multilayer film or a single-layer film having excellent gas barrier property, and therefore the air tightness of the airtight body is extremely excellent. Moreover, a hose prepared by turning a hose having the same structure as a fire hose inside out is used for the exterior body or which is a cylindrical fabric with painting applied thereon, and therefore the durability and rupture tolerance of the exterior body are significantly improved. Accordingly, the thin air jack does not experience air leakage or ruptures of the exterior body during use, and has higher safety.

[0038] Since the thin air jack of the present invention is composed of the airtight body in the shape of a bag, the cover body in the shape of a bag, the interior body in the shape of a bag and the cylindrical exterior body, its thickness can be extremely small when these are flattened, and as a result, it can be inserted into an extremely narrow opening, and is capable of lifting heavy objects such as automobiles.

[0039] In the thin air jack of the present invention, the hose attachment cylindrical parts into which the base end portions of the air supply hose and valve attachment hose are inserted respectively are formed on the opposing sides of the airtight body formed in the shape of a rectangular bag, the base end portions of the air supply hose and valve attachment hoses are inserted into the hose attachment cylindrical parts, respectively, and part or all of the outer circumferential surfaces of the hose attachment cylindrical parts is fastened by the fastening means to prevent the air supply hose and valve attachment hose from falling off. Therefore, the strength of the airtight body can be maintained compared to the case where a hole for inserting the air supply hose and valve attachment hose is bored on the airtight body; the air supply hose and valve attachment hose are unlikely to come off from the airtight body; the air tightness between the hose attachment cylindrical parts and the air supply hose and valve attachment hose is increased; and air leakage of the airtight body is unlikely to occur.

[0040] In the thin air jack of the present invention, the connector with check valve is provided at the tip portion of the air supply hose which supplies air to the airtight body, this connector with check valve is a onetouch joint type coupler with check valve. Therefore, air can be also supplied by a manual bicycle pump, a compressor or a foot

pump by changing the intermediary hose, providing handleability and excellent operability.

[0041] In the thin air jack of the present invention, the hose attachment cylindrical parts to which the base end portions of the air supply hose and valve attachment hose are attached are positioned in the inside of the airtight body, and therefore the hose attachment cylindrical parts does not receive an external force during expansion of the airtight body, so that the hose attachment cylindrical parts of the airtight body can be prevented from rupturing.

[0042] In the thin air jack of the present invention, the two sides not provided with the hose attachment parts of the airtight body are folded inwardly, respectively, and therefore the two sides are not forcefully stretched even when the airtight body expands, so that both end portions (the two sides not provided with the hose attachment cylindrical part) of a sealed body can be prevented from rupturing.

[0043] In the thin air jack of the present invention, parts of the air supply hose and valve attachment hose are strongly pressed to the inner circumferential surface side of the exterior body by the internal pressure of the airtight body when the airtight body expands. Therefore, it becomes difficult for the air supply hose to come off from the

airtight body, and no more strength than that required for preventing the air supply hose from coming off is necessary.

[0044] In the thin air jack of the present invention, the length of the air supply hose and valve attachment hose inserted into the hose attachment cylindrical parts of the airtight body are a few centimeters or longer, respectively, and therefore the air supply hose and valve attachment hose become less unlikely to come off from the airtight body.

[0045] In the thin air jack of the present invention, an adhesive layer is interposed between the outer circumferential surfaces of the base end portions of the air supply hose and valve attachment hose and the inner circumferential surfaces of the hose attachment cylindrical parts of the airtight body, and therefore the air supply hose and valve attachment hose are much less likely to come off from the airtight body, and the air tightness between the hose attachment cylindrical parts and the air supply hose and valve attachment hose is further increased, so that the air leakage of the airtight body is less likely to occur.

[0046] In the thin air jack of the present invention, a reinforcing piece made of a tape or cloth or resin sheet is affixed onto part or all of both sides of the outer circumferential edge of the airtight body, and therefore part or all of the outer circumferential edge of the airtight body is reinforced, and the outer circumferential edge of the

airtight body is less likely to be broken when compressed air is injected into the airtight body.

[0047] In the thin air jack of the present invention, the interior body is formed of a band-shaped woven fabric made of synthetic fiber, and both end portions of the band-shaped woven fabric are overlapped and the overlapping portions are attached by sewing or adhered, and the airtight body and cover body are accommodated in the inside of the interior body to retain both end portions of the airtight body by the inner face of the interior body. Therefore, both end portions of the airtight body is retained by the interior body when the airtight body expands, so that both end portions of the airtight body are less likely to be broken.

[0048] In the thin air jack of the present invention, a hose prepared by turning a hose having the same structure as a fire hose inside out or a cylindrical fabric with painting applied thereon is used for the exterior body, and therefore the wear resistance, weathering resistance, and other properties of the exterior body are improved, and the strength of the exterior body can be improved.

[0049] In the thin air jack of the present invention, part of the air supply hose and part of the exterior body are fixed by a caulking process with a metal ring, the air supply hose is much less likely to come off.

[0050] In the thin air jack of the present invention, the

biforked branch joint is attached at the tip portion of a piece of the air supply hose whose base end portions are attached to the airtight body in an airtight manner, and the connector with check valve and the safety valve are attached to this biforked branch joint, respectively. Therefore, the valve attachment hose can be omitted, and the simplification and reduced assembly time of the assembly operation of the thin air jack can be achieved. Moreover, in this thin air jack, the connector with check valve, the safety valve, the air supply hose, and the branch joint are arranged in a state that they are deviated to one of the long sides of the exterior body, and therefore the other long side portion of the exterior body has the thickness of only the airtight body, cover body, interior body and exterior body, so that the thin air jack can be inserted into an extremely narrow opening.

BRIEF DESCRIPTION OF DRAWINGS

[0051]

[FIG. 1] FIG. 1 is a plan view of a thin air jack according to an embodiment of the present invention.

[FIG. 2] FIG. 2 is an exploded perspective view of a thin air jack.

