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Refrigeration Chambers and Volumes for Use in Extreme Situations

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Abstract: ***Here are reviewed new solutions for chambers and volumes to be used in extreme situations. Furthermore, the main aspects of the basic requirements for their implementation are taken into consideration. Three typical solutions with inventive step of the author are reviewed.***

Keywords: types, new chambers and volumes, extreme situations.

I. INTRODUCTION

In extreme situations caused by natural disasters such as earthquakes, floods or major industrial accidents /Chernobyl/, as well as in warfare, buildings and technical infrastructure are substantially damaged or destroyed. This requires the development and construction of quickly erected sites – chambers and volumes necessary to meet the specialized and all other urgent needs of the population.

II. REQUIREMENTS FOR THE CHAMBERS AND VOLUMES

The following requirements are essential in the design of the chambers and volumes:

a. They should allow their structures to be assembled/ disassembled;

b. To be constructed of lightweight materials that provides structure solidity and heat, steam and gas insulation;

c. The structures have to be air-tight (gas-tight), since this type of structures are particularly suitable for use in case of bacteriological contamination of the environmentt, e.g. in case of leakage of ”radon”; for the storage of fruits and vegetables intended for consumption in winter and spring; for medical purposes and others.

d. The construction technology should allow their easy and fast disassembling and relocating.

III. ANALYSIS OF THE REQUIREMENTS

From the analysis of these requirements it can be deducted that the volumes for operation in extreme situations, should be made of prefabricated walls, floors and ceilings such as whole panels, striped vertical panels, horizontal strip panels and others. Ensuring air-tight links between the prefabricated elements will broaden the spectrum of use of the volumes in other cases: operating rooms and operating blocks. An appropriate supporting structure will allow overcoming the support distances and will allow classified mixed functions, for example- pressurized volume space with an area of 36-40 m^2 can be used as an operating room, a temperature-controlled warehouse for storing blood products, medicines, food and others.

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IV. TYPICAL AUTHOR (COPYRIGHT) DECISIONS

L. Aleksandrova has developed the „Solar energy application for hot water residential supply and air heating in a modular medical unit (operation theatre) in extreme situations“ - BG66192 (B1) [4], whereas the invention shall find application in the construction of temporary medical modules (operation rooms) in extreme situations with facilities for longer maintenance of constant temperatures in the hot water vessels, as well as for air heating due to the hothouse effect formed at the angular installation spaces.“ [4]

3.1. Patent for invention „Built-up refrigeration chamber“. BG63644 (B1). [1]. (Fig.1, 2.)

The chamber is used in the construction of industrial refrigerators, as well as in building of removable refrigeration tunnels. It achieves greater stability of the built-in volume. The four walls (1) of the chamber (2) are formed by beamed-walls (3) which have double T-section with trapeze-shaped belts. Panels (5), forming the ceiling and the floor of the chamber, have triangular shapes with chamfered peaks (6), and are fitted to each beamed-wall (3), by means of horizontal pivotal connections (4), fitted at the inner angle to the upper and to the lower trapeze-like belt of the beamed-walls (3) by their base, or by a triangular panel (5), respectively. The triangular panels (5) are fixed to each other at their chamfered peaks (6) by a clamp (7), and on the fronts of the triangular panels (5) sealing strips (13) are fitted, and the joints between the panels (5) at the floor and the ceiling are covered by gas impermeable layer (8).

3.2. Moveable cold storage chamber for positive temperature. BG111651 (A). [2]; (Fig. 3, 4.)

The invention relates to a cold storage chamber having a natural lighting along the edges of the chamber to create a greenhouse effect. There is a possibility for artificial lighting and heating of the storage by converting solar energy into electricity through photovoltaic coatings. The cold storage chamber has a supporting structure of longitudinal transparent frames (12) and transverse transparent frames (12-a), as to the columns of the frames are installed inside transparent guides (11, 13) for securing the walls of the chamber. Along the edges of the chamber are situated transparent elements - three angular planar elements (1, 8) horizontal angular of two planar elements (2, 7), a

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T-shaped angular member (3, 6) and the vertical angular of two planar elements (4). The walls are covered by not transparent wall panels (10) secured to the inner side of the guides (11, 13) and the ceiling is made of not transparent ceiling panels (9) secured to the inner side of the transverse frames (12a). On the wall panels (10) and the ceiling panel (9) is arranged a photovoltaic coating.

