

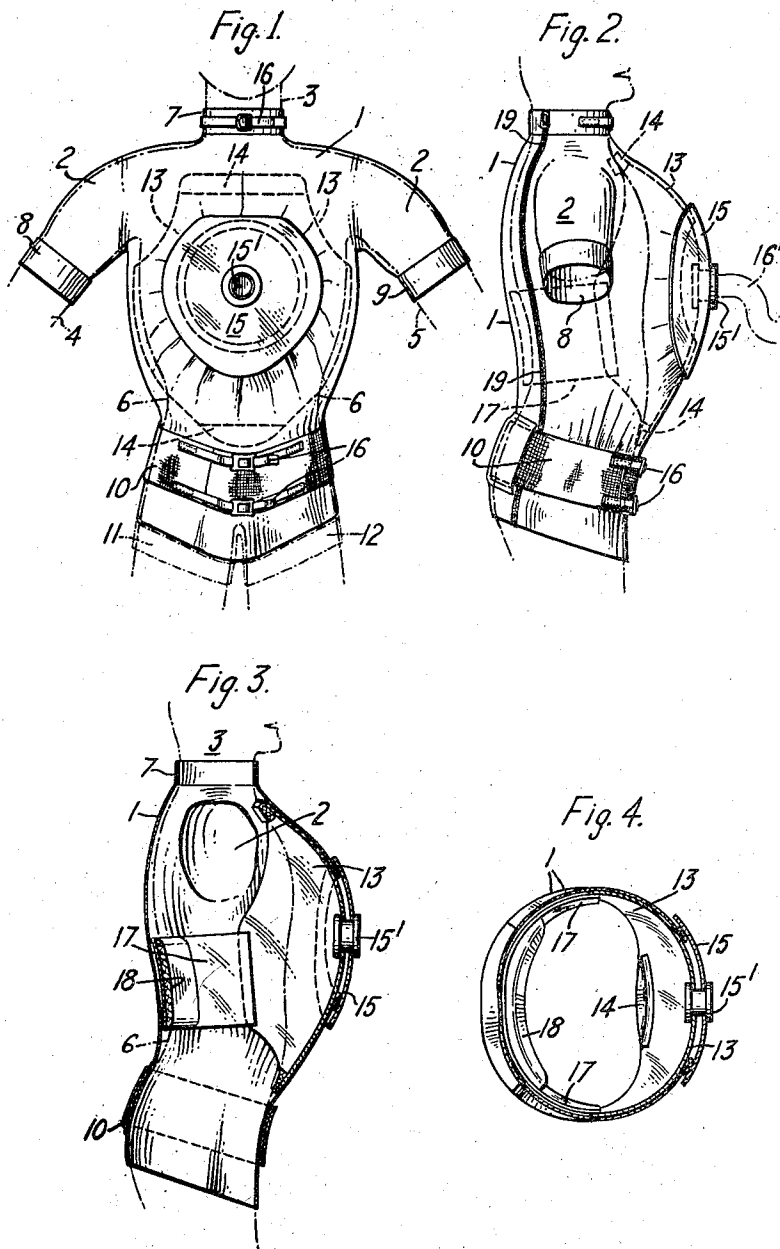
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MECHANICAL BREATHING APPARATUS

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MECHANICAL BREATHING APPARATUS

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This invention relates to apparatus which is used for the purpose of causing the breathing action of a human being to be maintained by mechanical action: such apparatus is of course widely used for cases of nervous disorder, among which may be mentioned polio or as it is more commonly termed "infantile paralysis" and also for resuscitation.

The apparatus commonly known as an "iron lung," which totally encloses the patient, is widely used for this purpose but certain known disadvantages of such an apparatus have resulted in the more recent use of what is known as a "cuirass" type which consists essentially of a sensibly rigid shell intended to fit around its perimeter to the frontal part of the body of the patient so providing between the body and itself a chamber to which air pulsations are supplied, the reduction and increase of air pressure in the chamber setting up the mechanical breathing action by action and reaction between the thorax and the shell.

The invention is concerned with the cuirass kind of apparatus as distinct from the iron lung kind and it has for its main object to avoid the disadvantages which are present with such apparatus as at present used.

In this cuirass type the perimeter of the shell is usually shaped to fit to the patient over the thoracic and abdominal areas: in order to make a sensibly airtight seal with the body at those areas the shell has around its perimeter a sealing fringe which may be made of rubber or sponge rubber which may also be pneumatically inflatable. To hold the shell to the body to press the sealing fringe against the body and also to provide the necessary reaction to the air-pressure variation in the air chamber, it is usual to provide the shell with straps which are passed around the back of the body of the patient and are then pulled tight.

