BIRD, Walter; REITMEIER, George, nº US 3,325,887
1961-1967

Soporte con medios de ajuste

Nota* Aplicado para aire y/u otros gases

Solicitud	16 octubre 1961
Fecha	20 junio 1967
Lugar	Williamsville, Nueva York
Inventor	W. W. Bird
Patente nº	US 3,325,887
Título	*Support with adjusting means*

June 20, 1967 W. W. BIRD ETAL 3,325,887

SUPPORT WITH ADJUSTING MEANS

Filed Oct. 16, 1961 2 Sheets-Sheet 1

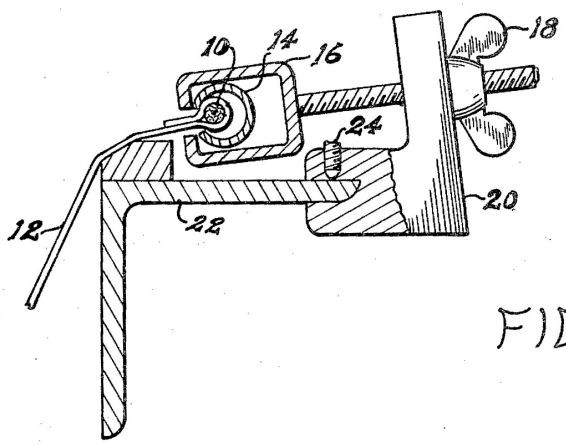


FIG. 1

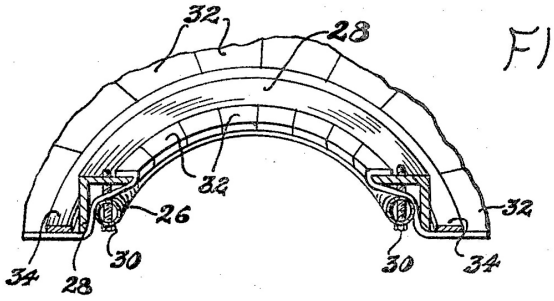


FIG. 2

INVENTORS
WALTER W. BIRD AND
GEORGE F. REITMEIER JR.
BY Wade Kooney and
William J. O'Brien
ATTORNEYS

June 20, 1967 W. W. BIRD ETAL 3,325,887

SUPPORT WITH ADJUSTING MEANS

Filed Oct. 16, 1961 2 Sheets-Sheet 2

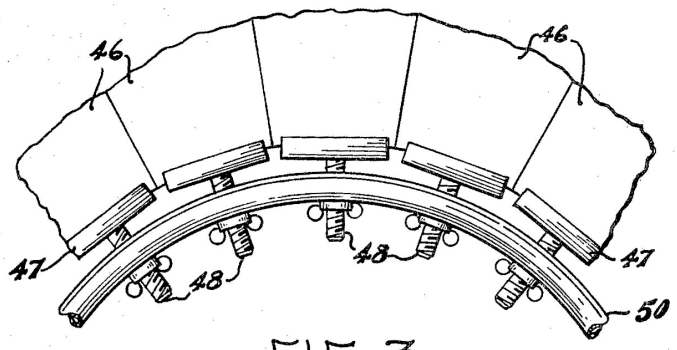


FIG. 3

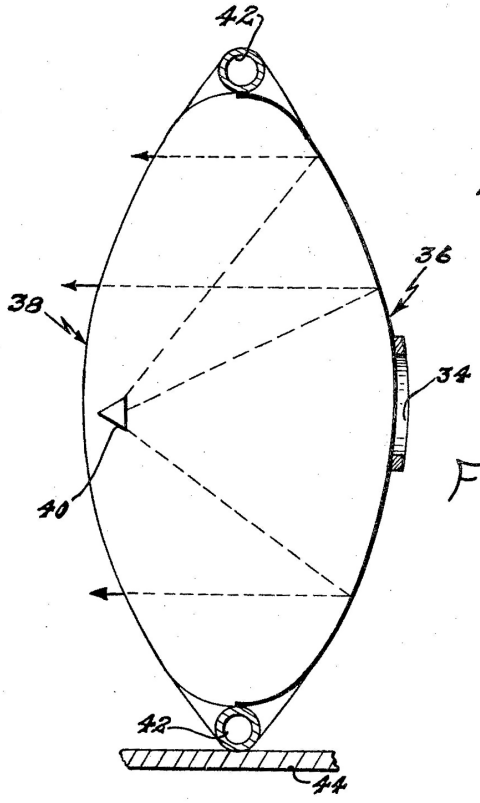


FIG. 4

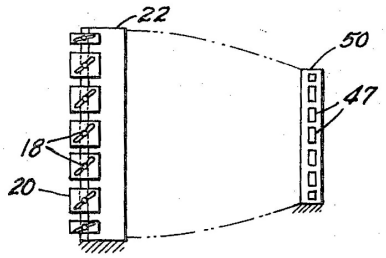


FIG. 5

INVENTORS.
WALTER W. BIRD AND
GEORGE F. REITMEIER Jr.
BY
Wood, Dalton, Phillips, Mason & Rowe
William J. O'Brien
ATTORNEYS

United States Patent Office 3,325,887
Patented June 20, 1967

3,325,887

SUPPORT WITH ADJUSTING MEANS

Walter W. Bird, Williamsville, and George F. Reitmeier, Jr., East Aurora, N.Y., assignors to the United States of America as represented by the Secretary of the Air Force

Filed Oct. 16, 1961, Ser. No. 145,517
2 Claims. (Cl. 29—256)

This invention relates to air-supported parabolic reflectors and more particularly to a method for joining together individual panels of fabric material to produce said reflectors and an apparatus for supporting an air-inflated parabolic antenna assembly such that the final contour of the resultant antenna can be controlled within close tolerances.

Air supported fabric assemblies having a parabolic contour have proved to be of value as radio energy reflectors. These reflectors are constructed by joining together individual pie-shaped panels of a flexible fabric material, such as vinyl coated fiberglass. The panels are joined together in such a manner as to form a balloon-like air-inflated structure having two symmetrically shaped parabolic half sections. One of the parabolic half sections is transparent to electromagnetic R.F. energy while the other parabolic half section is coated with an energy reflective material such as vapor deposited aluminum, aluminum particles or a silver pigmented vinyl resin.

The use of flexible woven fabrics in the manufacture of structural assemblies requiring close constructional and operational tolerances has presented serious problems due to the non-uniform characteristics of the fabric material. The warp tension and elasticity of these woven fabrics varies considerably in different sections of a fabric roll and, as a result, it is extremely difficult to produce a predetermined shape of precise construction within the contour tolerances required for antenna use.

Prior methods of construction in the field of parabolic antennas, such as sewing or cementing, proved to be inadequate in providing the necessary control over the shape of the final antenna structure. Consequently, in order to take advantage of the desirable lightweight characteristics of a woven fabric material, it is necessary that the fabric panels be joined together in a manner that will produce a smooth parabolic contour and permit close tolerance construction of the antenna assembly.

Accordingly, it is the primary object of this invention to circumvent the above described deficiencies of the prior art by providing a method and apparatus for the close tolerance construction of structural fabric assemblies having a precise predetermined shape.

Another object of this invention is to provide a method for producing an air-inflated fabric structure having a parabolic shape.

A further object of this invention is to provide an apparatus for supporting a preassembled fabric structure such that the tension and position of this fabric can be adjusted to obtain a smooth contour of predetermined shape.

The above and still further objects, and advantages of this invention will become readily apparent upon consideration of the following detailed disclosure thereof taken in conjunction with the accompanying drawings wherein:

FIGURE 1 is a view partly in section of the apparatus of this invention showing a portion of the fixture utilized to position and tension the outer ends of the antenna panels;

FIGURE 2 is an isometric view, partly in section of the apparatus of this invention showing the fixture employed for adjusting the inner ends of the antenna panels;

FIGURE 3 is a plan view of an alternative embodiment for the individual adjustment of the tension and position of the inner end of each antenna panel;

FIGURE 4 is a schematic representation of an air supported parabolic antenna assembly; and

FIGURE 5 is a schematic representation of the apparatus of FIGURE 1 and FIGURE 3 oriented for tensioning a parabolic reflector.

In order to assemble this type of antenna structure, it is necessary to pre-tension the panels forming the parabola in order to provide elastic characteristics that are as uniform as possible. The elastic characteristics of the material under load may be taken into account in patterning the unit in order to keep the required adjustment to a minimum.

After the panels or gores are cut to size and marked for assembly, they are joined together by cementing or heat sealing using a fin-type joint of sufficient strength to support the structure when inflated. The completed assembly is then mounted in a fixture which will support the panels in a manner similar to that of the final configuration. The fixture is so constructed that a pressure differential can be maintained across the material equal to that used for the completed antenna. Thus, the weight component and other factors causing distortion are accounted for during final adjustment. The fixture is described relative to FIGURES 1 through 3.

Referring to FIGURE 1, there is disclosed an adjusting fixture which is utilized to provide uniform support for the outer edges of a number of fabric panels which are joined together to form the paraboloid shaped half section which can be joined to a similar mating section to form an air-supported parabolic shaped antenna assembly. This fixture supports the outer edge of the panels in a manner which allows for the adjustment of the entire circumference of the paraboloid half section.

A rope 10 is inserted in the outer end of the fabric panel 12 and a slotted tube 14, fabricated from soft aluminum or other pliable material, is slipped over the roped edge in order to provide for continuous support. The tube 14 is in turn held by a tong-type adjusting clamp 16 and adjusting nut 18. The clamp 16 can be slipped along the tube 14 to any point where support or adjustment is required.

This support is spaced in such a manner that the fabric loads are distributed by the slotted tube, yet, the tube can still be shaped to provide fine contour adjustment as required. The clamp 16 is supported by means of a bracket 20 which slips over the extended flange of a circular angle frame 22 and is positioned thereon by means of a set screw 24.

The adjustment of the inner ends of the fabric panels is accomplished by employing the adjusting fixture disclosed in FIGURE 2. This fixture comprises a tubular ring 26 attached to a circular angle frame 28 by means of adjusting screws 30. The inner ends of the fabric panels 32 are cemented or otherwise secured to the tubular ring 26 and are adjusted and tensioned by means of the adjustment screws 30.

When adjustment of the fabric panels is completed, the final contour of the panels is fixed by cementing a ring 34 to the panel ends. The adjustment ends are then trimmed off and a closure sheet is sealed across the opening to complete the antenna surface.

FIGURE 3 discloses an alternative embodiment for securing adjustment of the inner ends of the panels. The panel ends 46 are attached to brackets 47 on adjusting screws 48 by means of cementing or clamping. The adjustment screws 48 are in turn attached to a circular framework 50. By utilizing the adjustment screws 48, the panels can be individually tensioned during the con-

touring process and maintained in their proper position until the seams have been fixed by final taping.

The holding fixture comprises the support of FIGURE 1, and either of the supports of FIGURES 2 or 3 which are fixed relative to one another on the axis of the parabola in accordance with the parameters of the desired parabolic shape. Any mount of conventional construction which fixes the supports may be utilized. The jigs of FIGURES 1 and 3 are shown in FIGURE 5 mounted on the axis of the parabola to accord with the parameters of the desired parabolic shape.

The material to be utilized for the reflective half section of the antenna is coated; however, an oppositely disposed half section, transparent to R.F. energy, is positioned on supports identical to that previously described. The half sections are placed in contact such that the outer edges may be sealed such that a balloon-like structure results. An inflated tube or rim **42** (FIGURE 4) is secured to and supports the structure at the joining points of the oppositely disposed half sections.

Although the parabolic half section which is transparent to R.F. energy is shown in FIGURE 4 as being identical to the reflective half section, it need not be supported in the same manner nor have an identical contour to that of the reflective half section since the final shape of the non-reflective portion is not critical.

A small compressor is attached to the unit and the tube or rim at convenient places and the antenna is inflated to a pressure of at least 10 p.s.i. A pressure differential of as little as .02 p.s.i. is sufficient for satisfactory operation. At this point, although there might be a small amount of leakage due to the fact that the rim and end portions are not yet sealed, the device will inflate. Individual adjustment of the tension and position of each panel is effected while the antenna is inflated. When the adjustment is completed, the final position of the antenna is fixed by cementing the ring **34** to the antenna, trimming off the adjustment ends and securing the outer ends to the inflated tube or rim **42** (FIGURE 4).

Finer adjustments may be achieved by utilizing a template prior to the application of a closure sheet across the central opening of the parabolic reflector. This template would be placed against the inflated fabric on the axis of the parabola, and minor adjustments may be made by opening the seams at the joints of the individual panels by means of a solvent or the application of a concentrated pressure across the jointed seams. In order to permanently fix the position of the jointed seams after adjustment, a vinyl coated fiberglass tape is cemented across the fin-joint seam and firmly rolled; thus, excessive overpressurization or handling problems will not cause a change in contour. A zipper joint may be provided on the antenna at any convenient position in order to allow workmen to enter and to allow for the removal of the template and supports.

The antenna assembly shown in FIGURE 4 has the paraboloid half section **36** coated with, for example, vaporized aluminum while the other paraboloid half section **38** remains transparent to energy. A feed horn **40** in conjunction with the support tube **42** and a suitable supporting framework **44** complete an antenna assembly which is capable of superior performance over conventional antennas, and at the same time is dimensionally stable.

It will be understood that while the method and apparatus disclosed herein illustrate a preferred form of the invention, modifications can be made by those skilled in the art without departing from the spirit and scope thereof and all such modifications as fall within the scope of these appended claims is intended to be included herein.

We claim:

1. A jig for supporting, prior to final contouring, a half section of an inflatable object of flexible material having a surface of revolution wherein cross-sections perpendicular to the axis of said surface of revolution form circles, comprising a pair of toroidal supports having coincident central axes, said toroidal supports being spaced along said axis, the size of said toroids corresponding to the shape of said half section at the position of each of said supports along the axis of said surface of revolution, and adjustable means on each of said toroidal supports for clamping the material forming said half section and adapted for continuously adjusting the tension thereof.

2. In combination, a half section of an inflatable object of flexible material having a surface of revolution wherein cross-sections perpendicular to the axis of said surface of revolution form circles, and a jig for supporting said inflatable object prior to final contouring, said jig comprising a pair of toroidal supports having coincident central axes, said toroidal supports being spaced along said axis, the size of said toroids corresponding to the shape of said half section at the position of each of said supports along the axis of said surface of revolution, and adjustable means on each of said toroidal supports for clamping the material forming said half section and adapted for continuously adjusting the tension thereof.

References Cited

UNITED STATES PATENTS

2,342,025	2/1944	Watter.	
3,024,525	3/1962	Wisberger	29—421

FOREIGN PATENTS

989,286	5/1951	France.
746,300	3/1956	Great Britain.
838,250	6/1960	Great Britain.

WILLIAM FELDMAN, *Primary Examiner.*

ARTHUR M. HORTON, BENJAMIN A. BORCHELT, MYRON C. KRUSE, *Examiners.*

S. W. ENGLE, *Assistant Examiner.*

BIRD, Walter, nº US 3,247,62 1962-1966

Estructura hinchable de doble membrana

Nota* Aplicado para aire y/u otros gases

Solicitud	25 septiembre 1962
Fecha	26 abril 1966
Lugar	Williamsville, Nueva York
Inventor	W. W. Bird
Patente nº	US 3,247,627
Título	*Dual wall air inflated structure*

April 26, 1966 W. W. BIRD 3,247,627

DUAL WALL AIR INFLATED STRUCTURE

Original Filed Sept. 25, 1962 3 Sheets-Sheet 1

FIG. 1

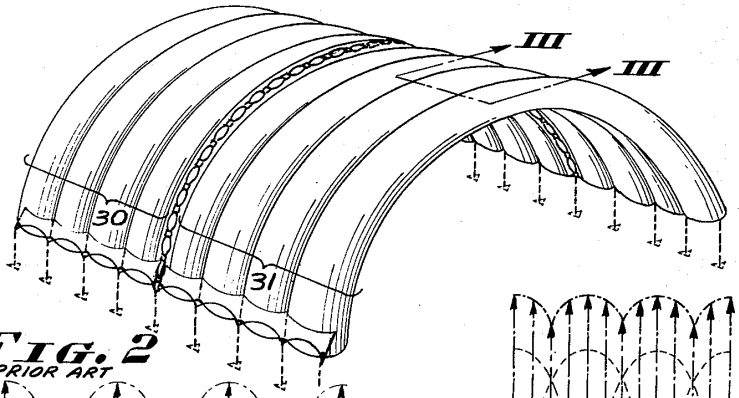
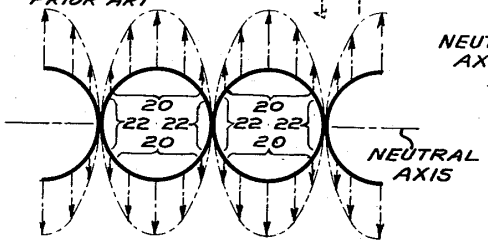


FIG. 2
PRIOR ART



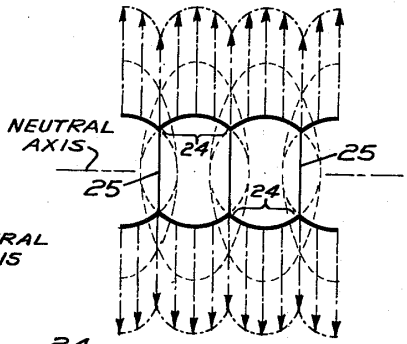


FIG. 2A

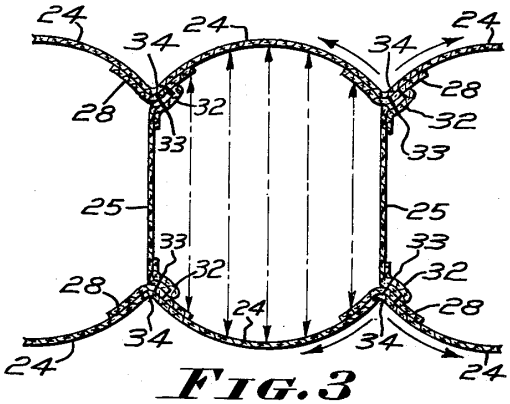


FIG. 3

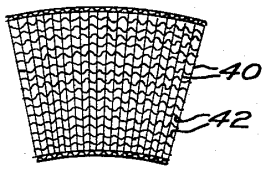


FIG. 4

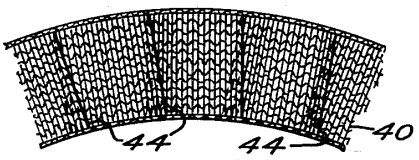


FIG. 5

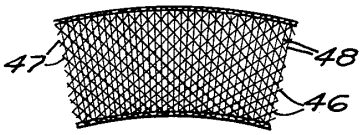


FIG. 6

April 26, 1966 W. W. BIRD 3,247,627

DUAL WALL AIR INFLATED STRUCTURE

Original Filed Sept. 25, 1962 3 Sheets-Sheet 2

FIG. 7

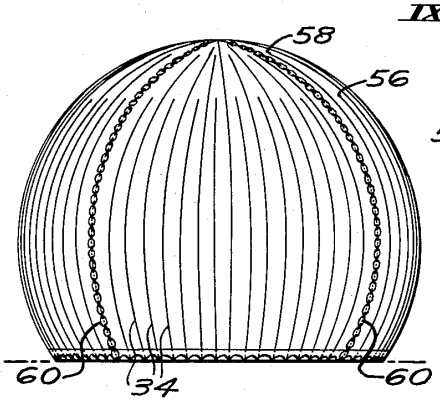


FIG 8

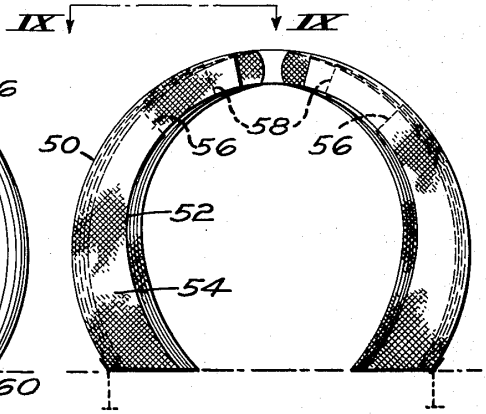


FIG. 9

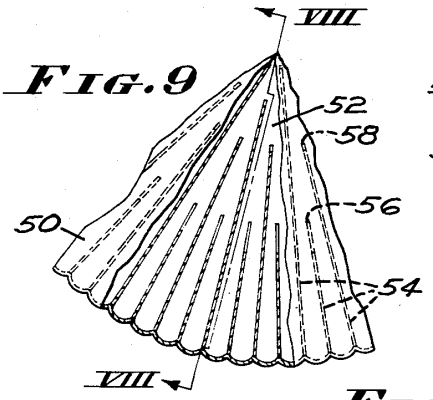


FIG. 10

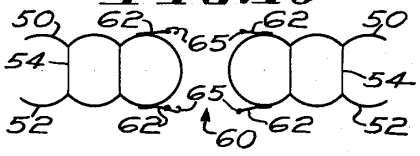


FIG. 11

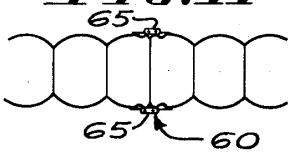


FIG. 13

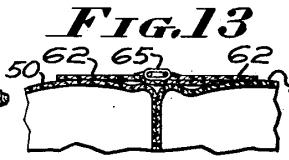


FIG. 14

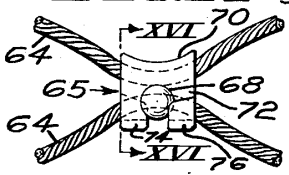


FIG. 12

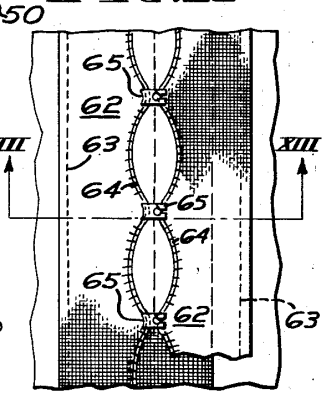


FIG. 16

FIG. 15

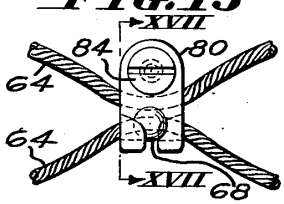
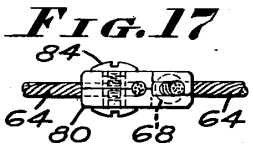


FIG. 17



April 26, 1966 W. W. BIRD 3,247,627

DUAL WALL AIR INFLATED STRUCTURE

Original Filed Sept. 25, 1962 3 Sheets-Sheet 3

Fig. 18

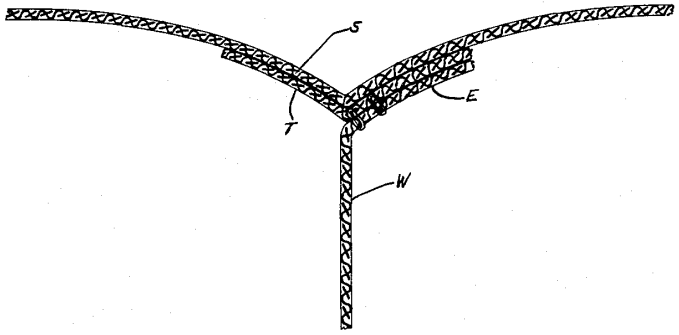
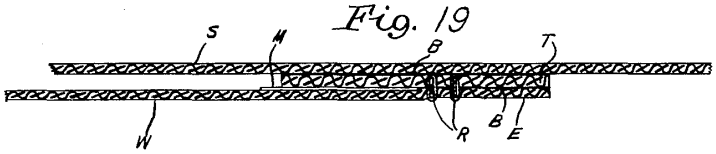


Fig. 19



INVENTOR.
WALTER W. BIRD

BY
Beau, Brooks, Buckley & Beau
ATTORNEYS

United States Patent Office 3,247,627
Patented Apr. 26, 1966

3,247,627

DUAL WALL AIR INFLATED STRUCTURE

Walter W. Bird, Williamsville, N.Y., assignor to Birdair Structures, Inc., Buffalo, N.Y.

Continuation of application Ser. No. 229,253, Sept. 25, 1962. This application Apr. 26, 1965, Ser. No. 453,875
18 Claims. (Cl. 52—2)

This invention relates to structural members, building structures and the like and, more particularly, the present invention is concerned with certain improvements in inflatable members, structures and the like wherein greater efficiency tending toward greater practicability and economy is realized as compared with prior art structures. This application is a continuation of my copending application Serial No. 229,253, filed September 25, 1962, a continuation-in-part of application Serial No. 709,025, filed January 15, 1958, both now abandoned.

This invention is principally concerned with increasing the efficiency and reducing the fabrication cost of dual wall air inflated structures. This primary objective is achieved by controlling the shape of a dual wall air inflated structure while simultaneously controlling the inflation-induced tension therein in a specific and particular fashion related to the controlled shape. In this manner, and according to the present invention, the materials used in fabricating the structure are utilized to maximum effectiveness while, concurrently therewith, the cost of manufacture is materially reduced as compared with prior art structures. Generally speaking, the specific manner of obtaining the beneficial results of this invention involves the method and means by which the inner and outer flexible skin elements of a dual wall structure are joined, such being effected by web elements which not only constrain the skin elements to assume a transversely corrugated form but also permit tensioning of the skin elements to a greater degree in the longitudinal direction. Accordingly, these two factors interact to substantially rigidify the structure in the longitudinal direction. Further, the web means according to this invention permits a longitudinal bow or arch to be imparted to the structure, thus additionally increasing its longitudinal rigidity and all without requiring exotic and expensive fabrication techniques.

In accord with this invention, in addition to forming the envelope of valleyed configuration and permitting of greater longitudinal tension in the skin or envelope, the web means readily permits the sections to be formed with a desired curvature or arch without requiring involved and expensive fabrication techniques.

A further object of this invention resides in novel means for joining the web means to the skin members, the joining being accomplished by means forming a strong joint, obviating the necessity for puncture of the skin members, and permitting of natural shaping of the structure without unduly stressing the joining means.

It is an object of the present invention to provide improvements in building constructions as aforesaid such as are suitable for use in large air-supported buildings of the hangar or other types. Another object of the invention is to provide improvements in the construction of hangar-like structures or the like, in which flexible fabric or film or sheet materials of low air permeability is employed and maintained in erect state by air pressure interiorly thereof. The features of the present invention are particularly applicable to construction of relatively large structures in sub-assembled sectional form subsequently relatively assembled by interconnection means as will be described hereinafter.

Generally stated, the present invention contemplates an improved form of structure as aforesaid, and a method

of assembling the components of an air supported structure which provides a structurally more efficient utilization of the structural materials used, while at the same time being a more economical method of construction, particularly well adapted to the building of large structures.

Air inflated members are capable of resisting bending load only to the degree to which they are pre-tensioned by the inflation pressure. The comprehensive load due to bending is thus resisted by the pre-tension in the compressed element. For maximum efficiency, the inflation pressure should provide the maximum amount of pre-tension in that portion of the material subjected to compressive loading.

An air inflated member inherently tends to assume a circular cross sectional form because this form represents an equilibrium condition. In generally cylindrical members the inflation pressure results in hoop tension having a value approximately twice that of the tension in the longitudinal direction. The ability of such a member to resist bending load is thus essentially limited to the pre-tension in the longitudinal direction at the point furthest from the bending axes of the member. When this value of pre-tension is reached in bending, the member will start to buckle. The pre-tension existing in the sides of the tube in the zones of intersection by the bending axis has little influence on the bending stiffness of the member although a large proportion of the inflation pressure is consumed in pre-tensioning this area. The present invention provides a method of designing an inflatable structure which results in pretensioning of the elements furthest from the neutral axis to values approximately double the pre-tension loads imposed upon the corresponding elements of a similar conventional tube structure under equal inflation pressures.

Thus, in accord with the present invention there is provided a structure employing less material which will support a much higher load; and the invention is applicable for example to replace conventional dual wall or multiple tube constructions, with increased efficiency.

Other objects and advantages of the invention will appear from the description hereinbelow and the accompanying drawing wherein:

FIG. 1 is a perspective view of an air-stiffened hangar type structure embodying the principles of the present invention;

FIG. 2 is a sectional view through a tubular structure of the prior art illustrating diagrammatically the distribution of loads due to bending;

FIG. 2*a* is a view corresponding to FIG. 2, but illustrating the more uniform distribution of bending loads and higher load resistance offered by the present invention;

FIG. 3 is a fragmentary section, on an enlarged scale, taken along line III—III of FIG. 1;

FIGS. 4, 5 and 6 illustrate schematically a variety of web component stock materials as may be used in the structure of the invention;

FIG. 7 is a side elevational view of another form of structure of the invention;

FIG. 8 is a sectional view taken along line VIII—VIII of FIG. 9;

FIG. 9 is a fragmentary plan view taken along line IX—IX of FIG. 8, with a portion of the outer skin component of the structure removed;

FIG. 10 is a view corresponding to FIG. 3, but illustrating the mode of relative assembly of two sections of structure of the present invention;

FIG. 11 corresponds to FIG. 10 but illustrates the structure when in relatively assembled position;

FIG. 12 is an elevational view of a joint arrangement

BIRD, Walter; REITMEIER, George, nº US 3,240,217
1963-1966

Montaje de la estructura

Nota* Aplicado para aire y/u otros gases

Solicitud	8 noviembre 1963
Fecha	15 marzo 1966
Lugar	Williamsville, Nueva York
Inventor	W. W. Bird
Patente nº	US 3,240,217
Título	*Structural assembly*

March 15, 1966 W. W. BIRD ET AL 3,240,217

STRUCTURAL ASSEMBLY

Filed Nov. 8, 1963 3 Sheets-Sheet 1

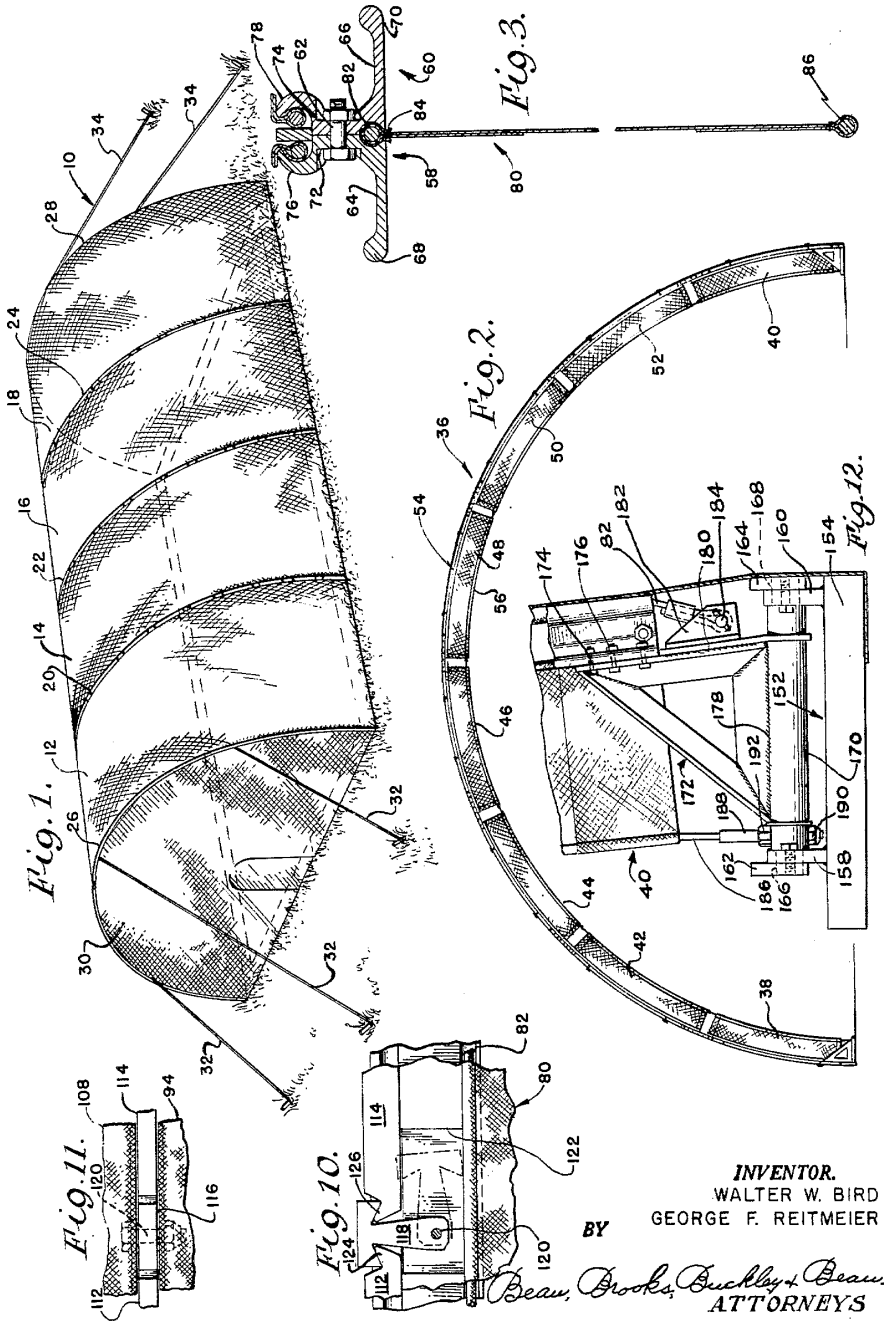


Fig. 1.

Fig. 2.

Fig. 3.

Fig. 12.

Fig. 11.

Fig. 10.

INVENTOR.
WALTER W. BIRD
GEORGE F. REITMEIER

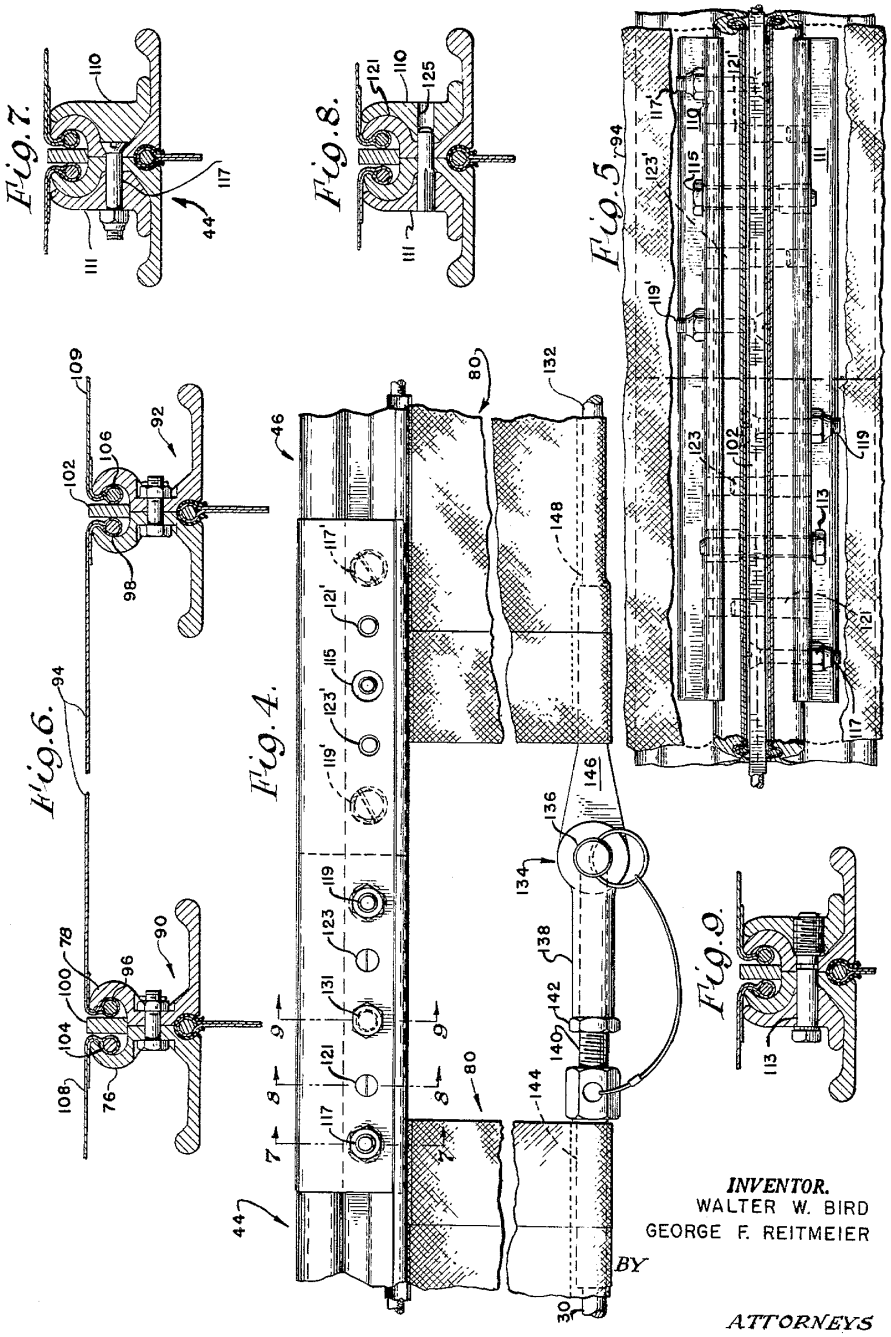
BY Beam, Brooks, Buckley & Beam.
ATTORNEYS

March 15, 1966 W. W. BIRD ET AL 3,240,217

STRUCTURAL ASSEMBLY

Filed Nov. 8, 1963

3 Sheets-Sheet 2



March 15, 1966 W. W. BIRD ET AL 3,240,217

STRUCTURAL ASSEMBLY

Filed Nov. 8, 1963 3 Sheets-Sheet 3

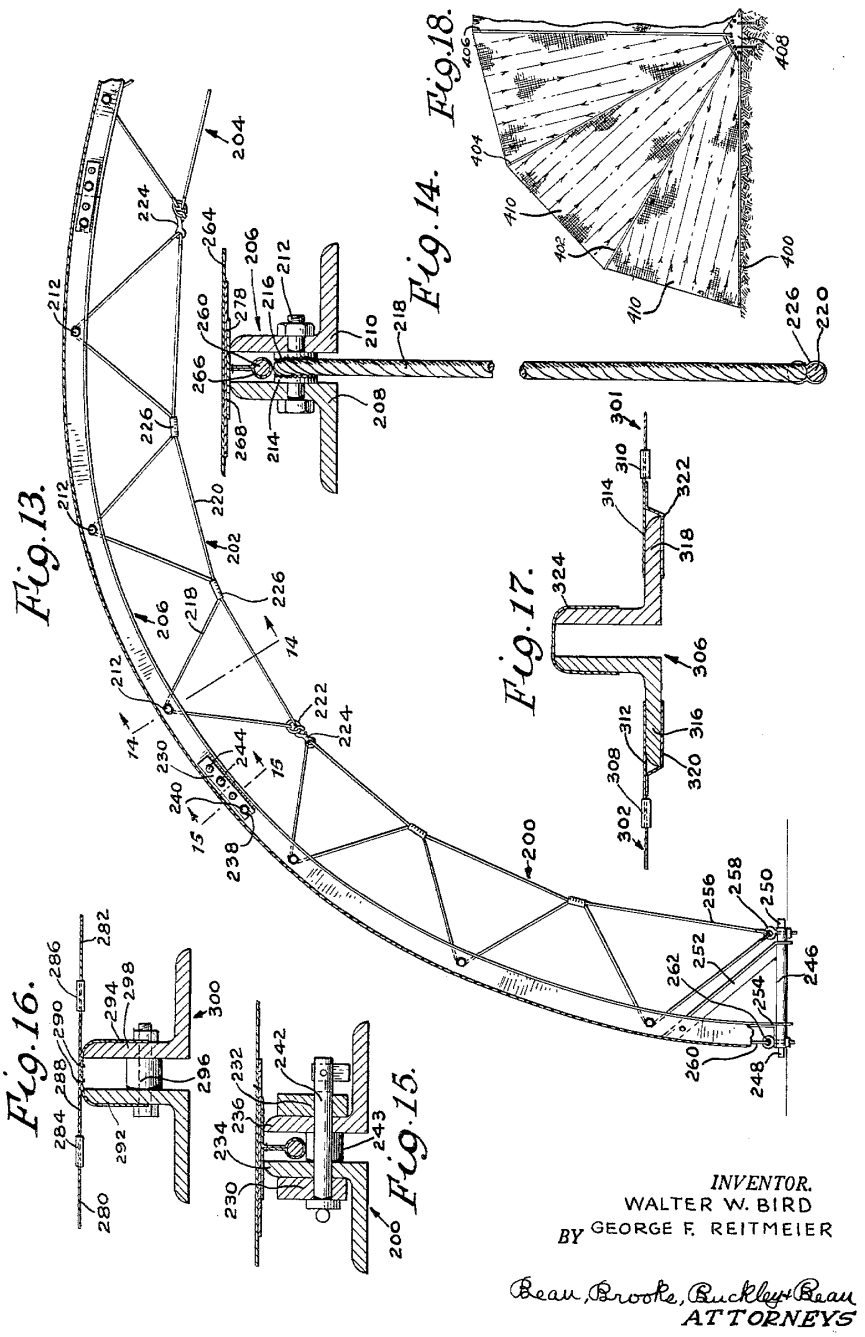


Fig. 13.

