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Cazalis

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[54] **GAS-TIGHT ENCLOSURES FOR SURGICAL OPERATIONS**

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[51] **Int. Cl.** **A61b 19/00**

[58] **Field of Search** ..... 128/204, 203, 272, 298, 128/299, 1 R, 1 B, 1 A, 142.5, 142.4, 30, 30.2, 132 D

[56] **References Cited**

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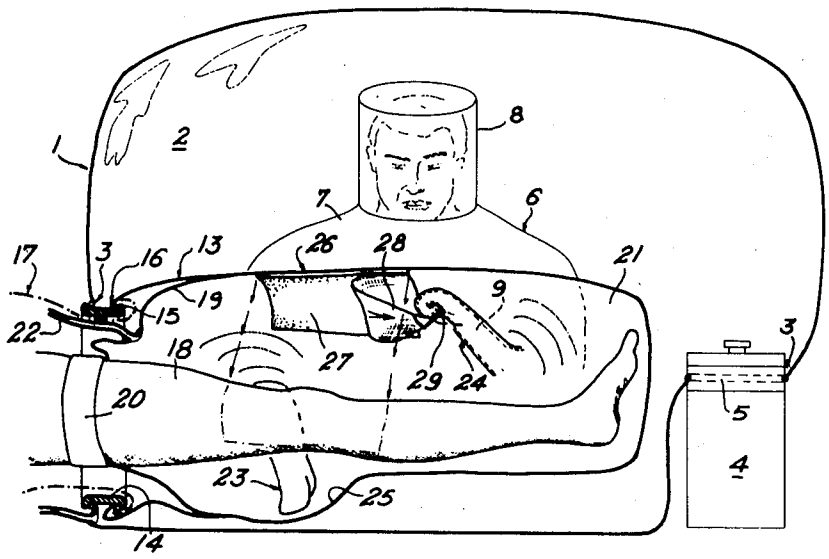
[57] **ABSTRACT**

An improvement to gas-tight enclosures for surgical operations, consisting in providing the enclosure wall 1 with at least one appendage 13, the size of which is such that it can receive a limb 18 to be operated on, said appendage 13 comprising an annular web carrying a garterlike member 20 for clasping said limb, an inlet orifice 22 for inflating said appendage with an inert gas, and an operative-field 26, one side of which is covered with a renewable self-adhesive coating 28.