With such cuirass apparatus there is a considerable difficulty in obtaining and maintaining an adequate air seal between the fringe and the body and as a result it becomes necessary to press the shell to the body to a degree which causes discomfort to the patient and also impairs the breathing action of the patient. In addition by reason of the nature of certain illnesses being treated, the obtaining of a seal around the fringe of the shell becomes more and more difficult as a result of progressive emaciation often greatest in just those parts against which the normal shell is designed to seal.

The sealing-rubber fringe has a detrimental effect on the skin with which it contacts and it can give rise to unhealthy skin conditions producing sweating, abrasions and rashes. Because of the nature of the areas selected for the shell to seal against, it is difficult if not impossible to ensure an adequate air-tight seal with a result that in the operation of the device leakage frequently occurs in the form of a localised draught which often produces on the patient local chills which may have serious consequences in view of the weakened condition of the patient. In addition the use of the tight rim seal is disadvantageous in that it inhibits natural movements of the rib cage by exerting restrictive pressure.

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One of the essentials of any apparatus of this nature is that it shall be maintained in a clean hygienic condition but rubber or sponge such as is used for the sealing fringe is not easily sterilised adequately and in addition, being of a porous nature, it may easily absorb toxic substances.

The main object of this invention is to provide an improved device which will avoid the difficulties referred to in the cuirass type of mechanical breathing apparatus.

Broadly stated the present invention consists in providing an encasing component which is formed to be placed about the upper part or trunk of the body and which is formed also to close about the neck, the arms and the lower part of the trunk, e. g. the hips or the upper thighs of a patient, so as to provide within the boundary of the closure a chamber between the component and the body of the patient: this encasing component is most conveniently in the form of a flexible air-tight or slightly permeable material forming a garment which incorporates a relatively rigid part which (when the garment is fitted) is opposed to the thorax, the abdomen or both of the patient to provide the desired local reaction surface against which the air pulsations applied to the chamber react to effect the desired mechanical breathing action.

The zones of closure which may be provided by the garment are constituted by bands or strips of a woven flexible or resilient material.

The invention is illustrated in the accompanying drawings in which Figure 1 is a front elevation showing the device or garment of this invention fitted to a patient and Figure 2 is a side elevation, Figure 3 a vertical section and Figure 4 a sectional plan.

Referring to the drawings, the reference 1 indicates a garment formed of a flexible material, which is fashioned to provide a jacket having sleeve parts 2. The garment is formed to provide zones of closure to cooperate with the patient at the neck 3, the arms 4, 5 and the lower part 6 of the trunk of the body. Thus, these closure zones are indicated for the neck at 7, for the arms at 8, 9 and for the lower trunk at 10: in the arrangement shown, the closure zone of the lower trunk is effected at the lower abdominal part of the trunk but it could equally well be arranged at the upper thighs or hips of the patient, in which case the garment could, as indicated at 11, 12 have two leg parts each with a closure zone.

The garment described incorporates a relatively rigid part 13 which, when the garment is fitted, registers with the thorax of the patient or, as is shown, with the thorax and the lower abdomen. This rigid part 13 is provided at its inner face with pads 14 to bear lightly against the skin of the patient. The part 13 is also formed with an opening closed by a frontal rigid piece 15 which clamps the flexible material 1 about the opening and which has a connection or socket 15' providing a connection for a pulsating air supply from a pipe 16' to the space or chamber between the encasing component constituted by the garment 1 and its rigid part 13 and the body of the patient.

The flexible part 1 of the garment is arranged to fit more or less closely to the body of the patient outside the area covered by the rigid part 13. When now pulsating air pressure is supplied via the connection 15' to the chamber referred to, the garment 1 provides the necessary reaction, against a large surface area of the body, to hold the rigid part 13 against displacement during the positive phase of the air supply and so enables the rigid part 13 to provide the reaction causing the displacement of air from the lungs, i. e. the required mechanical breathing operation.

The flexible material forming the garment 1 can be a single or multi-ply woven fabric of a weave of nylon, rayon or cotton: the material can be air-tight or in the alternative it can be slightly permeable to air: in this latter case, the garment provides for a seepage of air

which affords a ventilation operating to maintain the skin of the patient in a healthy condition.

Because by this invention the closure of the chamber described is effected at the parts of the body referred to, an adequate closure is more easily provided since those parts of the body are of a contour which is most suitable for the purpose and because also those parts of the body retain their contours most closely in cases of emaciation.

The closure at the parts 7, 8, 9 and 10 or 7, 8, 9, 11 and 12 can be arranged by providing the garment with closure bands consisting of woven flexible or elastic fabric which could be self-closing on to the skin and so provide the seal. In some cases, straps could be provided such as are indicated at 16, the straps either replacing the bands or more usually being used in addition to those bands.