Fig. 14.

Fig. 17.

Fig. 16.

Fig. 15.

Fig. 18.

INVENTOR.
WALTER W. BIRD
BY GEORGE F. REITMEIER

Beau, Brooke, Buckley & Beau
ATTORNEYS

United States Patent Office 3,240,217
Patented Mar. 15, 1966

3,240,217

STRUCTURAL ASSEMBLY

Walter W. Bird, Williamsville, and George F. Reitmeier, East Aurora, N.Y., assignors to Birdair Structures, Inc., Buffalo, N.Y.

Filed Nov. 8, 1963, Ser. No. 322,350
9 Claims. (Cl. 135—3)

This invention relates to structural members generally and pertains more particularly to a novel type of beam; particularly, although not necessarily restricted to, a beam of the type used in combination with an air-inflated fabric or like envelope in a building structure.

In its broadest sense, the present invention relates to a structural beam having a relatively stiff compression flange, a flexible tension flange disposed in spaced, generally parallel relation therewith, and flexible web means joining the compression and tension flange members; the compression flange member being deformed and held in such deformed condition by the tension flange member so that both the tension flange and the web means are pre-tensioned. In this manner, a maximum of beam stiffness may be accomplished with great economy of material.

More particularly, the present invention deals with a composite beam assembly which is so constructed as to be highly directional in its load-sustaining characteristics to thereby effect both a great saving of weight and the capability of being compactly stored. A beam assembly according to this invention, when used as a load-sustaining component of a building structure in which other of the building components lend lateral stability to the beam, is outstanding in its light weight character, ease of assembly and disassembly and compactness when stored. Therefore, this invention envisages a novel beam assembly per se as well as such an assembly in combination with means imparting lateral stability thereto. It is therefore an object of the present invention to provide a load-sustaining beam which is at once of lightweight construction, capable of storage with a minimum of space and yet possesses a high degree of rigidity in comparison to its over-all weight.

Tensioned fabric building structures and particularly air-inflated structures are becoming increasingly more popular since building of structures such as these possess certain inherent advantages not enjoyed by other types of structures. For example, recent developments have made possible the utilization of relatively lightweight fabrics providing an envelope which is inflated under relatively low pressure which lend a substantial degree of rigidity to the envelope due to the pressure-induced tension in the envelope or fabric so as to adapt the same for use as a quickly erected building unit. Such types of structures have, for example, adapted themselves for military purposes where a quickly erected and highly mobile type of structural assembly is desired. One disadvantage of such air-inflated structures is that they constantly require the presence of internal air pressure in order to remain erect. This poses no special problem insofar as sealing is concerned, but it does require the use of air locks in conjunction with any entrance to the building so as to avoid excessive loss of pressure during use of the entrance. Moreover, this problem is grossly magnified in installations requiring large entrance openings, the air lock requirements for a hangar, for example, attaining staggering proportions. Consequently, it is of primary interest in conjunction with this invention to provide a beam or structural member as aforesaid, which is characterized by its light weight, ease of assembly and disassembly and compactness in storage, so as to lend itself particularly, though not necessarily, to use in conjunction with air-inflated structures. In this fashion, an air-inflated envelope, reinforced with the structural members according to this invention, can be made so as to be self-sustaining without the use of internal air pressure, whereby the need for air locks is obviated. Ancillary to this object, and also of primary concern in connection with this invention, is the provision of an improved form of air-inflated structure having an air-inflated and tensioned envelope auxiliarly supported by beam members as aforesaid in which the envelope imparts lateral stability to the beam members while the beam members permit the building to remain erect even in the absence of internal pressure. In this fashion, the building may with impunity be fitted with large access means and, when closed, the building may be operated at minimum internal pressure under conditions of low weather loading and at increased pressures s weather loads increase.

Another object of this invention is to provide a beam structure which is of lightweight construction and which is formed of a plurality of individual sections readily joined together and wherein each one of the sections is so constructed as to permit the same to occupy a minimum of space for storage purposes, thereby materially simplifying logistical problems.

Still another object of this invention resides in the provision of a beam construction consisting essentially of a lightweight metallic flange having in association therewith a flexible tension member joined to the flange through the medium of a flexible web member so that when stored, the flexible web member and the tension member can be collapsed to occupy, with the metal flange, a minimum of space.

A further object of the present invention is to provide a structural beam in which the compression component thereof is formed of a metallic rigid member, wherein the tension portion thereof is formed of a flexible element such as a cable or the like joined to the ends of the compression components, deforming the same to pretension the tension element, and wherein the compression and tension components are joined along their lengths by a flexible sheet of material such as fabric or cables capable of distributing shear loads between the upper and lower elements of the beam and which also receives pretension by virtue of the deformation of the compression component.

It is still another object of this invention to provide a novel beam assembly which incorporates a plurality of individual sections to be joined together, each of which includes a rigid compression flange component and flexible web and tension components, all so related that when the sections are operatively joined, the bending stiffness of the compression flange components imparts tension to the tension components and thereby places the web components under tension throughout.

Other objects and advantages of the invention will ap-

BIRD, Walter, nº US 3,346,441 1963-1967

Estructuras hinchadas con aire

Nota* Aplicado para aire y/u otros gases

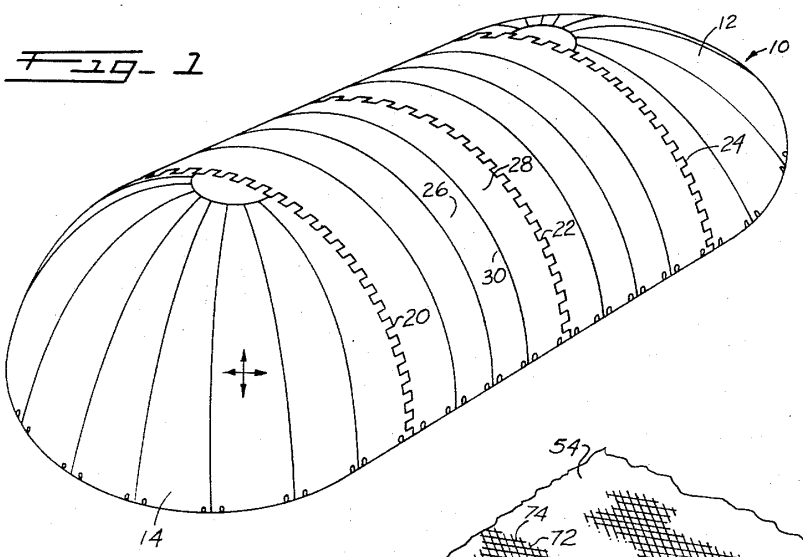
Solicitud	8 abril 1963
Fecha	10 octubre 1967
Lugar	Williamsville, Nueva York
Inventor	W. W. Bird
Patente nº	US 3,346,441
Título	*Air-inflated structures*

Oct. 10, 1967 W. W. BIRD 3,346,441

AIR-INFLATED STRUCTURES

Filed April 8, 1963 2 Sheets-Sheet 1

Fig. 1



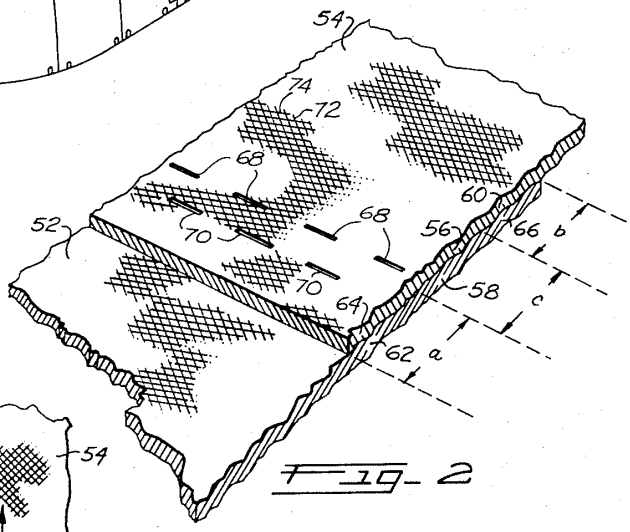


Fig. 2

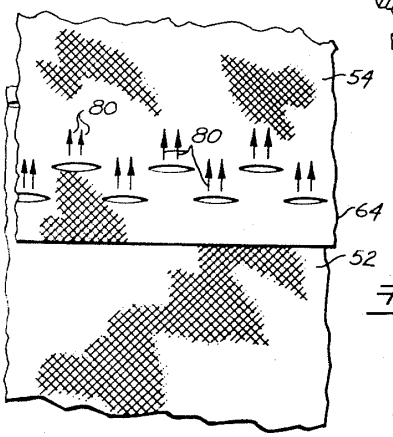


Fig. 3

INVENTOR.
WALTER W. BIRD
BY
Bean, Brooks, Buckley & Bean
ATTORNEYS

Oct. 10, 1967 W. W. BIRD 3,346,441

AIR-INFLATED STRUCTURES

Filed April 8, 1963 2 Sheets-Sheet 2

Fig. 4

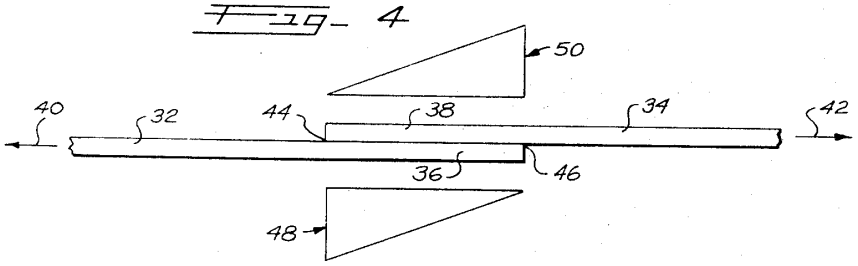


Fig. 5

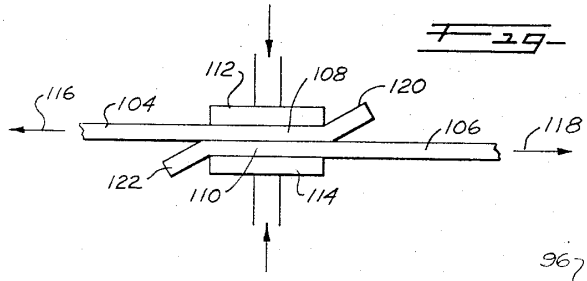
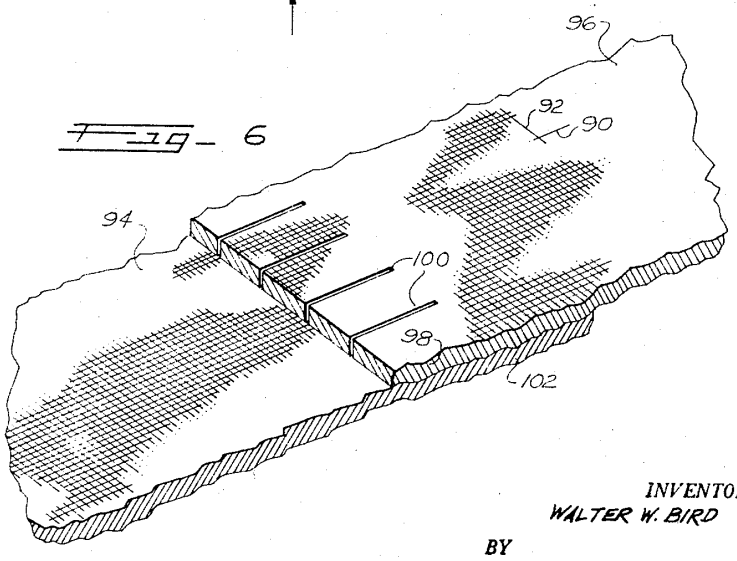


Fig. 6



INVENTOR.
WALTER W. BIRD
BY
Bean, Brooks, Buckley & Bean
ATTORNEYS

United States Patent Office

3,346,441
Patented Oct. 10, 1967

3,346,441

AIR-INFLATED STRUCTURES

Walter W. Bird, Williamsville, N.Y., assignor to Birdair Structures Inc., Buffalo, N.Y.

Filed Apr. 8, 1963, Ser. No. 271,225
5 Claims. (Cl. 161—36)

This invention relates to air-inflated building structures and pertains, more particularly, to improved means for joining adjacent panels forming an envelope structure of an air-inflated building.

In air-inflated building constructions such as are contemplated in connection with the present invention, the structural building envelope is constructed of flexible material and is formed from a plurality of panels joined in edge-to-edge relationship. The particular material employed is usually of the woven type and is treated with material such as latex or the like to fill the pores or interstices of the woven material and render the same substantially impervious to the leakage of air. In joining the panels as aforesaid in edge-to-edge relationship, it has been found that adhesives or, bonding methods in general, are by far the most economical since more conventional methods of attaching fabrics or flexible materials, such as by sewing, cannot provide the high strength and serviceability required and inherently destroy the air retention characteristics of the envelope and would therefore require subsequent treatment to restore the airtight nature of the envelope.

In my copending application Ser. No. 739,022, filed June 2, 1958, now U.S. Patent 3,116,746, there is disclosed means for joining sections of an air-inflated building envelope whereby such sections may be readily and easily detached or secured together. Such means are necessary under circumstances wherein the building is required to be moved from place to place periodically or where extremely large structures are involved. In the latter case, it is necessary and desirable to divide the envelope into a series of smaller sections so as to be readily transportable and easily managed and manipulated. Each of the sections, however, are further divided into a series of smaller panels which are necessary for obvious reasons since building constructions contemplated herein may be several hundreds of feet in length. It is in the joining together of these smaller adjacent panels that the present invention is directed. In joining such panels together, it is of importance to do so in such fashion as to obviate the existence of areas or regions of excessive stress concentration, it being appreciated that the joints between adjacent panels must transfer tension loads from one panel to another and which tension loads may be considerable. That is to say, the internal air pressure which holds the envelope in inflated condition itself tensions the envelope to a substantial degree. Additionally, external forces such as wind loads and the like may apply short-lived tension loads much greater than the inflation tension load. Consequently, the existence of any areas of stress concentration represents a potential source of failure.

As hereinbefore stated, the conventional means for joining adjacent panels together is by bonding or adhesive means and, in general, this is an entirely adequate method of joining the edges of the panels. However, it is always of interest to render the construction more efficient and on large, highly loaded structures it becomes increasingly difficult to provide a satisfactory joint. To this end, the present invention is directed to means whereby the tension loads transferred from one panel to another through the joined edges thereof are transferred in such fashion as to mitigate shear stresses in those areas and regions wherein the same are inherently greatest. According to the present invention, the overlapped edges of adjacent panels are adhesively secured, bonded or the like substantially throughout the area in which they are overlapped. Each such area of overlapping may be considered to be divided into three zones, a central zone, an inner zone and an outer zone with the overlapped edges being so positioned relative to each other that the central zones of each are disposed in opposed relationship to thereby position the inner zone of one panel edge in opposition to the outer zone of the other panel edge and vice versa. The outer zone of each panel edge area is constructed to be of less resistance to elongation in a direction normal to the joined edges than is the remainder or main body portion of the panel. In this fashion, as will hereinafter more clearly appear, stress concentrations are minimized in the most critical area or region of the joint between the two panels so that not only is the structure thereby rendered more efficient, and less likely to premature failure, but also the assembly can resist higher tension loads induced either by the inflation or external forces.

It is therefore of primary concern in connection with the present invention to provide an improved joint means between adjacent panels of an air-inflated structure in which the joint is characterized by inherently lower shear stress concentrations at the edge portions of the overlapped panels.

Other objects and advantages of the invention will appear from the description hereinbelow and the accompanying drawing wherein:

FIG. 1 is a perspective view showing an air-inflated and supported building structure of the type to which the present invention appertains;

FIG. 2 is a perspective view showing portions of adjacent overlapped panels and illustrating one form of joint which may be effected therebetween;

FIG. 3 is a plan view of the assembly shown in FIG. 2;

FIG. 4 is a diagrammatic view illustrating the transfer of tension loads across a joint;

FIG. 5 is a diagrammtic view illustrating the manner of constructing a modified form of joint according to the present invention; and

FIG. 6 is a view similar to FIG. 2 but illustrating another modification of joint construction.

Referring at this time more particularly to FIG. 1, the construction shown therein and indicated generally by the reference character **10** is an air-supported, air-inflated building structure in which the envelope defining the building is, in the particular instance shown, divided into four sections, the two end sections **12** and **14** and the intermediate sections **16** and **18**. These several sections may be detachably joined together as indicated by the joints **20**, **22** and **24**, such joints being in accordance, for example, with my aforementioned copending application Ser. No. 739,022, now U.S. Patent 3,116,746. Each section, or for that matter the entire envelope, may be formed from a plurality of adjacent panels such as those indicated by reference characters **26** and **28** for example in the intermediate section **16** and between these adjacent panels, there is formed a joint such as that indicated by the reference character **30** in FIG. 1. As has been set forth hereinabove, the envelope is preferably constructed of a woven material impregnated with suitable means which may be latex, plastic or the like which fills the interstices of the woven material and renders the same substantially impervious to the passage of air therethrough. This is necessary in order to retain the volume of air which fills and tensions the envelope so as to render it self-supporting. As has also been set forth hereinabove, it is desirable that a high strength joint be used in order to assume full utiliziation of material strength, and, for this reason, an overlapped joint such as is indicated in FIG. 4 is preferably used. In FIG. 4, adjacent panels **32** and **34** are diagrammatically illustrated, the same being provided with edge portions **36** and **38** respectively which

are disposed in overlapped relationship to each other and which are either adhesively secured together or otherwise bonded or connected in face-to-face contact substantially throughout the areas thereof which are in the overlapped relationship. In transferring tension from one panel to the next, through the overlapped joint, the tension force being diagrammatically indicated by the arrows **40** and **42**. It will be seen that for the panel **32**, maximum tension is encountered up to the point **44** at which the outer edge of the panel **34** is joined thereto and that this tension gradually diminishes to zero at the opposite counterpart edge portion **46**, all as is indicated by the diagram **48** below the correspodning portion of the panel **32**. By the same token and at the same time, tension is being built up in the portion **38** of the panel **34** starting from the zero point at the edge **44** to a maximum opposite the edge **46**; as is indicated by the diagram **50** in FIG. 4. The rate of transfer of load will of course vary with the elastic properties of the material, the lower the elasticity the more uniform the transfer.

Ordinarily, the panels **32** and **34** will be very similar in nature so that each has a finite and definite resistance to elongation which will be the same in each case. Consequently, it will be manifest that along the edge **44**, the panel portion **38**, since it is at a region of very little tension load therein as indicated by the diagram **50**, will not be subjected to very great elongation whereas the underlying portion of the panel **32** will be subjected to the greatest elongation that exists within the portion **36** thereof. Thus, a condition is present adjacent each of the edge points **44** and **46** wherein a maximum of shear stress occurs by virtue of the fact that the material underlying such edge portions **44** and **46** is stretched a maximum amount whereas the overlying edge portions are stretched a minimum due to the tension load characteristics as indicated by the two diagrams **48** and **50**. Thus, any tendency of the two poritons **36** and **38** to peel away from each other will occur predominantly at the edges **44** and **46**. Consequently, the structural design must be such that the maximum permissible shear stress to which the bonding or adhesive material may be subjected is not exceeded under actual conditions of usage.

According to the present invention, to reduce the shear stresses occurring as set forth hereinabove, edge portions of the two adjacent panels are constructed in such fashion that they have less resistance to elongation transversely of the joint than do the main body portions thereof and, more importantly, than is exhibited in the immediately underlying portions of the other panel. One manner in which this may be accomplished is shown in FIG. 2. In this particular case, the adjacent panels **52** and **54** are provided with overlapped edge portions as shown. Furthermore, each of these edge portions is divided into a central zone or region as indicated by reference characters **56** and **58** and by inner and outer zones respectively as indicated by the reference characters **60**, **62** and **64**, **66**. The two outer zones **64** and **66** are constructed so as to exhibit less resistance to elongation transversely of the joint formed than are the remaining areas of the two panels **52** and **54**. In the specific instance shown, this is accomplished by providing the line of slits **68** and the line of slits **70**. Preferably, as shown, these lines of slits are staggered relative to each other with no or substantially no overlap between the slits of the two lines. This particular method of rendering the outer zones **64** and **66** of less resistance to elongation is particularly well adapted and suited for 2-ply material where one ply is laid up on the bias as is indicated by the warp and fill threads **72** and **74** respectively in FIG. 2. Preferably, the warp and fill threads are at substantially the same angle, 45°, to the edges of the panels **52** and **54**. In this fashion, the load will be transferred from the panel **52** to the panel **54** as is shown in FIG. 3, wherein it will be noted that the loading at the edge of the material is picked up and transferred by

the bias ply which is inherently more elastic than the straight ply and carried up between the slits into the central zone of the joint. The slits **68** and **70** open up slightly, like eyelets, due to the relaxation of the outer zone **64** permitted by their existence. Thus, the existence of high shear stresses adjacent the edges **44** and **46** in FIG. 4 will be avoided.

This effect is achieved for the reasons stated in conjunction with the description of FIG. 4. That is to say, in the FIG. 2 embodiment, it will be appreciated that the region or zone **64** of the panel **54** has substantially less resistance to elongation due to the existence of the slits **68** and **70** than does the underlying inner zone **62** of the panel **52**. Since it is the inner zone **62** of the panel **52** which is subjected to the greatest tension in transferring the load across the joint, as is illustrated in FIG. 4, and since the zone or region **64** of the panel **54** exhibits a lessened resistance to elongation by virtue of the existence of the slits **68** and **70**, it will be appreciated that the zone **64** of the panel **54** will elongate by a greater amount than would otherwise occur, thus lessening the shear stress introduced in this zone or region. Therefore, whatever means is employed to secure the edge portions of the two panels **52** and **54** in overlapped relationship will not have as great a tendency to peel as would otherwise occur. In FIG. 2, the joint itself will be seen to have been divided into the three regions or zones as indicated by the reference characters *a*, *b* and *c*, the region *a* being the region or zone in which the two regions **62** and **64** of the respective panels **52** and **54** are in opposed relationship, the region *b* being that area within which the two regions **60** and **66** of the panels **54** and **52** respectively are opposed and the region *c* being that area wherein which the central zones or regions **56** and **58** of the two panels are in opposition. It is appreciated, of course, that it is the two zones **64** and **66** which contain the slits **68** and **70**, the zones **60** and **62** being similar as are the zones **56** and **58**.

FIG. 3 illustrates the panels as they are under tension transversely across the joint, it will be appreciated that the panels will also be under tension normally longitudinally or parallel of the joint and, in FIG. 3, the arrows **80** serve to indicate the manner in which the tension load transfer is transferred between the slits **68** and **70**.

As has been set forth, the specific construction according to FIG. 2 is most advantageously used in association with panels wherein a 2-ply, 45° bias laminated material is used. To illustrate the modification of the invention which is particularly well suited for applications where heavy single ply material is used wherein the warp threads are disposed at right angles to the edges of the panels, reference should be made to FIG. 6. In this figure, the warp threads are indicated by the reference character **92** and the fill threads by the reference character **90**. The relationship between the central, inner and outer zones of the two panels **94** and **96** is the same as was described in relationship to FIG. 2, it being noted that the outer zone **98** of the panel **96** is provided with a series of slits **100** which are parallel to the direction of the fill threads **90**. Thus, the slits **100** sever the warp threads **92** at spaced points therealong and do so up to the ends of the several slits **100**. Because of this relationship, when the panels **94** and **96** are tensioned so as to require transfer of the load through the joint the fill threads **90** in the outer zones **98** and **102** of the two panels are permitted to straighten out more easily than they otherwise would. This is due to the fact that the warp threads **92** normally form undulations or kinks in the fill threads and when the warp threads are severed, the fill threads are permitted to straighten out much more easily, under load, than would otherwise be the case. In the remainder of the body of the fabric panels **94** and **96**, it will be appreciated that both the fill and the warp threads are under tension so that the tension in the warp threads will tend to maintain the undulations or kinks within the fill threads unless they have been severed as is indicated by the slits **100**. Thus, in FIG.

BIRD, Walter, n° US 3,407,534 1967-1968

Puerta equilibrada por presión

Nota* Aplicado para aire y/u otros gases

Solicitud	1 marzo 1967
Fecha	29 octubre 1968
Lugar	Williamsville, Nueva York
Inventor	W. W. Bird
Patente n°	US 3,407,534
Título	*Pressure balanced door*

Oct. 29, 1968 W. W. BIRD 3,407,534

PRESSURE BALANCED DOOR

Filed March 1, 1967 4 Sheets-Sheet 1

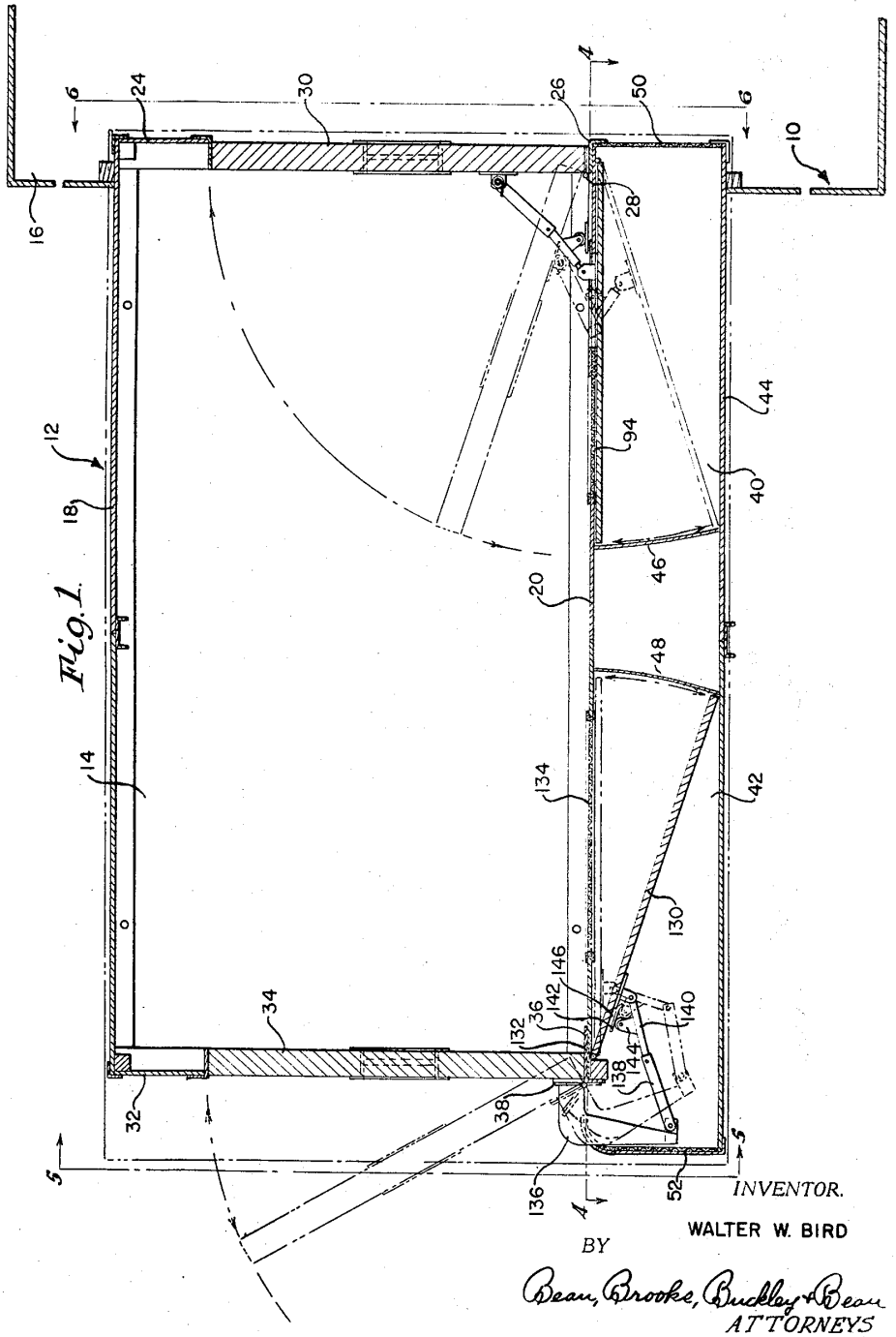


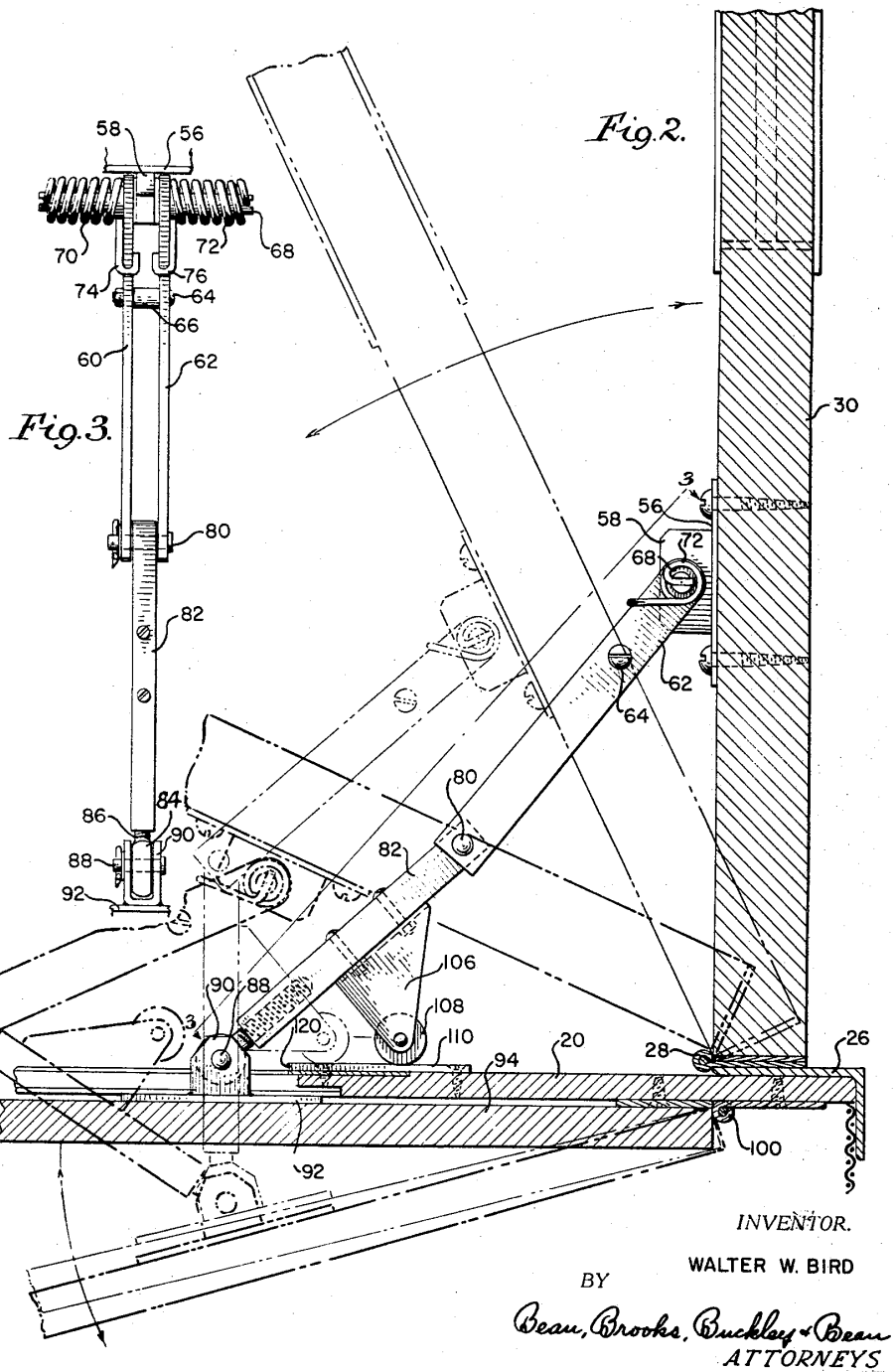
Fig. 1.

INVENTOR.
WALTER W. BIRD
BY
Bean, Brooke, Buckley & Bean
ATTORNEYS

Oct. 29, 1968 W. W. BIRD 3,407,534

PRESSURE BALANCED DOOR

Filed March 1, 1967 4 Sheets-Sheet 2



INVENTOR.
WALTER W. BIRD

BY
Beau, Brooks, Buckley & Beau
ATTORNEYS

Oct. 29, 1968 W. W. BIRD 3,407,534

PRESSURE BALANCED DOOR

Filed March 1, 1967 4 Sheets-Sheet 3

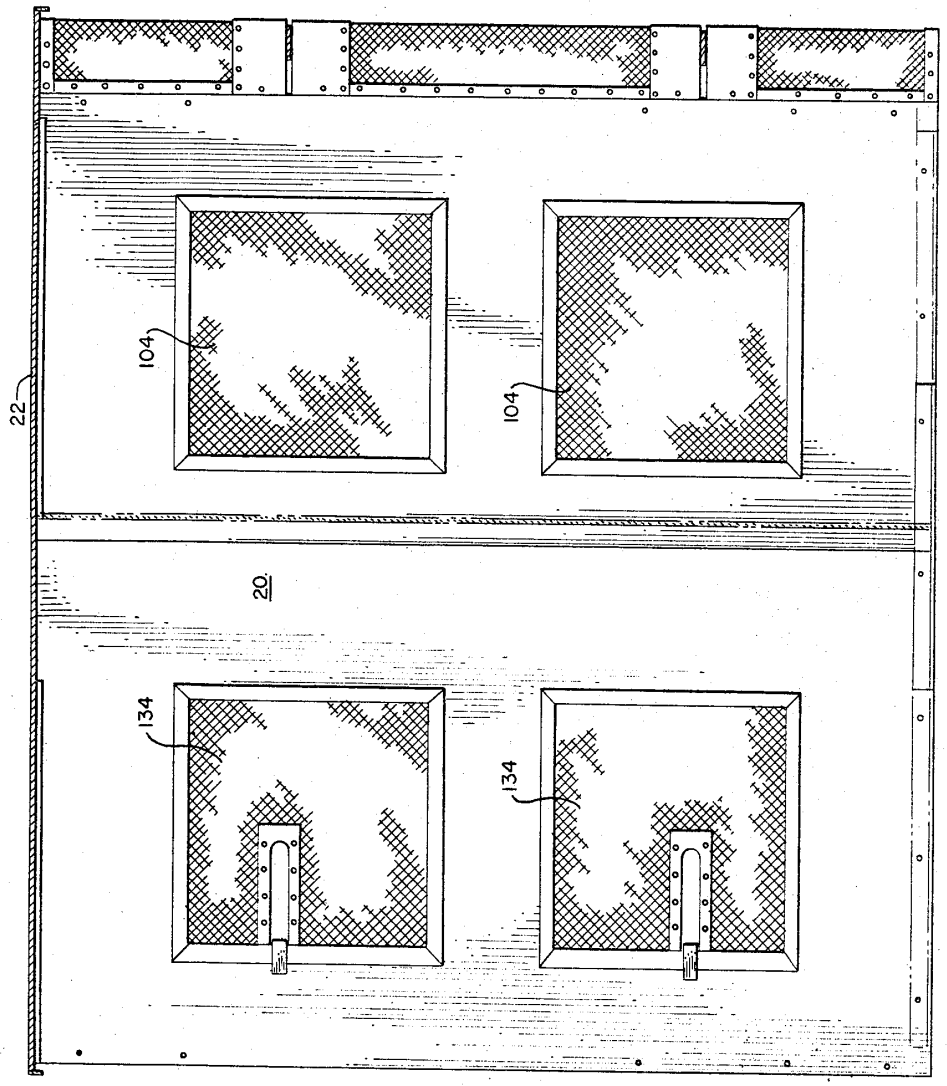


Fig. 4.

INVENTOR.
WALTER W. BIRD
BY
Beam, Brooks, Buckley & Beam
ATTORNEYS

Oct. 29, 1968 W. W. BIRD 3,407,534

PRESSURE BALANCED DOOR

Filed March 1, 1967 4 Sheets-Sheet 4

Fig. 6.