3.3. System for solar heating of cooling chamber with positive temperatures. BG111658 (A). [3]; (Fig. 5, 6.)

The invention finds application in extreme situations and features with solar heating to achieve the positive temperature, with naturally absentmindedly solar lighting in the area of vertical joints between the panels, as well as with combined thermal insulation of walls and the roof of transparent thermal insulation, at least half-filled with energy accumulation composition. Three flat corner is filled with the external transparent layer (1-a), an inner dense layer (7), as in layers (7) shaped the first vertical zigzag channel (7-a) and the second horizontal zigzag channel (7-b), as in the channel (7-a) is a heirloom layer (6), and the zigzag shaped element (6) is fixed to the thick layer (7) with the connector (4), (7) and behind this layer (6) are located in the thin heating coils (3-b)and between the outer transparent layer (1-a) and the inner dense layer (7) is a transparent thermal insulation (2), with its transparent walls (2) are shaped confined spaces, as at least half of these spaces are filled with energy accumulation composition, and a T-shaped three-flat corner (5) is filled with external vertical transparent layer (21), and the other two layers (1-a), and (7) are dense, such as in the layer (7) shaped the first vertical zigzag channel (7-a); and the second horizontal zigzag channel (7-b), as in the channel (7-a) is a heirloom layer (6), and zig-zag shaped element (6) is fixed to the thick layer (7) with the connector (4)as in the sewers (7-a) and behind this layer (6) are located in the thin heating coils (3-b), and to the same layer (6) are located on the thicker heating coils (23), such as to the left of the layer (1-a) are located other vertical curved channels (7-b), and the two flat corner (on the external walls of the enclosure) is filled with outdoor transparent layer (1-a), the inner dense layer (7) as in layers (7) shaped the first vertical zigzag channel (7-a) and the second horizontal zigzag channel (7-b), as in the channel (7-a) is situated heirloom.

V. CONCLUSIONS

1. In extreme situations the chambers and volumes should have a universal purpose.
2. The technical solution of the supporting structure and building envelope should allow the integrated use of the internal space of the volumes for different functions.
3. Ensuring a high level of assembly capability, combined with opportunities for quick disassembly of the volumes will allow greater operational flexibility, with options for relocating the volumes to different territories.
4. The use of air-tight materials in the structure of the links between the elements of the volume will allow their use for protecting in terms of bacteriological pollution, at high levels of radon-gas, where its separation can be induced as a result of displacement of the earth layers after earthquakes and others /PATENT BG63644 (B1) – BUILT- UP REFRIGERATION CHAMBER/. [1]
5. The sealed enclosure for positive temperatures, for storing fruits in an air contaminated environment can be used for medical purposes, for example, operating rooms and operating units, as long as the square surface can fit in the square surface of the chambers. Their temperature of +2 to + 8^0 C is ensured by the greenhouse effect, which is obtained after the direct penetration of sunlight into the rooms. /Application of the patent BG111651 (A). MOVEABLE COLD STORAGE CHAMBER FOR POSITIVE TEMPERATURE/ [2]
6. A positive temperature of 22 - 24^0 C required for the operating rooms, for example, is achieved with the help of solar energy, air or water collectors located on the roof of the volumes and included as components of the solar systems for heating water or air. /Application of the patent BG111658 (A) – SYSTEM FOR SOLAR HEATING OF COOLING CHAMBER WITH POSITIVE TEMPERATURES/ [3]
7. The glazing of the sealed volumes will allow the penetration of natural light, which is essential for the operation of their internal spaces during the day after the occurrence of the devastating impact caused by the effects of the extreme situation.

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2. Aleksandrov Yanko [BG] BG 111651 (A). Moveable cold storage chamber for positive temperature; Classification: international; E04H5/12; Espacenet.
3. Aleksandrov Yanko [BG] BG 111658 (A). System for solar heating of cooling chamber with positive temperatures;
4. Classification: international: E04B2/00; E04C1/00; Espacenet.
5. Aleksandrova Lyudmila [BG]; VSOU LYUBEN KARAVELOV [BG]
6. Patent BG66192 (B1) – 2011-12-30. Solar energy application for hot water residential supply and air heating in a modular medical unit (operation theatre) in extreme situations. Classification: international: F24J2/42; cooperative: Y02E10/40; Espacenet.

Professor Yanko Aleksandrov is the author and co-authors of more than 100 patents for inventions, whereas a significant part of them solve problems in the sphere of the energy efficiency of buildings, e.g. active-energy walls, energy-accumulating panel connections, systems for solar heating of buildings, sectional modules with autonomous energy supply for use in extreme situations, i.e. natural disasters, etc. Professor Yanko Aleksandrov in co-authorship is winner of the “Genius Grand Prix”and a Gold medal from the International Invention Fair in Budapest. His papers have roused high interest at numerous international conferences on architecture and sustainable development, e.g. in Tokyo, Seoul, Hong Kong, Kuala Lumpur, Cape Town, Florence, etc. He has been guest lecturer at the Faculty of Architecture of the Institute for Building Management in Belgrade, Serbia as well as “Erasmus” lecturer at the Riga Building College, Latvia in 2012, 2013, 2014 and 2015. The author teaches the course “Innovative design of buildings, constructions and details” at the Faculty of Architecture of the Civil Engineering Higher School “Liuben Karavelov” in Sofia, Bulgaria. Professor Aleksandrov together with his team has been finalist of several international Superskyscrapers competitions, e.g. Hong Kong – 2013, Singapore – 2014, London – 2014, “Elevator annual design competition” – 2014, TORONTO VELODROME – 2015; STEEL CITY - CONTAINER SKYSCRAPERS - MUMBAI, 2015; www. superskyscrapers.com, etc.