13 Claims, 7 Drawing Figures



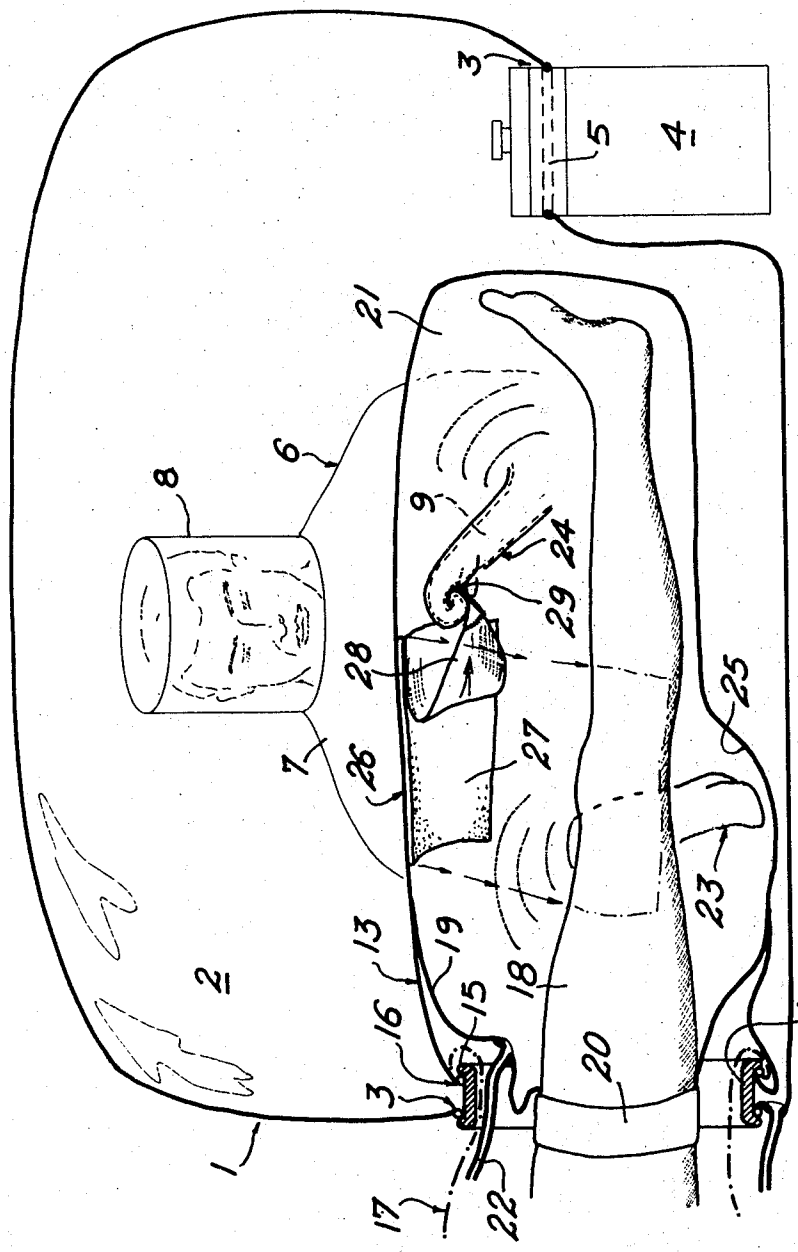


FIG. 1

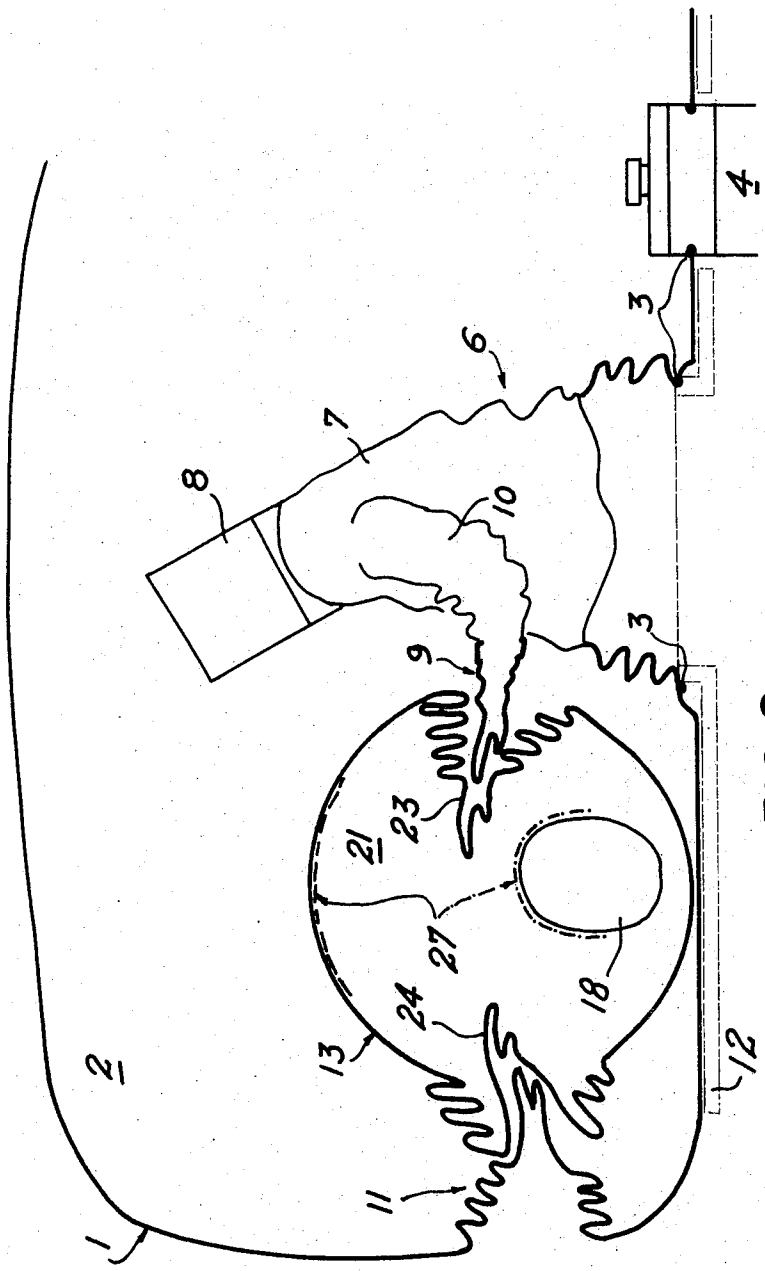


FIG.2

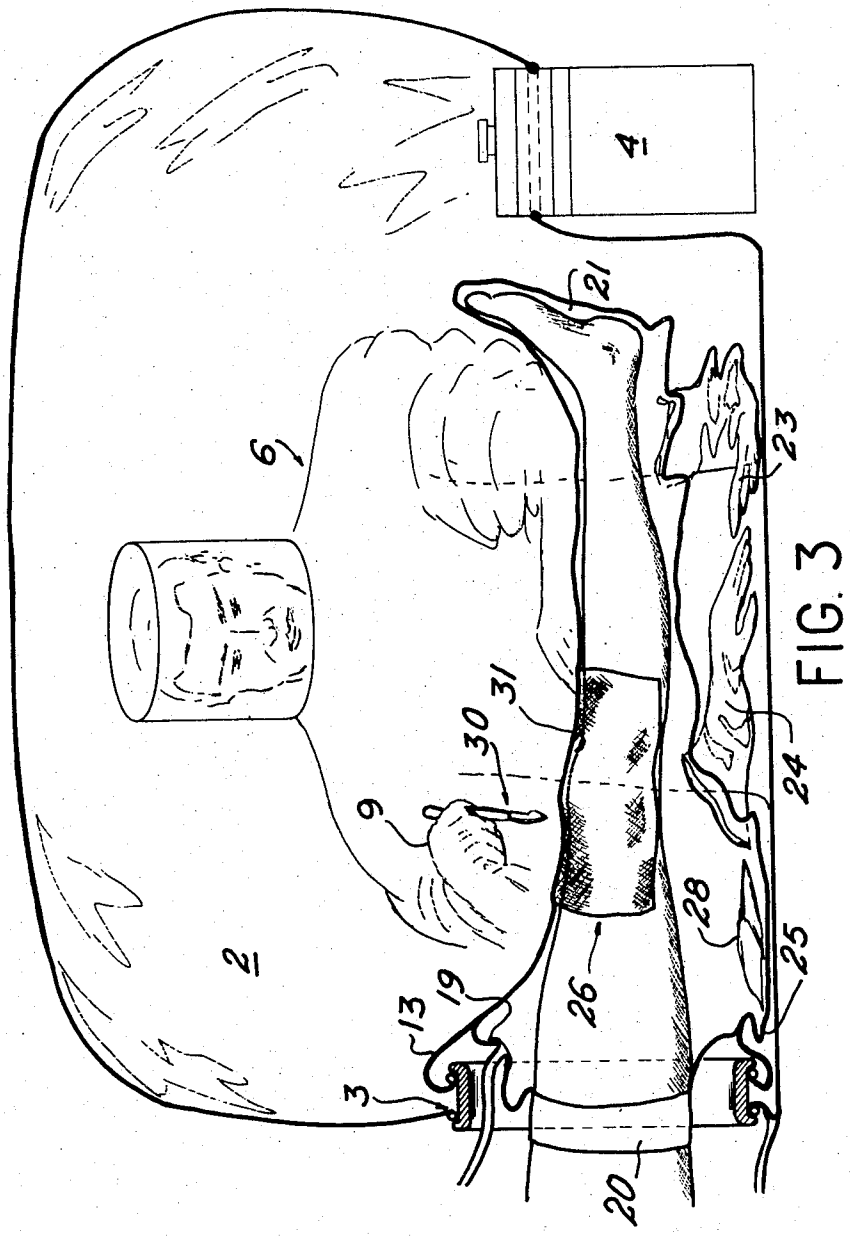


FIG. 3

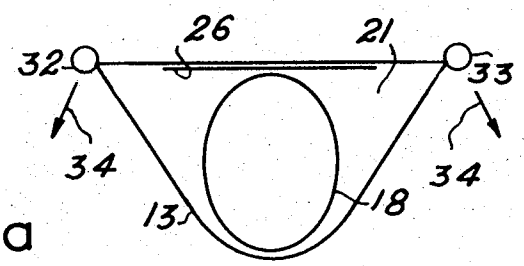


FIG. 4a

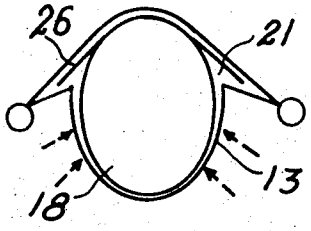


FIG. 4b

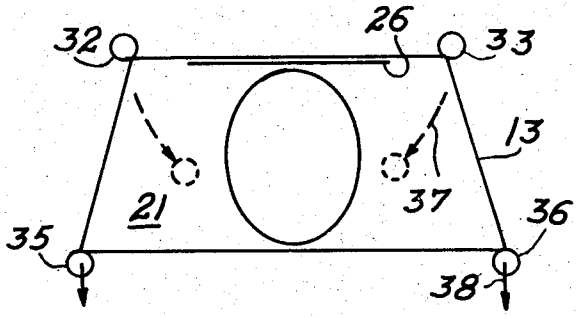


FIG. 5

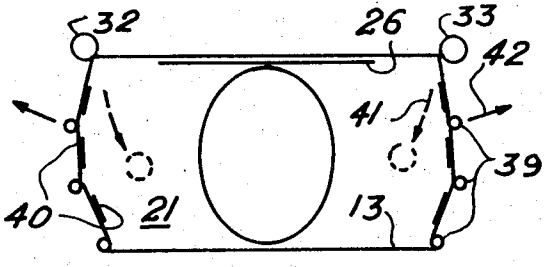


FIG. 6

GAS-TIGHT ENCLOSURES FOR SURGICAL OPERATIONS

The present invention relates to an improvement to gas-tight enclosures used for treating sick persons or operating on patients.

It is already known, in the prior art, to use gas-tight enclosures to that end, said enclosures comprising an usually flexible closed envelope, at least some portions of which are transparent, provided with ventilating means, with means for regulating the internal pressure and also with means giving access to a patient previously introduced into the enclosure without however impairing the gas-tightness of the latter.