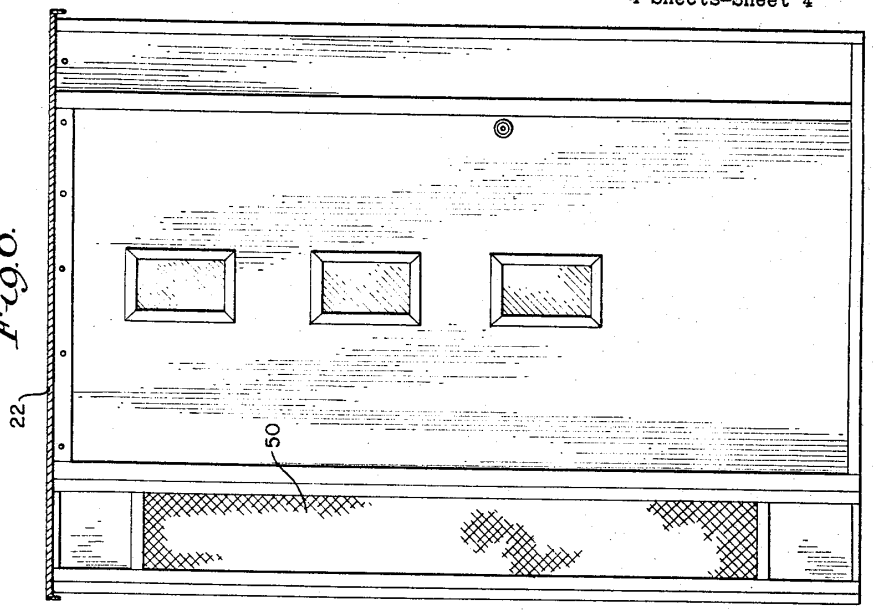
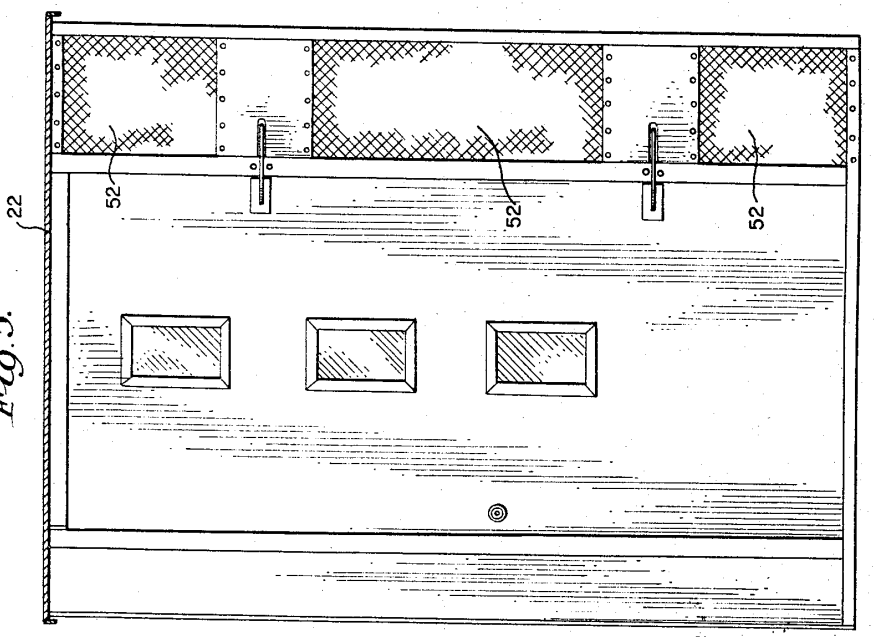


Fig. 5.



INVENTOR.

WALTER W. BIRD

BY

Beau, Brooks, Buckley & Beau

ATTORNEYS

United States Patent Office 3,407,534
Patented Oct. 29, 1968

3,407,534

PRESSURE BALANCED DOOR

Walter W. Bird, Williamsville, N.Y., assignor to Birdair Structures, Inc., Buffalo, N.Y.

Filed Mar. 1, 1967, Ser. No. 619,829
5 Claims. (Cl. 49—68)

ABSTRACT OF THE DISCLOSURE

An outwardly swinging door in association with an internally pressurized building and coupled to a piston or vane subjected to the internal pressure normally to hold the door closed. The manner in which the door is coupled to the vane is such as to exert a non-uniform closing force which is greatest at and near the closed position of the door.

Brief summary of the invention

This invention is directed in particular to the art of air inflated structures which depend upon internal air pressure to retain their structural integrity. In such an arrangement, it is desirable to minimize the loss of internal air incidental to door opening and closing action. With regard to this, the present invention is concerned with an airlock assembly.

A further problem and one which does not relate to the airlock is the provision of emergency door exits required by ordinance. Usually, the requirements necessitate an outwardly opening door which operates with a minimum of effort or manipulation. In an internally pressurized environment, it will be appreciated that an emergency door raises certain problems. For example, the door when closed will be subjected to considerable opening force due to the internal pressure. If this internal pressure is counterbalanced by a spring of sufficient strength to overcome the pressure, the door will be exceedingly difficut to open beyond that point at which the internal pressure ceases to exert any substantial door opening effect. On the other hand, a door held closed by a conventional panic lock will, when released, fly open and will require substantial effort to reclose.

The present invention involves basically an arrangement in which the internal pressure itself is used to hold the door closed and which tends to counterbalance the internal pressure against the door at and near the closed position.

It is a primary concern in connection with this invention to provide an improved form of door and means associanted with the door ad acted upon by differential fluid pressure serving to return or maintain the door in its closed position against the differential fluid pressure acting thereagainst.

Another object of this invention is to provide an improved structure as aforesaid incorporating a door and a movable vane, both operated upon by differential fluid pressure, there being link means joining the door to the vane and effective therewith to increase the door-closing force as the door is moving toward its closed position and vice versa.

Another object of this invention resides in the provision of an improved structure as aforesaid wherein the link means is in the form of pivotally interconnected strut members and a reaction member normally allowing the strut members to reside in over-center relation to thereby constrain the strut members to act as a compression or tension element joining the door and the vane, and wherein a cam plate is provided for cooperation with the reaction member to gradually move the strut members to and past dead center as the door is moved away from its closed position to thereafter allow these strut members to pivot relative to each other in substantially unrestrained fashion so as to substantially completely destroy their compression or tension transmitting effect, all to the end that the door and vane are interconnected for conjoint movement only in that region of movement of the door where it is at or near its closed position.

A further object of this invention is to provide an assembly according to the preceding object wherein spring means is associated with the strut members to cooperate with the aforesaid over-center strut arrangement to provide a return force on the door which does not abruptly terminate when dead center is passed.

Another object of this invention is to provide an improved airlock structure incorporating door assemblies as above described.

Other objects and advantages of the invention will appear from the specification hereinafter and the accompanying drawings, wherein:

FIG. 1 is a horizontal section taken through an airlock structure and a portion of an adjoining building constructed in accordance with the present invention;

FIG. 2 is an enlarged horizontal sectional view illustrating the details of the link means according to the present invention;

FIG. 3 is a horizontal elevational view taken substantially along the plane of section line **3—3** in FIGURE 2 showing further details of the link means;

FIG. 4 is a vertical section taken substantially along the plane of section **4—4** in FIGURE 1 and illustrating the vent means for the chambers housing the vane members;

FIG. 5 is a vertical elevational view taken substantially along the plane of section line **5—5** in FIGURE 1 illustrating the mounting of one of the doors; and

FIG. 6 is a vertical elevation taken substantially along the plane of section line **6—6** in FIGURE 1 showing the air access door mounting arrangement.

In what follows, the basic concept of a pressure balanced door is described in conjunction with an airlock assembly. It is to be understood, however, that an outwardly swinging emergency door separate and apart from any airlock feature may be installed by simply mounting one of the airlock doors at a suitable site in the building. In such a case, no external handle would be provided on the door whereas it is easily opened from inside simply by pushing against it. The amount of force required is minimal but, at the same time, the door will automatically close when released.

With reference at this time more particularly to FIGURE 1, the reference character **10** indicates in general a building construction which may taken any desired form such as for example it may be in inflatable type of building construction maintaining its shape and structural rigidity by virtue of internal air pressure to which the enclosure defined by the building is constantly maintained, as will be understood by those skilled in the art. The reference character **12**, on the other hand, indicates in general an airlock assembly constructed in accord with the principles of this invention. The airlock assembly provides means for entrance and egress and defines a secondary enclosure **14**, as distinct from the enclosure **16** defined by the building structure **10**, the secondary enclosure being adapted in a manner hereinafter more particularly pointed out, to isolate the building enclosure **16** from ambient atmosphere and minimize leakage of internal pressurizing fluid from the interior of the building **10** during entrance or egress.

The airlock structure **12** consists essentially of oppositely disposed side walls **18** and **20**, a top wall **22** (FIGURES 4–6), an inner end wall **24** having an access opening and hingedly mounting, as by a suitable frame member **26** and associated hinge **28**, an access door **30** for the interior **16** of the building **10** and swingable inwardly into

the airlock structure **12**, as indicated by dashed lines in FIGURE 1. The airlock structure **12** also includes an outer end wall **32** provided with an access opening and hingedly mounts an exterior door **34** which swings outwardly as shown, the structure having a suitable jam member **36** and associated hinge **38** mounting the door **34**, substantially as is shown.

The airlock structure also includes first and second chambers **40** and **42** defined between the outer wall structure **44** and the wall **20** spaced therefrom and by the associated top wall **22** and the corresponding inner wall members **46** and **48**. The chamber **40** is vented to the interior of the building **10** as by foraminous member **50** (FIGURES 1 and 6). The second chamber **42** is similarly vented but to ambient atmosphere by means of the foraminous means **52** (FIGURES 1 and 5).

The operation of the airlock structure is, in general, quite conventional. That is to say, the building structure **10** is subjected to some internal fluid pressure which is greater than the ambient atmosphere exterior to the building and the airlock structure **12**. The interior **14** of the airlock structure **12** will normally be at ambient pressure so that a differential pressure will be acting upon the access door **30**. This differential in pressure will tend to open the door **30** and permit the fluid to escape from the interior of the building into the airlock structure **12**. This invention concerns means for preventing this from occurring. Similarly, should the interior **14** of the airlock structure **12** be subjected to the same pressure or substantially the same pressure as the interior **16** of the building **10**, as when a person leaves the interior of the building and enters the airlock structure **14**, thus inescapably pressurizing the interior **14**, a differential pressure will then be acting upon the exterior door **34** tending to force this door open. This invention also concerns means for preventing this from occurring relative to the exterior door **34**.

Reference will be had now to FIGURES 2 and 3 to illustrate the details of the means for preventing unwanted motions of the door **30**. In these figures, it will be noted that the inner side of the door **30** is provided with a mounting bracket member **56** having an outstanding ear **58** fixed thereto. A pair of link members **60** and **62**, joined as by the fastener **64** and intervening spacer **66**, straddle the ear **58** and are pivotally joined thereto as by a shaft member **68**. A pair of torsion springs **70** and **72** have each one end thereof received in a notch in a respective end of the shaft **68** as is clearly shown in FIGURES 2 and 3 and the opposite ends thereof are provided with hook portions **74** and **76** which engage over the members **60** and **62** serving normally to urge these members in a counterclockwise direction when viewed as in FIGURE 2, the purpose of which will be presently apparent. Obviously, the shaft **68** must be fixed to the ear **58** to prevent rotation of the shaft **68**. A link pin **80** is carried by the free ends of the members **60**, **62** and a further member **82** is pivotally joined to the members **60** and **62** in the manner indicated most clearly in FIGURE 3. The free end of the member **82**, in turn, carries an eye member **84** which may have a threaded stem **86** engaged with the member **82** for adjustment purposes. The eye **84** engages a pivot pin **88** carried by the ears **90** of a bracket **92** fixed to one side of a vane member **94**, see particularly FIGURE 2. The vane **94** is hingedly mounted as at **100** to the airlock wall **20** and is located within the chamber **40** it being seen, from FIGURE 1, that the free edge of the vane **94** swings in close proximity to the wall member **46** which is arcuate as shown.

Thus, the vane **94** effectively divides or partitions the chamber **40** with one side of the vane **94** being communicated with the interior **14** of the airlock structure by gratings **104**, see particularly FIGURE 4, and with the outer side of the vane **94** communicating with the interior of the building **10** through the grating or foraminous means **50** previously described. Thus, there is a differential pressure acting on the vane **94** which will be the same as the differential pressure acting upon the access door **30**.

The link member **82** carries a bracket **106**, see FIGURE 2, which in turn mounts a roller member **108** adapted to bear against a cam plate member **110** fixed to the wall **20** of the airlock, substantialiy as is shown. As is clearly illustrated in FIGURES 2 and 3, the links **60**, **62** and **82** are in an over-center relationship when the door is closed (full line position). The purpose of the roller **108** and cam **110** is to allow this over-center position as shown, but to move the two links when ultimately passed over-center position as the door is first swung toward open position and vice versa. As previously described, the springs **70** and **72** normally urge the link **60**, **62** counterclockwise as shown in the drawing and when the roller **108** has passed beyond contact with the cam plate **110**, the springs **70** and **72** tend to prevent the two links from buckling. The differential pressure acting on the vane **94**, however, exerts sufficient force on the vane which resists movement thereof as imparted by the links so that a buckling action does take place as is shown in dashed lines. The net result is that the movement of the vane **94** is substantially uniform with respect to the door **30** only at the very beginning of door opening movement. The vane **94** passes through only a short arc before further motion is arrested. By this time, however, the over-center relation of the links is broken and continued opening of the door causes further buckling of the links and is resisted only by the action of the springs **70**, **72**, the roller simply pivoting away from the cam plate about the then-fixed pivot point **88**. This is illustrated in FIGURE 1 by full and dashed lines for the components under consideration.

During the initial movement of the door, it will be clear that the links **60**, **62** and **82** are acting really only as a compression strut, substantially as if they were rigidly joined and not articulated by the member **80**. Once, however, the dead center position is passed, the action of the springs **70** and **72** takes over. The net result is that while the door is near the region of being closed, the movements of the vane **94** and the door **30** are substantially uniform and, therefore, the greatest door-closing force is exerted. There again, the door closing force progressively diminishes as the door is continued to be moved toward its open position. This counteracts very closely the forces acting on the door due to differential pressure and still leaves a net return force acting on the door to close it when released. The action is, of course, reversed when the door moves toward closed position and assures that the door will be positively closed to minimize leakage of the internal pressurized air.

The same action applies for the door **30** and its associated vane **130**. The chamber **42** contains a vane **130** hingedly mounted as at **132** and the opposite sides of this vane are communicated respectively with ambient atmosphere through the grating **52** previously described and the grating means **134** on the wall structure **20**, see particularly FIGURE 4. As before, the free edge of the vane **130** runs in close proximity to the arcuate wall portion **48** in part defining the chamber **42**. As was the case in conjunction with the door **30**, the door **34** is provided with a bracket **136** which mounts the link means **138**. The link **138** corresponds to the members **60**, **62** of FIGURES 2 and 3 whereas the link **140** corresponds to the link member **82** of FIGURES 2 and 3. The vane **130** is normally disposed in the full line position shown in FIGURE 1 as opposed to the normal full line position of the vane **94**. The cam plate **142** for the roller assembly **144** carried by the link **140** is mounted on a suitable post or support member **146** which is, of course, fixed and stationary. The operation as between the door **34** and the vane **130** is in all of the respects, identical with the operation previously described in conjunction with the door **30** and the vane **94**.

I claim:

1. A building construction comprising, in combination:

BIRD, Walter, nº US 3,496,686 1967-1970

Sistema de cerramiento estanco

Nota* Aplicado para aire y/u otros gases

Solicitud	30 noviembre 1967
Fecha	24 febrero 1970
Lugar	Williamsville, Nueva York
Inventor	W. W. Bird
Patente nº	US 3,496,686
Título	*Weather-tight enclosure system*

Feb. 24, 1970 W. W. BIRD 3,496,686

WEATHER-TIGHT ENCLOSURE SYSTEM

Filed Nov. 30, 1967 3 Sheets-Sheet 1

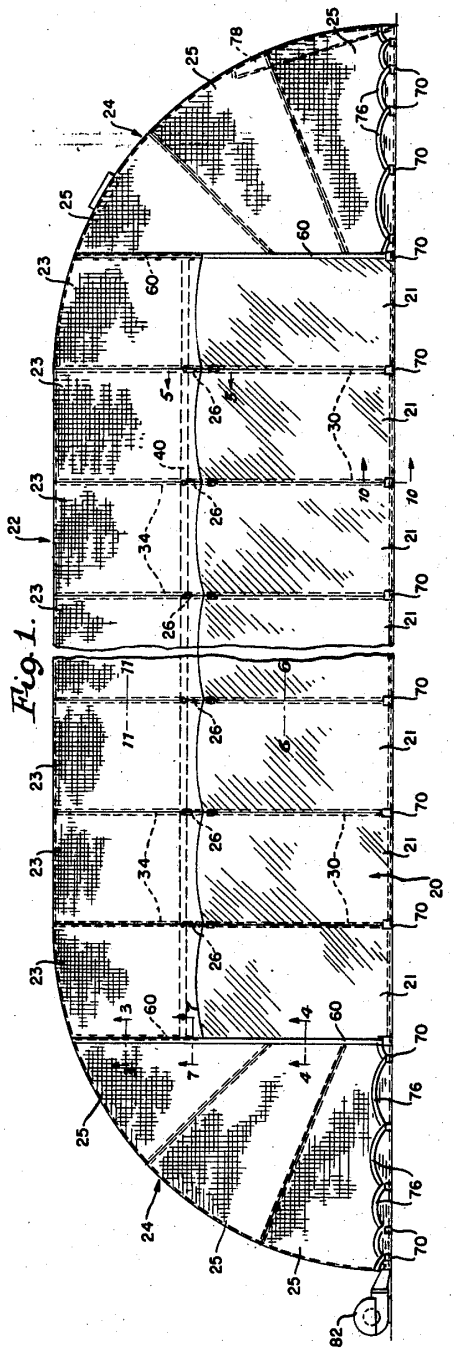


Fig. 1.

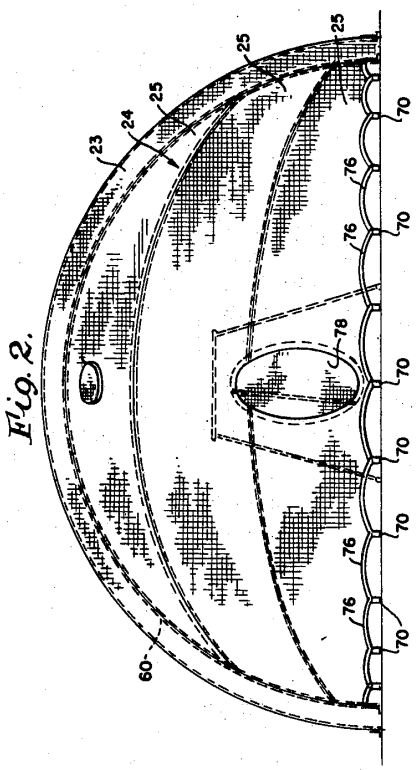


Fig. 2.

INVENTOR.
WALTER W. BIRD

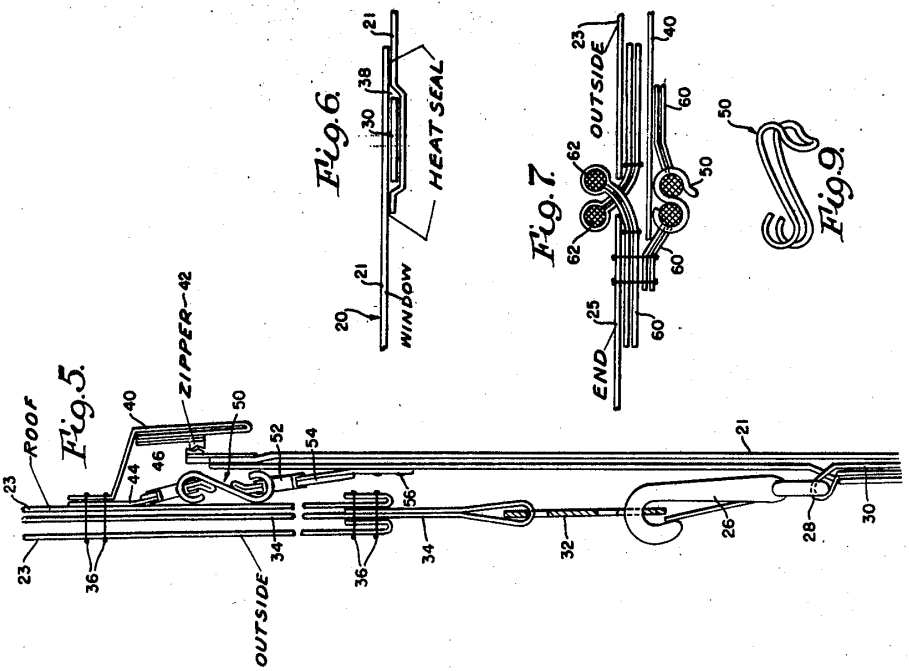
BY

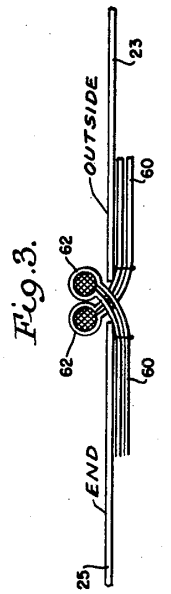
Bean, Brooke, Buckley & Bean
ATTORNEYS

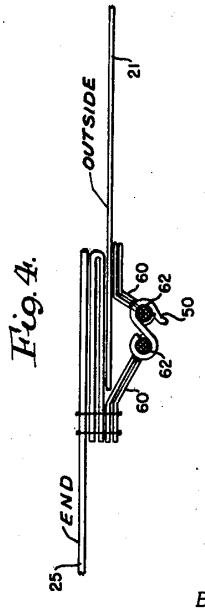
Feb. 24, 1970 W. W. BIRD 3,496,686

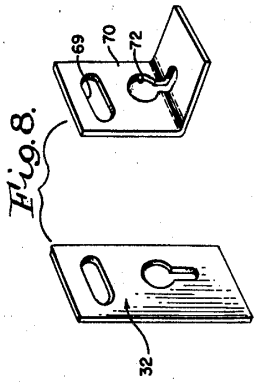
WEATHER-TIGHT ENCLOSURE SYSTEM

Filed Nov. 30, 1967 3 Sheets-Sheet 2









INVENTOR.
WALTER W. BIRD

BY

Beau, Brooke, Buckley & Beau
ATTORNEYS

Feb. 24, 1970 W. W. BIRD 3,496,686

WEATHER-TIGHT ENCLOSURE SYSTEM

Filed Nov. 30, 1967 3 Sheets-Sheet 3

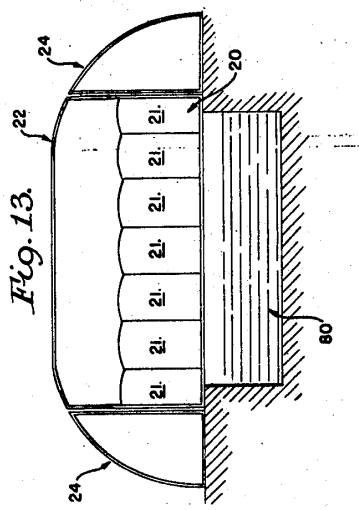


Fig. 13.

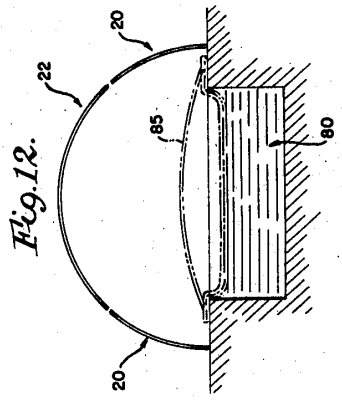


Fig. 12.

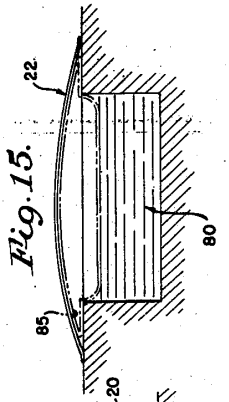


Fig. 15.

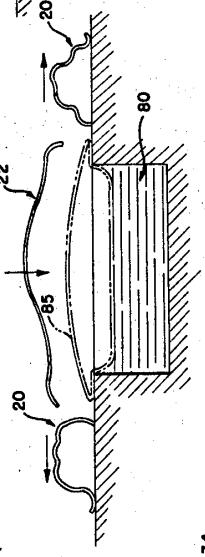


Fig. 14.

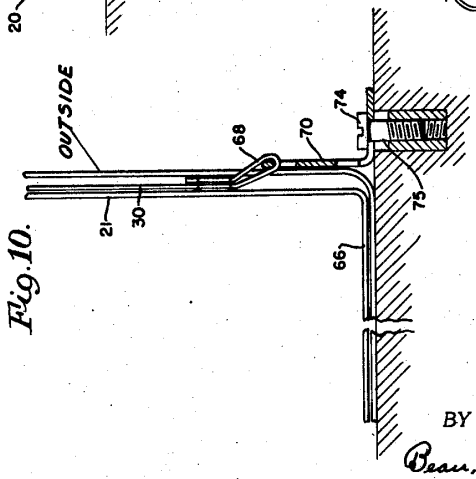


Fig. 10.

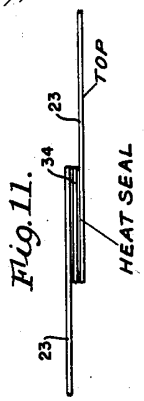


Fig. 11.

INVENTOR.
WALTER W. BIRD

BY
Bean, Brooks, Buckley & Bean
ATTORNEYS

United States Patent Office

3,496,686
Patented Feb. 24, 1970

3,496,686

WEATHER-TIGHT ENCLOSURE SYSTEM

Walter W. Bird, Williamsville, N.Y., assignor to Birdair Structures, Inc., Buffalo, N.Y.

Filed Nov. 30, 1967, Ser. No. 686,939
Int. Cl. E04b 1/345
U.S. Cl. 52—2 7 Claims

ABSTRACT OF THE DISCLOSURE

A weather-protection enclosure system particularly adapted, for example, to provide for comfortable year-round use of an outdoor swimming pool or the like in temperate or cool weather climate areas, comprising a sectionally formed shell-like structure which when assembled and ground-anchored is inflatable to provide an air-supported enclosure, and which when deflated and disassembled may be easily stored away. Portions of the disassembled structure are adapted to provide a water-surface cover for the swim pool, or the like during non-use seasons. An air-inflatable pillow is furnished in combination therewith to span the water surface of the pool and to provide an upwardly convex support for a section of the enclosure structure which thereupon functions as a rain, snow and/or debris shedding cover for the pool. The invention employs component interconnection devices facilitating conversion of the system parts from pool enclosure and/or pool covering and/or stored-away conditions; whereby by way of example in the case of a typical private swim pool installation, the owner himself may quickly and easily perform the conversion operations with unskilled and minimum assistance, if any.

BRIEF SUMMARY AND BACKGROUND OF THE INVENTION

Whereas various type enclosures have been previously used in connection with swim pools or the like, including air-supported shelters as disclosed for example in my earlier U.S. Patents 3,024,796; 2,509,655; 3,240,217; 3,247,627 and Design 183,113; the structures thereof were somewhat inconvenient with respect to any dismantling of such enclosure for store-away purposes during prolonged non-use periods, and with respect to subsequent re-erection thereof. Also, due to the form and shape of the envelope material of such prior enclosure systems, they were not conveniently suitable for alternative use as water-surface safety or anti-freeze or dirt shedding cover devices.

It is an object of the present invention to provide an improved shelter device for play or work areas such as swim pools or the like, comprising; primarily, a sectionally constructed air-inflatable shell or envelope which may be easily unfolded from storage and then assembled and erected by one or more inexperienced persons to enclose the area for comfortable inclement weather use; and which may as easily be dismantled and disassembled and then packed away and stored in a small space when not needed, such as during a pleasant weather season or during a prolonged owner-absence, or the like.

It is another object of the invention to provide a shelter device as aforesaid wherein one of the air-supported shelter sectional components thereof is shaped and dimensioned so as to also function as an easily arranged water-surface cover when applied to a swim pool or the like; thereby rendering the pool safe as well as dirt-free, such as during a prolonged absence of the owner.

It is still another object of the invention to provide, in conjunction with the envelope structure as aforesaid, an optionally usable air-inflatable pillow device which is adapted to float upon the pool water surface; thereby

providing an anti-freeze insulator as well as a vertically convex support for the envelope component which operates as the pool cover sheet; whereby an improved dirt and rain-snow shedding cover system is provided.

Still another object of the invention is to provide a system as aforesaid wherein the inflatable envelope structure comprises a combination of separable components of improved forms having different strength, transparency, and/or other physical and structural characteristics; whereby the parts thereof may be easily handled and/or replaced or repaired as may be necessary.

Other objects and advantages of the invention will be apparent from the following specification and the accompanying drawing; wherein:

THE DRAWING

FIG. 1 is a side elevational view of an inflated enclosure of the invention which by way of example is suitable for use as a weather-shelter for a commercial area, play area, swim pool, or the like;

FIG. 2 is a right-hand end view thereof;

FIGS. 3, 4, 5, 6, 7 are enlarged scale fragmentary sectional views taken as suggested by lines **3—3**, **4—4**, **5—5**, **6—6**, and **7—7**, respectively, of FIG. 1;

FIG. 8 is a composite perspective view of two forms of hold-down clip devices, such as are used in connection with the erection and maintenance of the enclosure of the invention;

FIG. 9 illustrates the form of clip device which is shown as being used in FIGS. 4, 7, to hold the seam lap devices in place;

FIGS. 10, 11 are enlarged scale fragmentary sectional views taken as suggested by lines **10—10** and **11—11**, respectively, of FIG. 1;

FIG. 12 is a vertical sectional view corresponding somewhat to FIG. 2 but illustrating schematically a first step in conjunction with the use of an auxiliary "pillow" device when preparing the previously air-inflated enclosure structure to function as a dirt and rain-snow shedding cover for a swim pool or the like during "off-season" or "owner-absent" periods;

FIG. 13 is a side elevational view of a structure as shown in FIG. 12 and illustrating diagrammatically the positional relationships of the enclosure envelope components when erected in area-covering position;

FIG. 14 corresponds to FIG. 12 but illustrates diagrammatically an intermediate stage in the dismantling of the swim pool enclosure, preliminary to a water-surface covering thereof; and

FIG. 15 corresponds to FIGS. 12, 14, but illustrates the cover component of the system as finally disposed in dirt and rain-snow shedding position.

DETAILED DESCRIPTION

As shown by way of example in the drawing herewith at FIGS. 1–11, inclusive, the invention may be embodied in an enclosure system comprising a pair of opposite side wall portions designated generally at **20—20**; a roof section designated generally at **22**; and a pair of shell-shaped end sections designated generally at **24—24**. It is to be understood that the sections **20—20**, **22** and **24—24** are conveniently fabricated to comprise series of side-by-side connected panels **21**, **23**, **25**, respectively, which are formed of any preferred type of flexible sheet material, having strength and wear-resistance and/or transparency characteristics, as may be preferred. Thus for example in the case of an enclosure designed specifically for swim pool coverage, the side panels **21** may be fabricated of substantially transparent plastic sheet material so as to transmit daylighting to the interior while protecting the occupants from cold air, wind, etc. The roof and end

BIRD, Walter, nº US 3,490,184 1968-1970

Junta tensionada en la unión de la membrana hinchada con aire

Nota* Aplicado para aire y/u otros gases

Solicitud	17 enero 1968
Fecha	20 enero 1970
Lugar	Williamsville, Nueva York
Inventor	W. W. Bird
Patente nº	US 3,490,184
Título	*Taped tension web-skin joint for air inflated structures*

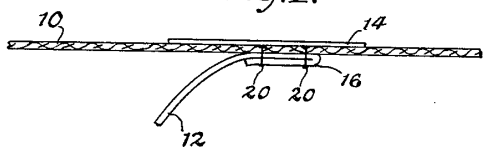
Jan. 20, 1970 W. W. BIRD 3,490,184

TAPED TENSION WEB-SKIN JOINT FOR AIR INFLATED STRUCTURES

Filed Jan. 17, 1968

PRIOR ART

Fig. 1.



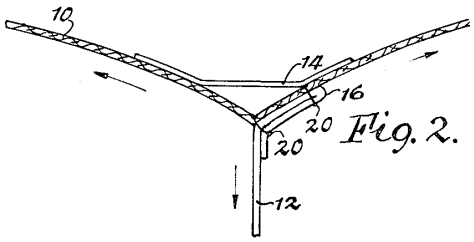
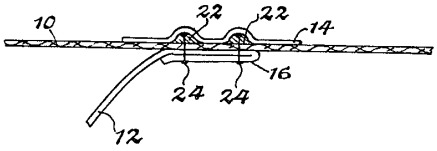


Fig. 2.

Fig. 3.



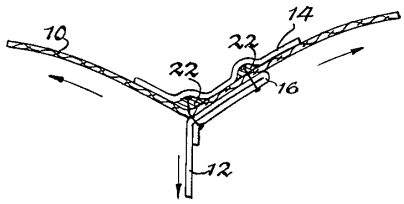


Fig. 4.

INVENTOR.
WALTER W. BIRD

BY

Beau & Beau
ATTORNEYS

United States Patent Office 3,490,184
Patented Jan. 20, 1970

3,490,184

TAPED TENSION WEB-SKIN JOINT FOR AIR INFLATED STRUCTURES

Walter W. Bird, Williamsville, N.Y., assignor to Birdair Structures, Inc., Buffalo, N.Y.

Filed Jan. 17, 1968, Ser. No. 698,560
Int. Cl. E04b 1/34
U.S. Cl. 52—2 9 Claims

ABSTRACT OF THE DISCLOSURE

A joint construction between a tension web member and a flexible fabric fluid-pressure retaining envelope skin member disposed generally normal to the web member, in an air inflated structure such as shown in my earlier U.S. Patent No. 3,247,627, the junction is effected by stitching an edge flange of the web member to the skin member while providing thereat an externally projecting protuberance overlying the stitch seam; then adhesively mounting a flexible tape against the outer face of the envelope to extend lengthwise of the seam while bridging the latter and permanently gripping the protuberance material and the skin material at opposite sides of the seam. The tape member compresses the protuberance material in fluid-sealing condition against the seam while at the same time providing a flexible anchorage platform for the mid-section of the tape; thereby permitting flexure accommodation of the tape to envelope-inflation distortions of the skin material at opposite sides of the seam, while avoiding stresses on the tape such as would otherwise tend to cause it to bridge the seam and/or separate from the skin material.

DESCRIPTION OF THE INVENTION

The invention relates to an improvement in structures as disclosed in my aforesaid referenced patent, and wherever inflated envelope skin members are supported at intervals by tension web devices, thereby providing a skin configuration of "valleyed" form. It has been found that such inflation distortions of the envelope skin members translate into stresses tending to cause the adhesively applied seam-covering tapes to "bridge" the valleys and to separate from the envelope skin material, thereby disrupting the seam-seal effect and/or resulting in peeling of the tape away from the envelope. The object of the present invention is to provide, by simple and inexpensive means, a solution to the above stated problem and disadvantages of prior web-envelope stitched-joint constructions, in air-inflated structures.

By way of example and to illustrate the features of the present invention the accompanying drawing is furnished, wherein:

FIG. 1 is a fragmentary sectional view taken through an envelope skin member having a tension web attached thereto and seam-taped in accordance with a typical prior art construction; the structure being shown as when it is under relaxed, non-inflated condition;

FIG. 2 corresponds to FIG. 1 but illustrates the disposition of the construction and stress results thereon when it is under inflation-distortion conditions;

FIG. 3 is a view corresponding to FIG. 1 but illustrates the construction of the present invention in contradistinction thereto; and

FIG. 4 corresponds to FIG. 3 but illustrates the construction of the present invention when operating under envelope-inflated conditions.

The invention is applicable to any situation wherein an envelope subject to air inflation is arranged to have a skin member thereof positionally restrained at intervals therealong by means of tension webs pulling in directions substantially normal to the general plane of the skin member.

Therefore, although the device is particularly useful for example in a construction as shown in my U.S. Patent No. 3,247,627, in order to simplify the illustration herein only one skin member and one associated tension web member are shown. The skin member is designated generally at **10**, and the web member is designated generally at **12**. The seam-sealing tape member is indicated generally at **14**.

FIGS. 1 and 2 illustrate how in accordance with one form of prior art construction the web member **12** is backfolded along its edge, as indicated at **16**, and then double stitched to the skin member **10** as indicated at **20—20**. A straight stitching technique is typically employed, whereby the outer surface of the skin member **10** remains substantially smooth and uninterrupted except for the perforations therethrough due to the stitching operation. Thus, during the envelope fabrication process of the skin member and web members are with ease and facility layered flatwise and machine-sewn together, and then seam-taped as illustrated at FIG. 1 to air-seal the joint. However, it has been found that joints so made are propense to early deterioration because of the stresses imposed thereon, due to the fact that when the envelope is inflated the skin member **10** balloons out from opposite sides of the joint seam into the bowed sectional form shown at FIG. 2. Incidental to such inflation the fabric of the skin member stretches somewhat, and therefore elongates transversely as viewed in the drawing herewith.

As a result, the cemented connection between the envelope skin and the sealing tape member **14** is subject to severe shear loads, and these stresses are relieved by separation of the adhesive connection either partially or totally throughout the width of the tape. Such separation occurs initially in the region of the apex of the valley formation in the envelope skin due to envelope inflation; whereby the tape **14** pulls partially away from the "bridges" the seam as illustrated at FIG. 2. Obviously, the seam-sealing effect is thereby disrupted and the tape tends to peel away from the joint, thereby exposing the joint to further adverse stress and weather deterioration effects.

As distinguished from the above, in the case of the present invention the junction between the envelope skin member and the tension web member is supplemented along the seam line so as to include a substantial external protuberance as indicated at **22** (FIGS. 3, 4). This protuberance may be provided by using a "chain stitch" sewing technique or the like, as indicated at **24**; or by otherwise providing an outwardly extending bead or ridge running the full length of the seam. For example, a welt or cord may be stitched along the outer surface of the seam to provide the desired protuberance. A sealing tape **14** is thereupon cemented in place as shown in the drawing herewith. It has been found that by virtue of such construction the tape member **14** embodies sufficient lateral expansion leeway to accommodate the previously described envelope skin distortion effects while avoiding tape separation stresses. It appears that the sinuous sectional form of the tape when so applied, provides a "reservoir" of the tape material allowing for ample transverse elongation without strain, while the material of the protuberance device **22** provides a flexible platform for carrying the tape during such flexural movements, without separation therefrom.