[FIG. 3] FIG. 3 is an illustrative drawing which shows the mounting state of the air supply hose and valve

attachment hose to the airtight body, (a) is a plan view of the airtight body before the air supply hose and valve attachment hose are attached, (b) is a plan view in which the base end portions of the air supply hose and valve attachment hose are attached to the hose attachment cylindrical part of the airtight body, (c) is a plan view of a state that an opening of the airtight body is welded, (d) is a plan view of a state that both end portions of the airtight body are folded inwardly.

[FIG. 4] FIG. 4 is a plan view of the airtight body with the air supply hose and valve attachment hose attached thereto.

[FIG. 5] FIG. 5 is an expanded sectional view taken along line A-A of FIG. 4.

[FIG. 6] FIG. 6 is a plan view of a state that the airtight body is accommodated in the cover body.

[FIG. 7] FIG. 7 is a plan view of a state that the airtight body and cover body are accommodated in the interior body.

[FIG. 8] FIG. 8 is a plan view of a state that the airtight body, cover body and interior body are accommodated in the exterior body and both end portions of the exterior body are closed.

[FIG. 9] FIG. 9 is an expanded sectional view of the portion of the air supply hose and valve attachment hose in a state that the thin air jack is inflated.

[FIG. 10] FIG. 10 is a plan view of a thin air jack according to another embodiment of the present invention.

[FIG. 11] FIG. 11 is a plan view of a state that the air supply hose having a branch joint, a connector with check valve and a safety valve attached thereto is attached to the airtight body.

[FIG. 12] FIG. 12 is a perspective view of a known air jack apparatus.

[FIG. 13] FIG. 13 is an expanded sectional view taken along line B-B of FIG. 12.

[FIG. 14] FIG. 14 is an expanded sectional view taken along line C-C of FIG. 12.

[Mode for Carrying out the Invention]

[0052] Embodiments of the present invention will be described below in detail with reference to drawings.

FIGS. 1 and 2 show a thin air jack 1 according to an embodiment of the present invention, where the thin air jack 1 is used for lifting an automobile when performing repair, inspection, or other operation on automobiles such as ordinary motor vehicles and special motor vehicles, or for lifting desired portions of collapsed buildings or the like

to save buried people in the event of earthquakes, typhoons or the like.

[0053] That is, the thin air jack 1 includes an airtight body 2 which is formed in the shape of a rectangular bag to have a sealed structure with a film, an air supply hose 4 having a base end portion inserted into an airtight body 2 in an airtight manner, and having a connector with check valve 3 which is connected to an air supply source provided at its tip portion, a valve attachment hose 6 having a base end portion inserted into an airtight body 2 in an airtight manner, and having a safety valve 5 provided at its tip portion, a cover body 7 which is formed with a synthetic resin material with small frictional resistance in the shape of a rectangular bag and which accommodates the airtight body 2 in a state that the tip portions of the air supply hose 4 and the valve attachment hose 6 protrude outwardly, respectively, an interior body 8 which is formed in the shape of a rectangular bag with a woven fabric made of synthetic fiber and which accommodates the airtight body 2 and cover body 7 in a state that the tip portions of the air supply hose 4 and the valve attachment hose 6 protrude outwardly, respectively, and a cylindrical exterior body 9 formed by turning a hose having the same structure as a fire hose inside out or by painting a cylindrical fabric having a strength, the exterior body 9 accommodates the airtight body

2, cover body 7 and interior body 8 in a state that at least the tip portions of the connector with check valve 3 and the safety valve 5 outwardly protrude from one end portion of the exterior body 9, and is formed in the shape of a flat bag in a state that both ends are closed.

DESCRIPTION OF EMBODIMENTS

[0054] The airtight body 2, as shown in FIG. 3(a), is formed in the shape of a rectangular bag by stacking two sheets of film materials formed in a rectangular shape with a multilayer film or a single-layer film having excellent gas barrier property, by welding 2b (heat welding or ultrasonic welding or high frequency welding) the outer circumferential edges of the two sheets of film materials for a few millimeters of the width other than short sides of one of the two sheets of film materials, and includes, on its opposing long sides, hose attachment cylindrical parts 2a in an inclined attitude, into which the base end portions of the air supply hose 4 and the valve attachment hose 6 are inserted, respectively. The two hose attachment cylindrical parts 2a are positioned the inside of the airtight body 2, respectively, and bring the inside and outside of the airtight body 2 into communication.

Herein, a multilayer film or a single-layer film having excellent gas barrier property refers to a multilayer film or

single-layer film having an oxygen permeability of 40 cc/m²·atm·day or lower and a water-vapor permeability of 8 g/m²·day or lower.

[0055] The airtight body 2 is configured to have the shape of a rectangular bag having a sealed structure by, as shown in FIGS. 3(b) and (c), inserting the base end portions of the air supply hose 4 and the valve attachment hose 6 into the hose attachment cylindrical parts 2a of the airtight body 2, respectively, and attaching them in an airtight manner, and then closing the open side (short side) of the airtight body 2 by welding 2b (heat welding or ultrasonic welding or high frequency welding).

[0056] Moreover, the two sides (short sides) to which the air supply hose 4 and the valve attachment hose 6 of the airtight body 2 are not attached, as shown in FIGS. 3(d) and 5, are folded in a V-shape (the portion positioned in the inside of the airtight body 2 is a V-shaped in a cross-section) into the inside of the airtight body 2, respectively, so that the two sides (short sides) are not forcefully stretched when the airtight body 2 expands. Accordingly, both end portions (the two sides not provided with the hose attachment cylindrical parts 2a) of the airtight body 2 can be prevented from being broken. Although the two sides (short sides) of the airtight body 2 are not illustrated, they may be folded in a W-shape (the portion

positioned in the inside of the airtight body 2 is in a W-shape in a cross-section) into the inside of the airtight body 2.

[0057] Furthermore, on the outer surfaces of both end portions on the side of the short sides of the airtight body 2, and on the outer surfaces of both end portions which is a portion opposing the air supply hose 4 and the valve attachment hose 6 and on the side of the long sides of the airtight body 2 as shown in FIGS. 2 and 4, reinforcing pieces 10 made of duct tape are affixed, so that part of the outer circumferential edge of the airtight body 2 is reinforced.