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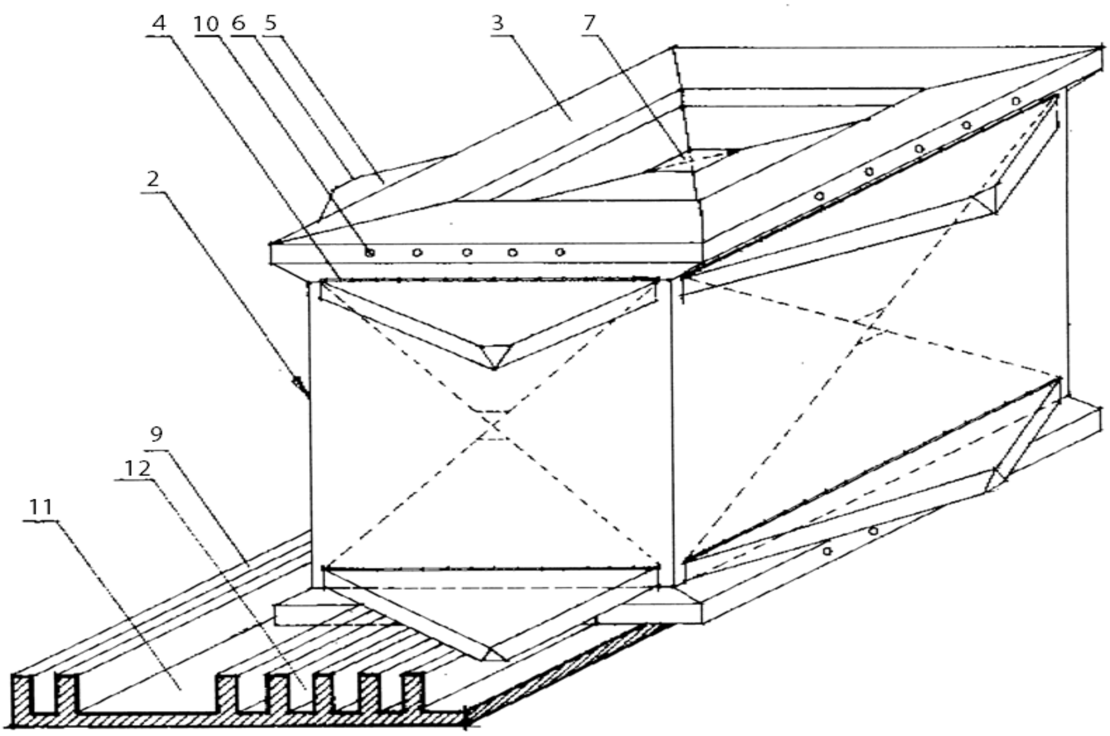

Fig.1. General view. Patent for invention„ Built-up refrigeration chamber“. BG63644 (B1). [1].
(1) four walls; (2) chamber; (3) beamed walls; (4) horizontal pivotal connections; (5) triangular panels; (6) chamfered peaks; (7) clamp; (8) gas impermeable layer; (9) rib; (10) cylindrical channels; (11) channel for foundation of the beamed walls; (12) channel.