In the latter case, the patient is usually lying on a bed located within the treatment enclosure. Now, as regards some specific surgical operations, and more especially in the field of orthopedic surgery or bone surgery, it may prove advisable, and, in some cases, necessary, to introduce into the enclosure only that part of the patient's body to be operated on. In this connection, flexible enclosures have already been manufactured, said enclosures being filled with an usually inert gas at a pressure slightly higher than atmospheric pressure and being adapted to be tightly applied against an operative field provided e.g. with two adhesive faces, one of which is intended to be applied against the patient's body part to be operated on, and the other against the enclosure wall.

The surgeon, who has access within the enclosure through the medium of gas-tight gloves, or else through a piece of clothing not unlike a portion of a diving-suit attached to the enclosure wall, is thus in a position to simultaneously cut the enclosure wall, the operative field and the patient's body part to be operated on, in such a manner that the wound thus opened be in contact solely with the gas filling the enclosure.

It has been observed, however, that such a known method is of no avail in some specific instances, in particular in cases where that part of the patient's body to be operated on is a limb or more generally, an area containing a joint, e.g. a hip or a shoulder. This is due to the fact that, in the latter case, the Surgeon, during or after the operation, must of necessity impart to the limb or to the area concerned, various motions in various directions (e.g. bending, rotating or twisting motions). Now, since the enclosure wall is directly fixed to the operative field, such motions are, in fact, substantially restricted by the enclosure wall itself which, in spite of its flexibility, cannot be stretched at will.