[0058] In this embodiment, for the airtight body 2, a three-layer film having an excellent gas barrier property and flexibility, that is, Triple Nylon (product name) manufactured by MICS Chemical Co., Ltd. is used, and the airtight body 2 is formed by welding 2b two rectangular film materials by impulse welding. This Triple Nylon has a thickness of 70 μm , a tensile strength of 45 MPa, a tensile elongation of 350%, a tear strength of 140 N/mm, an impact strength of 140 N $\cdot$ cm, a thrust strength of 5.0 N, an oxygen permeability of 40 $\text{cc}/\text{m}^2\cdot\text{atm}\cdot\text{day}$, and a water-vapor permeability of 8 $\text{g}/\text{m}^2\cdot\text{day}$.

[0059] Moreover, in this embodiment, the length of the airtight body 2 is set to about 56 cm, the width of the airtight body 2 to about 28 cm, the width of the welded joint

of the airtight body 2 to 5 mm, the lengths of the hose attachment cylindrical parts 2a of the airtight body 2 to about 5 cm to 10 cm, respectively.

[0060] In the above-mentioned embodiment, the airtight body 2 is formed by a three-layer film, but in other embodiments, the airtight body 2 may be formed of a single-layer film, e.g., a thermoplastic polyurethane film, a polylactic acid film, a polyester film such as PET, PEN, and PBT films, a barrier resin film such as EVOH, PVA, and barrier Ny, or the airtight body 2 may be formed from a four-layer film (for example, Diamiron M-G708 (product name)), a five-layer film (for example, Filmix HB (product name), Five Barrier (product name)) and the like.

[0061] Moreover, in the above-mentioned embodiment, the reinforcing piece 10 is affixed in part of both sides of the outer circumferential edge of the airtight body 2, but in other embodiments, the reinforcing piece 10 may be affixed on all of on both sides of the outer circumferential edge of the airtight body 2.

[0062] Furthermore, in the above embodiment, the reinforcing piece 10 made of a duct tape is affixed onto the airtight body 2, but in other embodiments, the reinforcing piece 10 made of an aluminum tape or a cloth adhesive tape or a gummed tape may be affixed onto the airtight body 2, or the reinforcing piece 10 made of cloth or of a synthetic resin

sheet may be affixed onto the airtight body 2 with a double-sided adhesive tape or an adhesive.

[0063] The air supply hose 4 is formed of a pressure resistant hose made of special polyurethane resin, has its base end portion inserted into one of the hose attachment cylindrical parts 2a of the airtight body 2, has part or all of the outer circumferential surfaces of the hose attachment cylindrical parts 2a fastened by a fastening means, and has the connector with check valve 3 connected to the air supply source (not illustrated) provided at its tip portion.

[0064] In this embodiment, a yarn 11 (polyester yarn) is used as the fastening means. That is, the base end portion of the air supply hose 4, as shown in FIG. 3(b), is inserted into one of the hose attachment cylindrical parts 2a from the outside of the airtight body 2, and the yarn 11 (polyester yarn) is tightly wound onto part (or all) of the outer circumferential surface of the hose attachment cylindrical part 2a positioned in the inside of the airtight body, and an adhesive is applied onto the portion for prevention of removal.

[0065] Moreover, between the outer circumferential surface of the base end portion of the air supply hose 4 and the inner circumferential surfaces of the hose attachment cylindrical parts 2a of the airtight body 2, an adhesive layer (not illustrated) is interposed, which prevents the

base end portion of the air supply hose 4 from falling off from the hose attachment cylindrical parts 2a, and also maintains the air tightness between the outer circumferential surface of the base end portion of the air supply hose 4 and the inner circumferential surfaces of the hose attachment cylindrical parts 2a of the airtight body 2.

[0066] Furthermore, the air supply hose 4 is inserted into the hose attachment cylindrical part 2a so that the insertion length of the hose attachment cylindrical part 2a of the airtight body 2 is a few centimeters or longer, preferably 3 cm or longer, and the length is set to such a degree that the air supply hose 4 is prevented from falling off easily from the airtight body 2.

[0067] In this embodiment, the insertion length of the hose attachment cylindrical part 2a into the hose attachment cylindrical part 2a of the air supply hose 4 is set to be almost the same as the length of the hose attachment cylindrical part 2a.

[0068] The connector with check valve 3 provided at the tip portion of the air supply hose 4 is composed of a socket type and onetouch joint type coupler with check valve, and is so configured to allow onetouch connection to the air supply source, i.e., a bicycle pump or a compressor or a foot pump via an intermediary hose (none illustrated).

[0069] In the above-mentioned embodiment, the connector

with check valve 3 is a socket type and onetouch joint type coupler with check valve, but in other embodiments, the connector with check valve 3 may be a plug type and onetouch joint type coupler with check valve.

[0070] The valve attachment hose 6 is formed of a pressure resistant hose made of special polyurethane resin, and its base end portion is inserted into the other one of the hose attachment cylindrical parts 2a of the airtight body 2, is prevented from falling off by fastening part or all of the outer circumferential surface of the hose attachment cylindrical part 2a with a fastening means, and the safety valve 5 is attached at its tip portion by a caulking process with a metal ring 13 (aluminum ring) via a hose nipple 12.

[0071] In this embodiment, a yarn 11 (polyester yarn) is used as the fastening means. That is, the base end portion of the valve attachment hose 6, as shown in FIG. 3(b), is inserted into the other one of the hose attachment cylindrical parts 2a from the outside of the airtight body 2, and the yarn 11 (polyester yarn) is tightly wound onto in part (or all) of the outer circumferential surface of the hose attachment cylindrical parts 2a positioned in the inside of the airtight body 2, and an adhesive is applied onto the same for prevention of removal.

[0072] Moreover, between the outer circumferential surface of the base end portion of the valve attachment hose 6 and

the inner circumferential surfaces of the hose attachment cylindrical parts 2a of the airtight body 2, an adhesive layer (not illustrated) is interposed, which prevents the base end portion of the valve attachment hose 6 from falling off from the hose attachment cylindrical parts 2a, and also maintains the air tightness between the outer circumferential surface of the base end portion of the valve attachment hose 6 and the inner circumferential surfaces of the hose attachment cylindrical parts 2a of the airtight body 2.

