

[54] METHOD AND APPARATUS FOR RAPIDLY IMMOBILIZING A PATIENT

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3,523,561 8/1970 Galeazzi..... 128/204 X

FOREIGN PATENTS OR APPLICATIONS

1,278,001 10/1961 France..... 128/204

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- [58] Field of Search..... 128/134, 133, 90, 87 R, 128/204, 2 A, 70, 73, 191; 119/103, 96; 269/322, 323, 328; 425/2; 250/441, 451; 5/327, 336

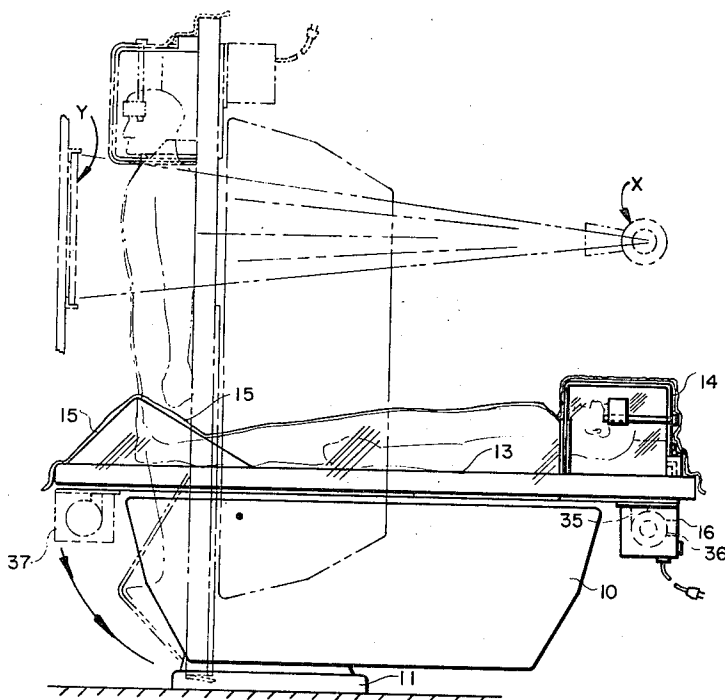
[57] ABSTRACT

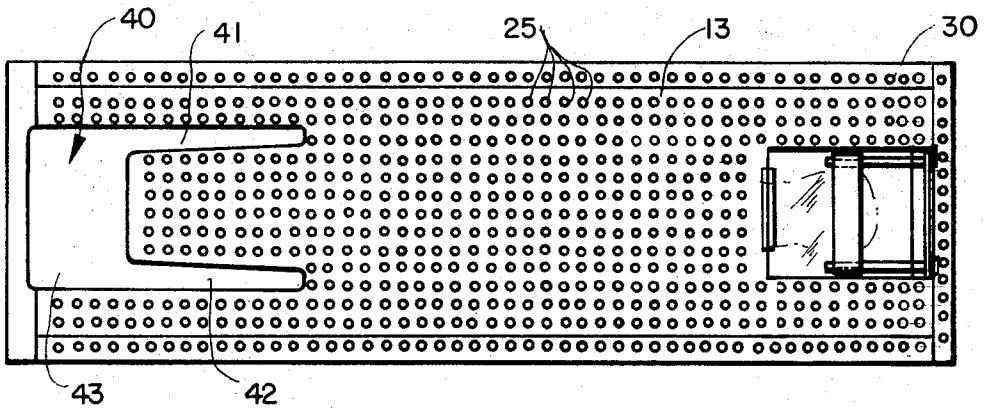
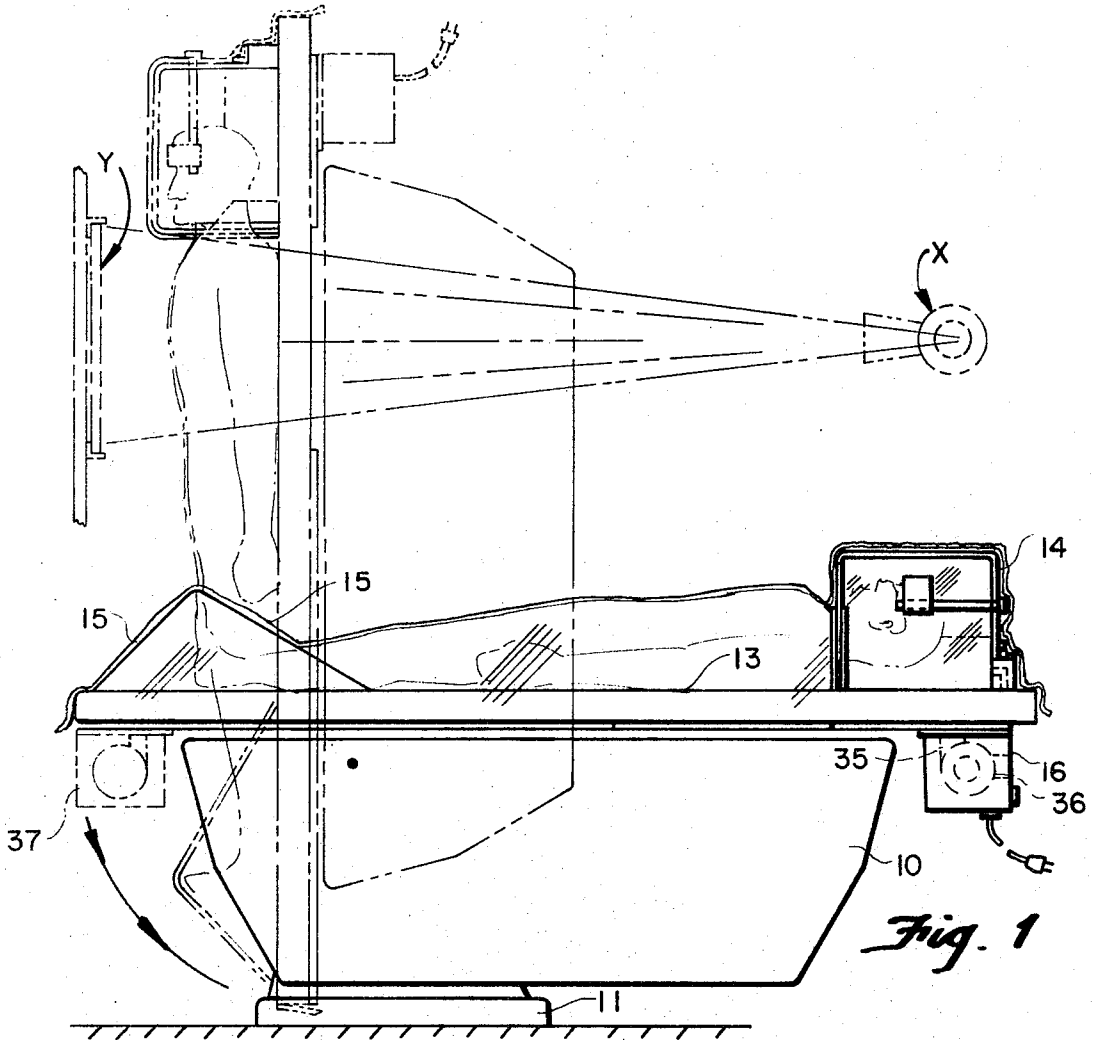
A method and apparatus for rapidly immobilizing an infant or other patient on a positioning platform by disposing a thin, air impervious sheet over the patient's body including his head, and vacuum evacuating the region between the sheet and the platform thereby establishing pressure differential forces that collapse the sheet about the patient's body and hold him in a position against the platform. A face mask maintains air communication between the patient's nose and mouth and other regions beneath the sheet so the patient can breathe while being held firmly in place beneath the sheet.