It may be desirable to extend the rigid parts 13 as by an extension 17 which, when the garment is fitted is opposed to the back of the body of the patient, this extension being faced by a pad 18 which bears against the back of the patient. This arrangement would operate to locate the patient and the breathing apparatus to one another.

The rigid part 13, which would be formed by a transparent plastic moulding would be of any shape or form required. It is to be noted that the pads 14 do not and are not intended to prevent the movement of air from the space bounded by the part 13 to the space bounded by the other part of the garment up to the closures referred to: a gentle aeration therefore takes place without affecting the essential pressure changes producing the mechanical breathing operation.

For ease in applying the garment to the patient, it can be made in parts fitted with fasteners such as zip fasteners 19 by which the parts can be united. Such a fastener can be used since the invention does not rely on obtaining a perfect air seal and such a fastener could be backed by a flexible strip of some material to hinder the passage of air through the fastener.

It may be found desirable to fit to the garment a strip which can be passed under the crutch of the patient so as to hold the rigid part 13 against upward displacement under the action of the pulsating air-pressure.

An encasing component or garment according to this invention does not attempt to make perfect air-tight seal with the body of the patient, but on the contrary it makes what may be termed a permeable closure permitting controlled ventilation or aeration: the invention does not attempt to make a seal or closure with parts of the body which are difficult for that purpose. As the encasing component or garment encloses the whole of the upper part or trunk of the body of the patient, there is no necessity for applying pressure to the component to hold it to the body as by highly tensioned straps the local pressure of which can be extremely disagreeable: the device therefore gives the patient greater comfort and this has an important psychological effect on the patient. Furthermore the use of a flexible garment enables movement of the rib cage to approximate more closely to that obtaining in natural conditions and the device is easily maintained in a proper hygienic condition.

Thus, it can be said that a garment in accordance with this invention avoids the objections which exist with the ordinary type of cuirass apparatus.

I claim:

1. A mechanical breathing apparatus in the form of a garment of flexible material to fit about the trunk of a patient and which incorporates a relatively rigid part in a position to be opposed when the garment is fitted to a frontal part of the body the displacement of which will induce a breathing action, the rigid part being formed to react at its boundary against the body of the patient and the garment being formed to make closures with the neck, the arms and the lower trunk of the patient and

the garment having means to connect the space bounded by the garment, the closures and the patient to a pulsating air supply.

2. A mechanical breathing apparatus in the form of a garment of flexible material to fit about the trunk of a patient and which incorporates a relatively rigid part in a position such as when the garment is fitted to extend about the body and to be opposed to parts of the body the displacement of which will induce a breathing action, the garment being formed to make closures about the neck, the arms and the lower trunk of the patient and the garment having means to connect the space bounded by the garment up to the closures and the body of the patient to a pulsating air supply.

3. A mechanical breathing apparatus in the form of a garment of flexible material to fit about the trunk of a patient and which incorporates a relatively rigid part in a position when the garment is fitted to be opposed at least to the thorax of a patient, the rigid part being formed to react locally against the opposing area of the body and the garment being formed to make closures with the neck, the arms and the lower trunk of the patient and the garment having means to connect the space between the garment and its closures and the body of the patient to a pulsating air supply.

4. A mechanical breathing apparatus in the form of a garment of flexible material to fit about the trunk of a patient and which incorporates a relatively rigid part in a position when the garment is fitted to be opposed to the thorax and abdomen of a patient, the rigid part being formed to react locally against the opposing area of the body and the garment being formed to make closures with the neck, the arms and the lower trunk of the patient and the garment having means to connect the space between the garment and its closures and the body of the patient to a pulsating air supply.

5. A mechanical breathing apparatus in the form of a garment of flexible material to fit about the trunk of a patient and which incorporates a relatively rigid part in a position when the garment is fitted to be opposed to the abdomen of a patient, the rigid part being formed to react locally against the opposing area of the body and the garment being formed to make closures with the neck, the arms and the lower trunk of the patient and the garment having means to connect the space between the garment and its closures and the body of the patient to a pulsating air supply.

6. A mechanical breathing apparatus in the form of a garment of flexible material to fit about the trunk of a patient and which incorporates a relatively rigid part in a position when the garment is fitted to be opposed at least to the thorax of a patient, the rigid part being formed to react locally against a frontal part of the body of the patient and having an extension formed to react against the back of the patient, and the garment being formed to make closures with the neck, the arms and the lower thigh of the patient and the garment having means to connect the space between the patient and the garment up to the closures to a pulsating air supply.

7. A mechanical breathing apparatus in the form of a garment of flexible material to fit about the trunk of a patient and which incorporates a relatively rigid part in a position when the garment is fitted to be opposed at least to the thorax of a patient the rigid part being formed to react locally against the opposing area of the body, and the garment being formed with closures of woven fabric disposed to make closures with the neck, the arms and the lower trunk of the patient and the garment having means to connect the space between the garment and its closures and the body of the patient to a pulsating air supply.