[0073] Furthermore, the valve attachment hose 6 is inserted into the hose attachment cylindrical part 2a so that the insertion length of the hose attachment cylindrical part 2a of the airtight body 2 is a few centimeters longer, preferably 3 cm or longer, and the length is set to such a degree that the valve attachment hose 6 is prevented from falling off easily from the airtight body 2.

[0074] In this embodiment, the insertion length of the valve attachment hose 6 into the hose attachment cylindrical part 2a is set to be almost the same as the length of the hose attachment cylindrical part 2a.

[0075] The safety valve 5 provided at the tip portion of the valve attachment hose 6 is so configured to automatically release the air in the airtight body 2 when the pressure in the airtight body 2 by excessive supply of air is higher than maximum working pressure (0.7 MPa) by 0.1 MPa to return the

pressure in the airtight body 2 to a predetermined pressure, so that the rupture of the airtight body 2 can be prevented. The setting pressure of this safety valve 5 is 0.8 MPa.

[0076] In the above-mentioned embodiment, the, yarn 11 is used as a fastening means, and the yarn 11 is tightly wound on the outer circumferential surfaces of the hose attachment cylindrical parts 2a of the airtight body 2 to prevent the air supply hose 4 and the valve attachment hose 6 from falling off from the hose attachment cylindrical parts 2a, but in other embodiments, a metal ring (not illustrated) or a thermal shrinkage tube (not illustrated) may be used as a fastening means. That is, the hose attachment cylindrical parts 2a into which the air supply hose 4 and the valve attachment hose 6 are inserted, respectively, may be caulked with a metal ring (not illustrated) to prevent the air supply hose 4 and the valve attachment hose 6 from falling off from the hose attachment cylindrical parts 2a, or the hose attachment cylindrical parts 2a into which the air supply hose 4 and the valve attachment hose 6 are inserted, respectively, with a thermal shrinkage tube (not illustrated) may be fastened and fixed to prevent the air supply hose 4 and the valve attachment hose 6 from falling off from the hose attachment cylindrical parts 2a.

[0077] The cover body 7 is, as shown in FIGS. 2 and 6, formed with (polyethylene tube) a synthetic resin tube with

small frictional resistance in the shape of a rectangular bag having one or both end portions being open, and on the sides (long sides) neighboring the open sides (short sides), withdrawal hole 7a for pulling out the tip portions of the air supply hose 4 and of the valve attachment hose 6, respectively, to the outside are formed. This cover body 7 is formed to have a size which is completely capable of accommodating the airtight body 2.

Herein, a synthetic resin with small frictional resistance means a synthetic resin having a coefficient of static friction of 0.1 to 0.3 and a coefficient of dynamic friction of 0.04 to 0.3.

[0078] In the above-mentioned embodiment, the cover body 7 is formed of a polyethylene tube, but in other embodiments, the cover body 7 may be formed in the shape of a bag of a polyethylene sheet, or the cover body 7 may be formed of a synthetic resin tube or a synthetic resin sheet with small frictional resistance such as a fluorine resin. For example, the cover body 7 may be formed of a Teflon sheet.

[0079] The interior body 8, as shown in FIGS. 2 and 7, is composed of a band-shaped woven fabric of aramid fiber having excellent strength and wearability and having little elongation, and by overlaying both end portions of the band-shaped woven fabric and attaching the overlapping portions by sewing 8a, an annular and plane shape is formed in a

rectangular shape.

[0080] Moreover, the airtight body 2 and the cover body 7 are accommodated in the interior body 8, and both end portions of the airtight body 2 are held by the inner faces of the folded portions of both end portions of the interior body 8.

[0081] Furthermore, the sides on both sides of both end portions in the longitudinal direction of the interior body 8 are attached by sewing 8b only for an appropriate length so that the accommodated airtight body 2 and the cover body 7 do not come out to the outside from the side edge of the interior body 8.

[0082] In the above-mentioned embodiment, the interior body 8 is formed from a woven fabric made of aramid fiber, but in other embodiments, the interior body 8 may be formed from woven fabric made of polyester fiber, woven fabric made of polypropylene fiber, woven fabric of polyethylene fiber, woven fabric of polystyrene fiber, woven fabric of vinylon fiber, woven fabric of LCP fiber (Zxion), woven fabric of polyarylate fiber (Vectran), woven fabric of PBO fiber (Zylon), woven fabric of ultra high molecular weight polyethylene fiber (Dyneema), among others.

[0083] Moreover, in the above-mentioned embodiment, the interior body 8 is formed by attaching by sewing 8a the band-shaped woven fabric, but in other embodiments, the interior

body 8 may be formed by adhering the band-shaped woven fabric with an adhesive.

[0084] The exterior body 9, as shown in FIGS. 1, 2 and 8, is formed of a hose having the same structure as a fire hose made by forming a lining layer made of a thermoplastic polyurethane elastomer on the inner circumferential surface of a jacket woven cylindrically with warps made of synthetic fiber and wefts made of synthetic fiber, the hose is turned inside out and used so that the lining layer faces outside. This hose used is one which is compliant with the type test (Type test performed by Japan Fire Equipment Inspection Corp.) for fire hoses in terms of the structure, the properties of the synthetic resin, the adherence intensity, the functions, the wear resistance and other properties.

For the warps and wefts made of synthetic fiber, polyester filament yarn, aramid filament yarn and the like are used.

[0085] Moreover, the exterior body 9 accommodates the airtight body 2, the cover body 7 and the interior body 8 in a state that the tip portion of the air supply hose 4, the connector with check valve 3 and the safety valve 5 protrude outwardly from the opening on one end of the exterior body 9, is formed in the shape of a flat bag by closing the openings in both end portions with a plurality of metal fittings 14 (eyelet metal fittings) and by ultrasonic welding 9a. The

size of the exterior body 9 is designed to accommodate the airtight body 2, the cover body 7 and the interior body 8. This exterior body 9 has a lining layer made of a thermoplastic polyurethane elastomer formed on its outer surface side, and it therefore has the advantages such as extremely high wear resistance, high mechanical strength, elasticity at wide range of usage temperatures, and further high impact strength and high low-temperature flexing, and good oil resistance, chemical resistance, fungus resistance, and the like.