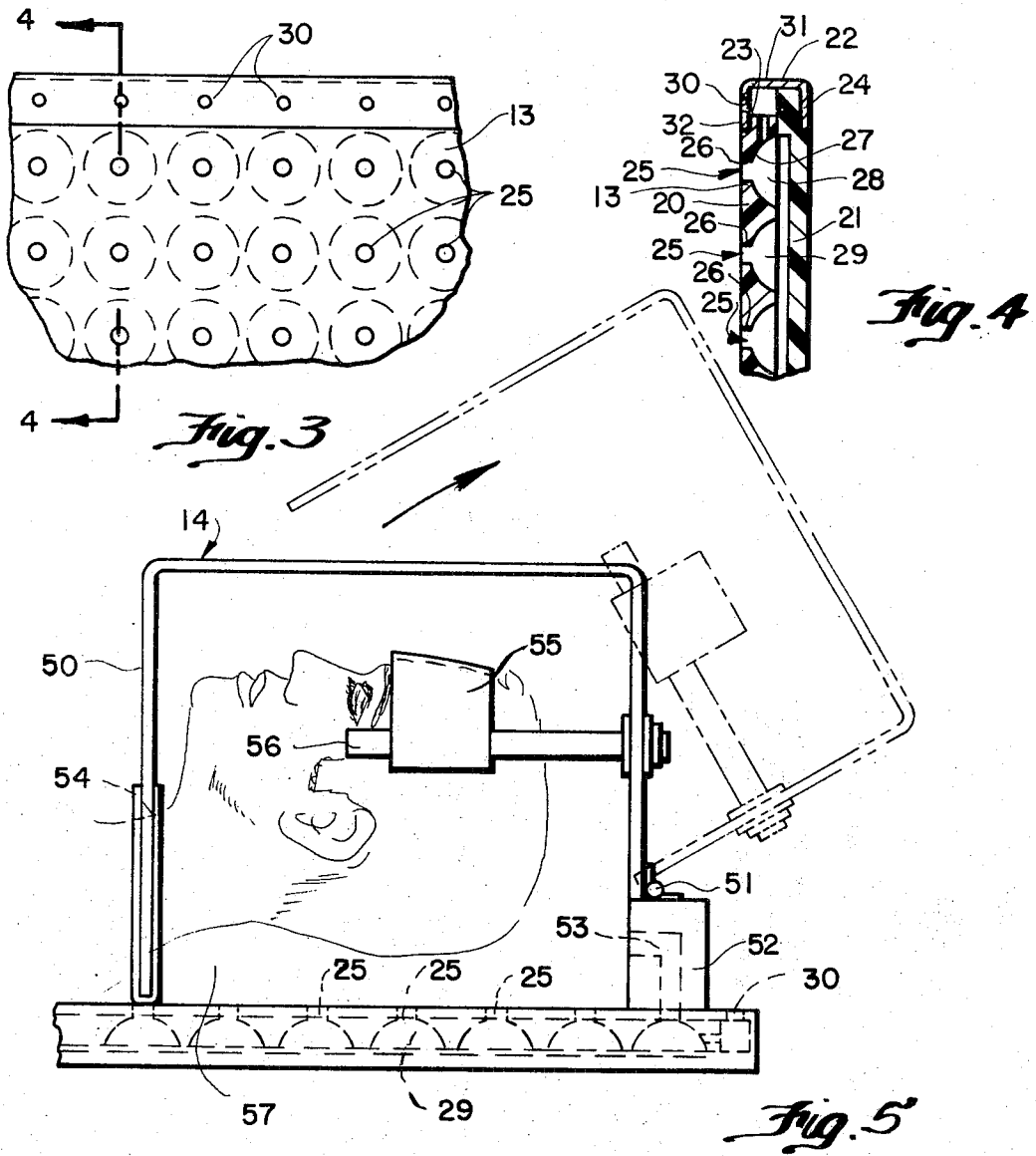
[56] References Cited  
UNITED STATES PATENTS

- 2,563,501 8/1951 Sperling..... 128/134
- 2,788,767 4/1957 Dooley..... 119/103
- 3,224,415 12/1965 Gottfried..... 128/134 X
- 3,286,693 11/1966 Clarke, Jr. et al..... 128/134 UX
- 3,345,985 10/1967 Fisher..... 128/204

22 Claims, 5 Drawing Figures







## METHOD AND APPARATUS FOR RAPIDLY IMMOBILIZING A PATIENT

### CROSS REFERENCE TO RELATED PATENT AND APPLICATION

TILTABLE X-RAY TABLE COMPRISING MEANS TO PRODUCE A VARIABLE SPEED TRANSLATIONAL MOVEMENT, U.S. Pat. No. 3,131,301 issued Apr. 28, 1964 to D. M. Barrett, et al.

METHOD AND APPARATUS FOR IMMOBILIZING A PATIENT, Ser. No. 111,602 filed Feb. 1, 1971 by Walk. H. Kliever now U.S. Pat. No. 3,783,863, issued Jan. 8, 1974.

### BACKGROUND OF THE INVENTION

#### 1. Field of the Invention

The present invention relates generally to a novel and improved system for quickly and painlessly immobilizing an infant or other patient.