Moreover, the above method requires the enclosure to be cut, which makes it definitively unserviceable after a single operation and, thus, very costly.

The present invention relates to an improvement to gas-tight enclosures of the above mentioned type, which is free of such drawbacks and permits to carry out operations in a confined, and possibly, inert atmosphere on certain parts of a patient's body (in particular, a limb or an area containing one or several joints) without compelling that the whole body be introduced into the enclosure, it being possible to carry out several operations with the same enclosure, which simply requires changing only a removable restricted portion of the wall thereof and sterilizing it after each operation.

The invention is also concerned with the novel arrangement, within the enclosure, of means allowing to

apply an operative field on the limb or any body's part to be operated on, while preventing any contamination of that limb and of the operative field by maintaining the enclosure perfectly gas-tight.

More specifically, the present invention relates to an improvement to a gas tight enclosure, the wall of which is flexible and/or extensible under the influence of a gas at a pressure slightly above atmospheric pressure, and containing means integral with the wall thereof, such as gloves or pieces of clothing of the diver's suit-type, giving a surgeon access to said enclosure while maintaining it gas-tight, said enclosure being characterized in that it comprises at least one appendage attached to the wall thereof and the size of which is such that it can receive a limb or any given part of a patient's body. Said appendage being provided, outside of said wall, with an annular wab which carries a garter-like member adapted to clasp the patient's limb from the outside, an inlet orifice for introducing into the space defined by said limb, said appendage and said web a gas, preferably inert, adapted to inflate said appendage against the gas pressure within said enclosure, and an operative field integral with said appendage or, having one of its sides stuck to that of said appendage surfaces which faces said limb while its other side is covered with a removable self-adhesive coating, so that, once said coating has been removed, said operative field can be applied against said limb to be operated on.

Apart from the above main features, the present invention has the following various minor features which should preferably be taken jointly but, in some cases, might be considered separately:

the appendage comprises at least one glove leaving access to the space defined by said appendage and by said annular web, while maintaining said space gas-tight;

the enclosure wall may be provided with at least one opening for tightly mounting a ring adapted to support said appendage, said ring being provided with an embossment which protrudes outwardly and cooperates with an annular flange, or bead, located at the end of said appendage;

the enclosure wall can be bonded to said appendage by tightly welding the end of the latter, or by any suitable connecting means;

the appendage can comprise a pouch accessible through the glove (or gloves), for storing disinfectants or the like;

the operative field is provided with an attachment permitting to exert a stripping stress on the self-adhesive coating within the space defined by the appendage and the annular web.

That attachment is, for instance, a cardboard member with a handle at the edge of the coating, or else a rod mounted transversaly on the operative-field for winding up the coating as the latter is being removed.

Moreover, according to another feature, the appendage may be provided, along either edge of the operative field, with tubular members adapted to receive stiff rods for tightening the appendage wall and, thus, making it easier to remove the operative-field coating and to apply the field on the limb to be operated on.

Such tubular members can be two or four in number, and, in the latter case, be mounted on the appendage so as to form the edges of a parallelepiped the cross-section, or base, of which is a trapezium.

The appendage may also comprise lateral pouches into which are engaged semi-rigid strips adapted to be removed as the operative field is being applied on the patient's limb.

Other features of the invention will appear from the following description, with reference to the accompanying drawing, in which

FIG. 1 is a front elevation of a gas-tight enclosure comprising an appendage according to the invention;

FIG. 2 is a side elevation of the enclosure of FIG. 1, showing how it is possible to have access to the appendage inside without impairing the gas-tightness thereof;

FIG. 3 is a view similar to FIG. 1, but in which the operative field is shown applied on a patient's limb to be operated on;

FIGS. 4*a* and 4*b* are cross-sections through the appendage, showing the means for positioning the operative field; and

FIGS. 5 and 6 are cross-sections through the appendage, showing other embodiments of the means for positioning the operative field.