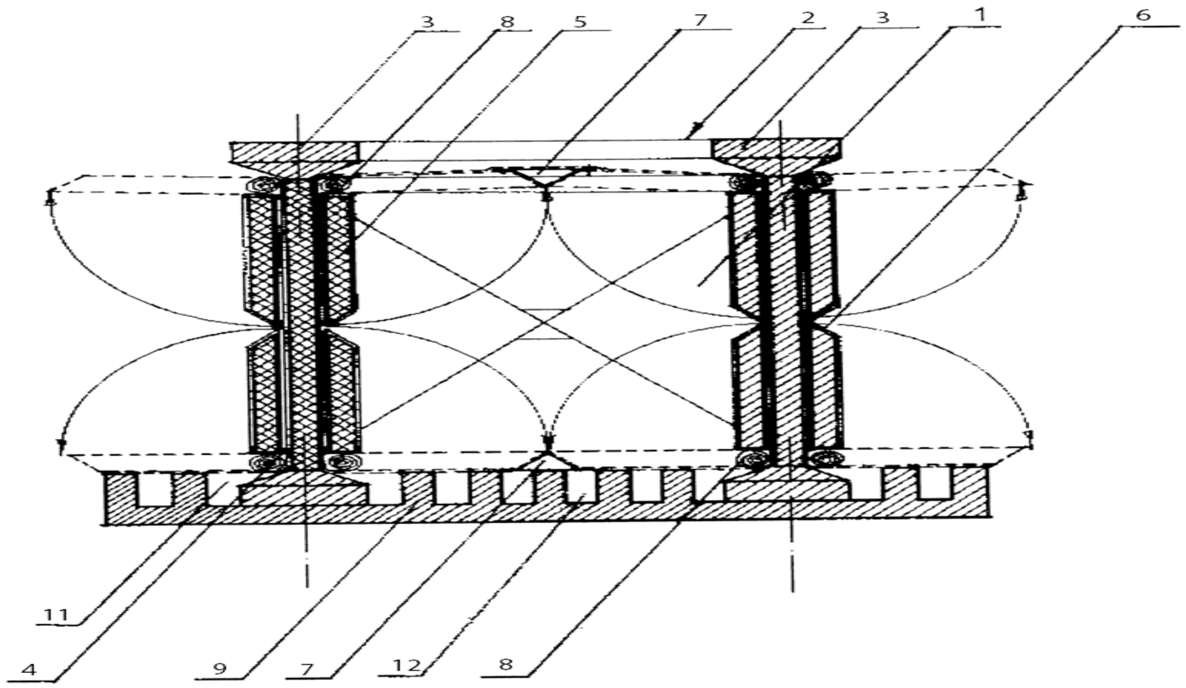

Fig.2. Section. Patent for invention „Built-up refrigeration chamber“. BG63644 (B1). [1].
(1) four walls; (2) chamber; (3) beamed-walls; (4) horizontal pivotal connections; (5) triangular panels; (6) chamfered peaks; (7) clamp; (8) gas impermeable layer; (11) channel for foundation of the beamed walls; (12) channel.