#### 2. Prior Art

Present day X-ray diagnostic techniques use straps, harnesses, and adhesive tape to immobilize an infant on a supporting surface such as an X-ray table in such a way as to prevent his movement. Where the infant has been injured by a fall or other accident, he is frequently in a state of excitement and fear even before the procedure of taping and strapping him to the supporting table surface has begun. The pre-existing fear, intensified by the sight of harnesses and the like, often results in a struggle to hold the infant still. The harness and other immobilization gadgetry are frequently so ungainly that even when they are in place, an X-ray technician or parent must still assist in holding the infant still, thereby exposing himself to radiation. Such radiation exposure is often dangerous and has been declared illegal in at least one state.

The referenced application discloses an improved patient restraining device wherein a thin transparent plastic sheet is disposed over portions of the patient's body. A vacuum seal is then formed between the edge portions of the plastic sheet and the table. By this arrangement, pressure differential forces are created such that the patient is held firmly on the table in a gentle and comfortable manner.

The plastic sheet employed in the referenced application is not extended over the patient's face and head, but rather is fitted and sealed around the patient's neck. In order to vacuum evacuate the region between the sheet and the table top, it will be appreciated that a continuous seal must be formed between the sheet and the table top, as well as around such portions of the patient as extend through or under the sheet. The procedure of effecting such a seal is frequently time consuming and is made more difficult where the patient is an uncooperative and excited infant.

The table top employed in the referenced application is perforated at spaced intervals with through apertures. This construction provides no problem of X-ray absorption when a number of known materials are used, but the range of operable materials and the thicknesses of material which can be used is limited. When some dense or thick materials are used in constructing the table top, the solid material between the apertures, in some instances, absorbs a sufficient quantity of radiation to produce an image of the table top on the film. The apertures show up as dark spots since they pass

substantially all radiation while the surrounding solid material absorbs some radiation.

### SUMMARY OF THE INVENTION

The present invention overcomes the foregoing drawbacks of the prior art and provides a simple system of patient immobilization which can be brought into play quickly to immobilize a patient in a firm and gentle manner thereby preventing infant patients from becoming even more frantic during the immobilization procedure.

A supporting platform is provided upon which the patient is positioned. A face mask pivotally mounted near one end of the platform is pivoted into position over the patient's face. An air impervious flexible sheet is placed over the patient and over the face mask to define an evacuable region between the sheet and the platform. A vacuum evacuation unit is then energized to partially evacuate the region thereby establishing pressure differential forces that collapse the sheet around the patient and hold the patient in position against the platform.

The air beneath the sheet need only be evacuated by about 0.5 psi to produce the needed immobilization force. Since atmospheric pressure is normally about 14.5 psi, it will be seen that a reduction to 14.0 psi is not of such magnitude as will cause any discomfort to the patient, and a more than ample supply of air remains beneath the sheet for breathing.

The face mask prevents the sheet from surrounding the patient's nose and mouth so as to choke off his supply of air. The mask is preferably rigid and carries a head supporting device which engages the patient's forehead to assist in positioning and immobilizing the patient's head. The mask is either formed of transparent material or of finely apertured material such as wire mesh in order that the patient can see and be seen therethrough.

A movable foot support is held in place by the same differential pressure forces that operate to immobilize the patient.

The table top is perforated with an array of through apertures of special configuration to prevent the formation of an image of the table top on the X-ray film. The upper end portions of the apertures are of uniform circular cross section. The lower ends comprise downwardly opening segments of a truncated ellipsoid. The cross section of the apertures is accordingly varied sufficiently gradually that the apertures will result in a minimal differential absorption of the X-ray beam. Such an arrangement enables a much wider range of materials and material thicknesses to be used in constructing the table top than would otherwise be possible.

Accordingly, it is a general object to provide novel and improved methods and apparatus for immobilizing infants and other patients for such medical procedures as X-ray diagnosis.

Other objects and a fuller understanding of the invention may be had by referring to the following description and claims in conjunction with the accompanying drawings.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevational view of a patient supporting apparatus constructed in accordance with the present invention and including a pivotal table shown being used with an X-ray apparatus;

FIG. 2 is a top plan view of the patient supporting table of FIG. 1;

FIG. 3 is an enlarged top plan view of a portion of the table top;

FIG. 4 is a cross-sectional view of the table top as seen from the plane indicated by the line 4—4 in FIG. 3; and,

FIG. 5 is an enlarged side elevational view of the face-shield pivotally carried near one end of the table top.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, a patient supporting table is shown having a body 10 tiltably mounted on a base or pedestal 11. The body 10 is tiltable between the generally horizontal position shown in solid lines and the generally vertical position shown in phantom. The referenced patent discloses and claims such a patient supporting table.