In FIGS. 1 and 2, reference numeral 1 designates the wall of a gas-tight enclosure, contingently of a known type, which in fact is outside the scope of the present invention.

Wall 1, which is usually of a flexible and extensible material, such as PVC, defines an internal space 2 made absolutely gas-tight with respect to the atmosphere and, therefore, capable of being filled with a gas, preferably inert, at a pressure slight above atmospheric pressure.

In order to give access to space 2, wall 1 is provided with inlet openings defined by annular flanges 3 adapted to conform to the outer periphery of devices which are to be introduced into the enclosure. In this connection, FIG. 1 shows, by way of example, a transfer casing 4 containing the various instruments required for a surgical operation. In that casing is made an annular groove 5 adapted to be engaged by a mating flange 3 of wall 1. Again, in FIG. 2, is shown an opening made in wall 1 for mounting a member 6 of the diver's suit-type.

The latter, which may be of the type disclosed in French Patent Application EN 71.13250 of Apr. 15, 1971 in the Applicant's name, comprises a piece of clothing 7 intended to cover the upper part of the surgeon's body and provided with a transparent mask 8 at the upper portion thereof and with gloves 9 tightly fitted at the end of sleeves 10.

Wall 1 also comprises other gloves such as 11 (FIG. 2) giving direct access to the enclosure. The whole enclosure rests on a table 12.

According to the present invention and as shown in FIGS. 1 and 2, wall 1 of the gas-tight enclosure is associated with an appendage 13, also of a flexible and extensible material, which may be made provisionally integral with wall 1 while being removable.

To this end, one of the openings in the enclosure wall defined by an annular flange 3 bears a supporting ring 14, the inner end of which (viz. its end located in spec 2) is provided with an outwardly protruding boss 15 in abutment with a flange 16 provided at the end of appendage 13 which, thus, is in the form of a tight bag with a closed end.

In view of the fact that the pressure within space 2 is slightly above atmospheric pressure, appendage 13, when at rest, protrudes outwardly from wall 1 and assumes the position diagrammatically shown in dot and line at 17 in the left portion of FIG. 1.

According to variants, appendage 13 might be made integral with wall 1 of the enclosure by welding it along the periphery of the enclosure opening, or by means of connecting members, such as sliding fasteners, of the so-called velvet type, made gas-tight by means of adhesive tapes.

In order to place in position a patient's limb 18 to be operated on in a strictly confined atmosphere, one first introduces said limb into appendage 13 by turning the latter inside out so as to put it in the position shown in full line in FIGS. 1 to 3.

In order to counteract the gas pressure within space 2 which prevents appendage 13 from being turned inside out and from being inflated, there is provided an internal annular web 19 ending in the form of a garter-like member 20, for instance of rubber or consisting of a tubular member located at the edge of web 19 and taut by any suitable means, which grasps the upper portion of limb 18.

Garter-like member 20, web 19 and the internal side of appendage 13 thus define a space 21 which can be filled with an appropriate pressurized inert gas through an inlet conduit 22 connected to web 19.

By suitably adjusting the gas pressure within space 21, it is possible to inflate the appendage sufficiently (as shown in FIG. 1) to cause it to stretch laterally within space 2 of the enclosure and to surround limb 18 to be operated on.

In order to give the surgeon direct access to the patient's limb 18 thus introduced into appendage 13, there are provided side gloves 23 and 24 welded to the appendage wall or in one piece with it. Finally, at the lower end of the appendage is provided a pouch or bulge 25 adapted to receive various items (not shown) previously introduced into the enclosure, e.g. a flask containing a disinfectant by means of which the already inert atmosphere of space 21 can be additionally asepticized, which is beneficial to the part of limb 18 which is to be operated on.

In each of the above operative steps, and in the following step which consists in applying an operative field on the body's part to be operated on, the physician or surgeon can have access to space 21 through space 2, by engaging the gloves 9 or suit 6 or gloves 11 into gloves 23 or 24 of appendage 13, as shown in FIG. 2.