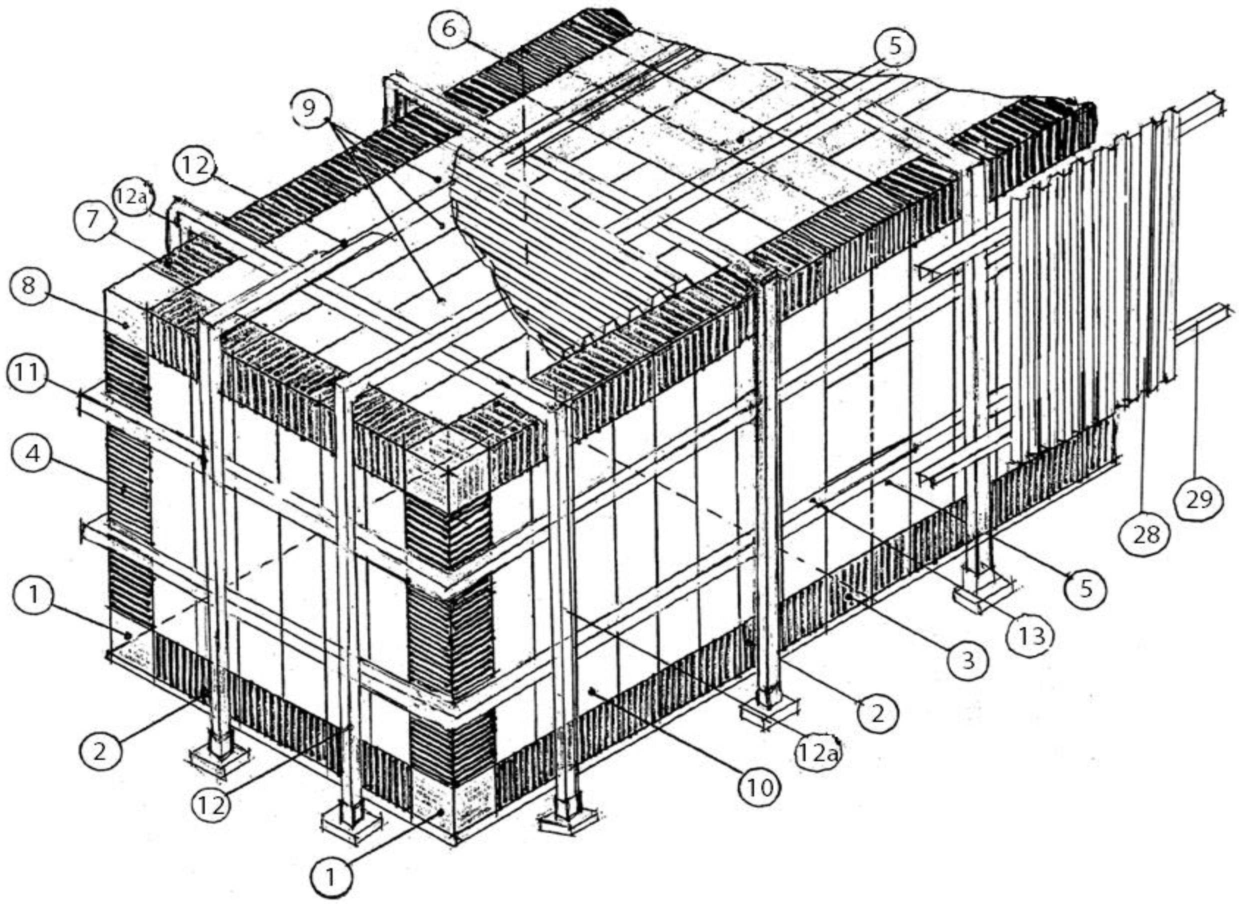

Fig.3. General view. „Moveable cold storage chamber for positive temperatures”. BG111651 (A). [2]
(1,8) three angular planar elements; (2,7) two planar elements; (3,6) „T“- shaped angular member; (4) the vertical angular of two planar elements; (9) not transparent ceiling panels; (10) not transparent wall panels; (11,13) the inner side of the guides; (12a) the inner side of the transverse frames; (12-a) transverse transparent frames; (11,13) inside transparent guides.

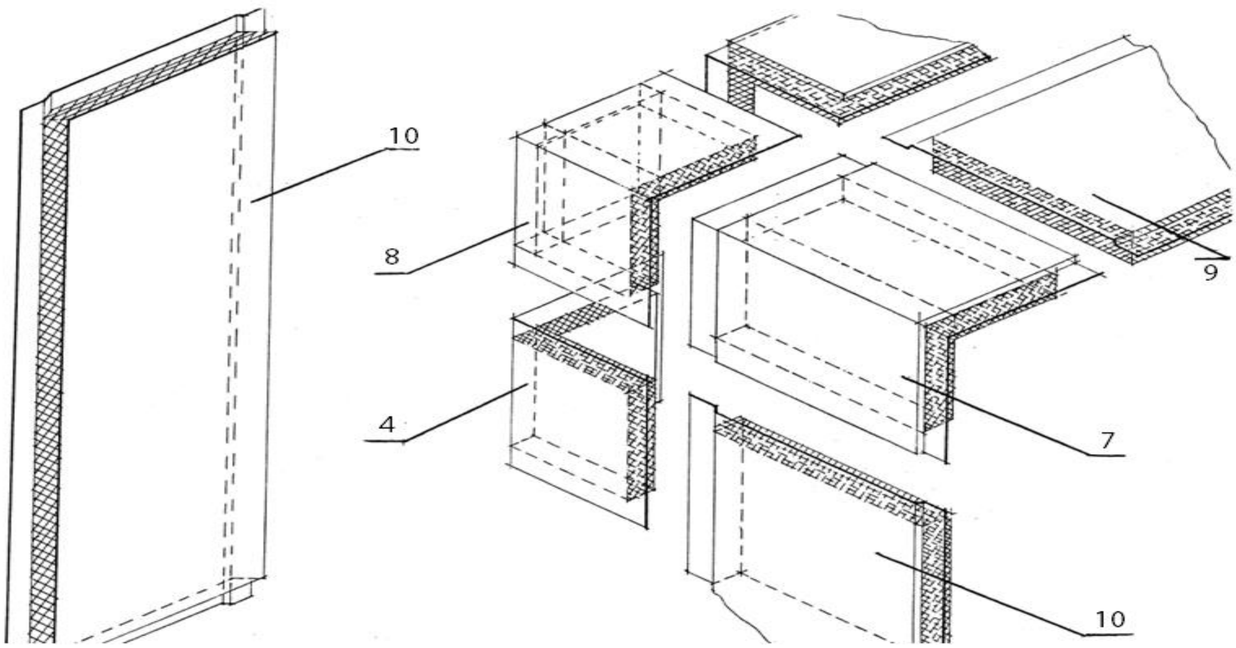

Fig.4. The basic elements. „Moveable cold storage chamber for positive temperature”. BG111651 (A). [2]
(4) vertical angular of two planar elements; (7) two planar elements; (8) three angular planar elements; (9) not transparent ceiling panels; (10) not transparent wall panels.