The present invention comprises a method and apparatus for rapidly and painlessly immobilizing a patient such as an infant on a supporting surface. Typically, the patient immobilizing system of the present invention is used to hold a patient securely in place on the supporting surface while X-ray exposures are made. Accordingly, the invention will be described in the environment of an X-ray application, an X-radiation source being illustrated schematically at X and an X-ray responsive device such as a film holding cassette being illustrated schematically at Y.

The table body 10 carries a perforated table top 13 for receiving and supporting a patient. It will be appreciated that such a table top can be used in attitudes other than the horizontal for positioning patients for a wide variety of medical procedures. A face-shield structure 14 is pivotally carried near the end of the table top 13. A thin transparent plastic sheet 15 is positioned over the patient and over the face shield 14 so as to define a vacuum evacuable region between the sheet 15 and the table top 13. A vacuum evacuation unit 16 is provided for partially evacuating this region.

The procedure of immobilizing a patient on the apparatus of the present invention may be summarized as follows:

1. The patient is assisted into position on the table top 13
2. The face-shield 14 is pivoted into position over the patient's face
3. The sheet 15 is laid in position over the patient and over the face shield 14
4. As the patient is held in the desired position, the evacuation unit 16 is actuated to establish pressure differential forces tending to clamp the patient in position against the table top 13. The face shield 14 assists both in holding the patient's head in position and in keeping the sheet 15 away from the patient's nose and mouth to maintain adequate airflow communication for breathing.

These four steps can all be carried out in a relatively rapid fashion as opposed to the rather lengthy known

patient immobilization procedures employing tape, straps and harness. Accordingly, a major advantage of the system of the present invention is the speed with which it can be brought into play.

Referring to FIGS. 3 and 4, the table top 13 comprises upper and lower members 20, 21. A frame 22 of channel-shaped cross section engages the peripheral edges 23, 24 of the members 20, 21 clamping the members together. The upper and lower members 20, 21 and the frame 22 are provided with an arrangement of openings and channels to establish air flow paths for vacuum evacuating the region beneath the plastic sheet 15, as will be explained presently.

The upper member 20 is perforated with an array of openings 25. The openings 25 have short upper end regions 26 of relatively small constant diameter. The lower end regions 27 of the openings 25 become progressively larger in diameter as they open downwardly. In the preferred embodiment the lower end regions take the form of truncated spherical or truncated ellipsoidal recesses.

The lower member 21 has a recessed central region 28 which communicates with the lower end regions 27 to define a vacuum manifold 29. By this arrangement air is drawn through the openings 25 and passed through the manifold 29 to the vacuum evacuation unit 16, as will be explained.

The frame 22 is also provided with upwardly opening apertures 30. A passageway 31 is formed within the frame communicating the apertures 30. Communication is established between the passageway 31 and the manifold 29 by means of apertures 32 formed in the upper member 20.

The apertures 30 extend around the periphery of the table top 13 to provide a means of drawing the plastic sheet 15 sufficiently snugly against the table top 13 to effect a seal. The openings 25 will serve a similar function where the sheet 15 comes into contact therewith.

A special configuration of the openings 25 is intended to minimize the effect of the openings on the resulting radiograph. The tapered walls of the lower end regions 27 will not produce a sharp differential in X-ray absorption where a wide range of materials and material thicknesses may be used to form the table top.

The evacuation unit 16 has an inlet 35 which communicates with the manifold 29. A blower 36 draws air from the inlet and discharges it into the atmosphere. While the evacuation unit 16 is shown in FIG. 1 as being mounted beneath the head of the table top 13, an alternate foot-end location is shown in phantom at 37.

A movable foot support is shown generally at 40 in FIG. 2. The support 40 comprises a U-shaped structure with a pair of legs 41, 42 extending in generally parallel directions from a transversely extending base 43. The support 40 serves the dual function of supporting the plastic sheet 15 around the patient's feet, and supporting the patient when the table body 10 is tilted to the vertical position shown in phantom in FIG. 1. The foot support 40 is held in position on the table top 13 by the differential pressure forces established across the plastic sheet 15.