[0086] Furthermore, on one surface of the exterior body 9, an annular center mark 15 which indicates the center position of the thin air jack 1, and a caution mark 16 indicating the precautions and other information of the thin air jack 1 are provided, respectively.

[0087] In the above-mentioned embodiment, the lining layer is formed from thermoplastic polyurethane elastomer, but in other embodiments, the lining layer may be formed from other synthetic resins, for example, PET (polyethylene terephthalate).

[0088] Moreover, in the above-mentioned embodiment, a hose produced by turning a hose having the same structure as a fire hose inside out is used for the exterior body 9, but in other embodiments, a cylindrical fabric with strength with painting applied thereon may be used as the exterior body 9.

For example, as the cylindrical fabric with strength, a cylindrical fabric made of polyester canvas is used, and urethane resin, acrylic resin, silicon resin, fluorine resin and the like are used as painting.

[0089] Furthermore, in the above-mentioned embodiment, both end portions of the exterior body 9 are closed by the metal fittings 14 and ultrasonic welding, but in other embodiments, both end portions of the exterior body 9 may be closed by the metal fittings 14 and attachment by sewing 9a, or both end portions of the exterior body 9 may be closed only by welding 9a or sewing.

[0090] Next, the method for producing the thin air jack 1 will be described.

[0091] First, the base end portions of the air supply hose 4 and the valve attachment hose 6 are inserted into the hose attachment cylindrical parts 2a, respectively, of the airtight body 2, in which one of the short sides is open, respectively, and the yarn 11 is tightly wound on part of the outer circumferential surfaces of the hose attachment cylindrical parts 2a positioned in the inside of the airtight body 2, and adhesive is applied to the portion (refer to FIGS. 3(a) and (b)). At this time, an adhesive layer is interposed between the outer circumferential surfaces of the base end portions of the air supply hose 4 and valve attachment hose and the inner circumferential surfaces of the

hose attachment cylindrical parts 2a. Accordingly, the air supply hose 4 and the valve attachment hose 6 are attached to the hose attachment cylindrical parts 2a of the airtight body 2 in an airtight manner.

[0092] Once the base end portions of the air supply hose 4 and the valve attachment hose 6 are attached to the hose attachment cylindrical parts 2a of the airtight body 2, respectively, the opening short side of the airtight body 2 is closed by welding 2b to seal the airtight body 2 (refer to FIG. 3(c)).

[0093] Once the airtight body 2 is given a sealed structure, both end portions on the side of the short side of the airtight body 2 are folded inwardly, and the reinforcing piece 10 made of a duct tape is affixed onto the outer surfaces of both end portions on the side of the short sides of the airtight body 2, and onto the outer surfaces of both end portions of a portion opposing the air supply hose 4 and the valve attachment hose 6, which is on the side of the long side of the airtight body 2 (Refer to FIGS. 3(d) and 4).

[0094] The reinforcing piece 10 is affixed onto the airtight body 2, then the airtight body 2 is accommodated in the cover body 7, and the tip portions of the air supply hose 4 and of the valve attachment hose 6 are pulled out to the outside of the cover body 7 from the pull out holes 7a of the cover body 7, respectively (refer to FIG. 6).

[0095] When the airtight body 2 is accommodated in the cover body 7, the airtight body 2 and the cover body 7 are accommodated in the interior body 8, and the tip portions of the air supply hose 4 and of the valve attachment hose 6 are pulled out to the outside of the interior body 8, respectively (refer to FIG. 7).

[0096] Finally, the interior body 8 accommodating the airtight body 2 and the cover body 7 is accommodated in the cylindrical exterior body 9, the tip portion of the air supply hose 4, the connector with check valve 3, and the safety valve 5 provided at the tip portion of the valve attachment hose 6 are caused to protrude outwardly from the openings on one end of the exterior body 9, both end portions of the exterior body 9 are closed by a plurality of the metal fittings 14 (eyelet metal fittings) and welding 9a, and part of the air supply hose 4 and part of the exterior body 9 are fixed by caulking with the metal rings 13 (refer to FIG. 8).

[0097] The thus-produced thin air jack 1 is formed to have the size of about 60 cm in length, about 24 cm in width, and about 6 mm in thickness (excluding the air supply hose 4, the valve attachment hose 6, the connector with check valve 3 and the safety valve 5), and is capable of lifting a heavy object weighting about 9,400 kg at the maximum.

Moreover, the withstand pressure of this thin air jack 1 is 2.1 MPa, operating temperature range is -20°C to 80°C, and

the mass is 1170 g.

[0098] The method for producing the thin air jack 1 is not limitedly interpreted to the above-mentioned embodiment, and is subject to various modifications.

[0099] Now, a case where a heavy object, for example, a forklift, is lifted using the thin air jack 1 will be described.

[0100] First, two sheets of boards are placed at a certain interval, metal plates are placed thereon, and a forklift is placed on the metal plates. Next, the thin air jack 1 is inserted into a gap between the ground and the metal plates, and the air supply hose 4 is pulled out from the gap to the outside. Subsequently, the connector with check valve 3 provided in the tip portion of the air supply hose 4 is connected to an air supply source (a bicycle pump or a compressor or a foot pump) through an intermediary hose, and the air supply source is operated to inject compressed air into the airtight body 2. Accordingly, the airtight body 2 expands, the exterior body 9 also expands in response to this, and the forklift can be lifted.

[0101] The aforementioned thin air jack 1 can generate the following outstanding effects.

(1) In the thin air jack 1, the airtight body 2 in the shape of a bag formed with a film is covered by the cover body 7 in the shape of a bag formed from the synthetic resin material

with little frictional resistance, and the frictional resistance of the airtight body 2 and the interior body 8 are greatly lowered by the cover body 7. As a result, when the airtight body 2 inflates upon application of a load onto the thin air jack 1, the airtight body 2 can inflate uniformly, and the load is prevented from being partially applied onto the airtight body 2, which prevents rupture of the airtight body 2 and provides great safety.