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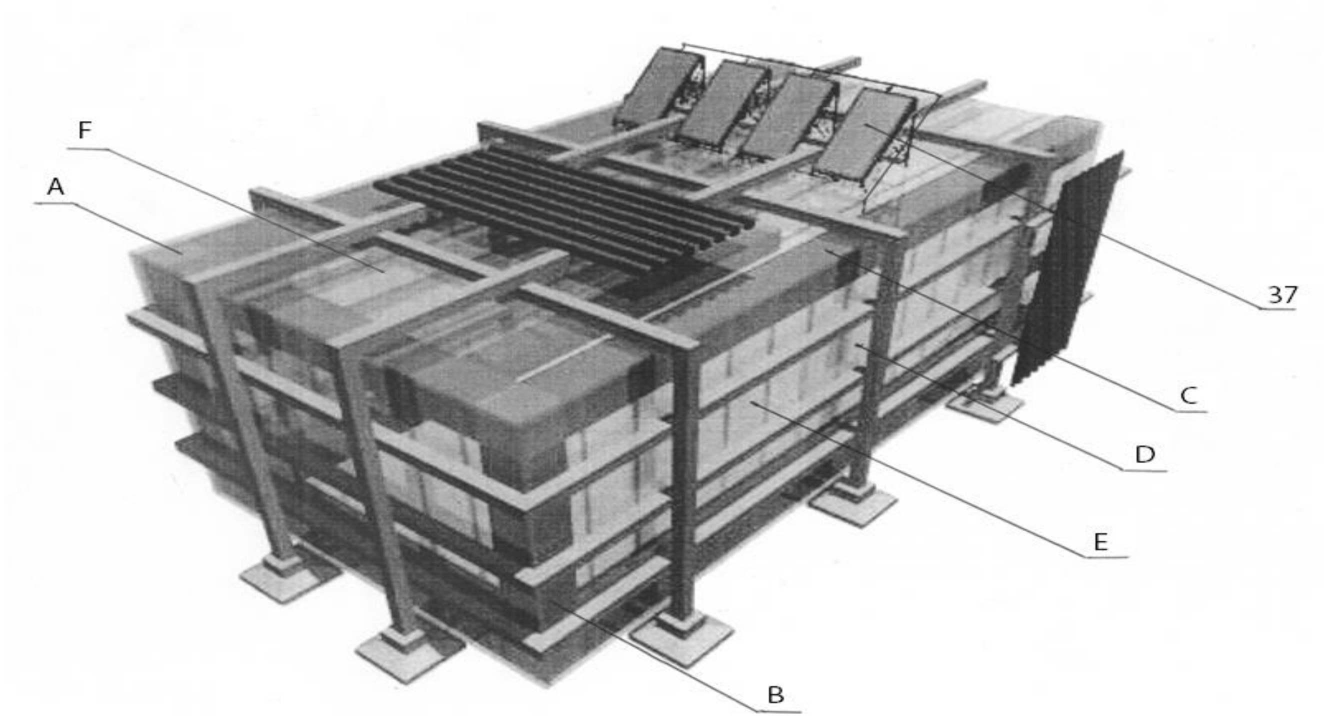

Fig.5. Elevation. „System for solar heating of cooling chamber with positive temperatures." BG111658 (A). [3]
A - three flat corners; B - two flat corners; C - „T"- shaped three flat elements; D - „T"- shaped two flat elements; E - flat vertical elements; F - flat horizontal elements; 37 - collectors.