Before carrying out the surgical operation proper, the surgeon has first to place in position an operative field 26 on the part of limb 18 to be operated on.

This operative field, which has previously been rendered aseptic according to a known method, has one of its sides stuck to that of the appendage surfaces which faces limb 18, with its other side 27, which is to be applied against limb 18, is covered a self-adhesive coating 28 which must be removed in a contamination free atmosphere, viz. in the inert atmosphere of space 21. In this connection, coating 28 may be provided, at one of its ends, with a member 29, e.g. of cardboard, to which is fixed a handle adapted to be grasped, through one of gloves 23 and 24, by one of gloves 9 and 11; by pulling member 29, it is thus possible to remove coating 28 from the operative field. Then the coating is crumpled and stored in pouch 25 in the lower portion of appendage 13.

In the following step, the surgeon carries out the application of the asepticized side **27** of operative field **26** on limb **18** with the utmost care: while exerting a controlled pressure on the wall of appendage **13** from space **2,** he gradually depressurizes space **21** through port **22.**

Finally, as shown in FIG. **3,** the operative field **26** is suitably positioned, and, through the pressure exerted by space **2,** even those portions of the limb not submitted to the surgical operation, are more or less tightly wrapped by the appendage.

Then, the surgeon wearing suit **6** is able to make the requested cuts **31** in operative field **26** by means of, e.g., a lancet, through the medium of glove **9,** by simultaneously cutting the appendage wall and the operative field and making in limb **18** a wound that gives him access to the limb's portion to be operated on.

The surgical operation can then proceed without contamination, since the open portion of the wound thus made can be in contact only of the gas filling space **2,** which as a matter of fact is absolutely inert.

Moreover, since, in view of its arrangement, appendage **13** is closely fitted on limb **18,** it is possible to impart to said limb perfectly free rotation or bending and twisting movements, due to the inherent flexibility of the appendage wall.

Once the surgical operation is over, the surgeon seals the wound **31** and closes the operative field **26** from inside the enclosure.

He then takes off garter-like member **20,** and limb **18** can be extracted from the appendage and from enclosure **1** without having been at any moment in contact with the outer atmosphere.

Finally, appendage **13** is easily dismounted from support ring **14** by snapping its flange **16** out of boss **15.** Thereafter and once space **2** has been sterilized again, a new appendage can be mounted, and the apparatus is thus ready for another surgical operation.

Taking account of the adhesive property of operative field **26,** and in view of the fact that the gas-pressure outside appendage **13,** viz in space **2** defined by the enclosure, increases as the operative field is being applied and becomes higher than the pressure within space **21,** it may prove difficult in some cases, to apply the operative field tightly and evenly on the portion of limb **18** to be operated on. It is to be noted that difficulties will still increase if, for my reason, it is not possible to inflate appendage **13** from outside in order to counteract the gas pressure within the enclosure. To that end, and according to various variants, the applicant has devised a few accessory arrangements for ensuring a better adherence of the operative-field during the above described operating steps.

For instance, as shown in FIGS. **4***a* and **4***b*, tubular members such as **32** and **33** can be provided on the outer surface of appendage **13,** for receiving, from space **2** defined by the enclosure, stiff rods (not shown) adapted to exert a tensile stress on the operative field and to maintain said field perfectly flat while self-adhesive coating **28** is being removed.

Once the coating has been removed, it is possible to apply the operative field gradually on limb **18,** by exerting a stress in the direction of arrows **34** on rods **32** and **33** and being applied taking care of preventing folds being formed in the operative field as it is being applied in view of the pressure decrease within space **21**; the final appearance of the appendage is then such as shown in FIG. **4***b*.

According to another variant, shown in FIG. **5,** four outer tubular members (**32, 33, 35** and **36**) instead of the above two members **32** and **33** on appendage **13.**

Arrows **37** and **38** diagrammatically designate the directions of the stresses exerted on the stiff rods engaged in the four tubular members, with a view to applying operative field **26** gradually and without folding it on the portion of limb **18** to be operated on.