2) The thin air jack 1 has the valve attachment hose 6, which is provided with the safety valve 5 and is attached to the airtight body 2. Therefore, when the airtight body 2 is inflated, even if an excessive amount of air is injected into the airtight body 2, the excess air is discharged from the safety valve 5. Thus, the airtight body 2 does not rupture, and provides higher safety.

(3) Since the thin air jack 1 has excellent air tightness of the airtight body 2, excellent durability, rupture tolerance and like properties of the exterior body 9, it is free of air leakage during use or rupture of the exterior body 9 during use, thereby having extremely high safety.

(4) Since the thin air jack 1 is composed of the airtight body 2 made of a film, the cover body 7 made of a synthetic resin tube, the interior body 8 made of synthetic fiber, the exterior body 9 having the same structure as a fire hose, and other components, when it is flattened, its thickness becomes

extremely small, and it can be inserted into an extremely narrow opening.

(5) The thin air jack 1 is provided with a coupler with check valve at the tip portion of the air supply hose 4, and therefore by changing the intermediary hose, air can be supplied even with a manual bicycle pump or a compressor or a foot pump, providing excellent handleability and operability.

(6) In the thin air jack 1, both end portions of the airtight body 2 are folded inwardly, respectively, and therefore even when the airtight body 2 expands both end portions are not forcefully stretched, both end portions of the sealed body can be prevented from rupturing.

(7) In the thin air jack 1, the base end portions of the air supply hose 4 and the valve attachment hose 6 are inserted into the two cylindrical hose attachment cylindrical parts 2a formed on the airtight body 2, respectively, and the yarn 11 is tightly wound on the outer circumferential surfaces of the hose attachment cylindrical parts 2a. Therefore, compared to the case where a hole for inserting the air supply hose 4 into the airtight body 2 is bored, the strength of the airtight body 2 can be maintained, and it is more difficult for the air supply hose 4 and the valve attachment hose 6 to come off from the airtight body 2. Moreover, the air tightness between the cylindrical part retaining the hose and the air supply hose 4 is increased to prevent air leakage.

(8) In the thin air jack 1, as shown in FIG. 9, when the airtight body 2 inflates, parts of the air supply hose 4 and the valve attachment hose 6 are strongly pressed to the inner circumferential surface side of the exterior body 9 by the internal pressure of the airtight body 2, so that it is difficult for the air supply hose 4 to come off from the airtight body 2, and any strength greater than strength required for retention of the air supply hose 4 is not required.

(9) In the thin air jack 1, the insertion lengths of the air supply hose 4 and of the valve attachment hose 6 into the hose attachment cylindrical parts 2a of the airtight body 2 are a few centimeters or longer, respectively, and an adhesive layer is interposed between the outer circumferential surfaces of the base end portions of the air supply hose 4 and the valve attachment hose 6 and the inner circumferential surfaces of the hose attachment cylindrical parts 2a of the airtight body 2. Therefore, it is more unlikely for the air supply hose 4 and the valve attachment hose 6 to come off from the airtight body 2, and the air tightness between the hose attachment cylindrical parts 2a and the air supply hose 4 and the valve attachment hose 6 is further increased so that air leakage can be prevented even more.

(10) In the thin air jack 1, the reinforcing piece 10 made of

a tape is affixed on the outer circumferential edge of the airtight body 2. Therefore, the outer circumferential edge of the airtight body 2 is reinforced, and the outer circumferential edge of the airtight body 2 is unlikely to be broken when air is injected into the airtight body 2.

(11) In the thin air jack 1, both end portions of the airtight body 2 are retained by the interior body 8 composed of a woven fabric of aramid fiber when the airtight body 2 inflates, and therefore both end portions of the airtight body 2 are unlikely to be broken.

(12) In the thin air jack 1, a hose produced by turning inside out a hose having the same structure as a fire hose is used for the exterior body 9, and therefore the wear resistance, weathering resistance, and other properties of the exterior body 9 are improved, achieving improvement in strength of the exterior body 97.

(13) In the thin air jack 1, part of the air supply hose 4 and part of the exterior body 9 are fixed by caulking with the metal rings 13, and therefore the air supply hose 4 is even more unlikely to come off.

(14) In the thin air jack 1, the hose attachment cylindrical parts 2a of the airtight body 2 are positioned in the inside of the airtight body 2. Therefore, during expansion of the airtight body 2, the hose attachment cylindrical parts 2a are not subject to external forces, and the hose attachment

cylindrical parts 2a of the airtight body 2 can be prevented from being broken.

[0102] In the above-mentioned embodiment, the thin air jack 1 is formed in a rectangular shape having a length of about 60 cm and a width of about 24 cm, but in other embodiments, the thin air jack 1 may be formed in a square shape, or may be formed in a long shape.

[0103] FIG. 10 and FIG. 11 show a thin air jack 1 according to another embodiment of the present invention, where the thin air jack 1 is used for lifting an automobile when performing repair, inspection, or other operation on automobiles such as ordinary motor vehicles and special motor vehicles, or for lifting desired portions of collapsed buildings or the like to save buried people in the event of earthquakes, typhoons or the like.

[0104] That is, the thin air jack 1 includes the airtight body 2 which is formed in the shape of a rectangular bag to have a sealed structure with a film, the air supply hose 4 whose base end portion is inserted into the airtight body 2 in an airtight manner and which has the branch joint 17 at its tip portion, the connector with check valve 3 connected to the air supply source and the safety valve 5 which are connected to the branch joint 17 respectively, the cover body 7 which is formed with a synthetic resin material with small frictional resistance in the shape of a rectangular bag and

which accommodates the airtight body 2 in a state that the tip portion of the air supply hose 4 protrudes outwardly, the interior body 8 which is formed in the shape of a rectangular bag with a woven fabric made of synthetic fiber, which accommodates the airtight body 2 and the cover body 7 in a state that the tip portion of the air supply hose 4 protrudes outwardly, and the cylindrical exterior body 9 formed by turning inside out a hose having the same structure as a fire hose or by applying a painting onto a cylindrical fabric, the exterior body 9 accommodates the airtight body 2, the cover body 7 and the interior body 8 in a state that the tip portions of at least the connector with check valve 3 and the safety valve 5 protrude outwardly from one end portion of the exterior body 9, and is formed in the shape of a flat bag in a state that both ends are closed.