Whereas in the drawing and specification hereinabove the invention is illustrated and described in connection with only a single envelope skin member and a single tension web member, it is to be understood that the invention may be employed in a variety of situations involving the same problems; such as for example in a dual-walled air inflated structure as shown in my earlier Patent No. 3,247,627. Also, it is to be understood that whereas the drawing herewith illustrates the juncture between the skin and web members to have been performed

Patentes realizadas por Walter Bird posteriores a 1970

BIRD, Walter, nº US 3,651,609 1970-1972

Estructuras hinchadas con aire

Nota* Aplicado para aire y/u otros gases

Solicitud	18 febrero 1970
Fecha	28 marzo 1972
Lugar	Williamsville, Nueva York
Inventor	W. W. Bird
Patente nº	US 3,651,609
Título	*Air inflated structure*

United States Patent

Bird

[15] **3,651,609**

[45] **Mar. 28, 1972**

[54] AIR INFLATED STRUCTURE

[72] Inventor: **Walter W. Bird,** Williamsville, N.Y.

[73] Assignee: **Birdair Structures, Inc.,** Buffalo, N.Y.

[22] Filed: **Feb. 18, 1970**

[21] Appl. No.: **12,177**

[52] **U.S. Cl.** **52/2**

[51] **Int. Cl.** **E04b 1/345**

[58] **Field of Search** ..... 52/2; 25/128 D; 249/65; 135/1

[56] **References Cited**

UNITED STATES PATENTS

1,302,182	4/1919	Lanchester	52/2
3,150,670	9/1964	Bird et al.	52/2
3,412,509	11/1968	Popil	52/2

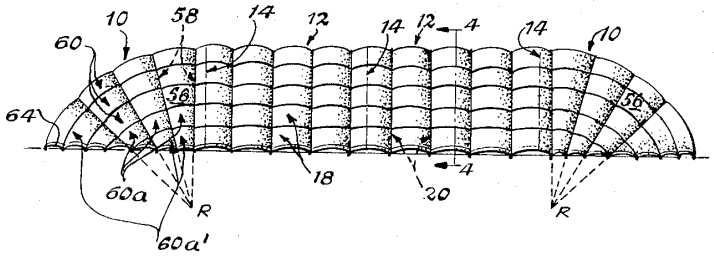
Primary Examiner—John E. Murtagh

Attorney—Bean & Bean

[57] **ABSTRACT**

An air inflated structure including an air inflated envelope formed by a plurality of relatively narrow, horizontally elongated panels having horizontally extending adjacent edge portions joined together, and a cable system having a series of widely spaced parallel flexible tension devices anchored to their opposite ends to the ground or other suitable structure base. The tension devices extend transversely of and are fixed relative to the envelope panels. The arrangement reduces the maximum fabric stresses in the envelope material, and permits substantially all loads to be transferred from the envelope panels horizontally into the tension devices and be carried thereby to the ground, thereby limiting propagation of rips or tears occurring in the envelope panels.

12 Claims, 11 Drawing Figures



Patented March 28, 1972 3,651,609

3 Sheets-Sheet 1

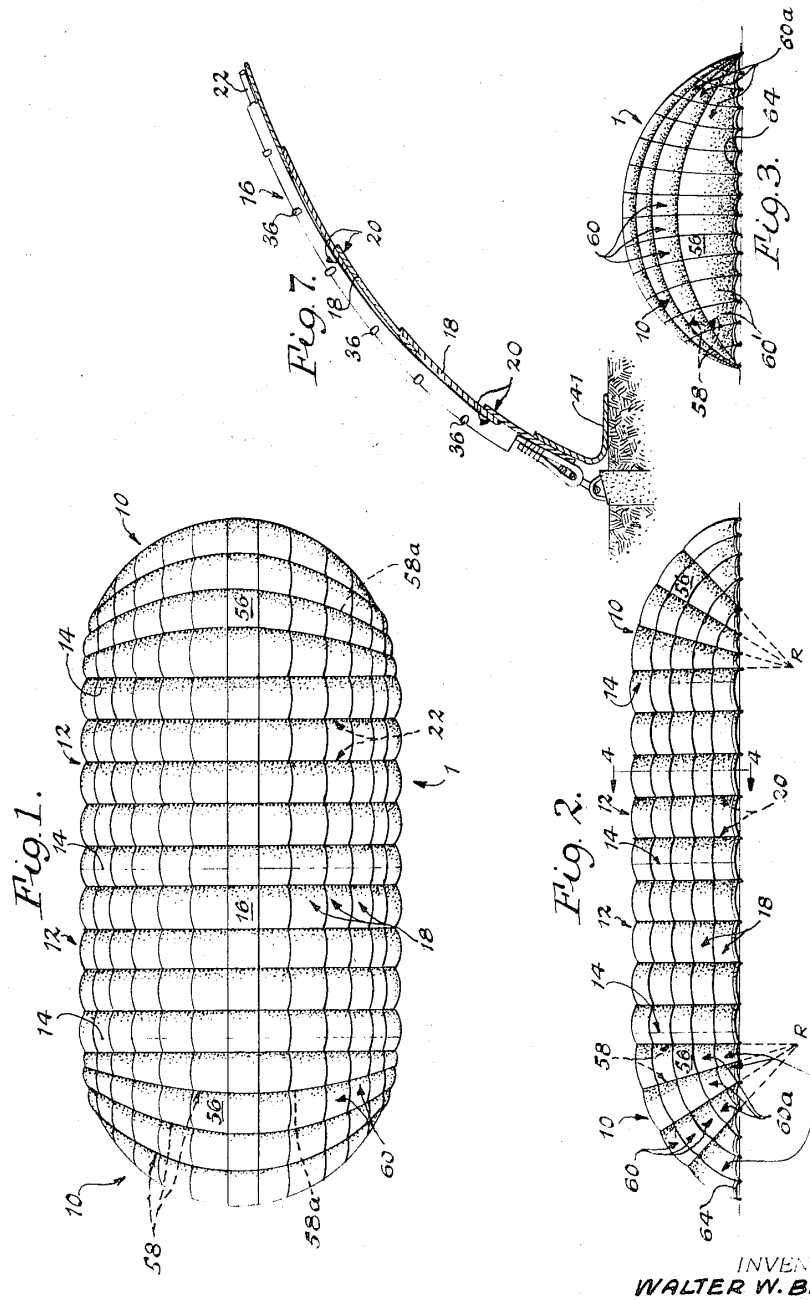


Fig. 5b.

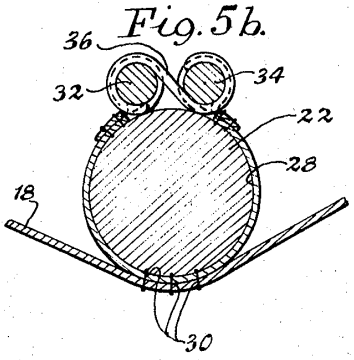


Fig. 6.

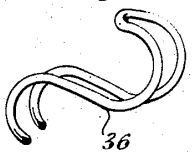
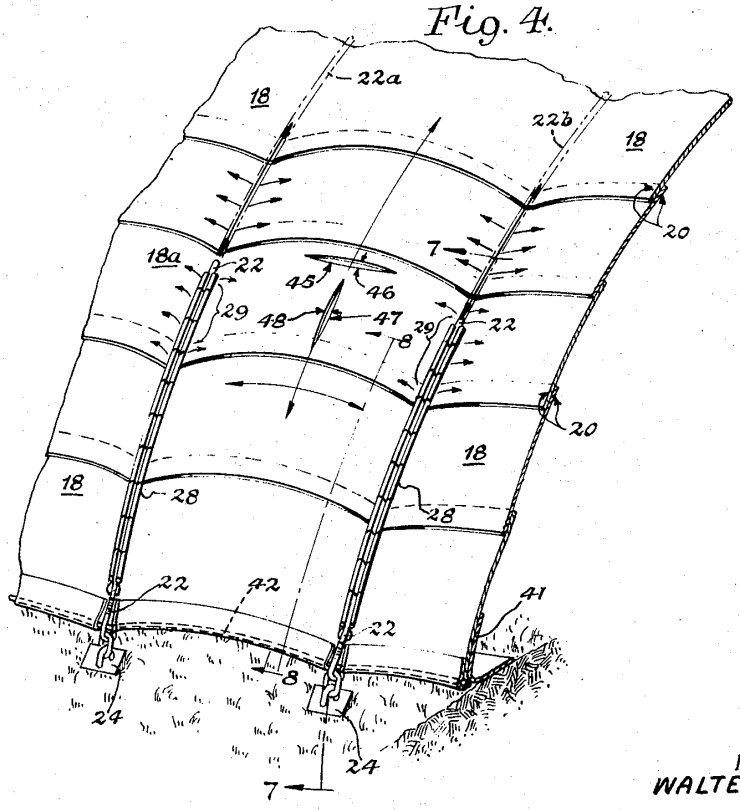


Fig. 4.



INVENTOR.
WALTER W. BIRD

BY

Beam & Beam
ATTORNEYS

Patented March 28, 1972 **3,651,609**

3 Sheets-Sheet 3

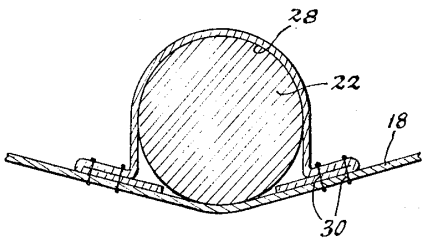


Fig. 5a.

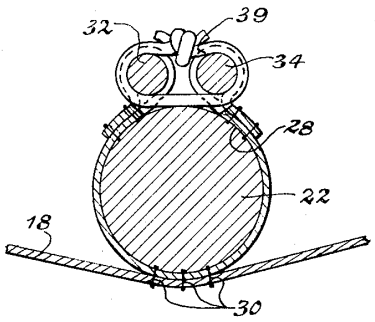


Fig. 5c.

Fig. 5d.

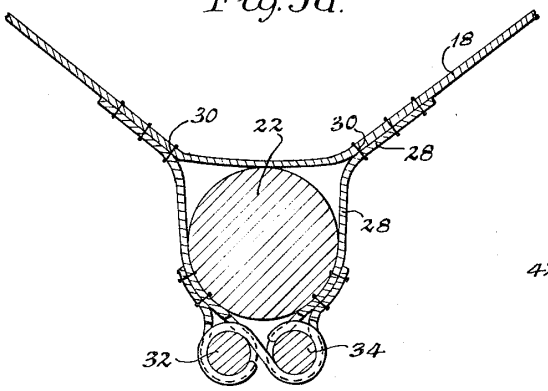
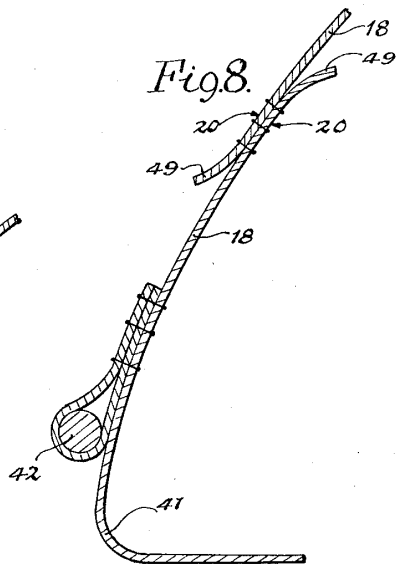


Fig. 8.



INVENTOR.
WALTER W. BIRD

BY

Bean & Bean
ATTORNEYS

AIR INFLATED STRUCTURE

BACKGROUND OF THE INVENTION

The majority of air supported structures used to date are simple air inflated envelopes, which are fabricated from high strength, coated fabric. These structure have been provided at low cost and have proven serviceable where they were of a size that could be fabricated from material currently available, where used for portable or semi-permanent applications and where temporary collapse, due to accidental damage or vandalism, would not be of serious consequence. However, with the growing interest in air supported structures of larger size and the need for more permanent installations, there is required a design which will result in low fabric stresses, a longer service life, greater reliability, less vulnerability to damage, and easier maintenance and repair.

Air supported structures have conventionally been shaped from generally spherical and cylindrical elements to form an enclosure of the desired size and shape. Normally, stresses in the envelope vary with the shape of the structure and in direct relation to the size of the structure and inflation pressure used to maintain stability. Aerodynamic and snow loads result in non-uniform loading in the envelope. The aerodynamic loading varies as the square of the wind velocity and is proportionately much larger than the normal stresses due to inflation pressure alone. Under non-uniform loading, equilibrium conditions in an air structure are achieved by redistribution of load, or by distortion of the envelope. With spherical elements or elements having a double curvature, loads can be redistributed between the intersecting circular elements. In effect, compressive loads are resisted as a relaxation of tension loads imposed by the initial inflation pressure. The spherical shape is therefore quite stable. However, with cylindrical sections, all stresses resulting from pressure differential must be carried by the circular elements, that is, as hoop tension. Longitudinal stresses in the envelope, that is in the straight elements, result from pressure of aerodynamic loads on the end sections, but are not effected nor have any influence on the local loading. Therefore, if the pressure varies along the circular element, distortion or a change in radius along the length of the element is required in order to result in approximately equal tension in the element from anchor point to anchor point, as is required for an equilibrium condition.

One obvious way to reduce the stress levels in the basic envelope would be to enclose it within a network of intersecting cables capable of carrying the entire aerodynamic of pressure loading. The envelope itself would thus be required only to distribute the pressure loading to the cable system. Uniform distribution of load can be achieved only if the cables are relatively closely spaced on approximately a uniform pattern over the entire surface, including the end sections of the structure.

As an alternate to the cable network, the envelope can be reinforced by running cables hoopwise across the cylindrical center section and radially from the crown of the spherical end sections in the manner illustrated in Lanchester's Pat. No. 1,302,182, Where such a cable system has been used, in combination with conventional envelope patterning wherein relatively inextensible coated fabric panels run vertically so as to form the circular elements of the structure, it has proven to be of limited effectiveness unless the cables are spaced very closely together. Otherwise, the cables relieve the stress only in the small area of the panels immediately adjacent to the cables, with the result that the remaining or mid-portions of the panels must still carry essentially the full load down to the structure base or support to which the cables are attached. Thus, the cabling system is not fully utilized, the distribution of load in the panels is indeterminate and thus difficult to design for, and the stress distribution under high wind conditions could result in severe propagation of any cut or tear in the panels resulting from accidental damage or vandalism. If the cables are shortened to press in on the envelope sufficient to allow for the required outward bulging of the envelope between the cables, then the envelope becomes very wrinkled,

resulting in an unsightly appearance and poor distribution of load.

Another difficulty encountered with conventional construction is that the growth and elastic characteristics of the materials in conventionally patterned structures results in a growth and resulting distortion of the envelope. Large variations occur primarily in the fill direction of the material which, with conventional patterning, is parallel to the longitudinal axis of the structure. While this high elasticity can normally be compensated for in the patterning of small structures, this is extremely difficult to do in large structures, particularly those with a high length-to-width ratio, as the greater stretch and changes in elongation under varying conditions of load, temperature, and humidity result in a possible variation of several feet in the location of attachments to the base of related equipment near the ends of the structure.

These difficulties can be overcome and a much more reliable structure having less vulnerability to damage and a much longer service life can be provided by using a cabling system and a method of patterning which will result in essentially toroidal-shaped panels, as proposed in my prior U.S. Pat No. 3,225,413. However, in this patent the individual panels were patterned so as to develop the toroidal shape and achieve approximately a uniform distribution of load in both hoop-wise and horizontal directions in order to assure minimum distortion under locally applied loads (such as the weight of concrete when applied to the air form).

SUMMARY OF THE INVENTION

The present invention relates to air supported structures, and more particularly to a patterning arrangement for air inflated structure having a generally cylindrical configuration.

It is a primary object of the present invention to fabricate an envelope for use in a generally cylindrical air inflated structure in such a manner that tears or rips occuring in any circular element of the envelope will be largely prevented from propagating themselves throughout more than a small predetermined surface area of the envelope.

It is another particularly important object of the present invention to provide a novel envelope paneling arrangement which will limit deformation of the circular elements of a cylindrical envelope under non-uniform loading and result in transfer of essentially all of the load-induced tension forces directly into the cable system.

In accordance with the preferred embodiment of the present invention a generally cylindrical envelope is formed by a plurality of relatively narrow, horizontally extending panels, which are joined along horizontally disposed edges thereof with vertically adjacent panels; the individual panels being fabricated from a material which is characterized by being appreciably more elastic or extensible in the fill or transverse direction than in the warp of machine direction. This is exactly opposite from the uniform elongation characteristic desired of materials used in conventional air supported structures or in my prior U.S. Pat No. 3,225,413 wherein major loads are to be distributed between both the warp and fill directions of the material, or in both hoop-wise and horizontal directions of the envelope. Where special procedures are not used to control or limit the fill-wise extensibility of the envelope material in conventional structures, severe distortion of the structures under normal loading generally occurs, resulting in not only poor appearance, but severe stress concentrations. An important advantage of the present novel method of patterning is that it eliminates the need for costly weaving, heat setting and coating procedures normally required to prevent high elongation in the fill direction of conventional envelope materials, thus making it possible to provide materials with improved properties at lower cost and to greatly enhance the performance and serviceability of the air structure.

When envelope panels of the type described are assembled, they cooperate to produce circular envelope elements having

a degree of elasticity in the direction of curvature of the cylindrical envelope surface sufficient to permit such circular envelope elements when inflated to assume a toroidal shaped configuration. Thus, the panels forming the circular envelope element will transfer substantially all of the load induced by the pressure differential horizontally across the surface of the envelope directly to the cable system with a minimum load being carried by the circular elements in a hoopwise or vertical direction without need for excessively contouring the individual panels.

The assembled panels are each joined to a cable system including a series of relatively widely spaced parallel flexible tension devices anchored at their opposite ends to the ground or other supporting base. By this arrangement, a tear or rip occuring in any panel cannot propagate itself beyond a limited envelope surface area defined by a pair of adjacent hoopwise extending tension devices and the horizontally extending side marginal edges of the damaged pane.

As the method of assembling the panels in accordance with the present invention results in a very low fabric stress in the vertical or hoopwise direction of the structure, there will be little concentration of stress on the ends of any horizontal tear or cut to cause propagation. Thus, even if a panel is cut by a vandal, the stresses in the fabric would be essentially parallel to the cut and little gap would result, thus greatly limiting air loss through the opening. If the damaged panel was cut in a vertical direction or across the loaded direction of the material, the concentration of load at the ends of the cut would be limited, as the load in the damaged panel would be transferred into the vertical cables or tension devices to which the panel is attached, rather than into an adjacent panel, such as would result under normal construction methods. Thus, the severe buildup of loads and concentration of stress in an adjacent panel, which could result in catastrophic failure of the entire envelope, is prevented. Propagation of a cut in the vertical direction would also be limited by the overlapping horizontal seams of vertically adjacent panels, which serve as a rip or tear stop. Where desirable, additional rip stop characteristics could be readily incorporated into the seams during assembly by incorporating strong cords, or by forming the seam with extending edges so as to effectively limit propagation of a tear thereacross.

In the preferred embodiment of the present invention, end sections of semi-spherical configuration are connected to the respective ends of the cylindrical or intermediate section of the air inflated structure, and the horizontally arranged panels defining the envelope of the cylindrical section extended into the end sections and patterned so as to provide for uniform loading thereof. The cabling system employed for the end sections includes base anchored tension devices, which lie along generally great circles through a common center. Because the circular elements between pairs of adjacent cables on the end sections are tapered, normal pressure loading varies along the cables or tension devices. This requires that the length of the horizontally disposed panels within each circular elements be varied hoopwise of the end section, such that in their inflated position, shorter panels approaching the ground have a greater radius of curvature than the upper panels of the same circular element. This minimized displacement of the adjacent cables from their normal plane and results in a stable shape. However, because of the tapered circular elements, the radius of curvature of the tension devices within their planes is not uniform, but can be blended into the cylindrical section by arbitrarily spreading the base anchors in order to achieve a smooth, undistorted transition between the end and cylindrical sections.

DRAWINGS

The present invention will now be more fully described with reference to the accompanying drawings wherein:

FIG. **1** is a top plan view of an air inflated structure formed in accordance with the present invention;

FIG. **2** is a side elevational view of the air inflated structure shown in FIG. **1**;

FIG. **3** is an end elevational view of the air inflated structure shown in FIG. **1**;

FIG. **4** is a fragmentary perspective view indicating the manner in which the respective envelope forming panels deform for the purpose of transferring a load to the cable system when the envelope is inflated;

FIGS. ***5a–5b*** are sectional views taken generally along the line **5—5** in FIG. **2**;

FIG. **6** is a perspective view of the cable system attaching clip shown in FIG. ***5b***;

FIG. **7** is a sectional view taken generally along the line **7—7** in FIG. **4**; and

FIG. **8** is a sectional view taken along line **8—8** in FIG. **4**, but showing a modified panel joining arrangement.

DETAILED DESCRIPTION

Now referring to FIG. **1**, it will be seen that the air supported structure according to the preferred embodiment of the present invention is generally designated as **1** and includes a pair of rounded or semi-spherical end sections **10**, which are bonded to or separably joined to one or more generally cylindrical intermediate sections **12**, as by suitable joiners **14**. While joiners **14** may be of any desired design, it is preferable to employ joiners of the types disclosed in U.S. Pat. No. 3,116,746 and 3,103,050. It will be understood, however, that one or both of end sections **10** may be dispensed with if the cylindrical section is otherwise attached in a manner capable of carrying imposed loads without excessive distortion. For instance, section **12** may be employed as an extension of a rigid building structure or to interconnect a pair of such building structures. Also, end section **10** may be replaced, if desired, by vertically extending end closures of the types disclosed by my U.S. Pat. Nos. 3,139,464 or 3,240,217.

More specifically, sections **12** are defined by an air inflatable envelope **16** formed by a plurality of relatively narrow, horizontally elongated panels **18** having their horizontally extending edge portions **20** joined together. Preferably, edge portions **20** of each panel are arranged in overlapping relationship with those of vertically adjacent panels, as best shown in FIG. **7**. Sections **12** also include a cable system defined by a plurality of parallel, relatively widely spaced, flexible tension devices, such as cables **22**, which are connected at their respective ends to ground anchors **24** of any suitable design, as best shown in FIG. **4**. The overlapping edge portions **20** of the panels are interconnected by suitable means, such as stitching or adhesive.

As by way of example, panels **18** may be on the order of four feet wide and the spacing between adjacent cables **22** may be on the order of twenty feet.

Referring to FIGS. **4** and ***5a–5d***, it will be understood that each of sections **12** is provided with a plurality of transversely extending attaching sleeves in the form of fabric strips **28**, which are suitably affixed across panels **18** at spaced points, lengthwise thereof, as by stitching **30**. Strips **28** may be sewn directly to the panels so as to provide a sleeve about a previously arranged cable, as indicated in FIG. ***5a***, or may be formed with roped or cabled edges **32, 34**, as shown in FIGS. ***5b–5d*** in order to facilitate subsequent attachment of the cables. Further, it will be understood that strips **28** may, as desired, be of one piece construction, as shown in FIGS. ***5a–5c***, or of plural piece construction, as indicated in FIG. ***5d***.

Strips **28** are preferably continuous lengthwise of cables **22** and attached to the envelope after panels **18** are assembled. However, strips **28** may be formed in a plurality of segments, which are aligned end to end when the panels are joined together.

The preferred arrangement for attaching cables **22** to attachment strips **28** is best shown in FIG. **5b**, wherein a generally S-shaped clip **36** of the type shown in FIG. **6**, is deformed around rope edge **32** with its opposite end hooked

BIRD, Walter, n°US 3,744,191 1971-1973

Estructuras soportadas por aire de gran tamaño

Nota* Aplicado para aire y/u otros gases

Solicitud	14 diciembre 1971
Fecha	10 julio 1973
Lugar	Williamsville, Nueva York
Inventor	W. W. Bird
Patente n°	US 3,744,191
Título	Large air supported structures

United States Patent [19]

Bird

[11] **3,744,191**

[45] **July 10, 1973**

[54] **LARGE AIR SUPPORTED STRUCTURES**

[75] Inventor: **Walter W. Bird,** Williamsville, N.Y.

[73] Assignee: **Birdair Structures, Inc.,** Buffalo, N.Y.

[22] Filed: **Dec. 14, 1971**

[21] Appl. No.: **207,914**

Related U.S. Application Data

[63] Continuation of Ser. No. 862,245, Sept. 30, 1969.

[52] **U.S. Cl.** **52/2,** 52/81

[51] **Int. Cl.** **E04b 1/345,** E04g 11/04

[58] **Field of Search** 52/2, 63, 80, 83, 52/81; 61/68

[56] **References Cited**

UNITED STATES PATENTS

R27,232	11/1971	McLorg	52/2
932,719	8/1909	Reinhardt	61/68
1,302,182	4/1919	Lanchester	52/2
3,139,957	7/1964	Fuller	52/80
3,277,615	10/1966	Marquez	52/2
3,432,609	3/1969	Duvall	52/2
3,686,818	8/1972	Bini	52/2
3,686,875	8/1972	Morgan	52/80

FOREIGN PATENTS OR APPLICATIONS

1,352,239	6/1964	France	52/80
713,972	8/1954	Great Britain	52/80
243,805	9/1969	U.S.S.R.	52/83
259,189	4/1967	Austria	52/2

Primary Examiner—Frank L. Abbott
Assistant Examiner—Henry E. Raduazo
Attorney—Bean & Bean

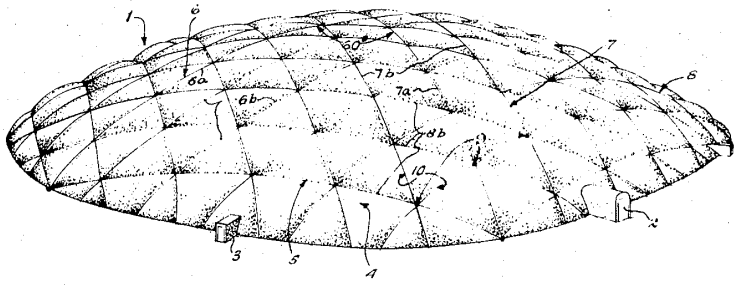
[57] **ABSTRACT**

A large air supported structure of generally spherical or spherical-sectioned configuration for use as a stadium cover or the like comprising a cabling system in the form of lattice work of cables attached at their points of intersection by joining devices, so as to form interstices of triangular shaped configuration, and an air inflatable envelope having elements thereof closing the cable interstices and formed with a double curvature configuration having radii of curvature substantially smaller than the radius of curvature of said structure.

In the preferred embodiment, the cabling system includes three groups of continuous cables arranged such that the centermost cables of the groups intersect adjacent the crown of the spherical structure at approximately 60° angles and the groups of cables cooperate to define interstices approximating equalateral triangles. Also, the envelope elements are preferably in the form of individual panels removably joined about their marginal edges to the cables defining the interstices. Sealing devices are arranged so as to provide an air seal between adjacent envelope panels outwardly of the cabling system, such that panels are removable outwardly of the structure, while the cabling system is fully enclosed but accessible internally of the structure.

An inflatable work access shelter is removably attachable to the outer surface of the structure by anchoring devices carried by the cabling joining devices, so as to permit replacement or repair of individual panels from a point exteriorly of the structure without loss of inflation air therefrom.

20 Claims, 23 Drawing Figures



PATENTED JUL 10 1973

3,744,191

SHEET 1 OF 8

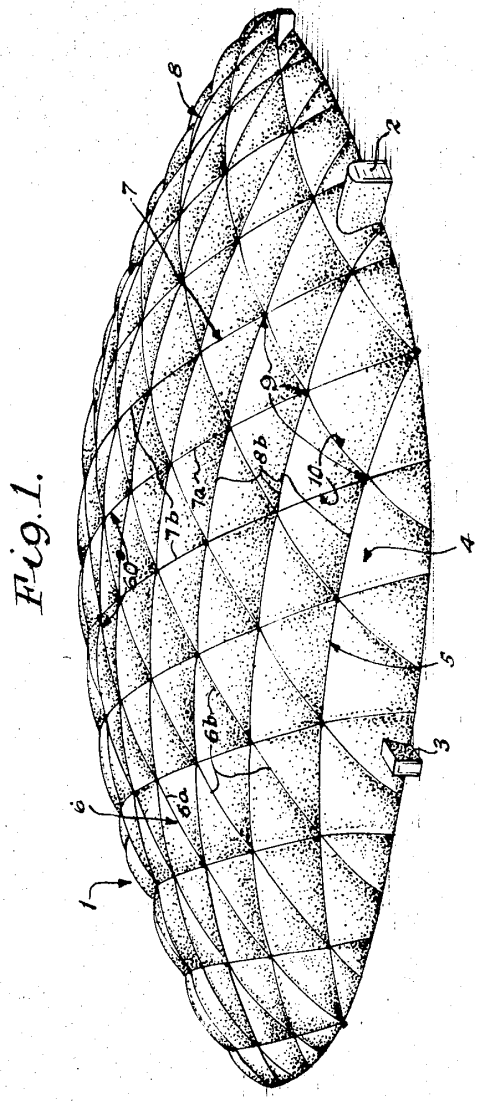


Fig. 1.

INVENTOR.
WALTER W. BIRD

BY

Bean & Bean
ATTORNEYS

Fig. 2.

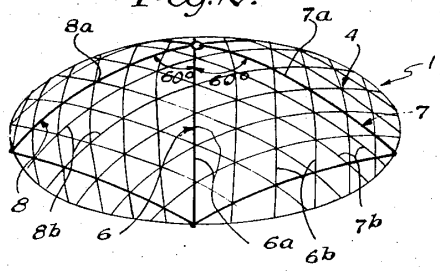


Fig. 3.

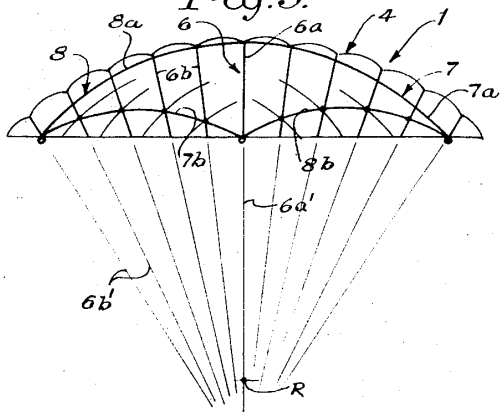
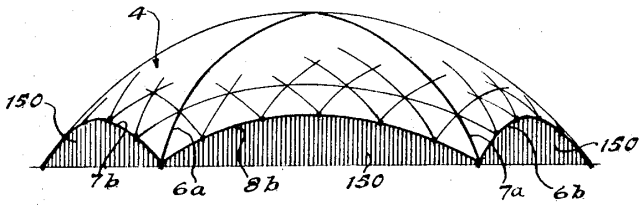


Fig. 20.



INVENTOR.
WALTER W. BIRD

BY

Beau & Beau
ATTORNEYS

PATENTED JUL 10 1973 3,744,191

SHEET 3 OF 8

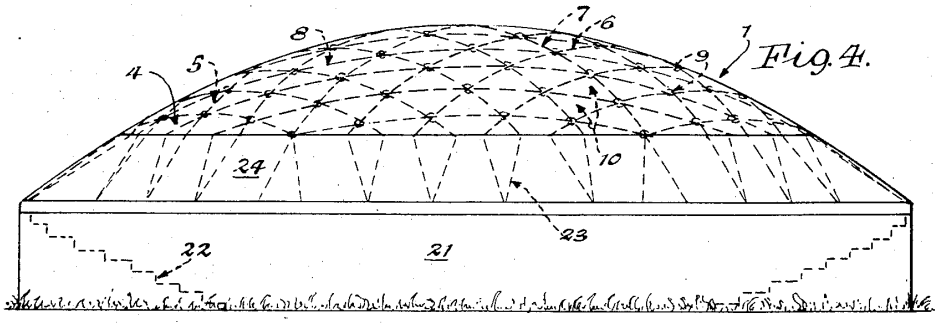
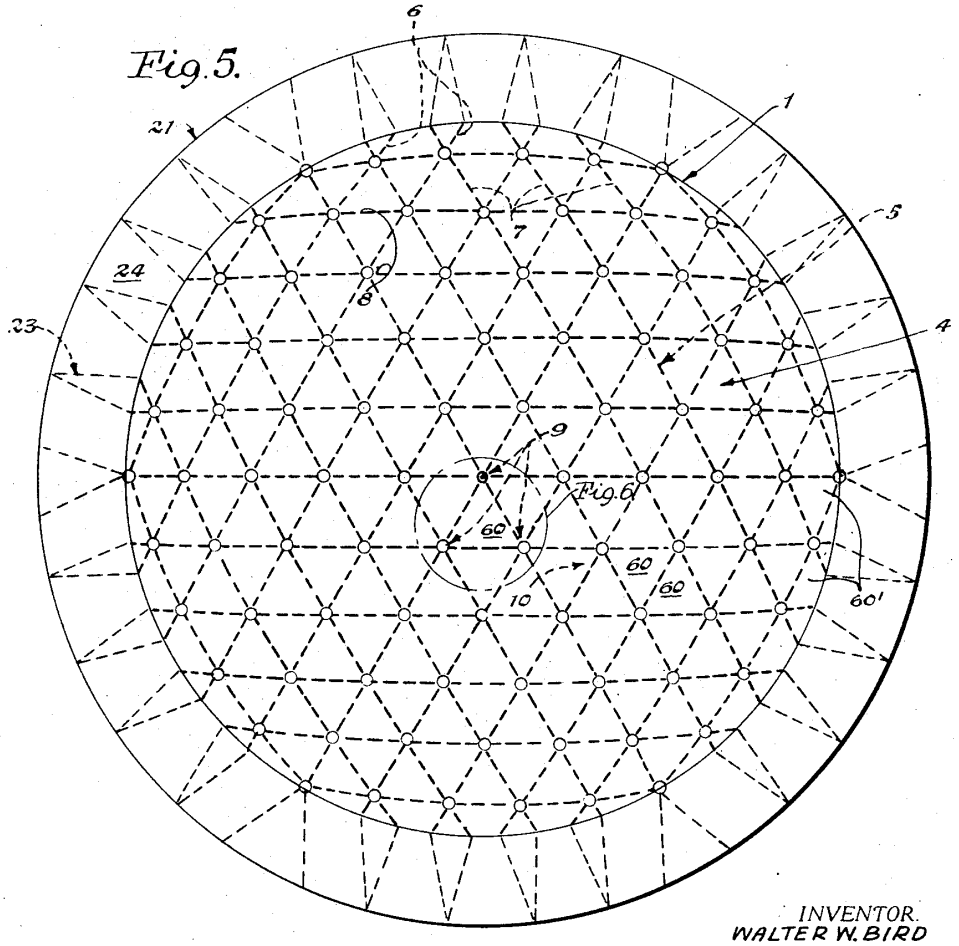


Fig. 4.

Fig. 5.



INVENTOR.
WALTER W. BIRD

BY

Bean & Bean
ATTORNEYS

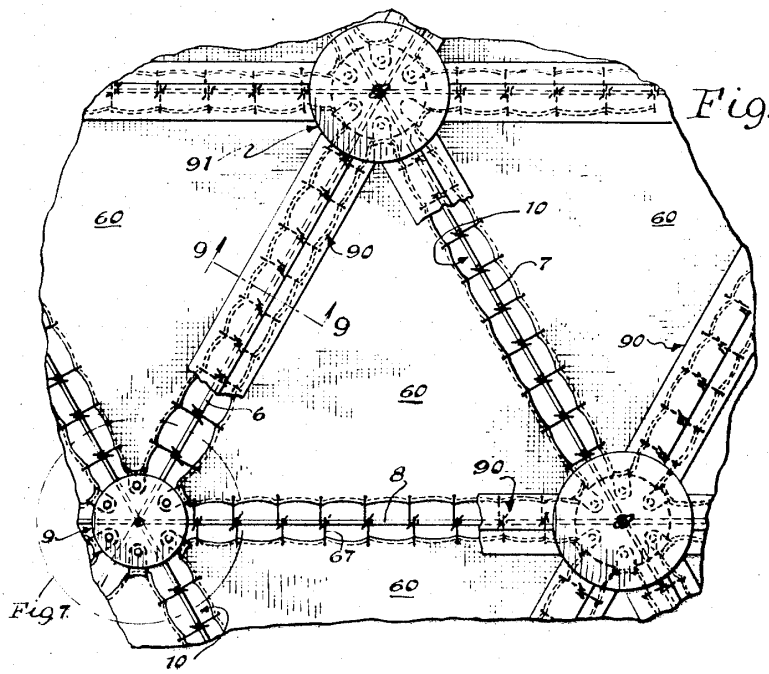
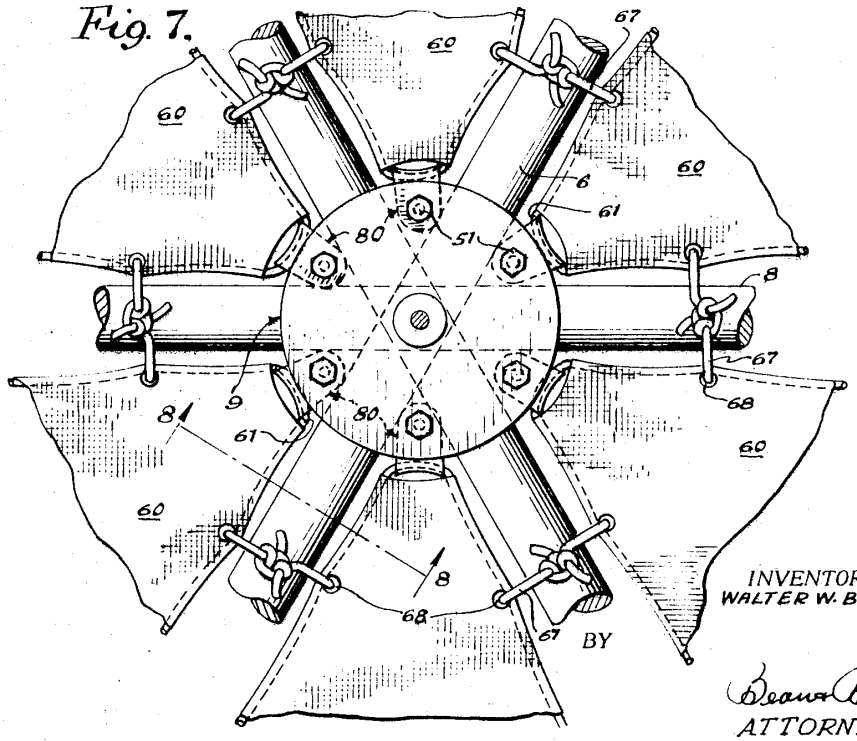


Fig.6

Fig.7.