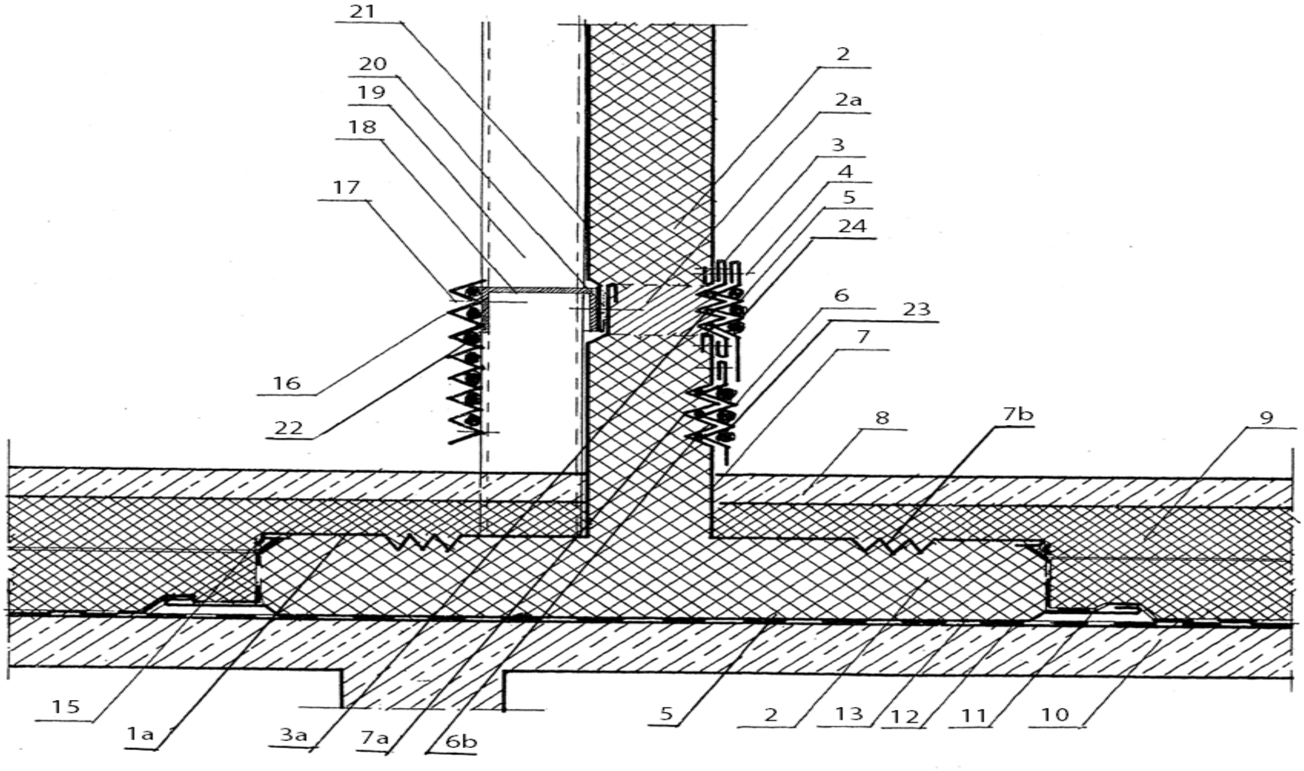

Fig.6. T"- shaped joint. „System for solar heating of cooling chamber with positive temperatures." BG111658 (A). [3]
(1-a) external transparent layer; (2) transparent thermal insulation; (3-b) thin heating coils;
(4), (17) connector; (5) "T"-shaped three-flat corner; (6) zig-zag shaped element; (7) inner dense layer; (7-a) first vertical zigzag channel; (7-b) second horizontal zigzag channel; (21) external vertical transparent layer; (23) thicker heating coils.

6.3. Membranes hung on tensegrity- structures and structures suitable to protect cameras and volumes in extreme situations;

6.3.1. **7 struts;** Kenneth Snelson . **Mesh Bag with 7 struts by Snelson. [ ]**

Kenneth Snelson put bars Snelson, Kenneth in a bag, forming a mesh bag tensegrity. One photo published on the web features 7 struts.

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Фиг. 7 . Mesh bag containing 7 tubes, by Kenneth Snelson. Chambers and volumes can be located under the net of the sack.

6.3.2. 12 struts. Models and Examples. Kenneth **Snelson 12 Strut Model.**

„ Kenneth Snelson constructed a series of four tensegrity structures that metamorphose slowly from evoking a truncated octahedron to evoking a truncated cube. Each model features 12 struts in a new arragement." **[ ]**

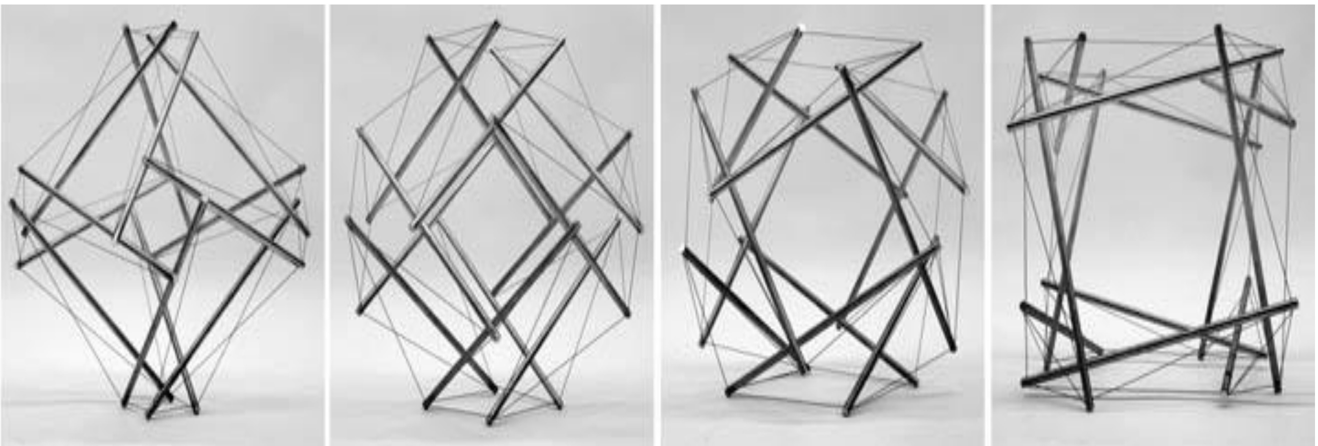

Fig.8 . Kenneth Snelson. Supporting 12-haired props cube, which can be located chambers or volumes for operation in extreme situations.

Cameras and volumes are mobile and built two parallel paths having two ramps and horizontal part are inserted into the tunnel operating at a risk of a corresponding extreme situation;

6.3.3. 270 struts. Table of Contents. 270 Strut Sphere by Leftwich. Links and References.