[0105] In the thin air jack 1, the biforked branch joint 17 is attached to the tip portion of the air supply hose 4 whose base end portion is attached to the airtight body 2 in an airtight manner, and the connector with check valve 3 and the safety valve 5 are attached to the tip portions of separate connecting hoses 4a, 4b, respectively, which are connected to this biforked branch joint 17, in which the valve attachment hose 6 may be omitted.

Moreover, the tip portion of the air supply hose 4, the branch joint 17, connecting hoses 4a, 4b and the safety valve

5 are in the state that they project to the outside from the exterior body 9, so that replacement and repair can be performed quickly and easily if damaged for any reason. At this time, the position of the branch joint 17 is to be 1 cm or longer away from one end of the exterior body 9.

[0106] In the above-mentioned embodiment, the lengths of the two connecting hoses 4a, 4b are made different, but in other embodiments, the lengths the two connecting hoses 4a, 4b may be the same.

[0107] Moreover, in the above-mentioned embodiment, the branch joint 17 is placed outside the exterior body 9, but in other embodiments, the branch joint 17 may be accommodated within the exterior body 9.

[0108] Another constitution of this thin air jack 1 has a structure similar to that of the thin air jack 1 shown in FIGS. 1 and 2, and the same reference numerals are given to the components and sites which are the same as those in the thin air jack 1 shown in FIGS. 1 and 2, and their detailed description will be omitted.

[0109] The thin air jack 1 shown in FIGS. 10 and 11 can produce the effects similar to those of the thin air jack 1 shown in FIGS. 1 and 2. Moreover, in the thin air jack 1 shown in FIGS. 10 and 11, the valve attachment hose 6 is omitted, and therefore the simplification and reduction in assembly time of assembly operation can be achieved compared

to the thin air jack 1 shown in FIGS. 1 and 2. Moreover, in the thin air jack 1 shown in FIGS. 10 and 11, the connector with check valve 3, the safety valve 5, the air supply hose 4, and the branch joint 17 are arranged in a state that they are deviated to one of the long sides of the exterior body 9, and therefore the other long side portion of the exterior body 9 has the thickness of only the airtight body 2, the cover body 7, the interior body 8 and the exterior body 9, so that the exterior body 9 can be inserted into an extremely narrow opening.

[0110] In the thin air jack 1 shown in FIG. 1, only the tip portion of the safety valve 5 is placed outside the exterior body 9, but the tip portion of the valve attachment hose 6 may be placed on the outside of the exterior body 9, and the entire safety valve 5 may be placed outside of the exterior body 9.

[0111] Moreover, in the thin air jack 1 shown in FIGS. 1 and 10, the tip portion of the air supply hose 4 are caused to protrude a few centimeters from one edge to the outside of the exterior body 9 in both cases, but a few-meters long hose may be used as the air supply hose 4, and the position of the connector with check valve 3 may be caused to greatly protrude from one end of the exterior body 9. This allows the thin air jack 1 to be used in the water, and if air is supplied into the thin air jack 1 from the connector with

check valve 3 located on the ground, for example, underwater heavy objects such as automobiles can be moved and floated. In this case, the length of the air supply hose 4 is to be about 5 m at the maximum. Moreover, when the thin air jack 1 shown in FIG. 1 is used underwater, the valve attachment hose 6 is to be as long as the air supply hose 4, and the safety valve 5 is to be located on the ground. When the thin air jack 1 is used underwater, if the length of the air supply hose 4 is too short, a different air supply hose 4 may be added by using a joint (not illustrated).

INDUSTRIAL APPLICABILITY

[0112] The thin air jack 1 of the present invention is used for lifting heavy objects such as automobiles, collapsed buildings and others, while the airtight body 2 and the exterior body 9 may be largely inflated until their apparent shapes are cylindrical and, the largely inflated thin air jack 1 may be arranged in parallel so that they can be used as rollers.

REFERENCE SIGNS LIST

[0113] 1 represents a thin air jack, 2 represents an airtight body, 2a represents a hose attachment cylindrical part of the airtight body, 2b represents welding of the airtight body, 3 represents a connector with check valve, 4

represents an air supply hose, 4a, 4b represent connecting hoses, 5 represents a safety valve, 6 represents a valve attachment hose, 7 represents a cover body, 7a represents a withdrawal hole of cover body, 8 represents an interior body, 8a represents attachment of the interior body by sewing, 9 represents an exterior body, 9a represents ultrasonic welding of exterior body, 10 represents a reinforcing piece, 11 represents a yarn, 12 represents a hose nipple, 13 represents a metal ring, 14 represents a metal fitting (eyelet metal fitting), 15 represents a center mark, 16 represents a caution mark, 17 represents a branch joint.

CLAIMS

1. A thin air jack comprising an airtight body which is formed in the shape of a bag having a sealed structure with a film, an air supply hose whose base end portion is inserted into the airtight body in an airtight manner and which is provided with a connector with a check valve connected to an air supply source at its tip portion, a valve attachment hose whose base end portion is inserted into the airtight body in an airtight manner and which is provided with a safety valve at its tip portion, a cover body which is formed in the shape of a bag with a synthetic resin material having low frictional resistance and which accommodates the airtight body in a state that the tip portions of the air supply hose and valve attachment hose protrude outwardly, respectively, an interior body which is formed with a woven fabric made of synthetic fiber in the shape of a bag and which accommodates the airtight body and cover body in a state that the tip portions of the air supply hose and valve attachment hose protrude outwardly, respectively, and a cylindrical exterior body formed by turning a hose having the same structure as a fire hose inside out or a cylindrical exterior body prepared by applying a painting onto a cylindrical fabric, the exterior body accommodating the airtight body, cover body and interior body in a state that the tip portions of at least

the connector with check valve and the safety valve protrude from one end portion of the exterior body outwardly, and being formed in the shape of a flat bag in a state that both end portions are closed.