The face shield 14 is illustrated in greater detail in FIG. 5. The shield 14 preferably comprises a rigid transparent cover 50 which maintains air communication for breathing. The shield can also take the form of

a sieve-like mask which permits vision therethrough but does not permit the collapse of the sheet 15 about at least one of the patient's breathing passages. The cover 50 is connected by a hinge 51 to a supporting block 52. The block 52 is provided with air passages 53 that communicate the region beneath the cover 50 and vacuum manifold 29. A number of the openings 25 also open into the region beneath the cover 50.

The cover 50 is configured to accommodate and support the patient's head. A padded U-shaped opening 54 is provided to accommodate the patient's neck. An adjustable padded forehead engaging band 55 is supported on a pair of rods 56 carried by the cover 50. A head supporting pad 57 positioned within the region beneath the cover 50 engages and supports the back of the patient's head. Accordingly, once the cover is positioned over the patient's head, head movement is substantially restricted and adequate head support is provided for movement of the patient during the various tilting movements of the table body 10.

The cover 50 is clamped down against the table top 13 by the pressure differential forces developed across the sheet 15 by the evacuation unit 16. Even though the patient's head is positioned with the vacuum evacuation region beneath the sheet 15, the vacuum drawn in this region is only of the order of 0.5 psi reduction in normal atmosphere pressure and is accordingly of insufficient intensity to interfere with the breathing of the vast majority of patients.

Although the foregoing description is necessarily of a detailed character, in order that the invention may be set forth it is to be understood that the specific terminology is not intended to be restrictive or confining, and that various rearrangements of parts and modifications of detail may be resorted to without departing from the scope or spirit of the invention as hereinafter claimed.

What is claimed is:

1. A patient immobilization apparatus for immobilizing a patient, comprising:

- a. a patient positioner for supporting a patient;
- b. a flexible member composed of an air impervious material extending over and peripherally from at least part of said positioner to cover at least part of a patient's body including the head and defining an evacuable region substantially sealed from atmosphere surrounding the apparatus, said region bounded by at least part of a patient's body, said member and at least part of said positioner and extending about a patient's head;
- c. evacuation means for partially evacuating said region to establish a pressure differential between atmosphere surrounding the apparatus and said region, said pressure differential providing differential pressure forces exerted on at least part of the patient's body via said member for holding a patient against said positioner;
- d. face mask means for maintaining said member spaced from at least part of a patient's face and for enabling a patient to breath air in said region while being held in place against said positioner.

2. The apparatus of claim 1 wherein said face mask means and said member comprise materials which are at least partially transparent to enable a patient to see and be seen therethrough.

3. The apparatus of claim 1 wherein said face mask means is supported for pivotal movement with respect

to said positioner between a first position wherein a patient is positioned with respect to said positioner and a second position wherein said face mask means is pivoted into its operative relationship with a patient's head.

4. The apparatus of claim 1 wherein said positioner comprises an elongated patient engaging platform and said face mask means comprises a mask member carried by said platform near one end thereof, said face mask means further including head engaging means to assist in supporting and immobilizing the patient's head.

5. The apparatus of claim 1 wherein said positioner is provided with a positioner surface defining a plurality of perforations communicating said region to said evacuation means.

6. The apparatus of claim 5 wherein said positioner surface is defined on a positioner member and said perforations comprise an array of apertures extending through said positioning member, the aperture ends opening through said surface being of lesser area than the opposite end openings thereof.

7. The apparatus of claim 6 wherein said apertures define first portions extending from said surface which are of a relatively constant area and second portions which increase in area proceeding away from said first portions.

8. The apparatus of claim 7 wherein said second portions each comprise a segment of a downwardly opening truncated ellipsoid.

9. A patient immobilization apparatus comprising:

a. a patient support for a patient, the patient support including a portion for engaging a patient's head;

b. a face mask movably connected to said patient support for movement between a retracted position spaced from said head engaging portion and an operational position overlying said head engaging portion;

c. a flexible member composed of an air impervious material extending over and peripherally from at least part of said patient support to cover the patient's body and said face mask to define an evacuable space between said member, at least portions of said support, a patient's body and between said face mask and said head engaging portion; and,

d. evacuation means for partially evacuating said space so as to establish pressure differential forces that collapse said member against a patient and hold a patient against said support, said face mask preventing the member from collapsing about a patient's head.

10. The apparatus of claim 9 wherein said face mask and said member comprise materials which are at least partially transparent to enable the patient to see and be seen therethrough.