Read here about tensegrity structures composed of 270 struts, part of a series of pages organized by strut count. **270 Strut Sphere by Leftwich.**

„Jim Leftwich posted details of his 270 strut model to the Well. It was constructed with wooden dowels and nylon thread. The colored hairbands wre added last, as an additional method to hold the nylon tendons in place." [ ]

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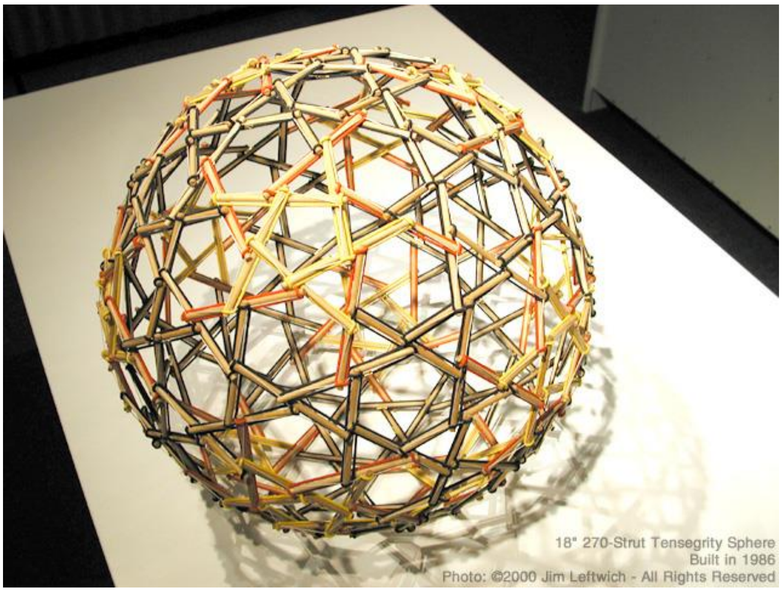

Fig. 9 . 270 strut tensegrity sphere by Jim Leftwich.

Hemispheres can also be used for covering large areas; in such areas can be placed chambers and volumes used in second use in extreme situations. [Fig. 9]

Fig. 10. Arrange volumes under tight membrane. (Homecolorides, info)

Volumes are protected from direct external influences: acid rain, volcanic ash, solar radiation; it is appropriate volumes to be sealed ie filled with gas-tight connections between the panels of the walls and ceiling;

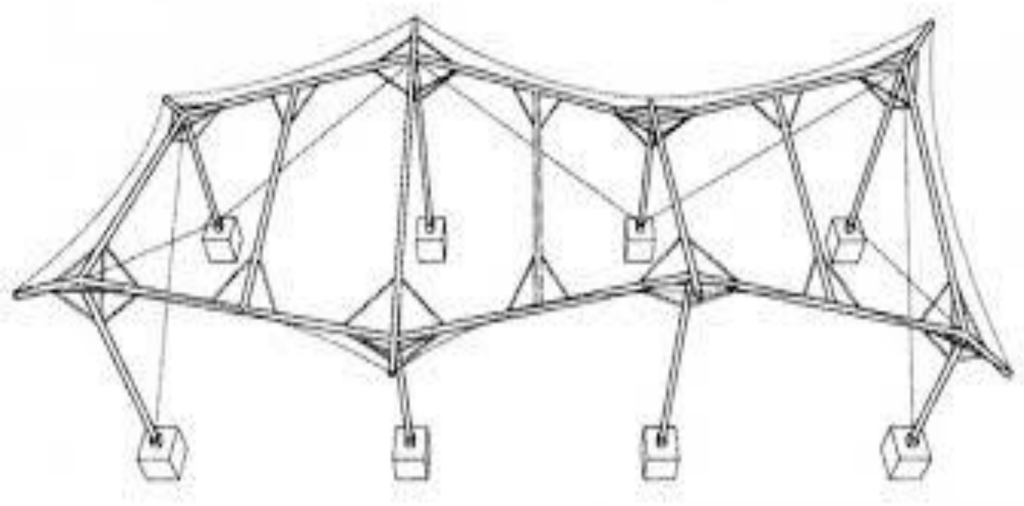

Fig.11. Overall structure of the transparent membrane, (secure.ifai.com)

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A membrane consisting of a peripheral shoulder loop, reinforced by transverse ribs and consoles protruding from the contour; between the loop and the ribs are stabilizing horizontal hinge- batters; Wear shoulder contour of vertical columns connected by a vertical contour payanti- batters; on three sides of the structure diagonals stabilize columns against hinge horrizontal forces of wind; front between columns can be nserted chambers or volumes under the membrane;

Fig. 12 . (www.research.cege.ucl)

Network membrane stretched over supporting elements seen ropes and belts.

Fig.1. Butterfly. (en.wikipedia.org)

The skin of the wings of a butterfly in the open position, as a prototype of modern membrane; the fibers of the skin are ropes stretched on supporting contour worn by columns; Another version- skin is stretched over the tops of the tensegrity structure that is self-supporting;

Fig.14. Arrangement of chambers and volumes stretched membrane suspended from the supporting structure.

Fig. 15. Space formed under the stretched membrane of tensegrity-structure suitable for placement of chambers and volumes for medical purposes.

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