INVENTOR.
WALTER W. BIRD

Beaman Beaman
ATTORNEYS

PATENTED JUL 10 1973 3,744,191

SHEET 5 OF 8

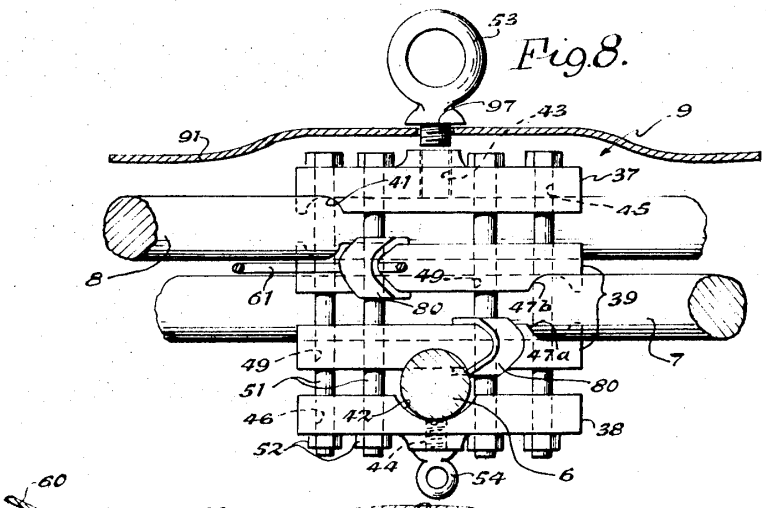


Fig.8.

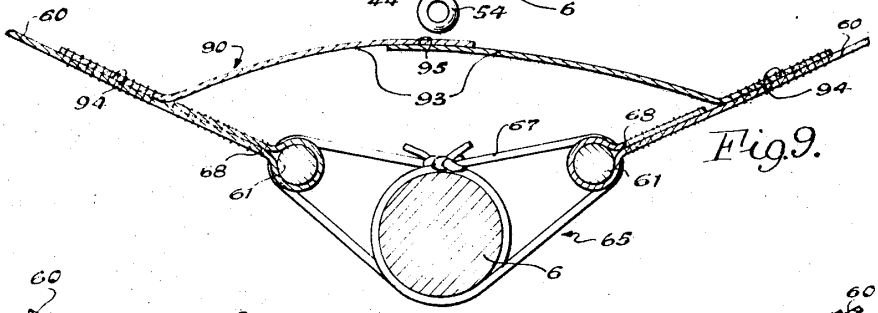


Fig.9.

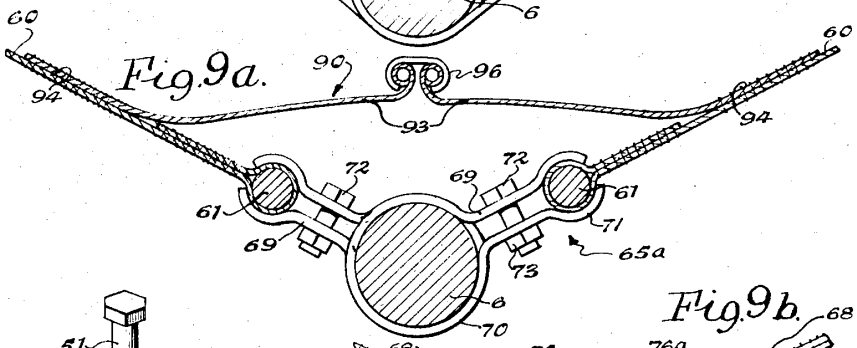


Fig.9a.

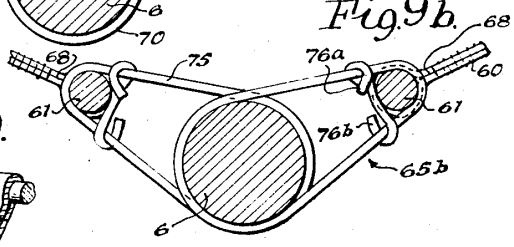


Fig.9b.

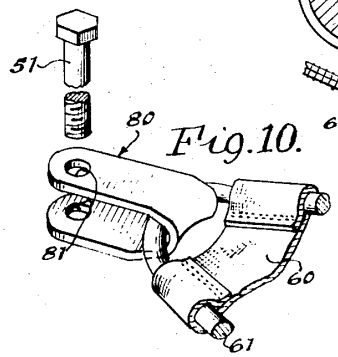


Fig.10.

INVENTOR.
WALTER W. BIRD

BY

Bean & Bean
ATTORNEYS

PATENTED JUL 10 1973 3,744,191

SHEET 6 OF 8

Fig. 11.

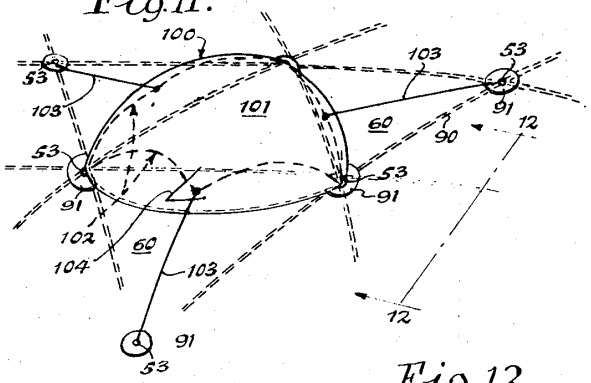


Fig. 12.

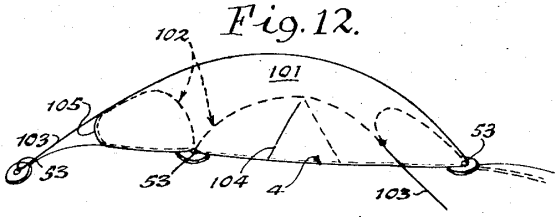
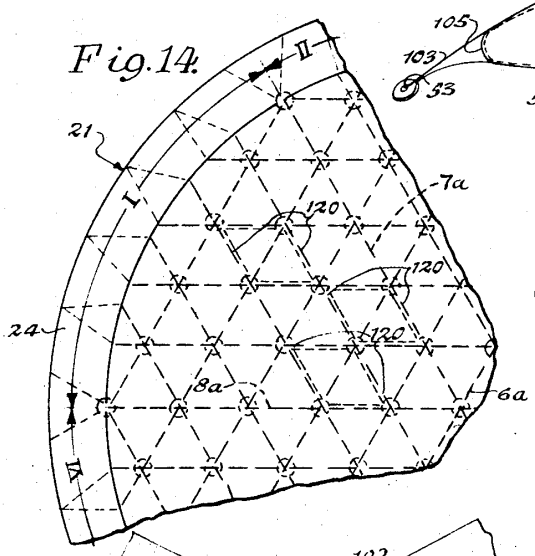


Fig. 14.



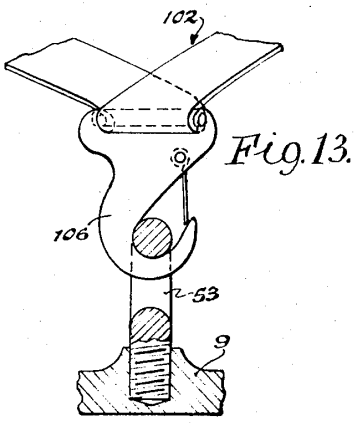


Fig. 13.

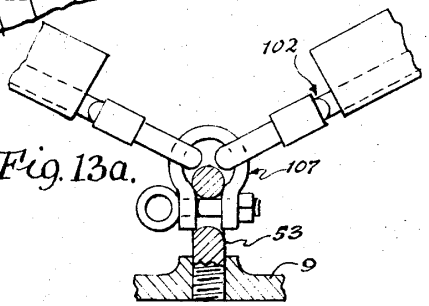


Fig. 13a.

INVENTOR.
WALTER W. BIRD

BY

Bean & Bean
ATTORNEYS

PATENTED JUL 10 1973

3,744,191

SHEET 7 OF 8

Fig.15.

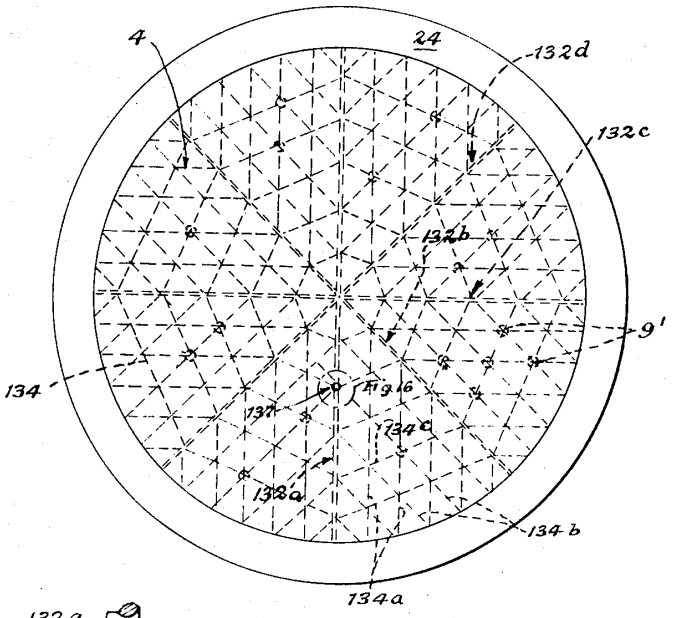


Fig.16.

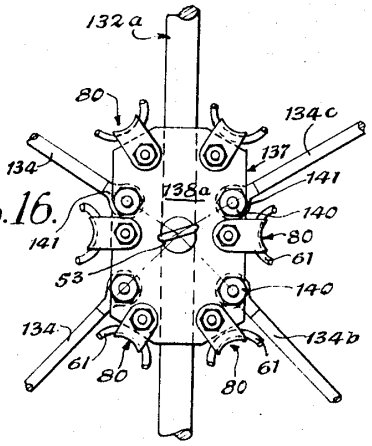
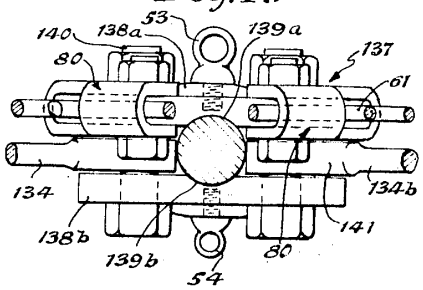


Fig.17.



INVENTOR.
WALTER W. BIRD

BY

Bean & Bean
ATTORNEYS

Fig. 18.

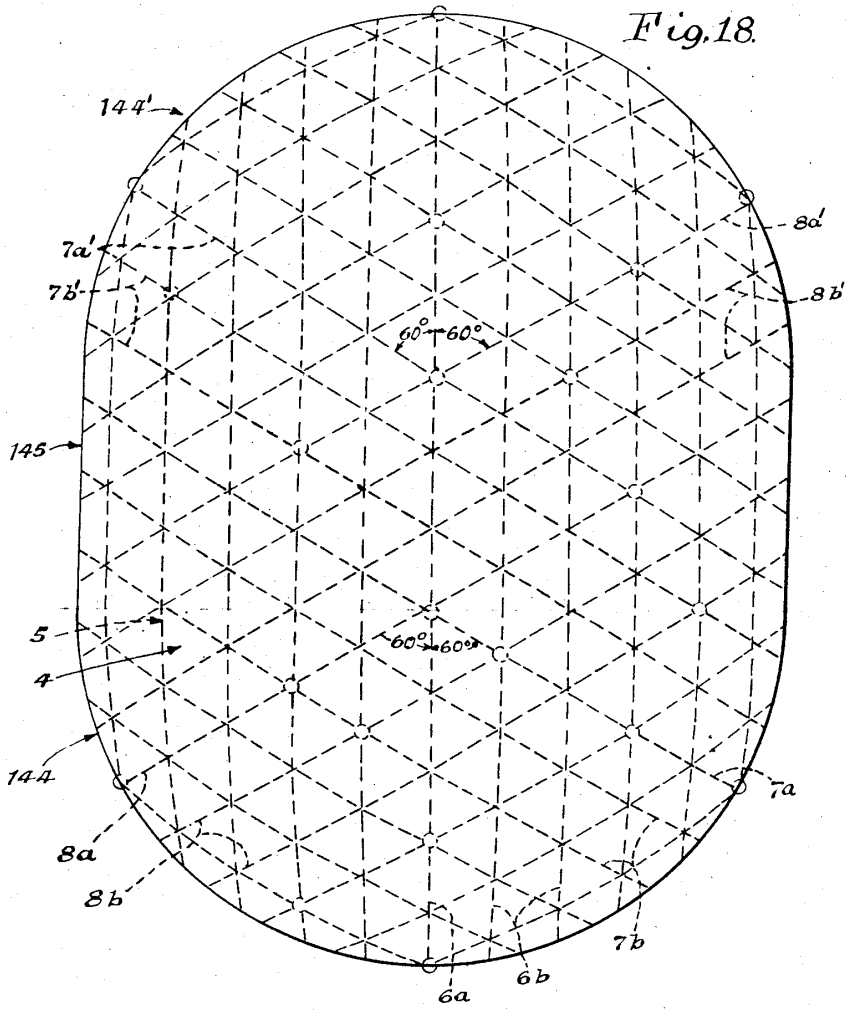
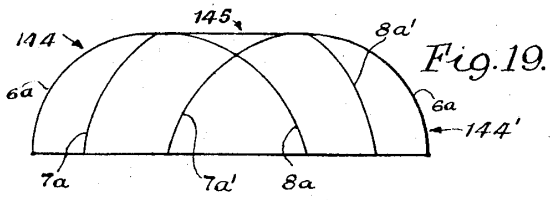


Fig. 19.



INVENTOR.
WALTER W. BIRD

BY

Bean & Bean
ATTORNEYS

LARGE AIR SUPPORTED STRUCTURES

CROSS REFERENCE TO RELATED APPLICATION

This application is a continuation of application Ser. No. 862,245, filed Sept. 30, 1969.

BACKGROUND OF THE INVENTION

The stresses developed in an air-supported structure, as a result of the pressure differential that must be maintained within the structure in order to pretension and stabilize it sufficiently to resist wind and snow loads, are directly proportional to the diameter or size of the structure. In the case of a spherically shaped envelope structure, the stresses are distributed in an essentially uniform manner throughout the envelope. However, superimposed wind or snow loads result in a widely varying pressure differential across the envelope.

When a spherical envelope is fabricated with a conventional gore-shaped pattern, which results in tension fibers running in essentially radial and circumferential directions, the varying pressure differential and resulting distortion and redistribution of stress can cause severe stress concentrations. Distortion and stress concentrations can be controlled by using a bias plied material, which introduces load carrying fibers at an angle to the normal direction of the material-normally 45° for convenience in manufacture, to obtain isotropic characteristics in the envelope. This method of fabrication results in a much more dimensionally stable construction, making it practical to build large air-supported structures, such as the 210 ft. diameter Telstar radome developed by this inventor to cover the first satellite communications stations. However, as the fabric stresses are proportional to the radius of curvature of the envelope, exceedingly high stresses are developed in the larger domes, necessitating the use of very costly materials and construction methods and, accordingly, limiting the economic feasibility of this type of construction for large dome stadiums or similar structures.

In order to limit the stresses in the envelope and permit the use of lower cost materials, various types of strap, rope or cable reinforcing has been used. Reinforcement duplicating the 45° bias patterning developement for radomes would be structurally acceptable but is not economically feasible. Because of the difficulty of developing a cabling system which would conform to a spherical contour, attempts at reinforcing spherical envelopes or the spherical end sections of generally symmetrical air structures have een largely limited to the use of radial cables joined at the crown. However, because of the varying width of envelope surface area acting on the cables, as the cables progress toward the crown, this arrangement results in a varying normal load on the cables and consequently severe distortion in the plane of the cables, i.e., the structure tends to flatten out at the top and bulge at the sides in an effort to equalize the loads along the cables. Unless the envelope is specially patterned, which is difficult to do, there is little reduction of stress in major sections of the envelope and the cabling thus fails to accomplish the desired reduction in stress levels. The flat top is also undesirable as it tends to trap snow causing additional distortion.

Of even greater concern, particularly for large structures for which the air structure offers the potential of greatest economic advantage is that the radial patterning, even with additional intermediary cables fails to provide the resistance to distortion and movement needed to achieve the stable configuration required if air structures are to be used to enclose large areas, such as stadiums. Conventional radial cabling systems also fail to provide controlled distribution of stress levels and thus do not appreciably reduce vulnerability to damage, or the propagation of any cuts or tears which can result in complete collapse of an air structure.

These deficiencies in the design of air structures have severely limited their application for use on large dome structures for which they potentially offer the greatest economic advantage.

SUMMARY

The present invention has been conceived and developed to overcome the deficiencies inherent to air-supported structures currently in use and is directed to large, air supported structures for use in forming a permanent covering for a large area, such as a stadium or athletic field having a diameter or width measured in hundreds of feet.

In the preferred embodiment of the present invention, there is provided a novel cabling system for a dome structure formed of a plurality of cables arranged in an intersecting relationship so as to define a pattern consisting of three groups of essentially parallel cables, wherein centermost cables of each group intersect at approximately 60° angles at or near the crown of the structure. Joining devices are provided for fixedly interconnecting the cables at their points of intersection, such that the cables of the three groups cooperate to define on the surface of the structure interstices approximating equalateral triangles.

In the simplest form of the dome structure, an envelope, which when inflated supports the full weight of the structure together with the aerodynamic and snow loads imposed thereon, would be of unitary construction and disposed inwardly of the cabling system such that elements thereof protrude outwardly through the cable interstices. Preferably, the elements are formed with a double curvature configuration having a radii of curvature substantially smaller than the radius of curvature of the overall structure so as to result in low fabric stresses. Also, by forming the panel elements in this manner there is obtained improved acoustical characteristics over that inherent in domes having smooth or relatively uniform surfaces.

The utilization of a lattice work or matrix formed from triangular cable interstices allows for maximum structural stability of the dome structure under non-uniform wind or snow loading and also permits the utilization of continuous cables which may be end anchored directly to the domed structure base or support. A continuous cable arrangement simplifies fabrication and erection procedures and requires that heavy machine fittings be employed only at the ends of the cables where they are attached to the support. Simple, clamp-type joining devices may be employed to join the cables at their points of intersection since maximum load transfer occurs between cables of the respective groups due to the fact that the cables are arranged on approximately uniform continuous arcs with a minimum variation or deviation at the cable intersections.

The above described cabling system may also be employed in reinforcing an air supported ellipsoidal

BIRD, Walter, nº US 3,893,268 1973-1975

Sección final cuadrada para estructuras hinchables

Nota* Aplicado para aire y/u otros gases

Solicitud	27 agosto 1973
Fecha	8 julio 1975
Lugar	Williamsville, Nueva York
Inventor	W. W. Bird
Patente nº	US 3,893,268
Título	Squared end section for air supported structure

United States Patent [19]

Bird

[11] **3,893,268**

[45] **July 8, 1975**

[54] **SQUARED END SECTION FOR AIR SUPPORTED STRUCTURE**

[75] Inventor: **Walter W. Bird**, Williamsville, N.Y.

[73] Assignee: **Birdair Structures, Inc.**, Buffalo, N.Y.

[22] Filed: **Aug. 27, 1973**

[21] Appl. No.: **392,093**

[52] **U.S. Cl.** **52/2**

[51] **Int. Cl.** **E04b 1/345**

[58] **Field of Search** 52/2, 80

[56] **References Cited**

UNITED STATES PATENTS

3,416,762	12/1968	Headrick	52/2
3,651,609	3/1972	Bird	52/2
3,661,693	5/1972	Pierson	52/2
3,728,831	4/1973	Bird	52/2
3,772,836	11/1973	Geiger	52/80

FOREIGN PATENTS OR APPLICATIONS

1,183,483	3/1970	United Kingdom	52/2
1,235,093	3/1960	France	52/2

OTHER PUBLICATIONS

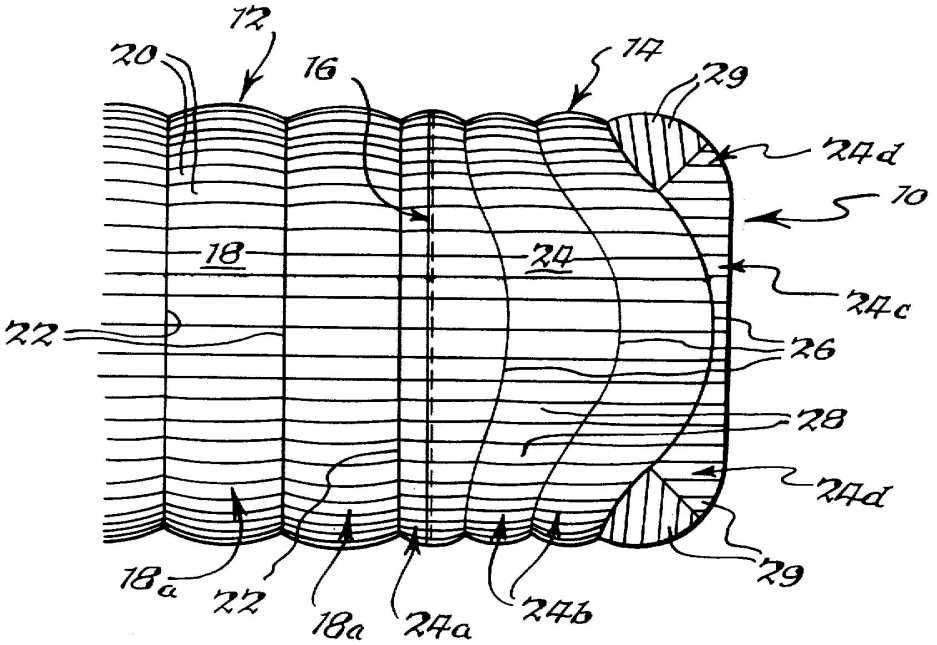
Popular Science pages 73–75, August, 1971.

Primary Examiner—Ernest R. Purser
Assistant Examiner—Henry Raduazo
Attorney, Agent, or Firm—Bean & Bean

[57] **ABSTRACT**

The air inflated envelope of a square end section of an air supported structure is reinforced by a cabling system providing for relatively uniform distribution of longitudinal stress to the envelope of the central section of the structure. The cabling system may be employed to reduce the longitudinal stress loading to a value less than *pr*.2.

14 Claims, 12 Drawing Figures



PATENTED JUL 8 1975

3,893,268

SHEET 1

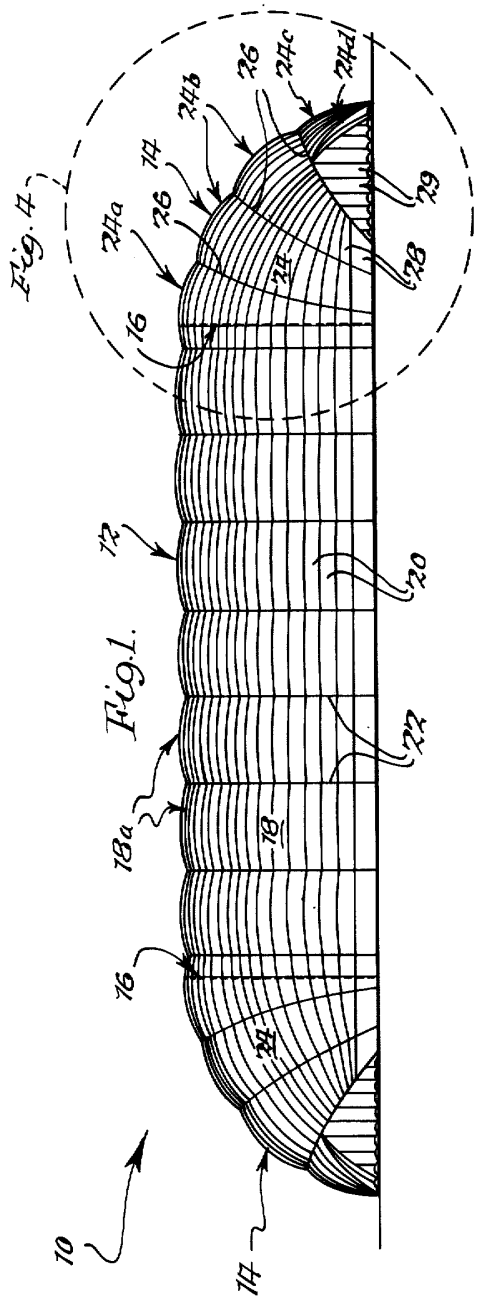


Fig. 1.

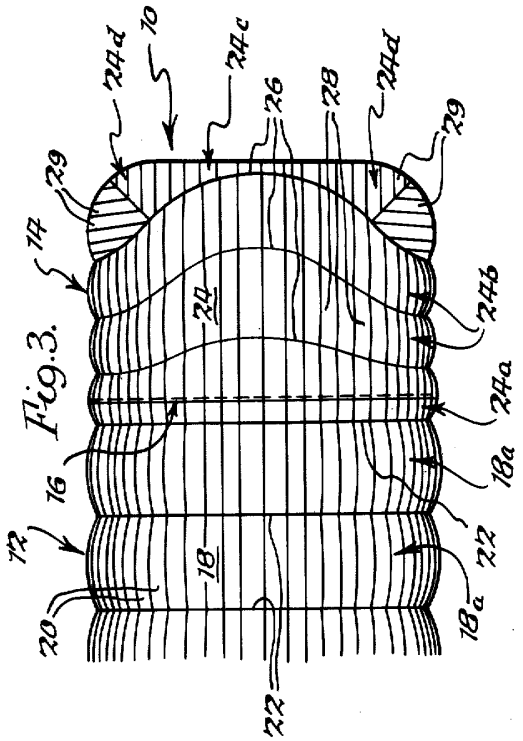


Fig. 3.

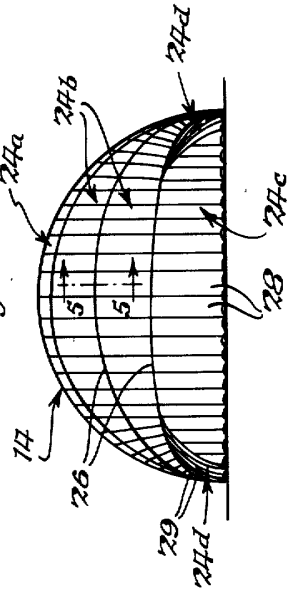


Fig. 2.

PATENTED JUL 8 1975 SHEET 2 3,893,268

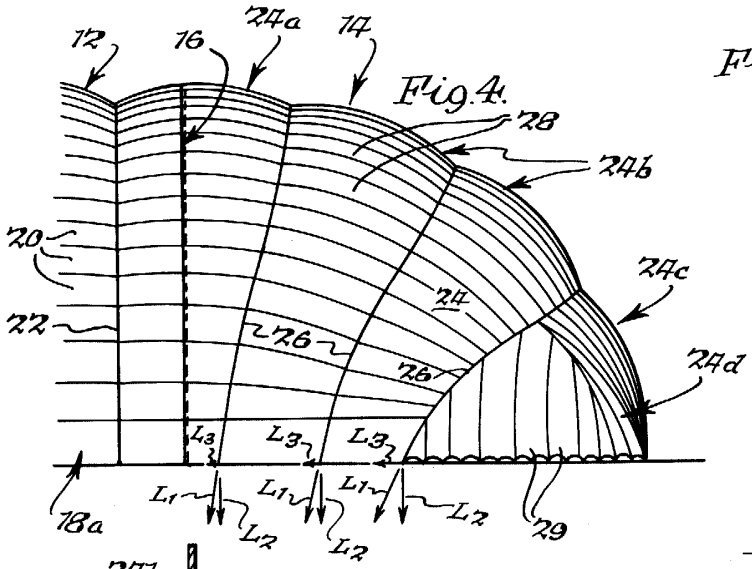


Fig.4.

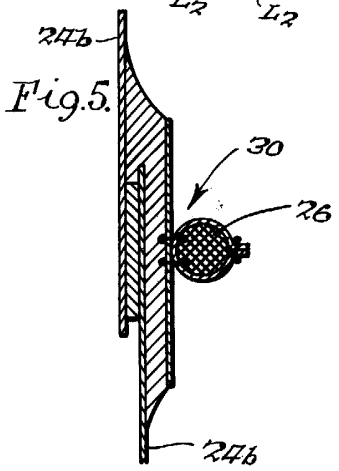


Fig.5.

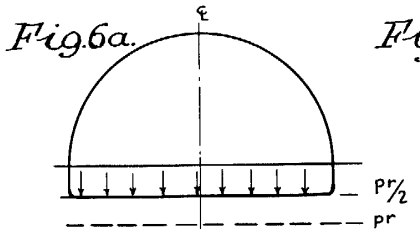


Fig.6a.

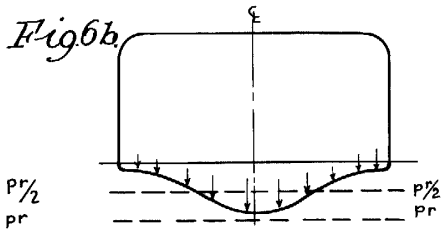


Fig.6b.

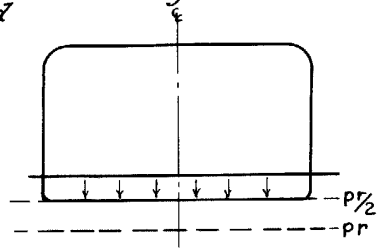


Fig.6c.

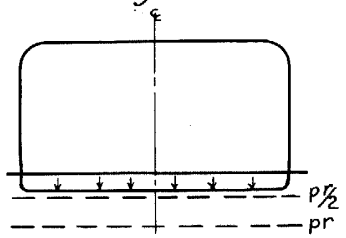


Fig.6d.

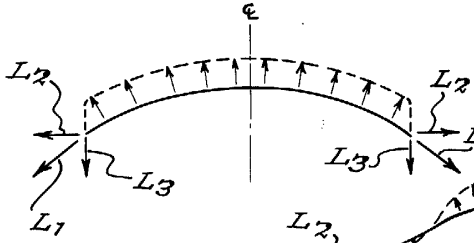


Fig.7a

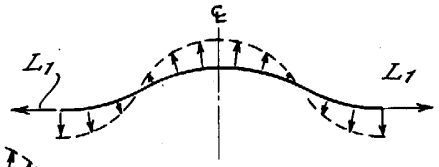


Fig.7b.

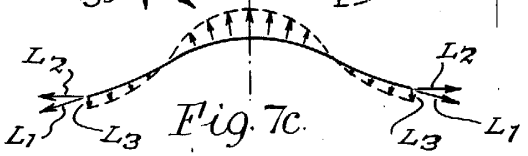


Fig.7c.

SQUARED END SECTION FOR AIR SUPPORTED STRUCTURE

BACKGROUND OF THE INVENTION

Air inflated structures having end sections of spherical surface or circular plan form base line configuration, which are attached to the ends of a partial generally cylindrically shaped central section are well known in the art. A decided drawback of these structures is that they cannot be tailored for use in covering a rectangular area, without there being either an excess of unnecessary floor space and/or useless floor space adjacent the base line of the ends of the structures.

The drawback of this type of air inflated structure led to my development of air inflated structures having squared ends, that is, end sections having essentially squared corners, whereby to provide a structure having an essentially rectangular plan view configuration. In one form of this development, which is disclosed in my U.S. Pat. No. **3,728,831,** each of the end sections is formed with a generally cylindrical end portion bounded by small, generally spherical corner portions in order to maximize head room usable space for a given covered area. By proper patterning of the end section envelope portion and by the utilization of a cabling system including tension transmitting cables disposed to extend lengthwise of the central section, it is possible to construct a squared end structure with almost any proportions, while keeping longitudinal stress values applied to the central section envelope portion relatively low and somewhat uniformly distributed hoopwise thereof.

However, it has been found that for certain installations, such as large tennis enclosures requiring seasonal erection and handling, a simplified cabling arrangement, as well as more head room or vertical clearance adjacent the base line of the end section was needed.

SUMMARY OF THE INVENTION

The present invention is directed towards an improved squared end section for use with an air inflated structure. More specifically, the present invention is directed towards the utilization of a simplified cabling system for use in providing relatively uniform distribution of longitudinal stress from the envelope portion of a squared end section to the envelope portion of a central section at points spaced hoopwise of the latter and for providing for reduction of longitudinal stress values to less than *pr*/**2.**

In accordance with the present invention, flexible tension devices, such as cables, are fixed to the end section envelope portion to extend transversely of the structure and have their opposite ends fixed to the ground anchorage. Elements of the end section envelope between cables are patterned so as to transfer essentially all hoopwise directed envelope loadings transversely into the cables, i.e., longitudinally of the structure, for subsequent transfer by the cables to the ground anchorage. The cables, although placed under tension upon inflation of the end section envelope, are constrained thereby to assume a double curvature configuration when viewed in the plane of the envelope. By this arrangement, the cables additionally serve to pick up end or lengthwise directed loadings from the relatively highly stressed top or central portion of the envelope and redistribute such loadings to the lower side

portions of the envelope. As a result, there is achieved a longitudinal stress distribution at points hoopwise of the central section, which approximates the uniform distribution of longitudinal stress obtained for a non-cable reinforced spherically shaped end section.

The value of longitudinal stress applied to the central section may be reduced below a value of *pr*/**2** by arranging the opposite ends of the end section cables to lie within planes intersecting the plane of the ground anchorage at values of less than **90°.**

DRAWINGS

The nature and mode of operation of the present invention will now be more fully described in the following detailed description taken with the accompanying drawings wherein:

FIG. **1** is a side view of an air inflated structure incorporating squared end sections of the present invention;

FIG. **2** is an end view thereof;

FIG. **3** is a partial plan view thereof;

FIG. **4** is an enlarged view of the area designated generally as FIG. **4** in FIG. **1**;

FIG. **5** is a sectional view taken generally along line **5—5** in FIG. **2**;

FIGS. **6A** and **6B** are diagrammatic views illustrating the distribution of longitudinal stress for a non-cabled rounded end section and a non-cabled squared end section, respectively;

FIGS. **6C** and **6D** are diagrammatic views illustrating the distribution of longitudinal stress for alternative forms of the improved cabled, squared end section of the present invention;

FIG. **7A** is a diagrammatic view illustrating the stress distribution in an envelope attached to bowed cable;

FIG. **7B** is a diagrammatic view illustrating the stress distribution in an envelope attached to a cable having a double curvature;

FIG. **7C** is a diagrammatic view illustrating the stress distribution in an envelope attached to a cable having a double curvature, but differing end conditions.

DETAILED DESCRIPTION

Reference is now made to FIGS. **1** through **3** wherein an air inflated structure is generally designated as **10** and shown as including a partial generally cylindrically shaped central section **12** and a pair of essentially squared corner end sections **14,** which are formed in accordance with the present invention. Erection and disassembly of the structure may be facilitated by removably joining the end sections to the central section in areas, designated as **16,** by any suitable means, such as joiner devices of the type disclosed in prior U.S. Pat. Nos. **3,116,746** and **3,103,050.** In a like manner, the central section may be formed from a plurality of individual sections in order to permit the central section to be selectively constructed in multiples of some given, easily handled length. The placement of the joiner devices is a mere matter of choice and design convenience.

It will be understood that one of the end sections may be dispensed with in a situation where for instance the central section is to be employed as an extension of a rigid building structure. Also, the central section may be dispensed with and only one end section employed as a rigid building extension. In either of these cases, it would of course be necessary to seal the remaining air

Anexo 3: Documentos inéditos.

Índice Anexo 3: Documentos inéditos.

Documentación inédita del grupo AJS-Aerolande. 713

Manuscrito para la exposición de la Vª Bienas de Paris de 1967. 715

Estructura auto - tensada, 1967. 721

Construcciones flotantes: utilización de un elemento tórico neumático, 1968. 729

Construcciones flotantes con sobrepresión interna, 1968. 733

Mobiliario hinchable, 1968-69. 737

Mobiliario hinchable, luminarias y sillón de doble membrana, no realizado, 1969. 757

Documentación inédita de Jean Aubert. 765

Cuaderno de croquis del proyecto fin de carrera o diploma, 1966. 767

Teatro itinerante para 5000 espectadores, 1967. 777

Cuaderno nº 3, mobiliario hinchable - refugios hinchables, 1967. 783

Cuaderno nº4, 1967. 787

Cuaderno nº6, Exposición: *L´Univers des Jeunes,* Galerías Lafeyette, 1967. 791

Cuaderno nº7, croquis de mobiliario hinchable, 1968. 795

Documentación inédita de Antonie Stinco. 799

Pabellón itinerante para la exposición de objetos cotidianos, 1967. 801

Cuaderno de croquis nº1 y nº2 de hinchables (circa 1966-1967). 805

Cuaderno de croquis nº 4 de refugios hinchables, 1969. 811

Documentación inédita de Jean Paul Jungmann. 815

Dos cuadernos de croquis sobre estructuras neumáticas, 1966. 817

Cuaderno de Croquis para la Bienal de París de 1967. 821

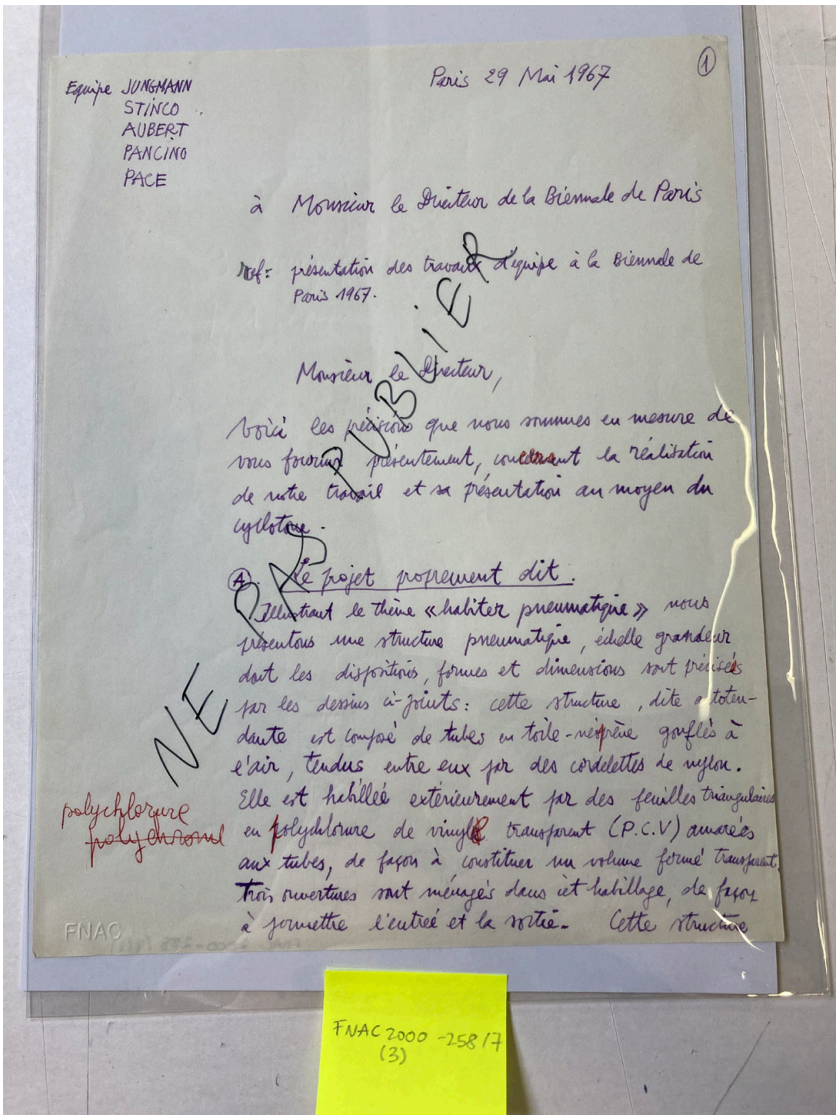
Hábitat neumático experimental. Primera versión, 1967. 827

Dyodon. Hábitat neumático experimental, 1967. 831

Documentación inédita del grupo Aerolande

Manuscrito para la exposición de la Vª Bienal de Paris, 1967.