Finally, according to a still further variant, shown in FIG. **6,** appendage **13,** in addition to the two tubular members **32** and **33** comprises a plurality of pouches **39,** on its side faces, said pouches defining pockets adapted to receive semi-rigid rods **40** for preventing said sides faces, in view of the pressure decrease from adhering to limb **18** before operative field has been placed in position; these rods are withdrawn one by one as the operative field is being stuck to limb **18,** by displacing tubular members **32** and **33** in the direction of arrows **41.**

Thus is obtained a gas-tight enclosure provided with one or several appendages of the above-described type and by means of which it is possible to carry out surgical operations on a limb or on any part of a patient's body without, however, having to introduce all the patient's body into the enclosure.

A surgical operation can therefore be carried out in a permanently gas-tight enclosure and without any risk of contaminating the part of the patient's body being operated on.

Moreover, in view of the simple way the appendage is mounted, the latter can be very easily exchanged for a new one after a surgical operation which is thus much less costly.

It is to be noted that the above description is given merely by way of example and does not restrict the scope of the invention which is fully defined by the appended claims.

The appendage, instead of being removably attached to the enclosure wall, might just as well be welded to the latter or be made integral therewith in any manner.

What is claimed is:

1. A gas-tight enclosure for surgical operations, comprising a wall flexible and extensible under the influence of a gas at a pressure slightly above atmospheric pressure, means integral with said wall including gloves and pieces of clothing of the diver's suit-type giving a surgeon access to said enclosure while maintaining it gas-tight,

at least one hollow appendage extending inwardly of said enclosure forming a gas-tight sterile enclosure having an open proximal end portion attached to said wall to receive a given part of a patient's body and a closed distal end portion, an annular web secured to said appendage at the proximal end thereof, a garter-like member secured to said web adapted to clasp about the part of the patient's body from the outside to close said appendage,

an inlet orifice opening into and for introducing into the space defined by the part of the patient's body, said appendage and said web, an inert gas to inflate said appendage against the gas pressure within said enclosure,

an operative-field integral with said appendage having a removable self-adhesive coating on the inside surface of said appendage, whereby, once said coating has been removed, said operative field can be applied against the part of the patient's body.

2. A gas-tight enclosure according to claim **1,** wherein said operative field is adhered to said appendage facing the part of the patient's body.

3. A gas-tight enclosure according to claim **1,** said appendage including at least one glove providing access to the space defined by said appendage and by said annular web, while maintaining said space gas-tight.

4. A gas-tight enclosure according to claim **1,** wherein said enclosure wall is provided with at least one opening, a ring tightly mounted in said opening adapted to support said appendage, an embossment on said ring which protrudes outwardly and cooperates and an annular flange at the end of said appendage cooperating with said embossment.

5. A gas-tight enclosure according to claim **1,** including a welding tightly bonding said enclosure wall to said appendage.

6. A gas-tight enclosure according to claim **1,** said appendage including a storage pouch accessible through said gloves.

7. A gas-tight enclosure according to claim **1** including an attachment for said operative field for applying a stripping stress on said self-adhesive coating within the space defined by said appendage and said annular web.

8. A gas-tight enclosure according to claim **7,** said attachment being a cardboard member and a handle for said member at the edge of said coating.

9. A gas-tight enclosure according to claim **7,** said attachment being a rod mounted transversely on said operative-field for winding up said coating as said coating is removed.

10. A gas-tight enclosure according to claim **1** including tubular members along either edge of said operative field, stiff rods in said tubular members for tightening the appendage wall whereby it is easier to remove said operative-field coating and to apply said field on the part of the patient's body.

11. A gas-tight enclosure according to claim **10,** wherein two tubular members are provided.

12. A gas-tight enclosure according to claim **10,** wherein said tubular members are four in number and mounted on said appendage to form the edges of a parallelepiped the cross-section of which is a trapezium.

13. A gas-tight enclosure according to claim **10,** wherein said appendage includes lateral pouches and semi-rigid strips in said pouches adapted to be removed as said operative-field is applied on the part of the patient's body.

* * * * *