11. The apparatus of claim 9 further comprising structure supporting said face mask for pivotal movement between said positions.

12. The apparatus of claim 9 wherein said face mask includes a head engaging element to assist in the support and immobilization of a patient's head.

13. A method of immobilizing a patient, comprising the steps of:

a. positioning a patient in engagement with a positioning surface;

- b. positioning a shield adjacent to at least a portion of the patient's face including at least one of the patient's breathing passages;
- c. positioning a flexible member composed of an air impervious material over at least a portion of the patient's body including the patient's head and the shield to define an evacuable region between the surface and the member with the patient and shield positioned therein;
- d. partially evacuating the region to establish pressure differential forces that collapse the member against the patient and urge the patient against the surface; and,
- e. maintaining said portion of a patient's face in communication with said region by preventing the member from collapsing into engagement with said portion of the patient's face whereby a patient's breathing is uninterrupted when said member is collapsed.

14. The method of claim 13 wherein the patient is maintained within the view of the person operating the immobilization apparatus by using a shield and a member, both of which permit the patient to see and be seen therethrough.

15. The method of claim 13 additionally including the step of holding the patient in a desired position as the region is being initially partially evacuated, whereby the patient will be immobilized in the desired position.

16. The method of claim 13 additionally including the step of positioning at least one patient engaging support structure between said surface and said member prior to evacuating said region to aid in holding the patient in a desired immobilized position whereby said pressure differential forces additionally serve to clamp said patient engaging support structure in place on said surface.

17. Immobilization apparatus for an animate, breathing subject comprising:

- a. a subject support defining a subject engaging surface portion;
- b. cover means positioned with respect to said subject support to partially extend about a first body portion of a subject engaging said surface portion to provide a first region bounded at least in part by said cover means and said support and in which the subject may breathe;
- c. a flexible member composed of a substantially gas impervious material extending over and peripherally from at least part of said subject support to cover at least a second body portion of the subject to define a second region bounded at least in part by said member, said support and the subject; and,
- d. pressure differential creating means effective to create a pressure differential between said first and second regions and atmosphere surrounding said apparatus, the pressure in said regions being of lesser magnitude than the pressure of the atmosphere surrounding the apparatus, said pressure differential creating means effective to establish differential pressure forces for collapsing said member against the subject and urging the subject against said support surface while urging at least portions of said member into sealing engagement with said support;

e. said differential pressure forces applied to said cover means to maintain said structure in position with respect to said support and said subject.

18. The apparatus claimed in claim 17 wherein said cover means comprises a subject engaging element in said first region, said element effective to transmit at least a portion of the pressure force applied to said structure to the subject for urging the engaged portion of the subject in the direction of the support.

19. The apparatus claimed in claim 17 wherein said member covers said cover means and extends peripherally from said cover means into sealing engagement with said subject support, said member effective to substantially prevent communication between the atmosphere surrounding the apparatus and said first region.

20. The apparatus claimed in claim 17 further including cover means supporting means supporting said structure for movement between its operative position establishing said first region and a second position wherein a subject is positionable on said support surface without interference with said structure.

21. A method of immobilizing a breathing animate subject comprising:

- a. positioning a subject against a subject support;
- b. providing a first region extending about a body portion of the subject and in which the subject can breathe, said region defining a boundary which is spaced from said subject body portion to enable unobstructed breathing;
- c. providing a second region bounded by at least a second body portion of the subject, a flexible member composed of substantially gas impervious material extending peripherally from at least said second body portion to the subject support, and the subject support;
- d. substantially preventing communication of air between the first and second regions and the surrounding air;
- e. creating a pressure differential between the first and second regions and the surrounding air with the magnitude of the pressure in said first region and said second region being less than the magnitude of the surrounding air pressure;
- f. establishing a first differential pressure force resulting from the differential pressure between said first region and the surrounding air, said first pressure force at least partly transmitted to a predetermined location of the first subject body portion to urge the first body portion toward the support while maintaining the first region boundary spaced from the first subject body portion to enable unobstructed breathing in said first region; and,
- g. establishing a second differential pressure force resulting from the pressure differential between said second region and the surrounding air, said second pressure force applied to said second subject portion for urging said subject against said support.

22. The method claimed in claim 21 wherein said first region boundary is defined in part by said flexible member and a member support structure, and further comprising preventing said member from collapsing against said first subject portion to enable continued breathing by said subject while being urged against said subject support.