AJS-AEROLANDE. Manuscrito para la exposición de la Vª Bienal de Paris, 1967. Fechado 29 de mayo de 1967. Consta de 3 páginas manuscritas a bolígrafo. Fuente: Documentación inédita facilitada por el centro Pompidou. FNAC 2000-258 (1), AM 2007-DEP 7. (MNAM/CCI) 258/7 (3)


Equipe JUNGMANN
STINCO
AUBERT
PANCINO
PACE

Paris 29 Mai 1967 ①

à Monsieur le Directeur de la Biennale de Paris

Réf: présentation des travaux d'équipe à la Biennale de Paris 1967.

Monsieur le Directeur,

Voici les précisions que nous sommes en mesure de vous fournir présentement, concernant la réalisation de notre travail et sa présentation au moyen du cyclotron.

A. Le projet proprement dit.

Illustrant le thème «habiter pneumatique» nous présentons une structure pneumatique, idéelle grandeur dont les dispositifs, formes et dimensions sont précisés par les dessins ci-joints: cette structure, dite «totu-dante» est composé de tubes en toile-néoprène gonflés à l'air, tendus entre eux par des cordelettes de nylon. Elle est habillée extérieurement par des feuilles triangulaires en polychlorure de vinyle transparent (P.C.V) amarrées aux tubes, de façon à constituer un volume fermé transparent. Trois ouvertures sont ménagées dans cet habillage, de façon à permettre l'entrée et la sortie. Cette structure

polychlorure polychrome

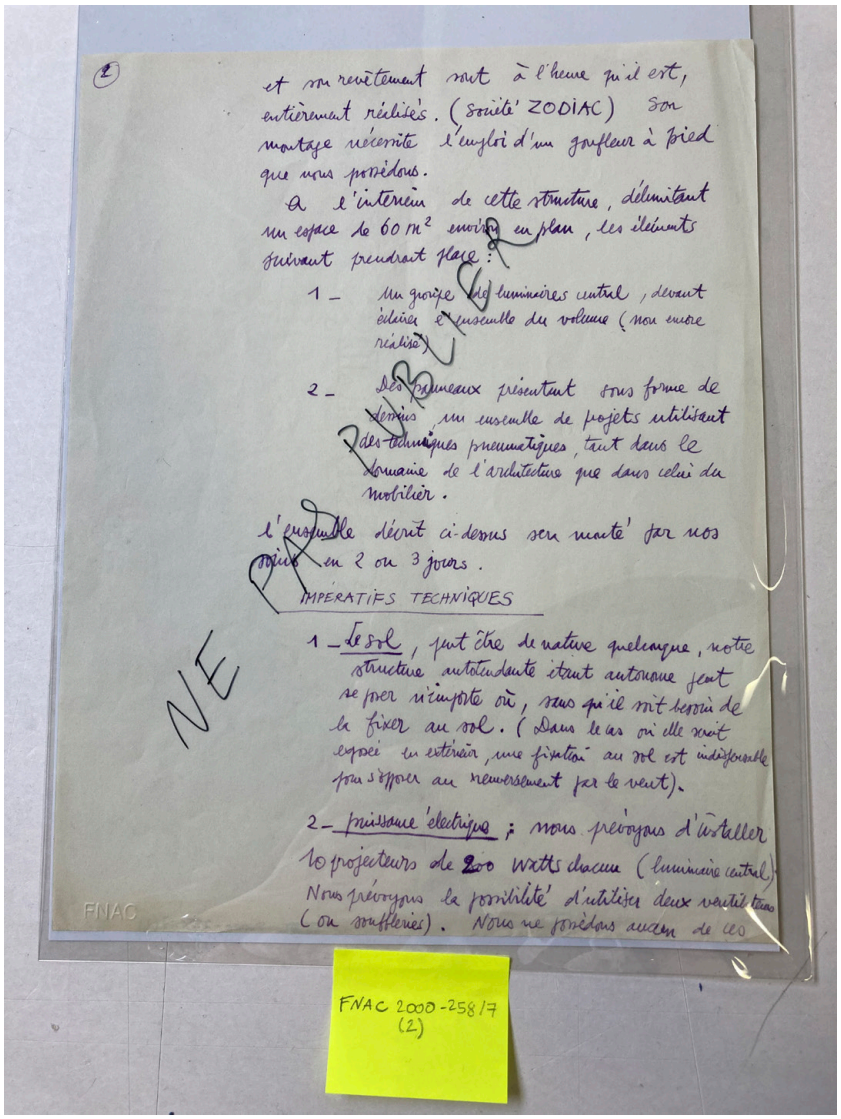
FNAC

FNAC 2000 -258 (3)

AJS-AEROLANDE. Manuscrito para la exposición de la Vª Bienal de Paris, 1967. Fechado 29 de mayo de 1967. Consta de 3 páginas manuscritas a bolígrafo. Fuente: Documentación inédita facilitada por el centro Pompidou. FNAC 2000-258 (1), AM 2007-DEP 7. (MNAM/CCI) 258/7 (3)

[Fig A.01]

Grupo AJS-AEROLANDE. Página 1 de 3 del manuscrito.



(2)

et son revêtement sont à l'heure qu'il est, entièrement réalisés. (société ZODIAC) Son montage nécessite l'emploi d'un gonfleur à pied que nous possédons.

A l'intérieur de cette structure, délimitant un espace de 60 m² environ en plan, les éléments suivant prendront place :

1 – Un groupe de lumières central, devant éclairer l'ensemble du volume (non encore réalisé)

2 – Des panneaux présentant sous forme de dessins un ensemble de projets utilisant des techniques pneumatiques, tant dans le domaine de l'architecture que dans celui du mobilier.

L'ensemble décrit ci-dessus sera monté par nos soins en 2 ou 3 jours.

IMPÉRATIFS TECHNIQUES

1 – Le sol, peut être de nature quelconque, notre structure autotendante étant autonome peut se poser n'importe où, sans qu'il soit besoin de la fixer au sol. (Dans le cas où elle serait exposée en extérieur, une fixation au sol est indispensable pour s'opposer au renversement par le vent).

2 – puissance électrique : nous prévoyons d'installer 10 projecteurs de 200 watts chacun (lumières central). Nous prévoyons la possibilité d'utiliser deux ventilateurs (ou soufflerie). Nous ne possédons aucun de ces

NE

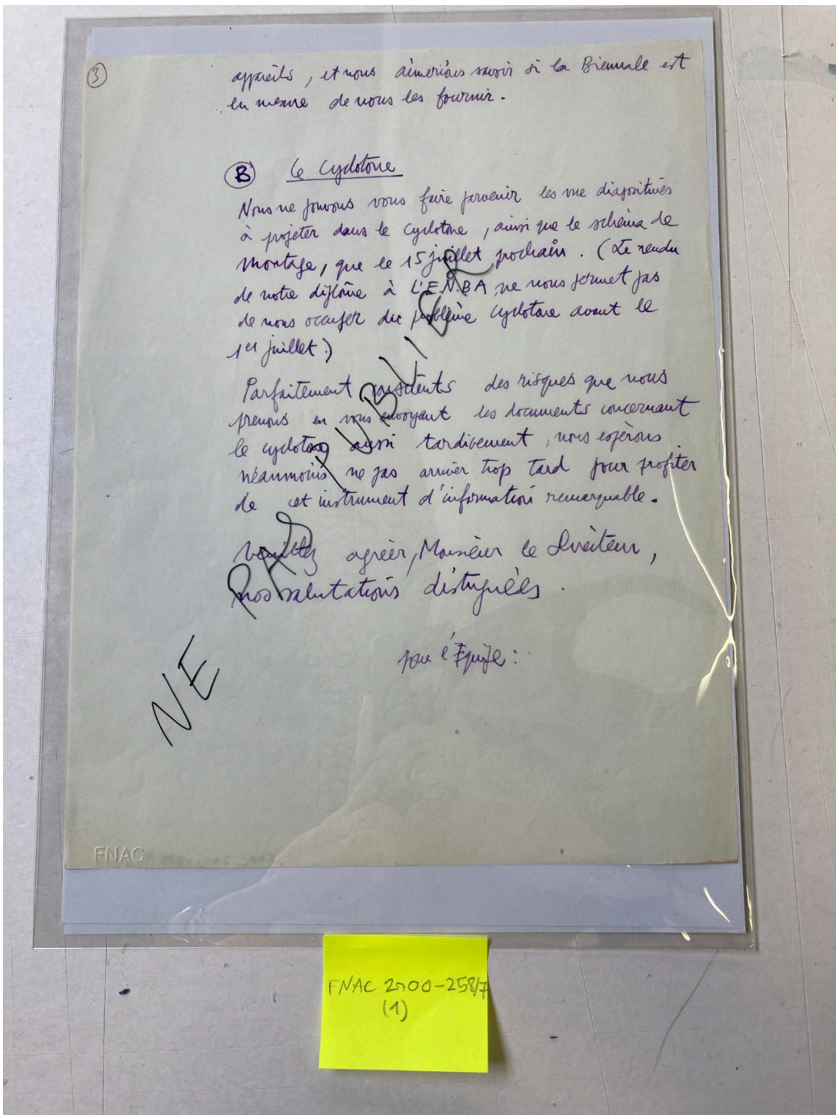
FNAC

FNAC 2000-258/7 (2)

AJS-AEROLANDE. Manuscrito para la exposición de la Vª Bienal de Paris, 1967. Fechado 29 de mayo de 1967. Consta de 3 páginas manuscritas a bolígrafo. Fuente: Documentación inédita facilitada por el centro Pompidou. FNAC 2000-258 (1), AM 2007-DEP 7. (MNAM/CCI) 258/7 (3)

[Fig A.02]

Grupo AJS-AEROLANDE. Página 2 de 3 del manuscrito.



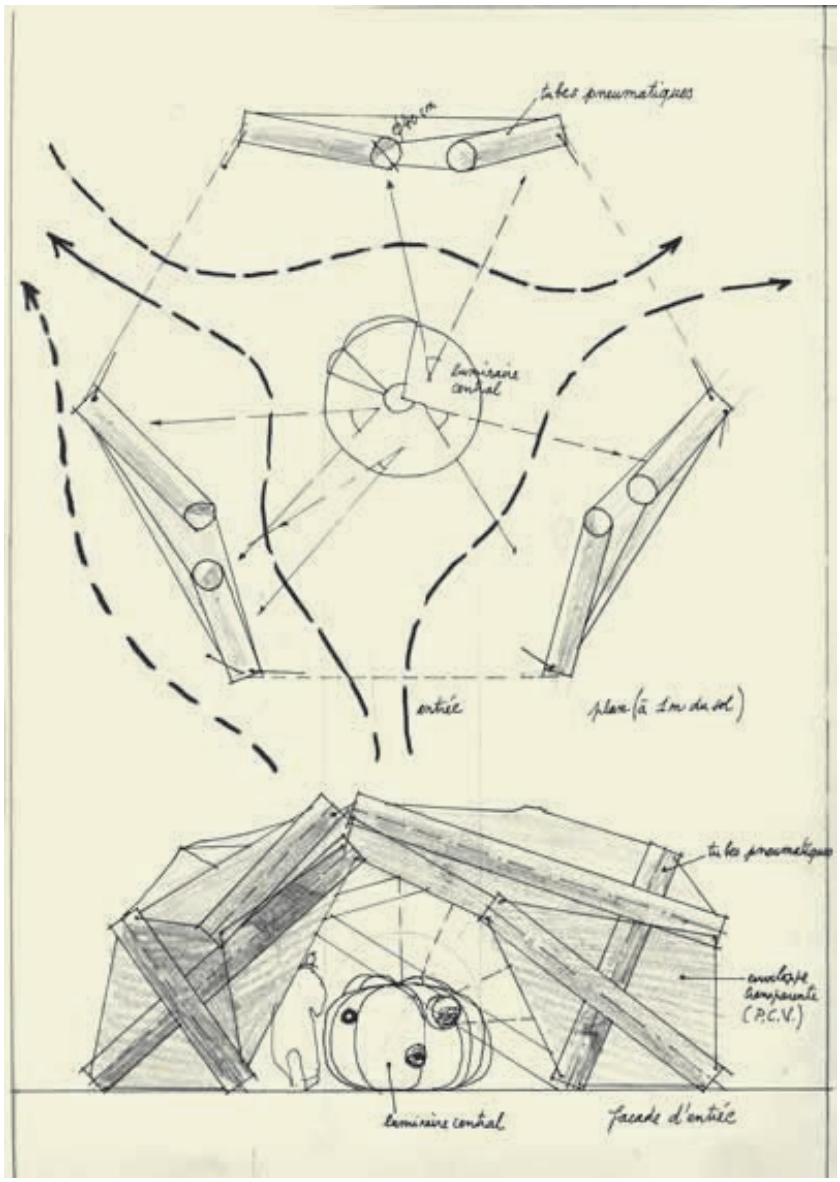
AJS-AEROLANDE. Manuscrito para la exposición de la Vª Bienal de Paris, 1967. Fechado 29 de mayo de 1967. Consta de 3 páginas manuscritas a bolígrafo. Fuente: Documentación inédita facilitada por el centro Pompidou. FNAC 2000-258 (1), AM 2007-DEP 7. (MNAM/CCI) 258/7 (3)

[Fig A.03]

Grupo AJS-AEROLANDE. Página 3 de 3 del manuscrito.

Estructura auto - tensada, 1967.

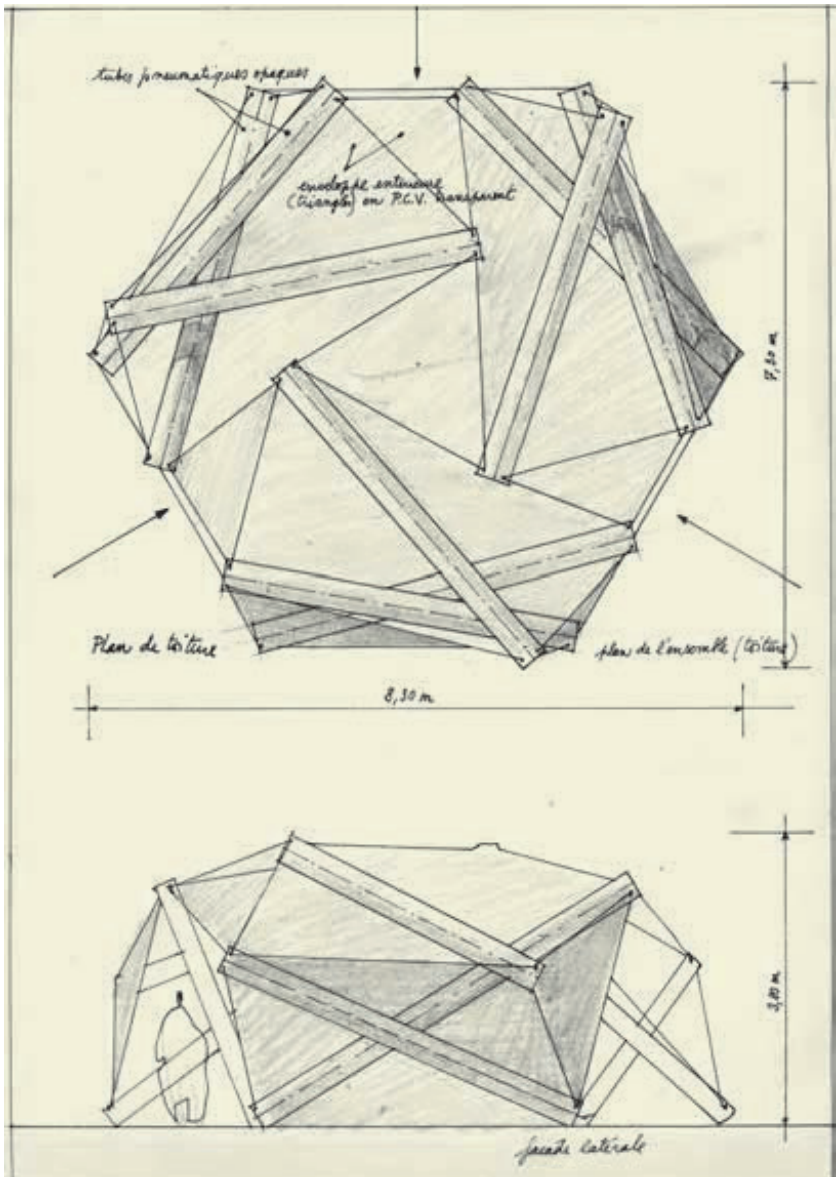
AJS-AEROLANDE. Estructura auto - tensada, 1967. Fuente: Documentación inédita facilitada por Jean Paul Jungmann. La documentación original se encuentra en *Cité de l'Architecture et du Patrimoine, París*. Parte de la documentación se encuentra en *Agence H20*, París.



[Fig A.04]

AJS-AEROLANDE. Construcción de una estructura compuesta por 9 tubos hinchables de 6m, tensados y una cubierta de plástico transparente para la película *L'ECUME DES JOURS* de Charles Belmont.

Planta con corte a 1m y alzado. Técnica: tinta negra y lápiz sobre papel de calco. Dimensiones 23x33cm.

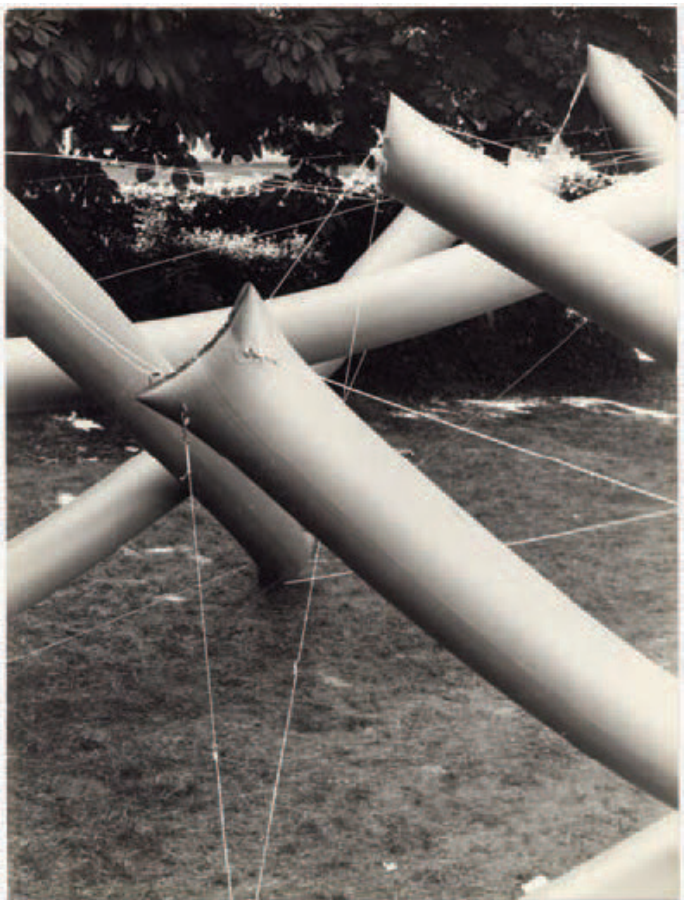


AJS-AEROLANDE. Estructura auto - tensada, 1967. Fuente: Documentación inédita facilitada por Jean Paul Jungmann. La documentación original se encuentra en *Cité de l'Architecture et du Patrimoine, París.* Parte de la documentación se encuentra en *Agence H20*, París.

[Fig A.05]

AJS-AEROLANDE. Construcción de una estructura compuesta por 9 tubos hinchables de 6m, tensados y una cubierta de plástico transparente para la película *L'ECUME DES JOURS* de Charles Belmont.

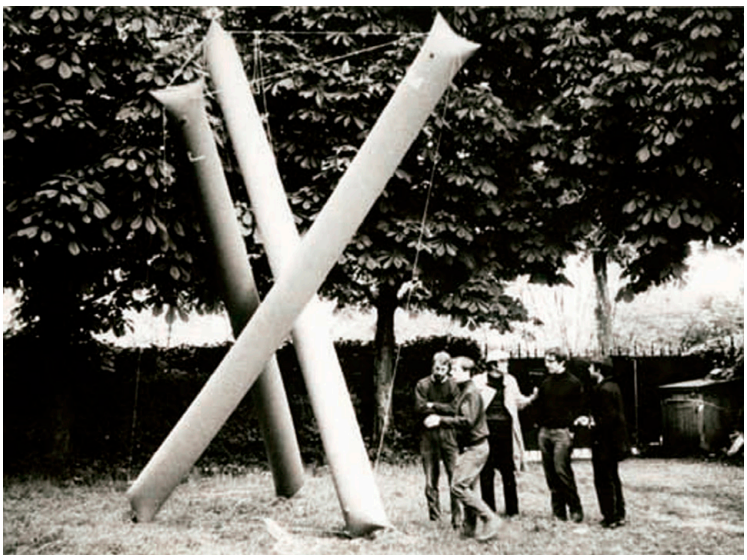
Planta de cubierta y alzado lateral. Técnica: tinta negra y lápiz sobre papel de calco. Dimensiones 23x33cm.



[Fig A.06]

AJS-AEROLANDE. Construcción de una estructura compuesta por 9 tubos hinchables de 6m, tensados y una cubierta de plástico transparente para la película *L'ECUME DES JOURS* de Charles Belmont.

Fotografías en blanco y negro del montaje de la prueba final con los tubos de tejido opaco. Imagen inferior.



AJS-AEROLANDE. Estructura auto - tensada, 1967. Fuente: Documentación inédita facilitada por Jean Paul Jungmann. La documentación original se encuentra en *Cité de l'Architecture et du Patrimoine, París.* Parte de la documentación se encuentra en *Agence H20*, París.

[Fig A.07]

AJS-AEROLANDE. Construcción de una estructura compuesta por 9 tubos hinchables de 6m, tensados y una cubierta de plástico transparente para la película *L'ECUME DES JOURS* de Charles Belmont.

Imagen superior: fotografía en blanco y negro del montaje de la prueba final con los tubos de tejido opaco. Imagen centro e inferior: fotografías en blanco y negro del plató durante el rodaje de la película.

[Fig A.08]

AJS-AEROLANDE. Construcción de una estructura compuesta por 9 tubos hinchables de 6m, tensados y una cubierta de plástico transparente para la película *L'ECUME DES JOURS* de Charles Belmont.

Fotografías en blanco y negro durante el montaje de una prueba de estructura con tubos de PVC transparentes fabricado con PVC soldado.

AJS-AEROLANDE. Estructura auto - tensada, 1967. Fuente: Documentación inédita facilitada por Jean Paul Jungmann. La documentación original se encuentra en *Cité de l'Architecture et du Patrimoine, París.* Parte de la documentación se encuentra en *Agence H20*, París.

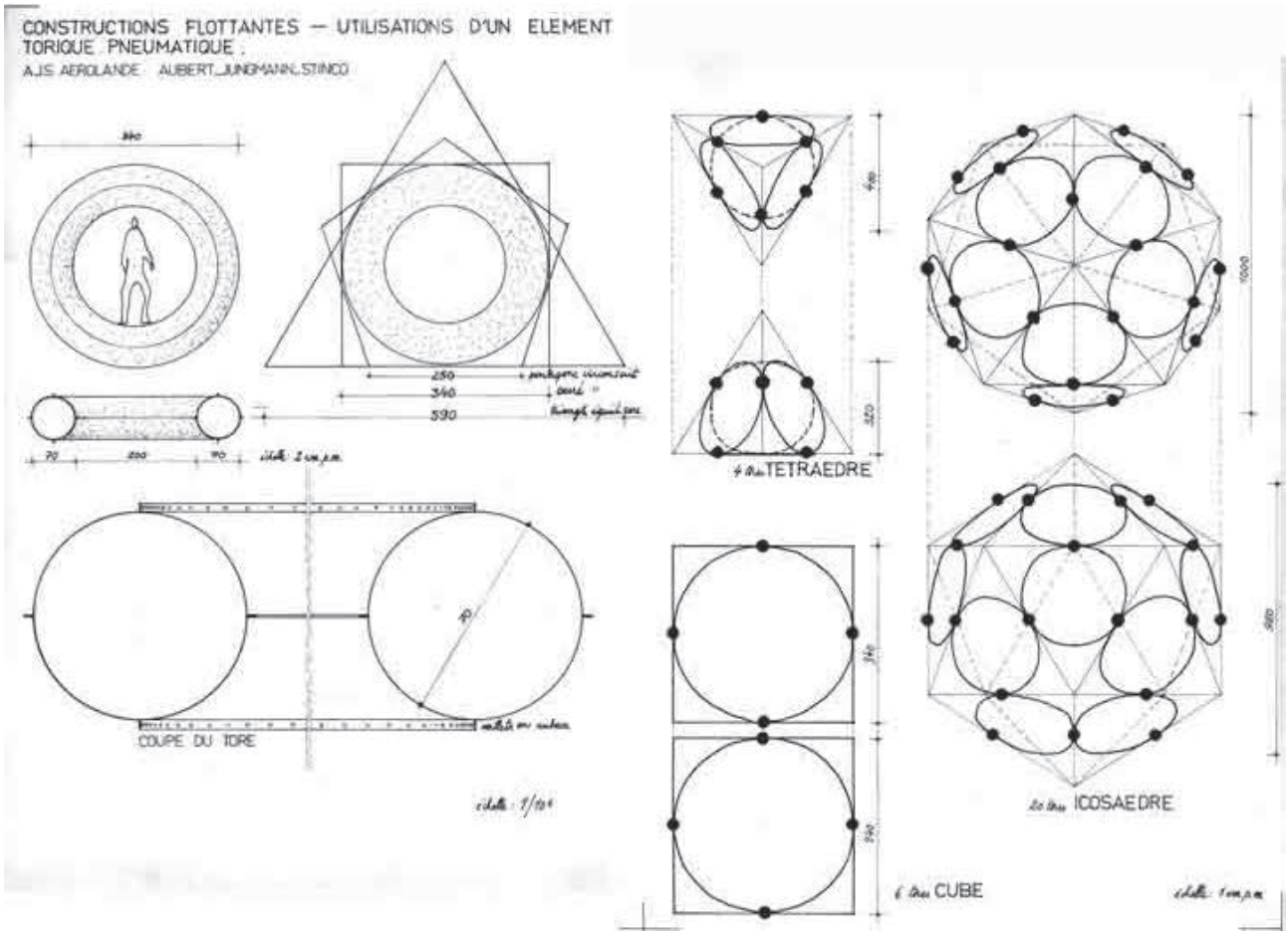
[Fig A.09]

AJS-AEROLANDE. Construcción de una estructura compuesta por 9 tubos hinchables de 6m, tensados y una cubierta de plástico transparente para la película *L'ECUME DES JOURS* de Charles Belmont.

Fotografías en blanco y negro del plató durante el rodaje de la película.

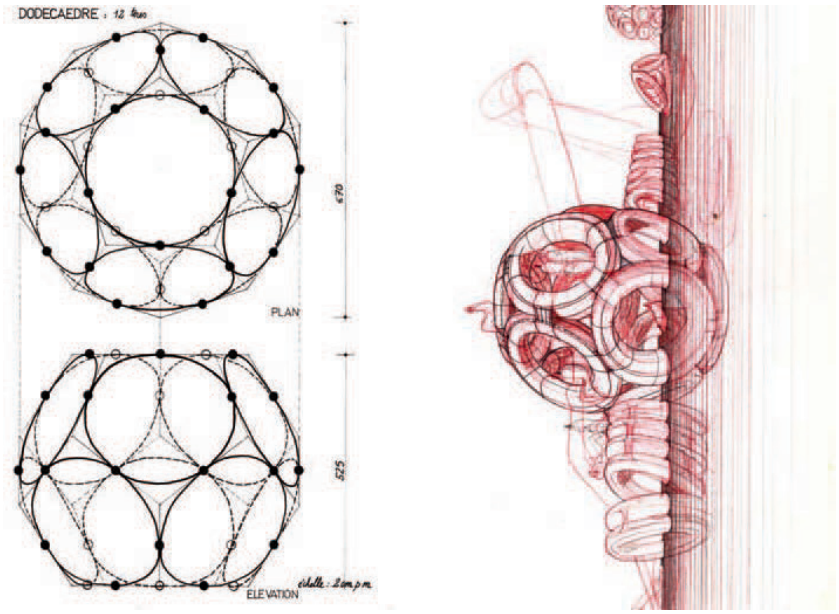
Construcciones flotantes: utilización de un elemento tórico neumático, 1968.

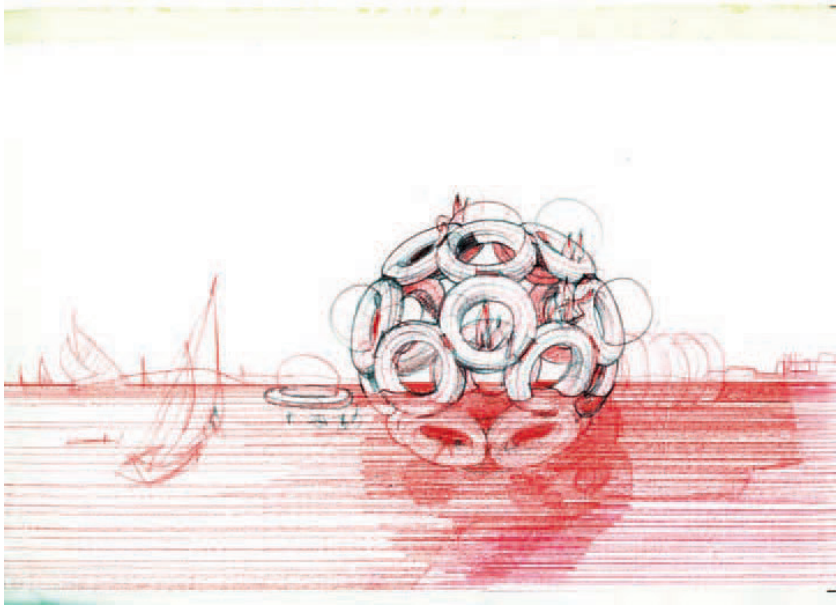
AJS-AEROLANDE. Construcciones flotantes - utilización de un elemento tórico neumático, 1968. Fuente: Documentación inédita facilitada por Jean Paul Jungmann. La documentación original se encuentra en *Cité de l'Architecture et du Patrimoine,* París.



[Fig A.10]

AJS-AEROLANDE. Plantas y alzados de esquemas de estructura con 4 caras = tetraedro, 6 caras = cubo, 20 caras = icosaedro. Varias técnicas: tinta negra sobre papel de calco. 34x50cm.





AJS-AEROLANDE. Construcciones flotantes - utilización de un elemento tórico neumático, 1968. Fuente: Documentación inédita facilitada por Jean Paul Jungmann. La documentación original se encuentra en *Cité de l'Architecture et du Patrimoine*, París.

[Fig A.11]

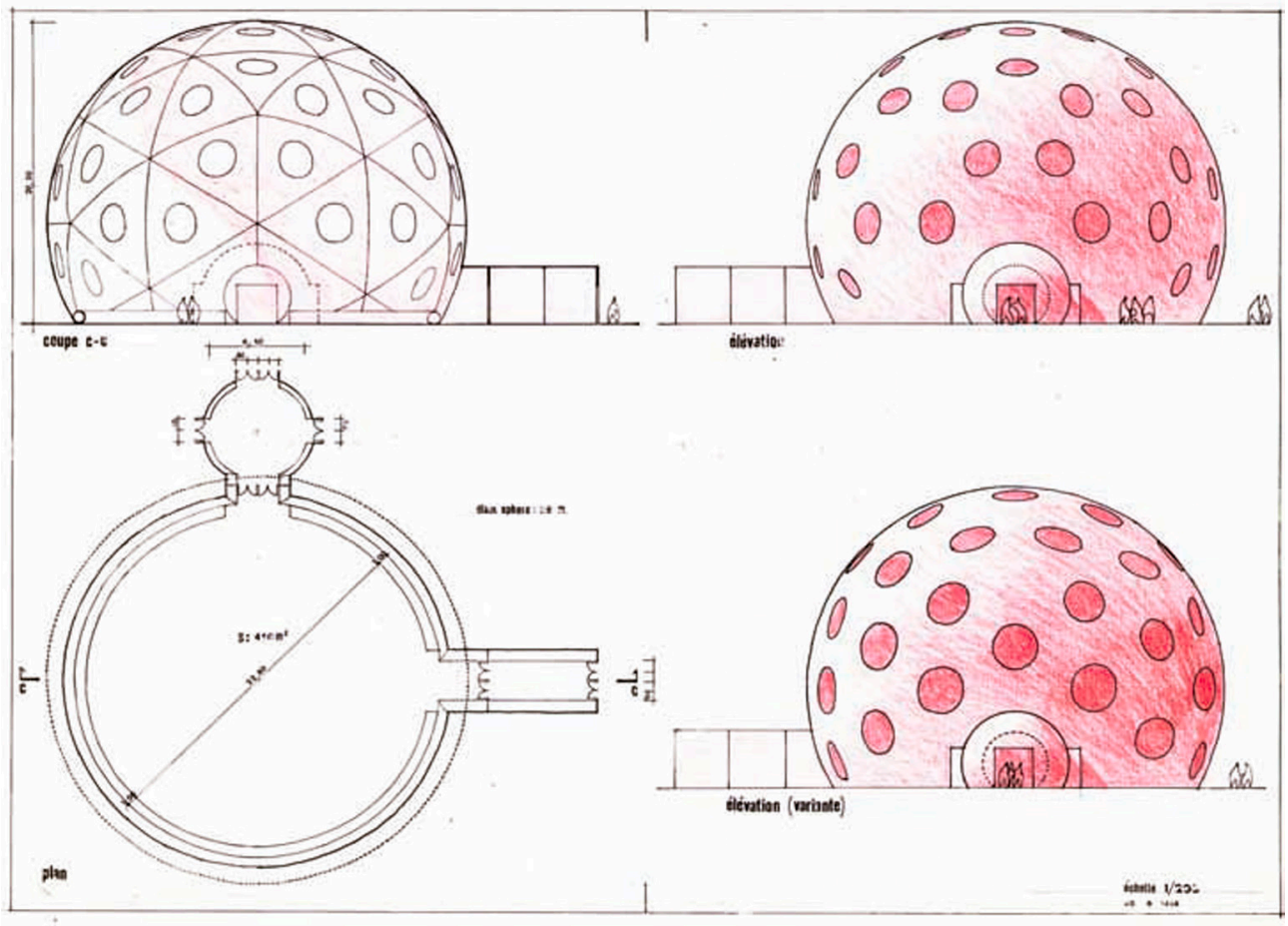
AJS-AEROLANDE. Planta y alzado y perspectiva de estructura con 12 caras = dodecaedro. Varias técnicas: tinta negra y pintura roja sobre papel de calco. 34x41cm.

[Fig A.12]

AJS-AEROLANDE. Perspectiva de estructura con 20 caras = icosaedro. Varias técnicas: tinta negra y pintura roja sobre papel de calco. 34x23cm.

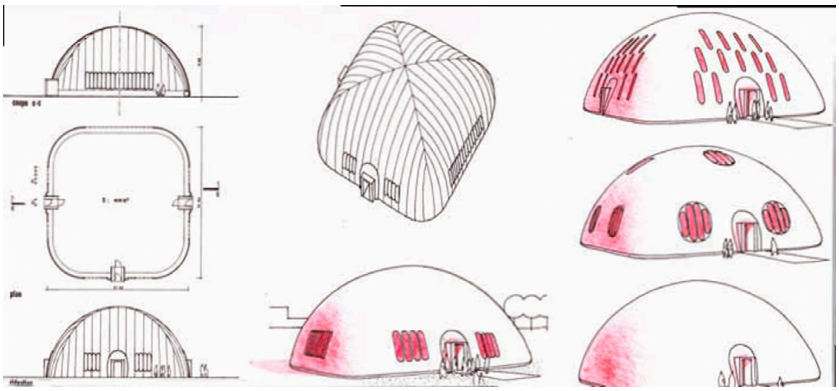
Construcciones flotantes con sobrepresión interna, 1968.

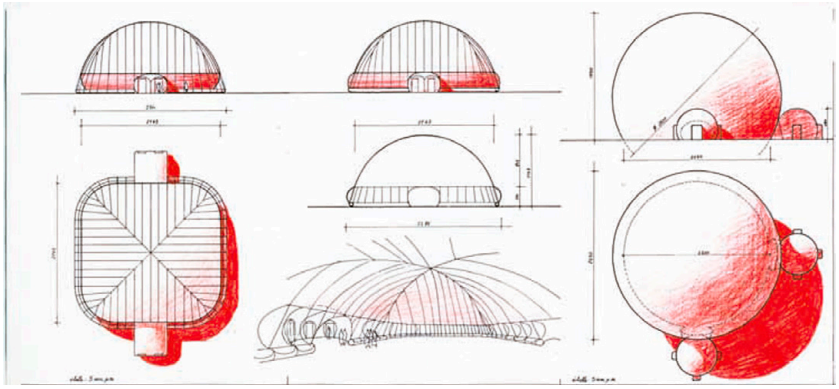
AJS-AEROLANDE. Construcciones flotantes con sobrepresión interna, 1968. Fuente: Documentación inédita facilitada por Jean Paul Jungmann. La documentación original se encuentra en *Cité de l'Architecture et du Patrimoine*, París.

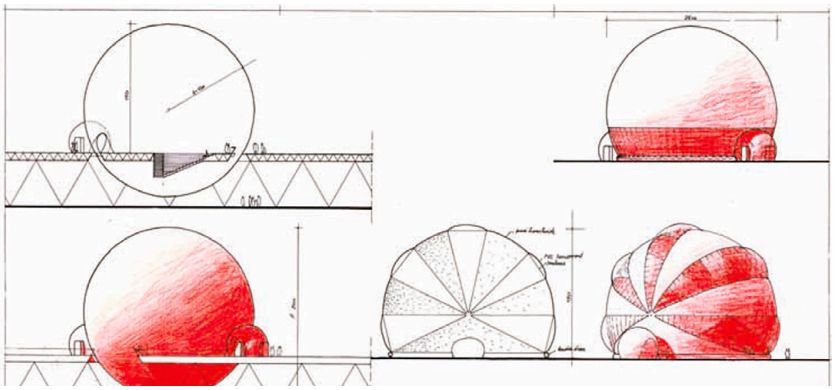


[Fig A.13]

AJS-AEROLANDE. Cúpula esférica, diámetro: 28m, superficie 450m2, a escala 1/200. Varias técnicas: tinta negra y pintura roja sobre papel de calco. 32x44cm.