8. A mechanical breathing apparatus in the form of a garment of flexible material to fit about the trunk of a patient and which incorporates a relatively rigid part in a position to be opposed when the garment is fitted to a

frontal part of the body the displacement of which will induce a breathing action, the rigid part being formed with pads to react against the body of the patient and the garment being formed to make closures with the neck, the arms and the lower trunk of the patient and the garment having means to connect the space bounded by the garment, the closures and the patient to a pulsating air supply.

9. A mechanical breathing apparatus in the form of a garment of flexible material which is slightly permeable to air and which is fashioned to fit about the trunk of a patient and to make closures with the neck, the arms and the lower trunk of the patient, the garment having a part of relatively rigid material to extend about the body of the patient and to be opposed to the parts of the body to be displaced to effect a breathing action and the garment having means to connect the space bounded by the garment and the closures to a pulsating air supply.

10. A mechanical breathing apparatus in the form of a garment of flexible material which is slightly permeable to air and which is fashioned to fit about the trunk of a patient and which incorporates a relatively rigid part in a position to be opposed when the garment is fitted to a frontal part of the body the displacement of which will induce a breathing action, the rigid part being formed to react at its peripheral zone against the body of the patient and the garment being formed to make closures with the neck, the arms and the lower trunk of the patient and the garment having means to connect the space bounded by the garment, the closures and the patient to a pulsating air supply.

11. A mechanical breathing apparatus in the form of a garment of flexible material which is slightly permeable to air and which is fashioned to fit about the trunk of a patient and which incorporates a relatively rigid part in a position to be opposed at least to the thorax of a patient, the rigid part reacting locally against the body, and the garment being formed to make closures with the neck, the arms and the lower trunk of the patient and the garment having means to connect the space between the garment and its closures and the body of the patient to a pulsating air supply.

12. A mechanical breathing apparatus in the form of a sleeved jacket to fit about the trunk and arms of a patient, the jacket having closures to close about the neck, the arms and the lower trunk of the body, and the jacket having a relatively rigid part which when the jacket is fitted is opposed to the part of the body which is to be displaced by a mechanical breathing action and which is shaped to make a local reaction engagement with the body of the patient and the jacket having a connection for a pulsating air supply.

13. A mechanical breathing apparatus in the form of a sleeved jacket of a material slightly permeable to air to fit about the trunk and arms of a patient, the jacket having closures to close about the neck, the arms and the lower trunk of the body, and the jacket having a relatively rigid part which when the jacket is fitted is opposed to the part of the body which is to be displaced by a mechanical breathing action and the jacket having a connection for a pulsating air supply.

14. A mechanical breathing apparatus comprising a garment of material which is flexible and is fashioned to fit about the trunk of a patient and which incorporates a relatively rigid part to extend about the patient in a position opposed to parts of the body to be displaced by the mechanical breathing action, the rigid part where opposed to the frontal part of the body having a greater area than the part opposed to the rear of the body, the garment being formed to make closures to the neck, the arms and the lower trunk of the body and the garment having means to connect the chamber so defined between the garment and the body of the patient to a pulsating air supply.

15. A mechanical breathing apparatus comprising a garment of material which is flexible and slightly permeable to air and is fashioned to fit about the trunk of a patient and which incorporates a relatively rigid part to extend about the patient in a position opposed to parts of the body to be displaced by the mechanical breathing action, the rigid part where opposed to the frontal part of the body having a greater area than the part opposed to the rear of the body, the garment being formed to make closures to the neck, the arms and the lower trunk of the body and the garment having means to connect the chamber so defined between the garment and the body of the patient to a pulsating air supply.

16. A mechanical breathing apparatus in the form of a sleeved jacket formed of a material slightly permeable to air and fashioned to fit about the trunk and arms of a patient, the jacket having closures of woven fabric to close about the neck, the arms and the lower trunk of the body, and the jacket having a relatively rigid part which when the jacket is fitted is opposed to the part of the body which is to be displaced by mechanical breathing action and the jacket having a connection for a pulsating air supply.

References Cited in the file of this patent

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 2,825,327

March 4, 1958

Edward Albert James Tunnicliffe

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

In the grant, lines 2 and 12, and in the heading to the printed specification, line 4, name of assignee, for "Electronic & X-Ray Appliances Limited", each occurrence, read --Electronic & X-Ray Applications Limited--.

Signed and sealed this 1st day of July 1958.

(SEAL)
Attest:

KARL H. AXLINE
Attesting Officer

ROBERT C. WATSON
Commissioner of Patents