2. A thin air jack comprising an airtight body which is formed in the shape of a bag having a sealed structure with a film, an air supply hose whose base end portion is inserted into the airtight body in an airtight manner and which has a branch joint provided at its tip portion, a connector with check valve and a safety valve connected to the air supply source connected to the branch joint, respectively, a cover body which is formed in the shape of a bag with a synthetic resin material having low frictional resistance and which accommodates the airtight body in a state that the tip portion of the air supply hose protrudes outwardly, an interior body which is formed with a woven fabric made of synthetic fiber in the shape of a bag and which accommodates the airtight body and cover body in a state that the tip portion of the air supply hose protrudes outwardly, and a cylindrical exterior body formed by turning a hose having the same structure as a fire hose inside out or a cylindrical exterior body prepared by applying a painting onto a cylindrical fabric, the exterior body accommodating the airtight body, cover body and interior body in a state that

the tip portions of at least the connector with check valve and the safety valve protrude from one end portion of the exterior body outwardly, and being formed in the shape of a flat bag in a state that both end portions are closed.

3. The thin air jack according to claim 1, wherein the airtight body is formed to have a sealed structure in the shape of a rectangular bag with a multilayer film or single-layer film having excellent gas barrier property, has hose attachment cylindrical parts into which the base end portions of the air supply hose and valve attachment hose are inserted, respectively, on its opposing two sides in an inclined attitude, and the air supply hose and valve attachment hose have their base end portions inserted into the hose attachment cylindrical parts of the airtight body, respectively, and part or all of the outer circumferential surfaces of the hose attachment cylindrical parts is fastened in an airtight manner by fastening means to prevent falling off.

4. The thin air jack according to claim 2, wherein the airtight body is formed to have a sealed structure in the shape of a rectangular bag with a multilayer film or single-layer film having excellent gas barrier property, has a hose attachment cylindrical part into which the base end portion

of the air supply hose is inserted on one of its sides in an inclined attitude, and the air supply hose has its base end portion inserted into the hose attachment cylindrical part of the airtight body, and part or all of the outer circumferential surface of the hose attachment cylindrical part is fastened in an airtight manner by fastening means to prevent falling off.

5. The thin air jack according to claim 3 or 4, wherein the multilayer film is made of a nylon multilayer film, and the single-layer film is made of a thermoplastic polyurethane film.

6. The thin air jack according to claim 3, wherein the hose attachment cylindrical parts of the airtight body and the base end portions of the air supply hose and valve attachment hose are positioned on the inside of the airtight body, and the tip portions of the air supply hose and valve attachment hose are positioned on the outside of the airtight body.

7. The thin air jack according to claim 4, wherein the hose attachment cylindrical part of the airtight body and the base end portions of the air supply hose are positioned on the inside of the airtight body, and the tip portion of the air supply hose is positioned on the outside of the airtight

body.

8. The thin air jack according to claim 3 or 4, wherein opposing two sides of the airtight body with no hose attachment cylindrical part provided are folded inwardly, respectively.

9. The thin air jack according to claim 3, wherein the insertion lengths of the air supply hose and the valve attachment hose into the hose attachment cylindrical parts of the airtight body are a few centimeters or longer, respectively.

10. The thin air jack according to claim 4, wherein the insertion length of the air supply hose into the hose attachment cylindrical part of the airtight body is a few centimeters or longer, respectively.

11. The thin air jack according to claim 3, wherein adhesive layers are interposed between outer circumferential surfaces of the base end portions of the air supply hose and valve attachment hose and an inner circumferential surface of the hose attachment cylindrical parts of the airtight body, respectively.

12. The thin air jack according to claim 4, wherein adhesive layers are interposed between an outer circumferential surface of the base end portion of the air supply hose and an inner circumferential surface of the hose attachment cylindrical part of the airtight body, respectively.

13. The thin air jack according to claim 1 or 2, wherein a reinforcing piece made of a tape or cloth or resin sheet is affixed onto part or all of both sides of the outer circumferential edge of the airtight body.

14. The thin air jack according to claim 1 or 2, wherein the connector with check valve is a onetouch joint type coupler with check valve.

15. The thin air jack according to claim 1, wherein the cover body is formed in the shape of a rectangular bag having at least one of the sides being open with a synthetic resin tube or synthetic resin sheet, and withdrawal holes for pulling out the tip portion sides of the air supply hose and valve attachment hose to the outside, respectively, are formed on the sides neighboring the open side.

16. The thin air jack according to claim 2, wherein the cover body is formed in the shape of a rectangular bag having at

least one of the sides being open with a synthetic resin tube or synthetic resin sheet, and a withdrawal hole for pulling out the tip portion side of the air supply hose to the outside is formed on the side neighboring the open side.

17. The thin air jack according to claim 1 or 2, wherein the interior body comprises a band-shaped woven fabric made of synthetic fiber, both end portions of the band-shaped woven fabric are overlapped and the overlapping portions are attached by sewing or adhered, and the airtight body and cover body are accommodated in the inside of the interior body to retain both end portions of the airtight body by the inner face of the interior body.

18. The thin air jack according to claim 1, wherein the exterior body is formed of a hose having the same structure as a fire hose turned inside out and made by forming a lining layer made of a thermoplastic polyurethane elastomer on the inner circumferential surface of a jacket woven cylindrically with warps made of synthetic fiber and wefts made of synthetic fiber, or formed of a cylindrical fabric having a painting thereon, and is formed in the shape of a flat bag by closing the openings in both end portions of the fire hose or cylindrical fabric by at least one of metal fittings, welding and attachment by sewing in a state that the tip portions of

at least the connector with check valve and the safety valve protrude to the outside from the openings of the base end portion of the exterior body.

19. The thin air jack according to claim 2, wherein the exterior body is formed of a hose having the same structure as a fire hose turned inside out and made by forming a lining layer made of a thermoplastic polyurethane elastomer on the inner circumferential surface of a jacket woven cylindrically with warps made of synthetic fiber and wefts made of synthetic fiber, or formed of a cylindrical fabric having a painting thereon, and is formed in the shape of a flat bag by closing the openings in both end portions of the fire hose or cylindrical fabric by at least one of metal fittings, welding and attachment by sewing in a state that the tip portions of at least the connector with check valve and the safety valve protrude to the outside from the opening of the base end portion of the exterior body.

20. The thin air jack according to claim 1 or 2, wherein part of the air supply hose and part of the exterior body are fixed by a caulking process with a metal ring.