AJS-AEROLANDE. Construcciones flotantes con sobrepresión interna, 1968. Fuente: Documentación inédita facilitada por Jean Paul Jungmann. La documentación original se encuentra en *Cité de l'Architecture et du Patrimoine*, París.

[Fig A.14]

AJS-AEROLANDE. Cúpulas sobre una planta cuadrada de superficie de 419 m2, a escala 1/200. Varias técnicas: tinta negra y pintura roja sobre papel de calco. 32.5x79cm.

[Fig A.15]

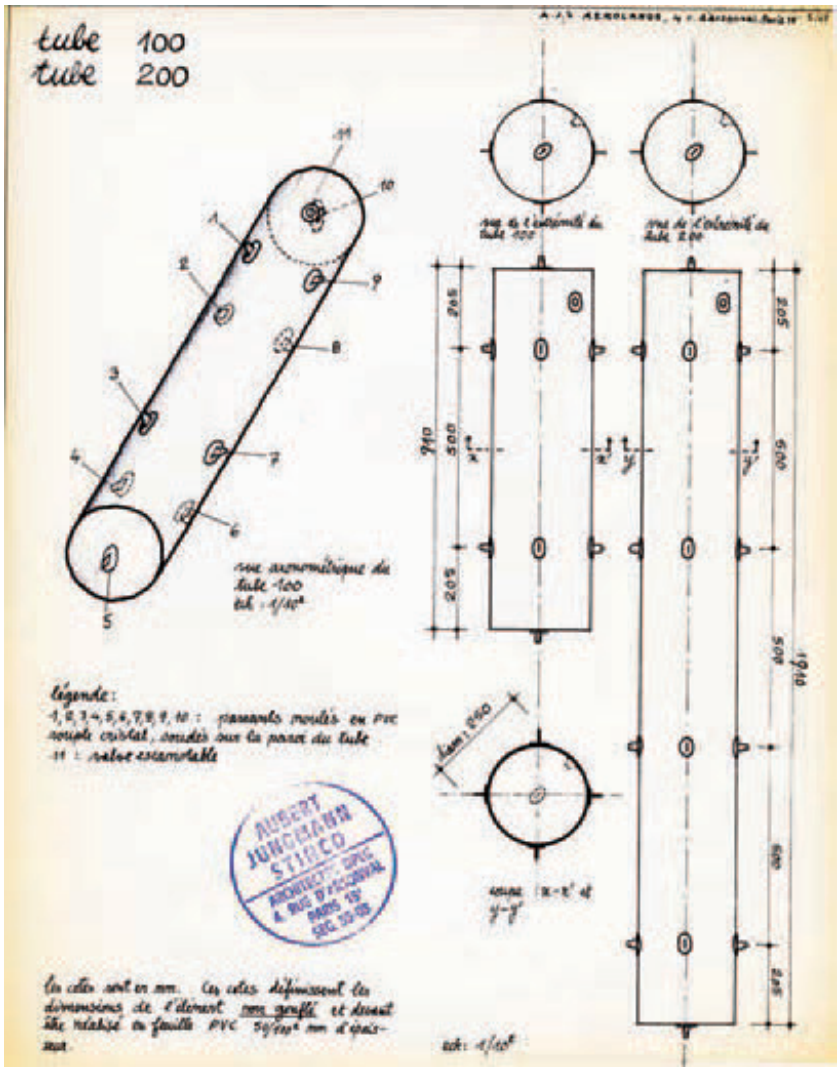
AJS-AEROLANDE. Imágen izquierda: Cúpula plana cuadrada. Imagen derecha: cúpula esférica, de diámetro 26m. Varias técnicas: tinta negra y pintura roja sobre papel de calco. 32.5x91cm.

[Fig A.16]

AJS-AEROLANDE. Imágen izquierda: Cúpula circular, diámetro 23m, con lastre de agua textil alrededor del perímetro. Imagen derecha: 2 proyectos de cúpulas circulares de diámetro 25m. Varias técnicas: tinta negra y pintura roja sobre papel de calco.

Mobiliario hinchable, 1968-69.

AJS-AEROLANDE. Mobiliario hinchable, 1968-69. Fuente: Documentación inédita facilitada por Jean Paul Jungmann. La documentación original fue adquirida en el año 2000 por Le FNAC de París (Fondo Nacional de Arte Contemporáneo) y desde el año 2007 se encuentra en MNAM/CCI de París (Museo Nacional de Arte Moderno/ Centro Pompidou). Parte de la documentación se encuentra en *Galerie Mercier & Associés, Galerie Utopie Ed. Bernard* y probablemente en *Cité de l'Architecture et du Patrimoine*, París.



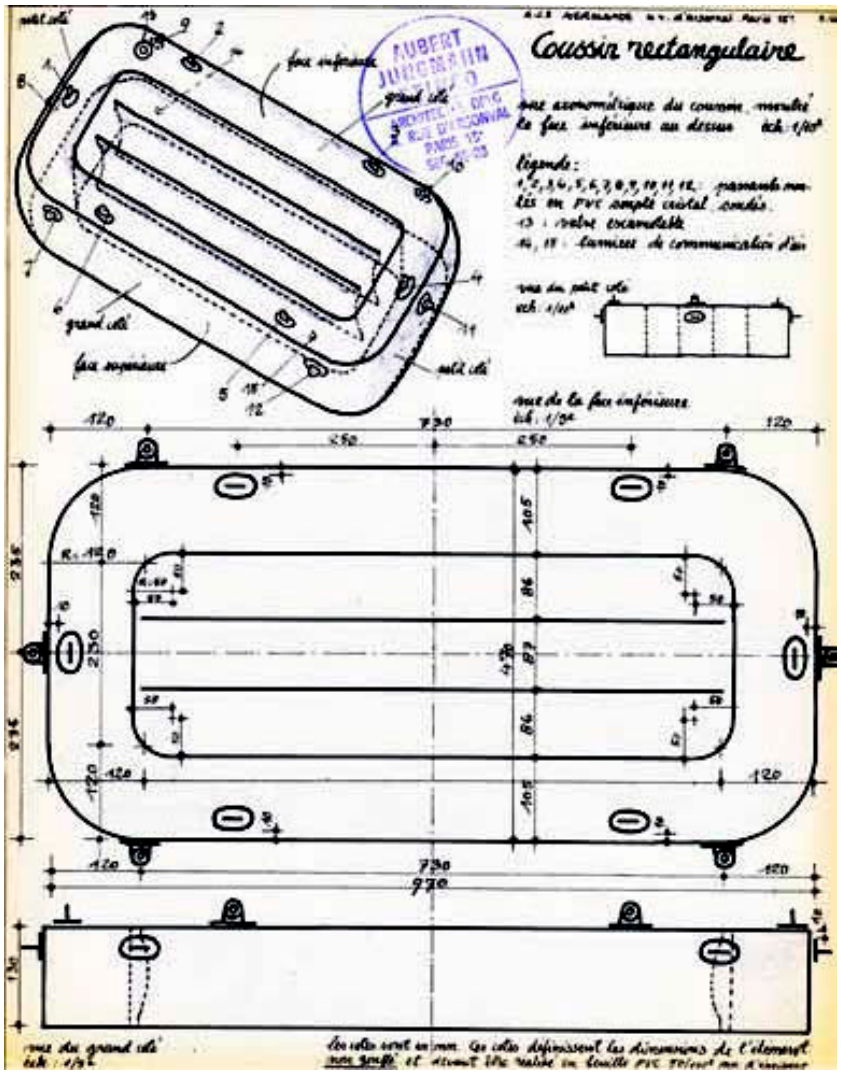
[Fig A.17]

AJS-AEROLANDE. Planos en planta, sección, alzado y axonometría de tubos hinchables: Tubo 100 y Tubo 200, a escala 1/10. Técnica: tinta negra. 29x23cm.

AJS-AEROLANDE. Mobiliario hinchable, 1968-69. Fuente: Documentación inédita facilitada por Jean Paul Jungmann. La documentación original fue adquirida en el año 2000 por Le FNAC de París (Fondo Nacional de Arte Contemporáneo) y desde el año 2007 se encuentra en MNAM/CCI de París (Museo Nacional de Arte Moderno/Centro Pompidou). Parte de la documentación se encuentra en *Galerie Mercier & Associés, Galerie Utopie Ed. Bernard* y probablemente en *Cité de l'Architecture et du Patrimoine,* París.

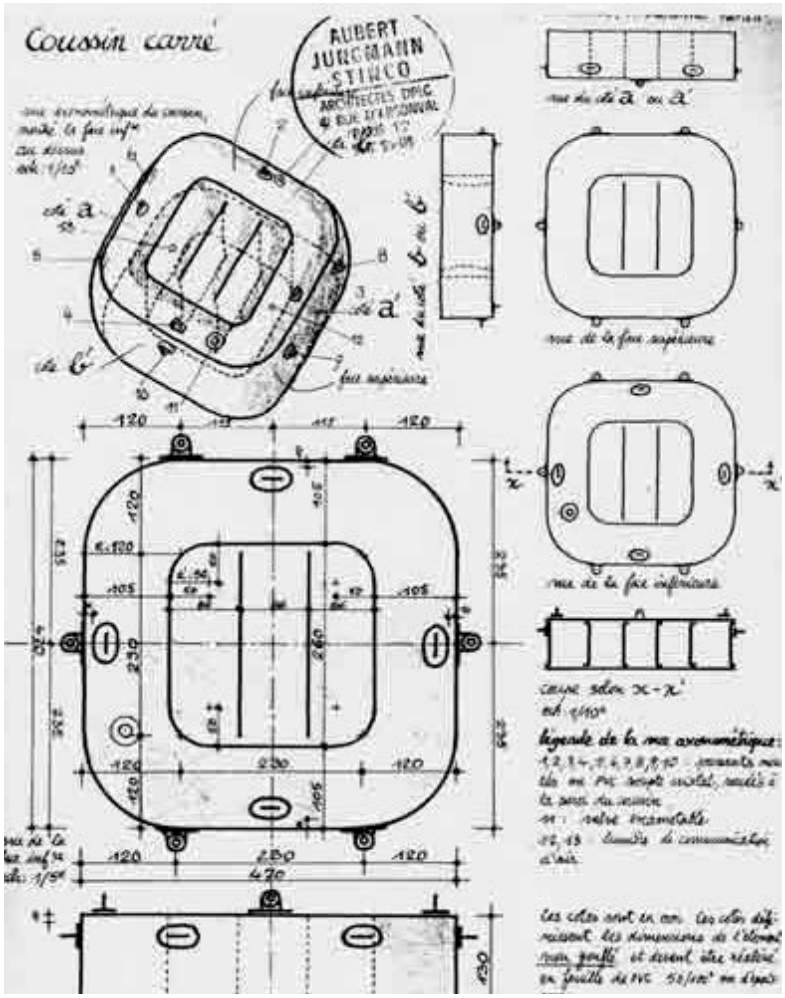
[Fig A.18]

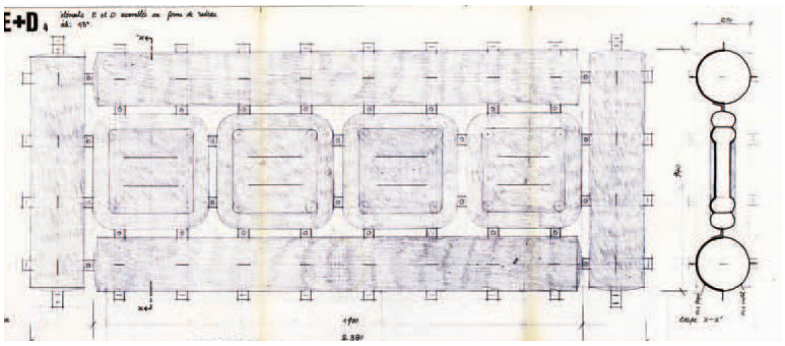
Fotografía en blanco y negro de mobiliario hinchable.

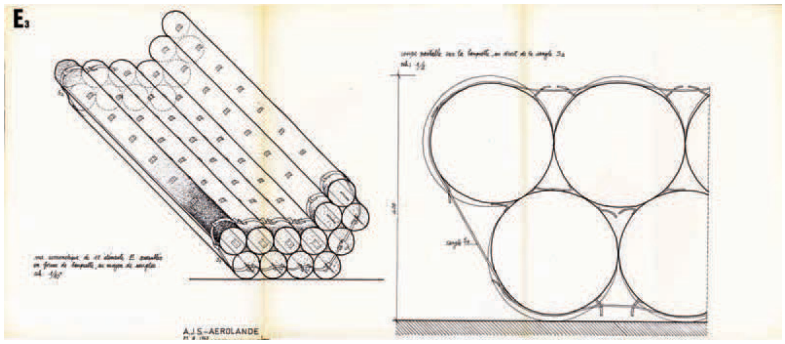


[Fig A.19]

AJS-AEROLANDE. Planos en planta, sección, alzado y axonometría de cojín rectangular hinchable, a escala 1/5. Técnica: tinta negra y lápiz. 29x23cm







AJS-AEROLANDE. Mobiliario hinchable, 1968-69. Fuente: Documentación inédita facilitada por Jean Paul Jungmann. La documentación original se encuentra en MNAM/CCI de París (Museo Nacional de Arte Moderno/Centro Pompidou). Parte de la documentación se encuentra en *Galerie Mercier & Associés, Galerie Utopie Ed. Bernard* y probablemente en *Cité de l'Architecture et du Patrimoine*, París.

[Fig A.20]

AJS-AEROLANDE. Planos en planta, sección, alzado y axonometría de cojín cuadrado hinchable, a escala 1/5. Técnica: tinta negra.

[Fig A.21]

AJS-AEROLANDE. Planos en planta y sección de tubos y cojines cuadrados hinchables unidos formando asiento hinchable, a escala 1/5. Técnica: tinta negra.

[Fig A.22]

AJS-AEROLANDE. Planos en axonometría y sección de tubos hinchables unidos en forma de banco, a escala 1/10. Técnica: tinta negra.

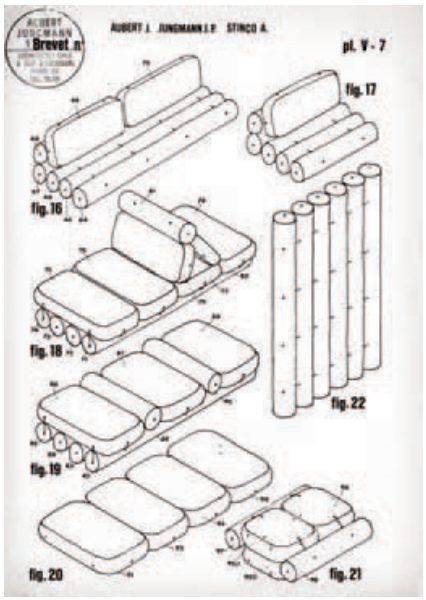
[Fig A.23]

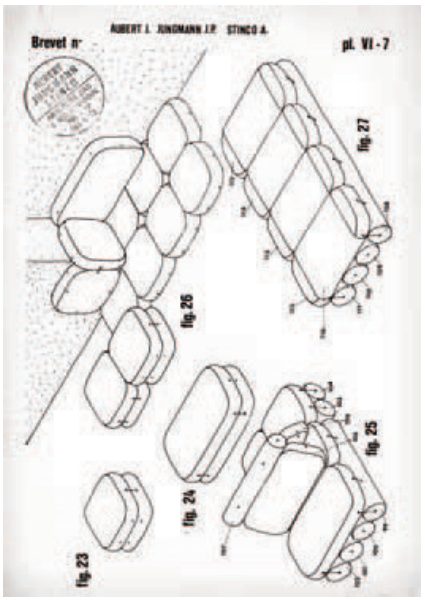
Fotografía en blanco y negro de mobiliario hinchable.

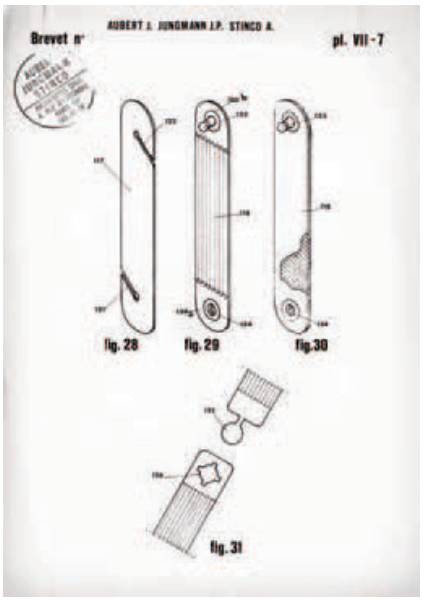
AJS-AEROLANDE. Mobiliario hinchable, 1968-69. Fuente: Documentación inédita facilitada por Jean Paul Jungmann. La documentación original se encuentra en MNAM/CCI de París (Museo Nacional de Arte Moderno/Centro Pompidou). Parte de la documentación se encuentra en *Galerie Mercier & Associés, Galerie Utopie Ed. Bernard* y probablemente en *Cité de l'Architecture et du Patrimoine*, París.

[Fig A.24]

Fotografía en blanco y negro de mobiliario hinchable en la exposición "El universo de los jóvenes" en las galerías Lafayette.





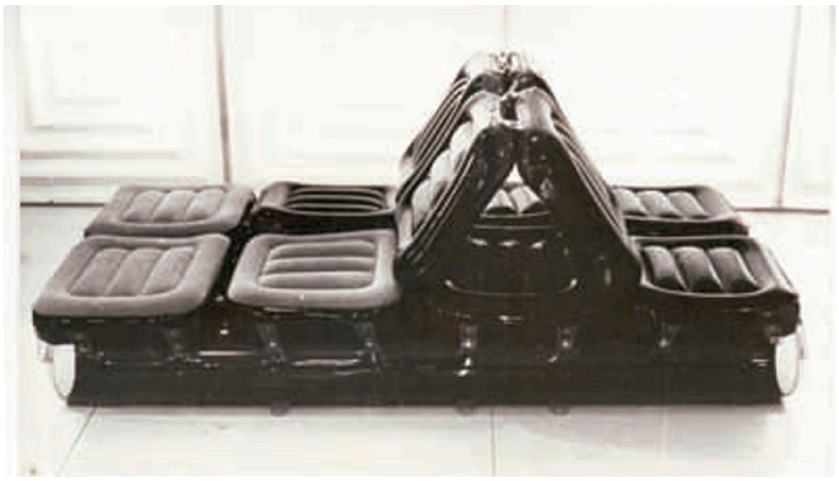


[Fig A.25]

AJS-AEROLANDE. Planos para fabricante de axonometrías con posibilidades de unión de elementos tubo y cojines para la formación de diferentes asientos hinchables. Técnica: tinta negra y lápiz.

[Fig A.26]

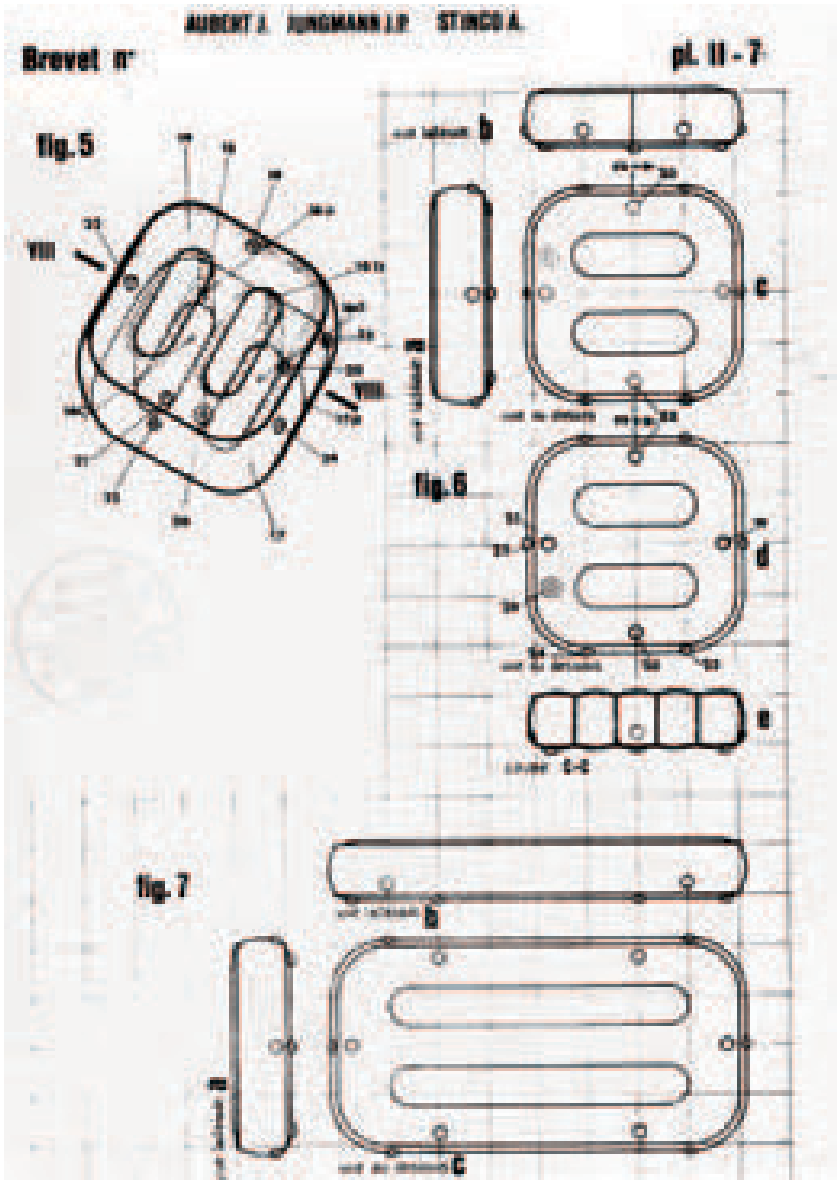
AJS-AEROLANDE. Planos para fabricante de detalle de unión de piezas hinchables. Técnica: tinta negra y lápiz.



AJS-AEROLANDE. Mobiliario hinchable, 1968-69. Fuente: Documentación inédita facilitada por Jean Paul Jungmann. La documentación original se encuentra en MNAM/CCI de París (Museo Nacional de Arte Moderno/Centro Pompidou). Parte de la documentación se encuentra en *Galerie Mercier & Associés, Galerie Utopie Ed. Bernard* y probablemente en *Cité de l'Architecture et du Patrimoine*, París.

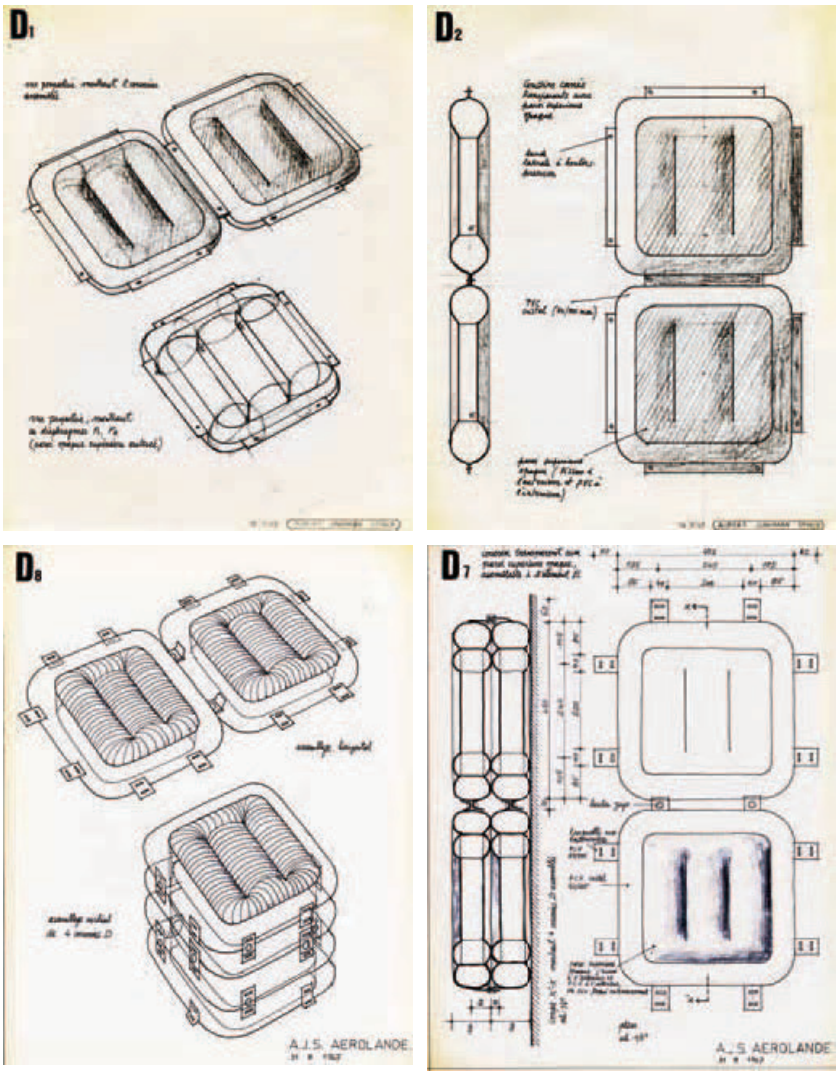
[Fig A.27]

Fotografía en blanco y negro de asiento formado por tubos y cojines cuadrados hinchables unidos de diferentes modos mostrando la versatilidad del conjunto.



[Fig A.28]

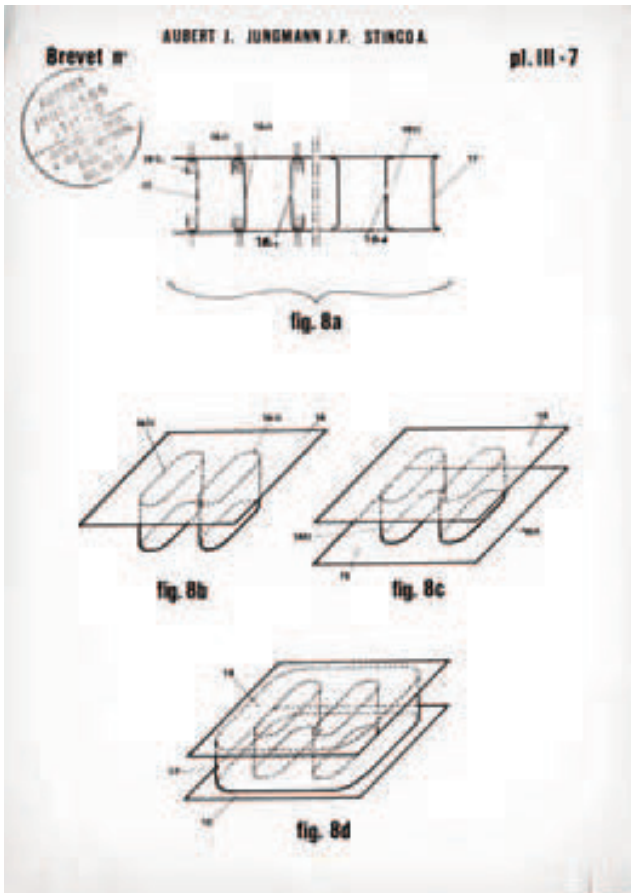
AJS-AEROLANDE. Planos para fabricante en planta, alzado y sección para la elaboración del cojines cuadrado y rectangular hinchable con difetente compartimentación de espacios de aire comprimido en su interior. Técnica: tinta negra y lápiz.

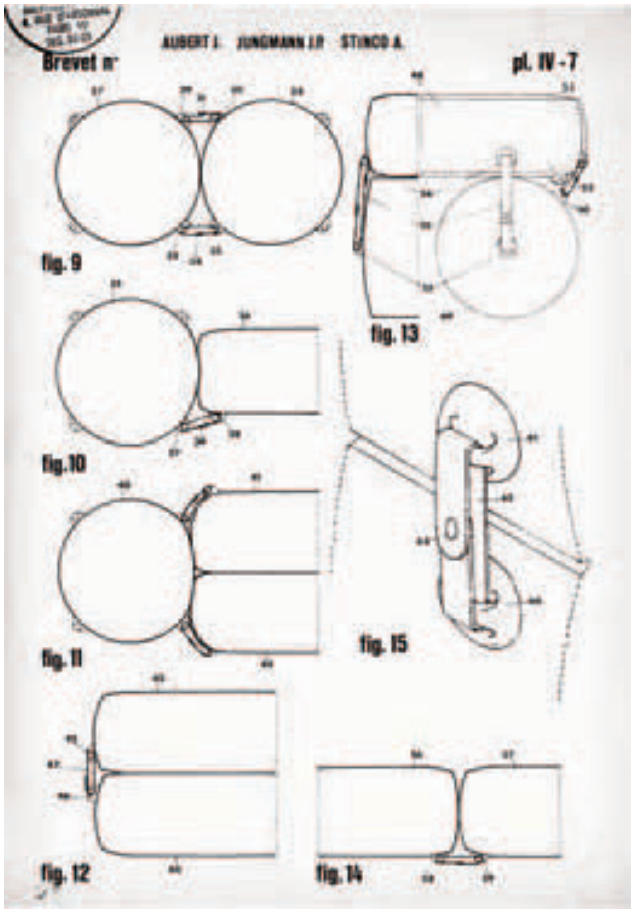


AJS-AEROLANDE. Mobiliario hinchable, 1968-69. Fuente: Documentación inédita facilitada por Jean Paul Jungmann. La documentación original se encuentra en MNAM/CCI de París (Museo Nacional de Arte Moderno/Centro Pompidou). Parte de la documentación se encuentra en *Galerie Mercier & Associés, Galerie Utopie Ed. Bernard* y probablemente en *Cité de l'Architecture et du Patrimoine*, París.

[Fig A.29]

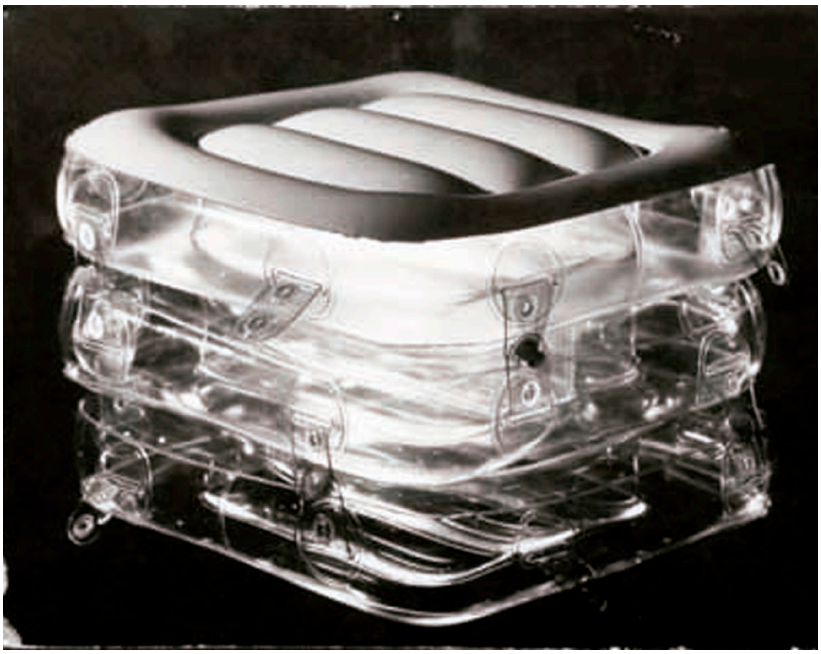
AJS-AEROLANDE. Planos de estudio de ensamblaje de cojín cuadrado hinchable para formar un asiento. Técnica: tinta negra y lápiz.





[Fig A.30]

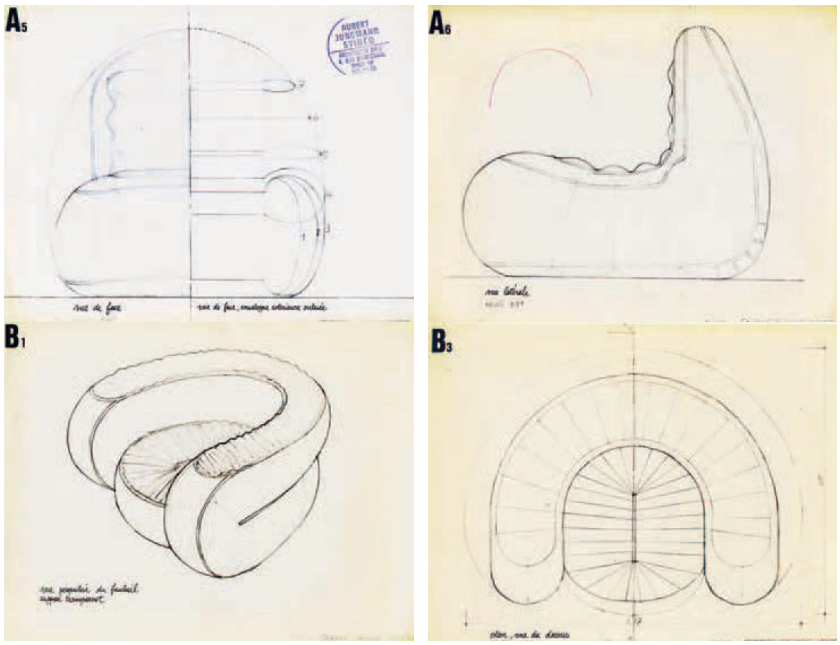
AJS-AEROLANDE. Planos de detalle para su fabricación. Axonométrica, planta, alzado y sección para la elaboración del cojines cuadrados hinchables con difetente compartimentación de espacios de aire comprimido en su interior y detalles de ensamblaje de tubos hinchables con éstos. Técnica: tinta negra y lápiz.



AJS-AEROLANDE. Mobiliario hinchable, 1968-69. Fuente: Documentación inédita facilitada por Jean Paul Jungmann. La documentación original se encuentra en MNAM/CCI de París (Museo Nacional de Arte Moderno/Centro Pompidou). Parte de la documentación se encuentra en *Galerie Mercier & Associés, Galerie Utopie Ed. Bernard* y probablemente en *Cité de l'Architecture et du Patrimoine*, París.

[Fig A.31]

Fotografías de poufs presentes en la exposición "Estructuras hinchables" de 1968.



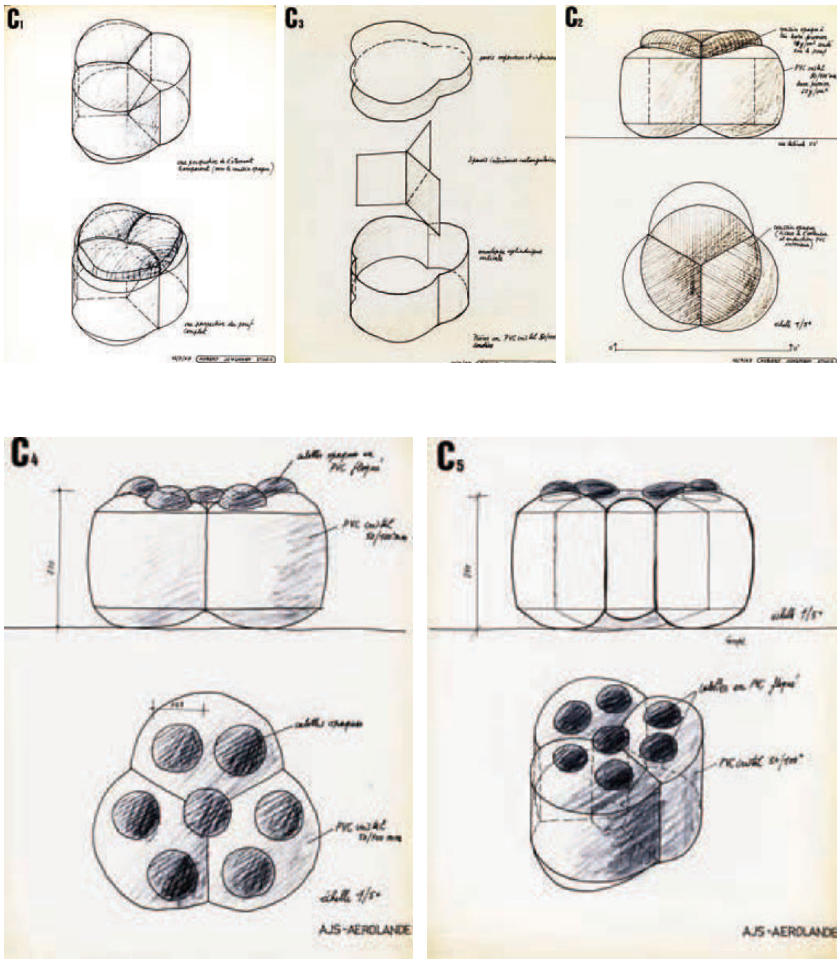
[Fig A.32]

AJS-AEROLANDE. Primeros estudios del sillón y la silla toroidal antes de su realización. 1967.

AJS-AEROLANDE. Mobiliario hinchable, 1968-69. Fuente: Documentación inédita facilitada por Jean Paul Jungmann. La documentación original se encuentra en MNAM/CCI de París (Museo Nacional de Arte Moderno/Centro Pompidou). Parte de la documentación se encuentra en *Galerie Mercier & Associés, Galerie Utopie Ed. Bernard* y probablemente en *Cité de l'Architecture et du Patrimoine*, París.

[Fig A.33]

Fotografías en color del sillón y la silla toroidal en la exposición DESIGN miroir du siècle, en el Grand Palais, París. 1993



[Fig A.34]

AJS-AEROLANDE. Croquis en planta, alzado y axonometría de un pouf formado por tres espacios de aire.

[Fig A.35]

AJS-AEROLANDE. Croquis en planta, alzado y axonometría de un pouf formado por cuatro espacios de aire.

AJS-AEROLANDE. Mobiliario hinchable, 1968-69. Fuente: Documentación inédita facilitada por Jean Paul Jungmann. La documentación original se encuentra en MNAM/CCI de París (Museo Nacional de Arte Moderno/Centro Pompidou). Parte de la documentación se encuentra en *Galerie Mercier & Associés, Galerie Utopie Ed. Bernard* y probablemente en *Cité de l'Architecture et du Patrimoine*, París.

[Fig A.36]

Fotografía en blanco y negro del pouf toroidal.

[Fig A.37]

Fotografía en blanco y negro de la silla y el pouf toroidal en varias exposiciones.

[Fig A.38]

Fotografía en blanco y negro de la silla y el pouf toroidal en la exposición "El universo de los jóvenes" en las galerías Lafayette.

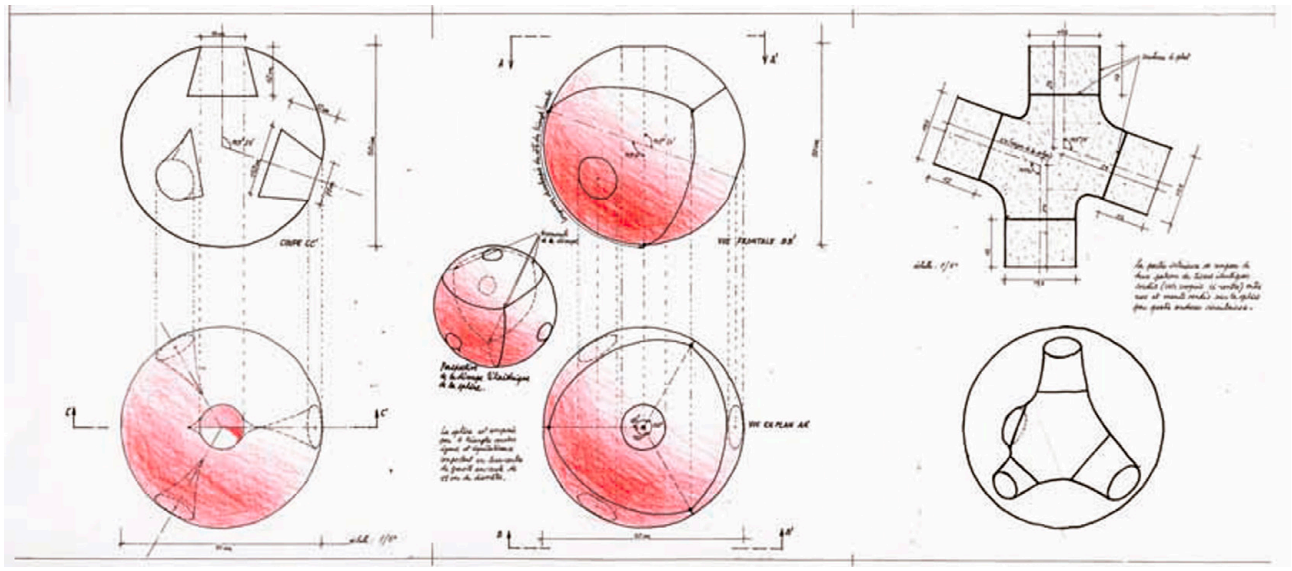
AJS-AEROLANDE. Mobiliario hinchable, 1968-69. Fuente: Documentación inédita facilitada por Jean Paul Jungmann. La documentación original se encuentra en MNAM/CCI de París (Museo Nacional de Arte Moderno/Centro Pompidou). Parte de la documentación se encuentra en *Galerie Mercier & Associés, Galerie Utopie Ed. Bernard* y probablemente en *Cité de l'Architecture et du Patrimoine*, París.

[Fig A.39]

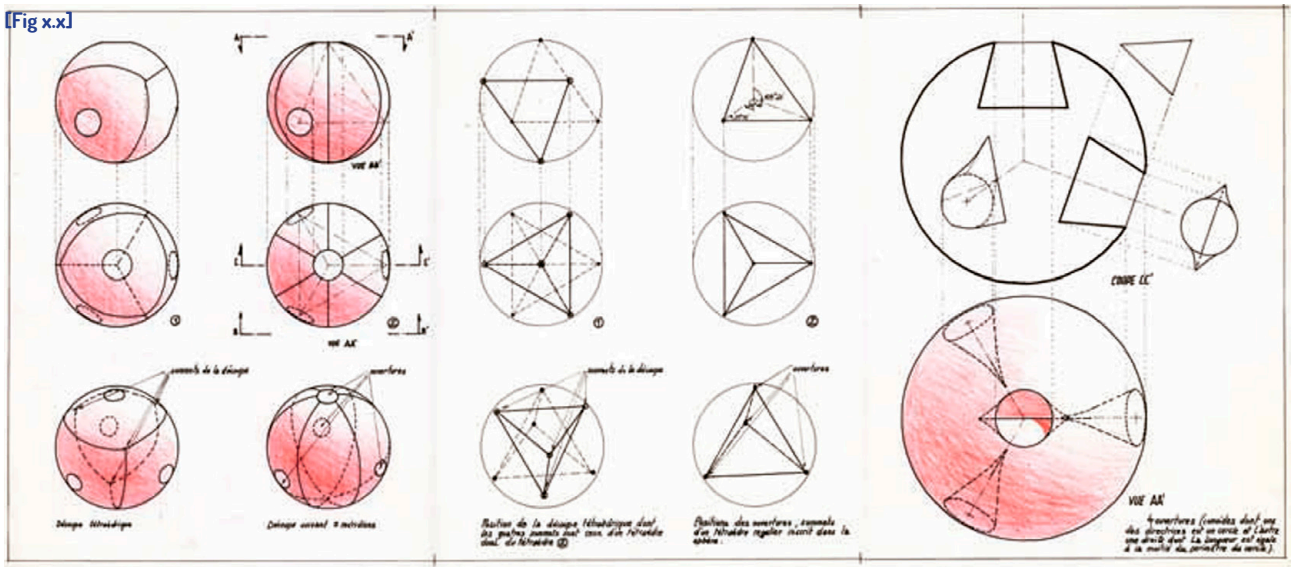
Fotografía en blanco y negro del conjunto de muebles hinchables diseñados y elaborados en la exposición "El universo de los jóvenes" en las galerías Lafayette.

Mobiliario hinchable, luminarias y sillón de doble membrana, no realizado, 1969.

AJS-AEROLANDE. Mobiliario hinchable - luminarias y sillón de doble pared, no realizado, 1969. Fuente: Documentación inédita facilitada por Jean Paul Jungmann.



[Fig x.x]

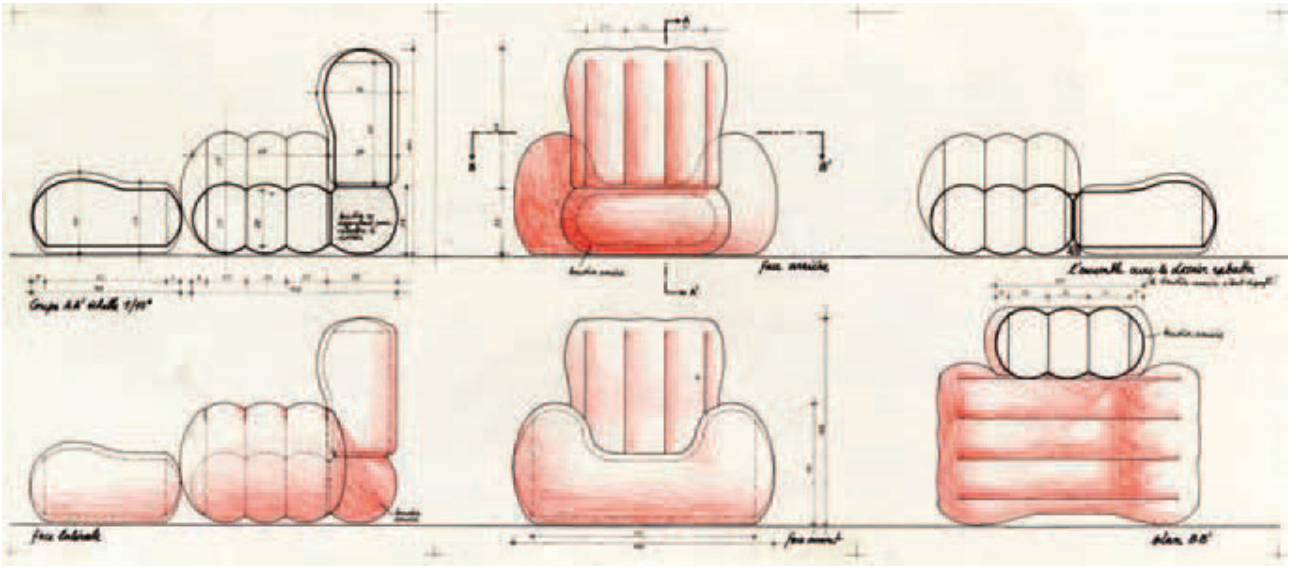


[Fig A.40]

AJS-AEROLANDE. Montaje de luminarias esféricas. Croquis de esfera hinchable con cuatro aperturas y el desarrollo de su parte interior, a escala 1/5. Técnica: tinta negra realzada con pintura roja sobre papel de calco.

[Fig A.41]

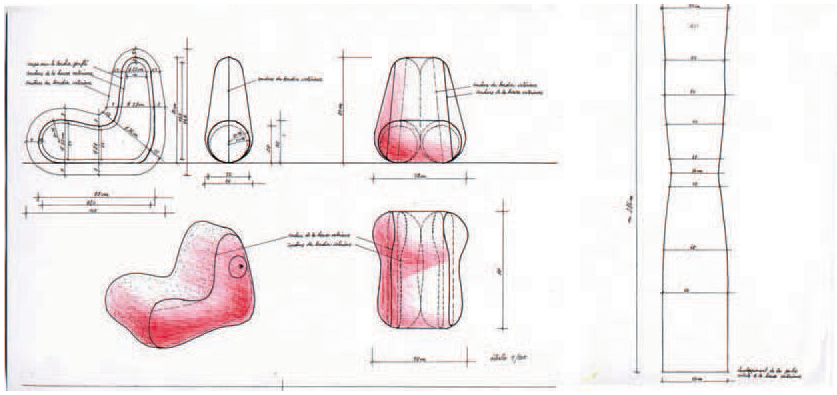
AJS-AEROLANDE. Montaje de luminarias esféricas. Croquis del patrón geométrico de la esfera hinchable. Técnica: tinta negra realzada con pintura roja sobre papel de calco. 29x65cm.

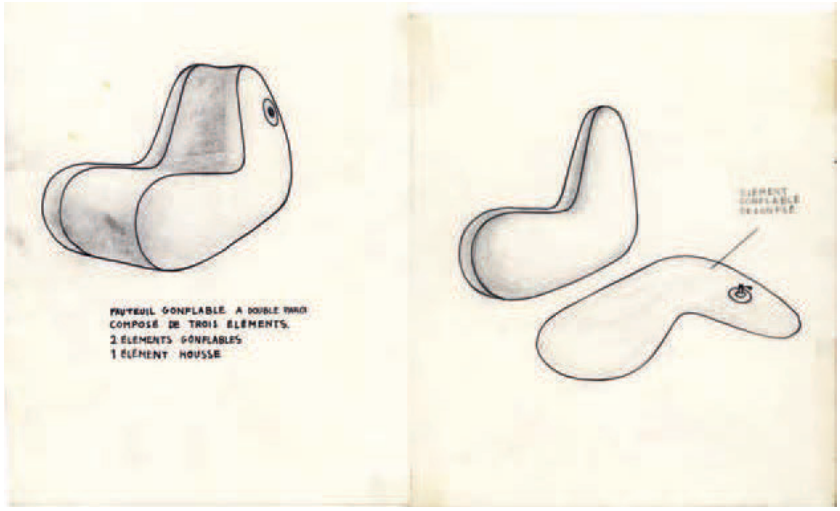


AJS-AEROLANDE. Mobiliario hinchable - luminarias y sillón de doble pared, no realizado, 1969. Fuente: Documentación inédita facilitada por Jean Paul Jungmann.

[Fig A.42]

AJS-AEROLANDE. Croquis en planta, alzado y sección de silla hinchable con respaldo abatible y reposapiés, a escala 1/10. Técnica: tinta negra realzada con pintura roja sobre papel de calco. 30x66 cm.



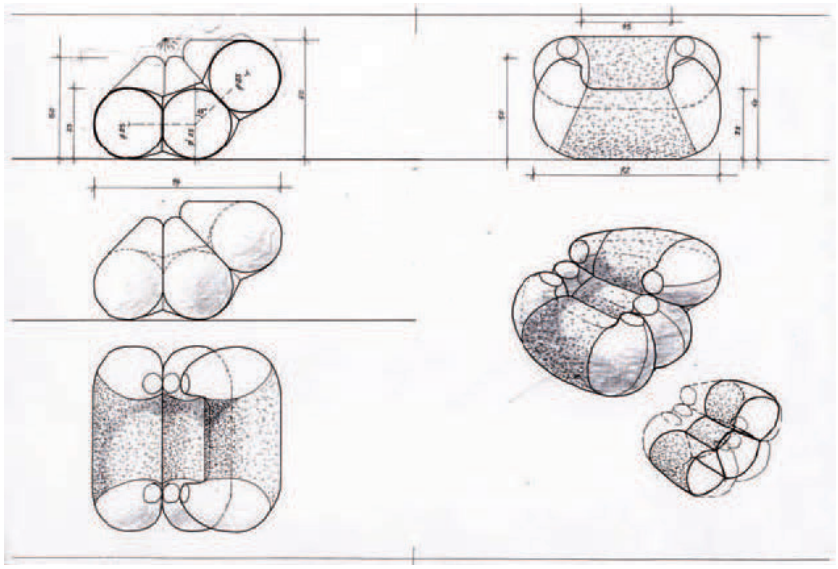


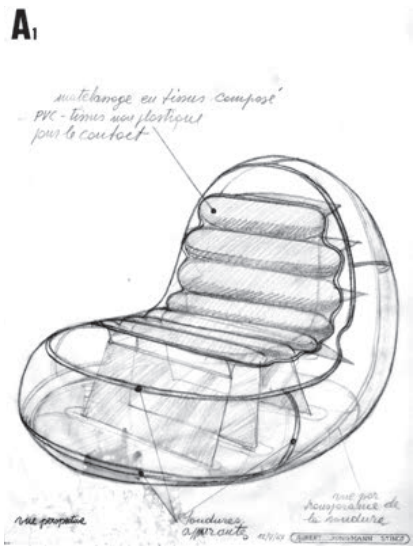
[Fig A.43]

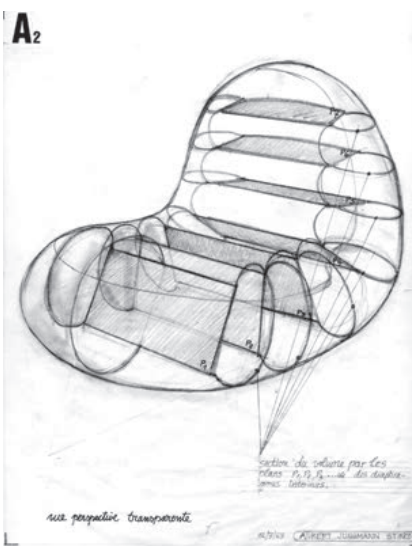
AJS-AEROLANDE. Silla hinchable de doble pared compuesta por tres elementos: 2 elementos hinchables y una funda como envolvente. Vistas en planta, alzado y perspectiva, a escala 1/10. Técnica: tinta negra realzada con pintura roja sobre papel de calco. 31x105cm.

[Fig A.44]

AJS-AEROLANDE. Detalle de la funda. Vistas en perspectiva. Técnica: tinta negra sobre papel de calco. 29x44cm.







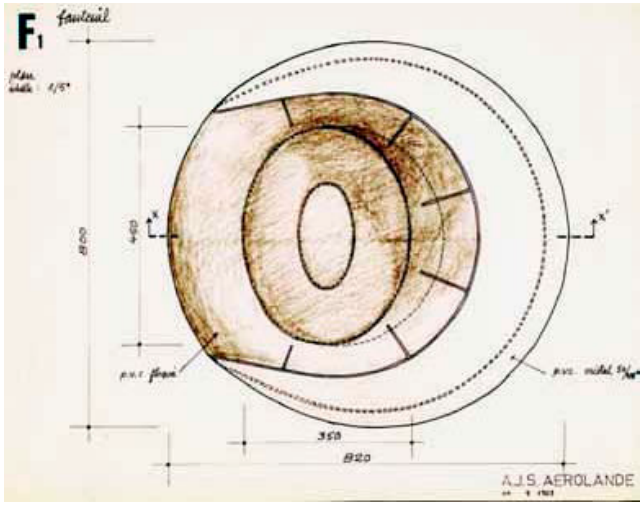
AJS-AEROLANDE. Mobiliario hinchable - luminarias y sillón de doble pared, no realizado, 1969. Fuente: Documentación inédita facilitada por Jean Paul Jungmann.

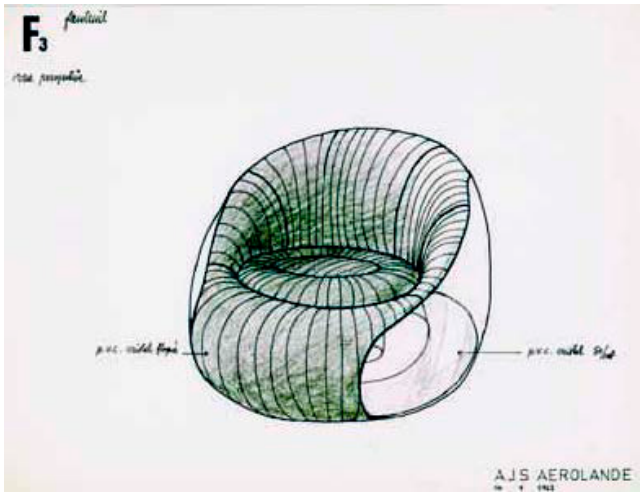
[Fig A.45]

AJS-AEROLANDE. Sillón hinchable de doble pared compuesto por cuatro elementos: 3 elementos hinchables idénticos y una funda como envolvente, a escala 1/10. Técnica: tinta negra realzada con pintura roja sobre papel de calco. 29x44cm.

[Fig A.46]

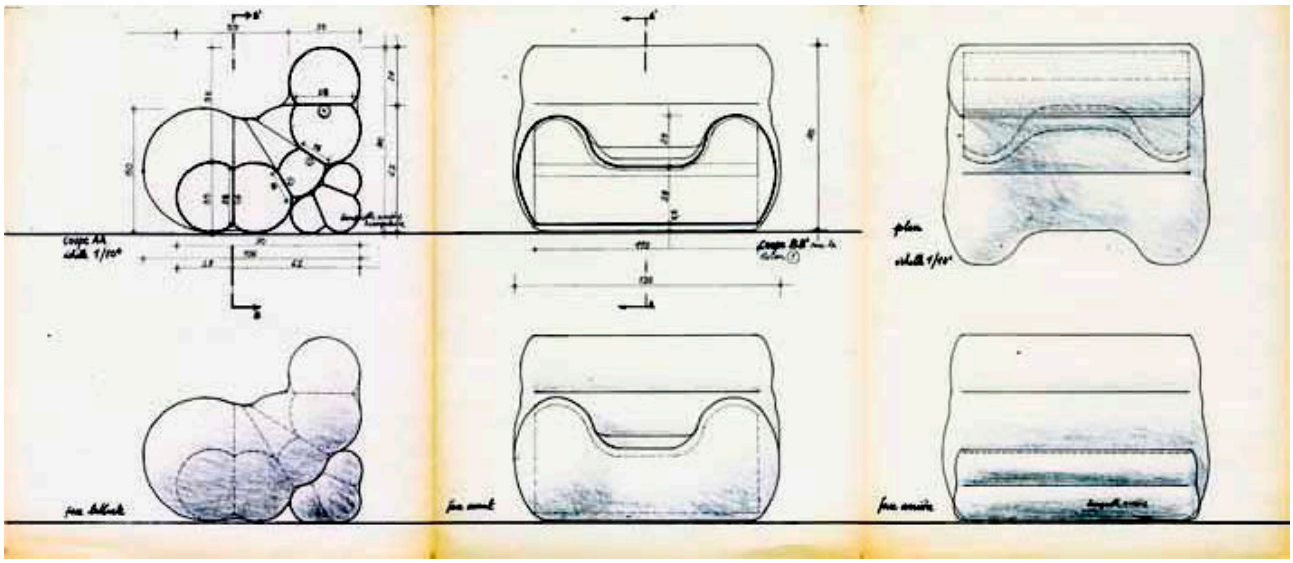
AJS-AEROLANDE. Croquis de un sillón de doble pared. Técnica: tinta negra sobre papel de calco. 33x24cm.





[Fig A.47]

AJS-AEROLANDE. Bocetos de sillón. Técnica: tinta negra sobre papel de calco.



AJS-AEROLANDE. Mobiliario hinchable - luminarias y sillón de doble pared, no realizado, 1969. Fuente: Documentación inédita facilitada por Jean Paul Jungmann.

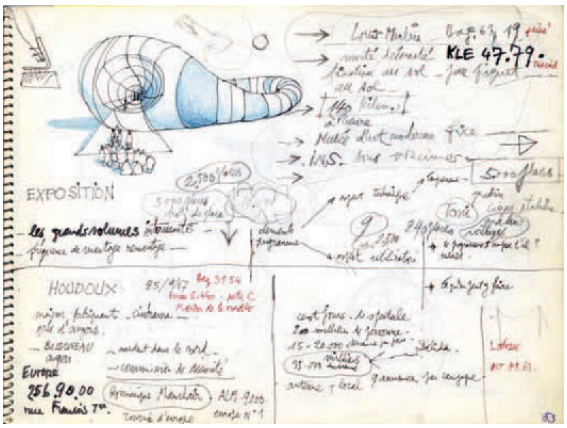
[Fig A.48]

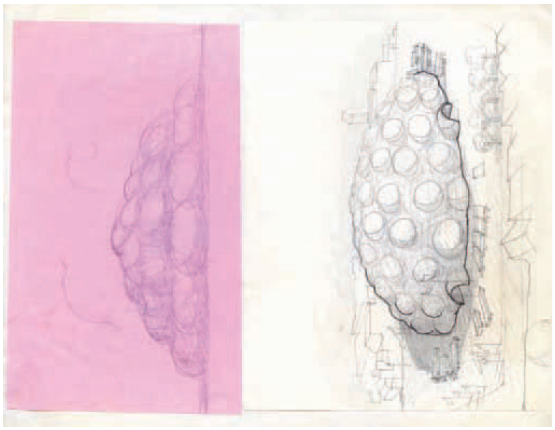
AJS-AEROLANDE. Sillón hinchable de diferentes elementos: elementos hinchables y una funda como envolvente, . Técnica: tinta negra sobre papel de calco.

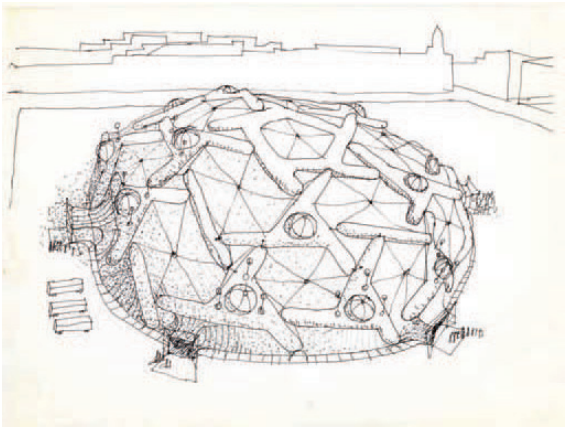
Documentación inédita de Jean Aubert

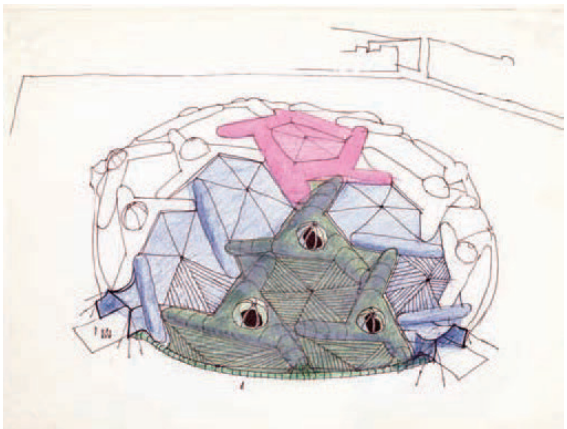
Cuaderno de croquis del proyecto fin de carrera o diploma. 1966

AUBERT, Jean. Cuaderno de croquis del proyecto fin de carrera o diploma. 1966. Fuente: Documentación inédita facilitada por Jean Paul Jungmann. La documentación original se encuentra en la colección privada de Smiljan Radic, Nueva York.



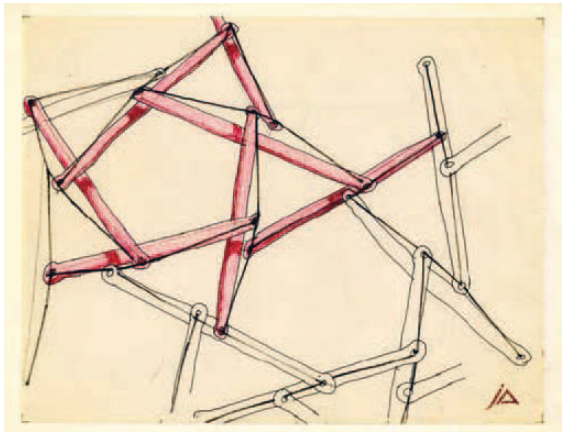


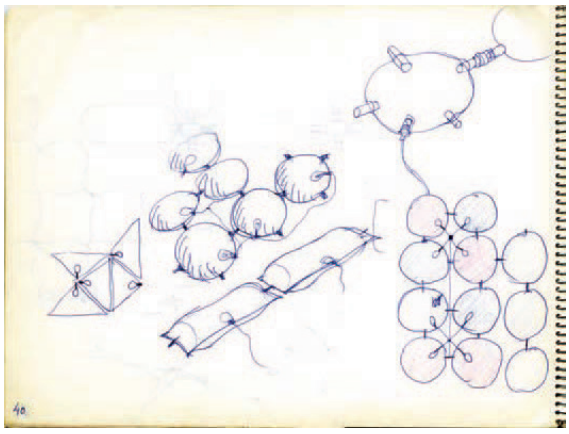


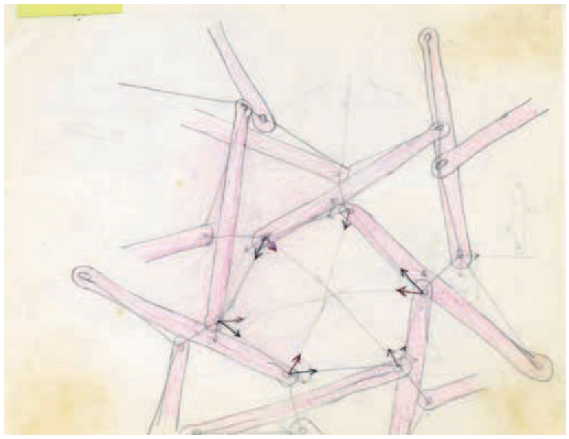


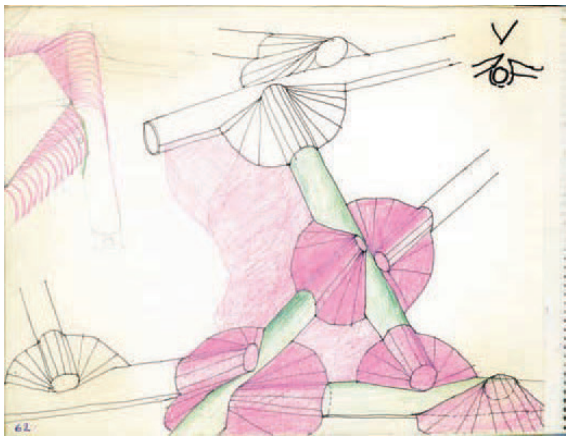
[Fig A.49]

AUBERT, Jean. Cuaderno nº 1. Croquis en axonometría y alzado del Teatro itinerante. Técnica: tinta y lápiz de color sobre papel. Extracción de varias páginas del cuaderno de croquis. 24 x 32 cm.









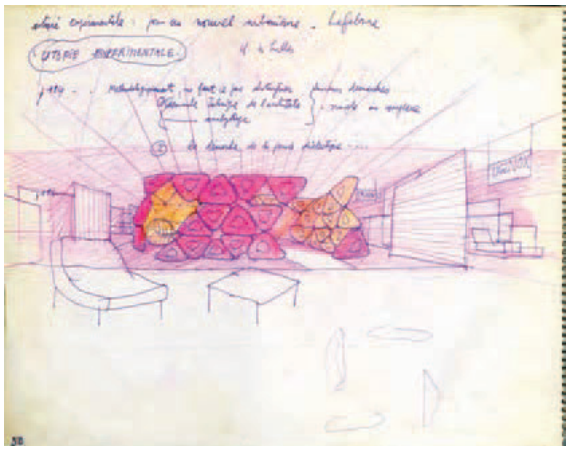
AUBERT, Jean. Cuaderno de croquis del proyecto fin de carrera o diploma. 1966. Fuente: Documentación inédita facilitada por Jean Paul Jungmann. La documentación original se encuentra en la colección privada de Smiljan Radic, Nueva York.

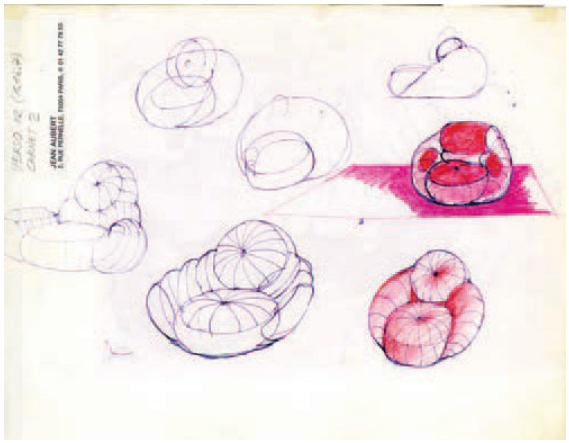
[Fig A.50]

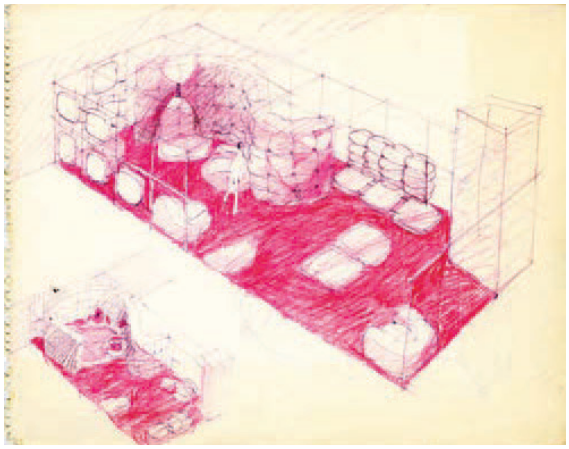
AUBERT, Jean. Cuaderno nº1. Croquis de detalle del Teatro itinerante. Técnica: tinta y lápiz de color sobre papel. Extracción de varias páginas del cuaderno de croquis. 24 x 32 cm.

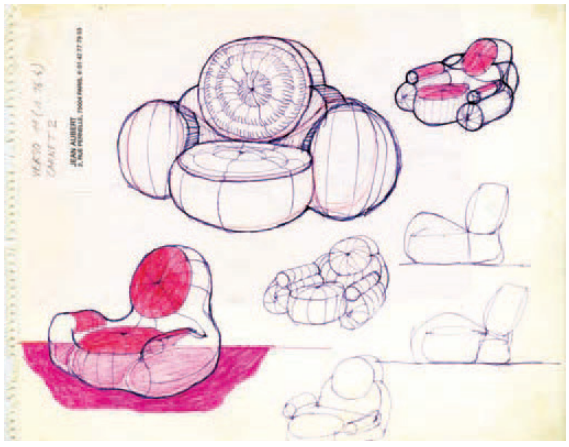
[Fig A.51]

AUBERT, Jean. Cuaderno nº 2. Croquis en axonometría de estructuras hinchables. Técnica: tinta y lápiz de color sobre papel. Extracción de varias páginas del cuaderno de croquis. 27 x 34.5 cm.





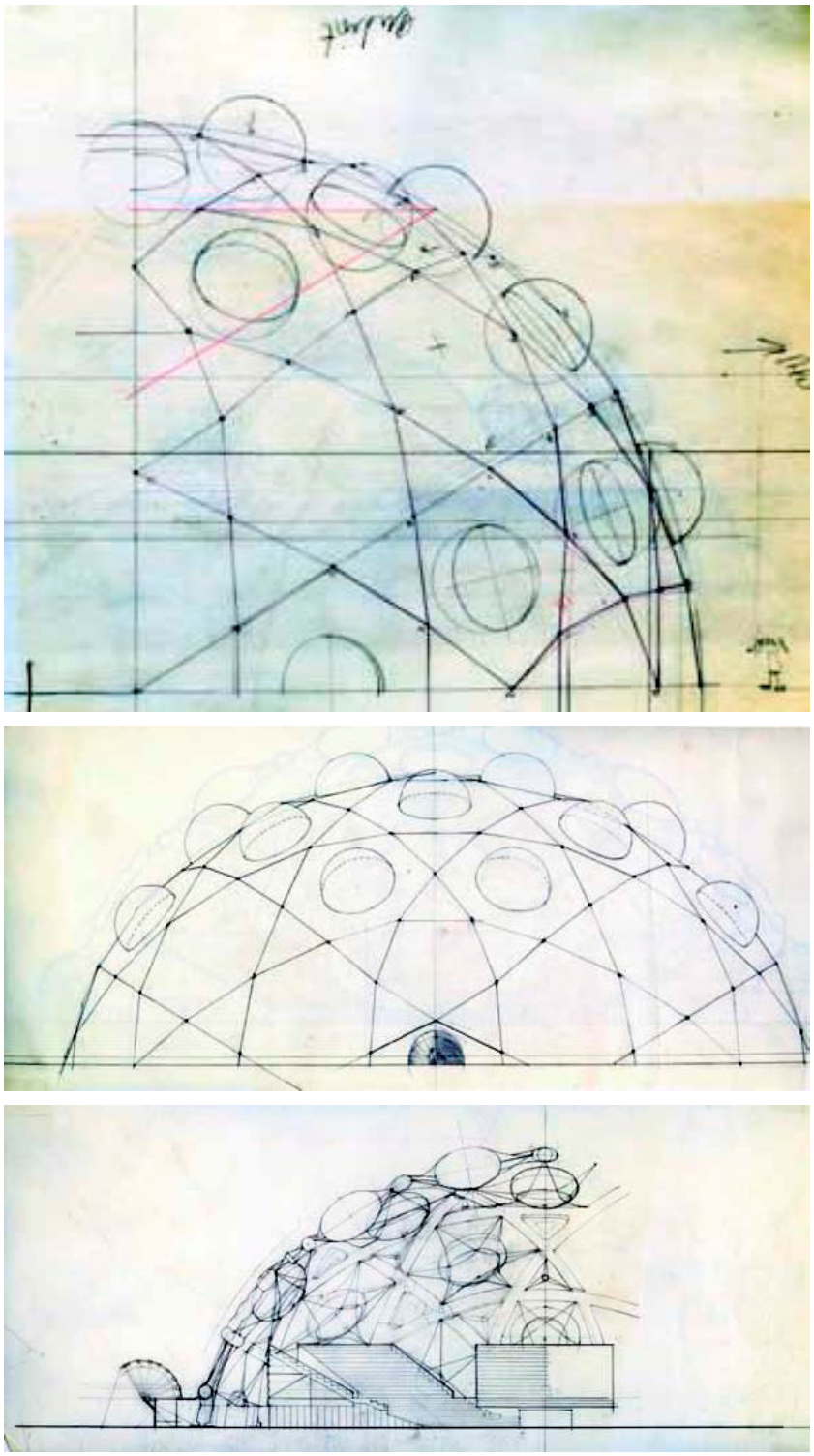




AUBERT, Jean. Cuaderno de croquis del proyecto fin de carrera o diploma. 1966. Fuente: Documentación inédita facilitada por Jean Paul Jungmann. La documentación original se encuentra en la colección privada de Smiljan Radic, Nueva York.

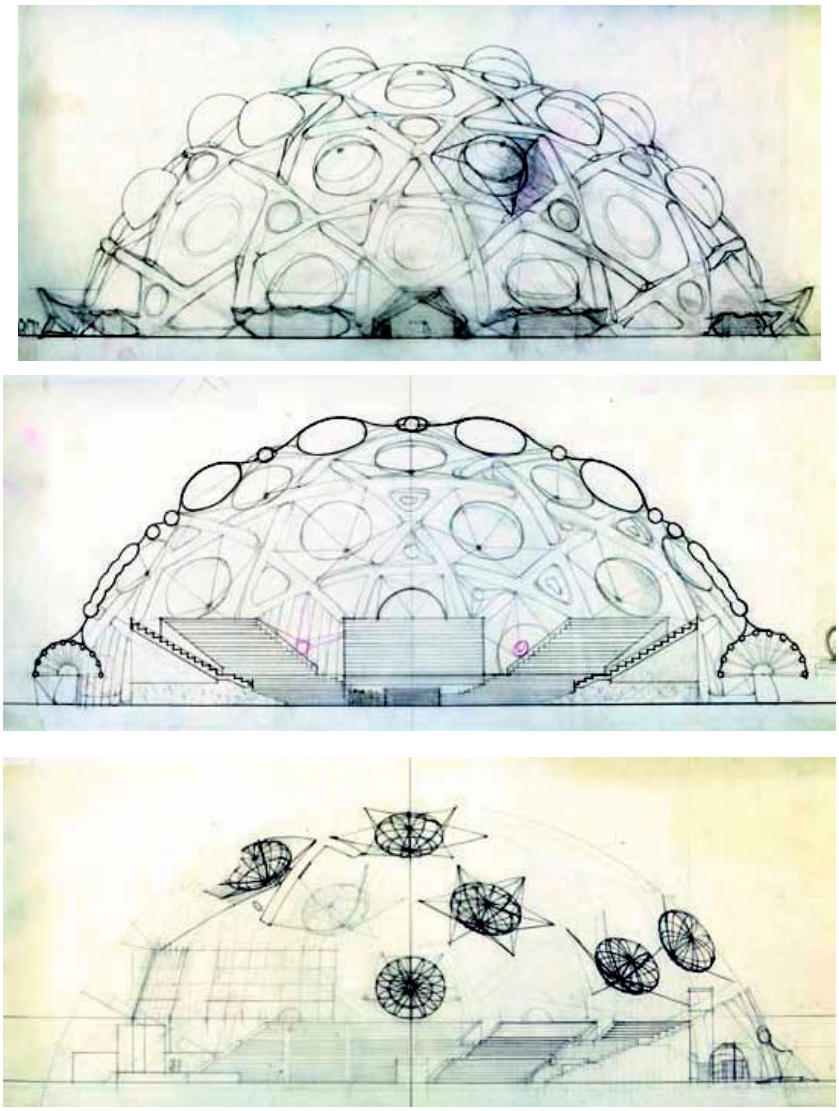
[Fig A.52]

AUBERT, Jean. Cuaderno nº 2. Croquis en axonometría y perspectivas de muebles hinchables. Técnica: tinta y lápiz de color sobre papel. Extracción de varias páginas del cuaderno de croquis. 27 x 34.5 cm.



[Fig A.53]

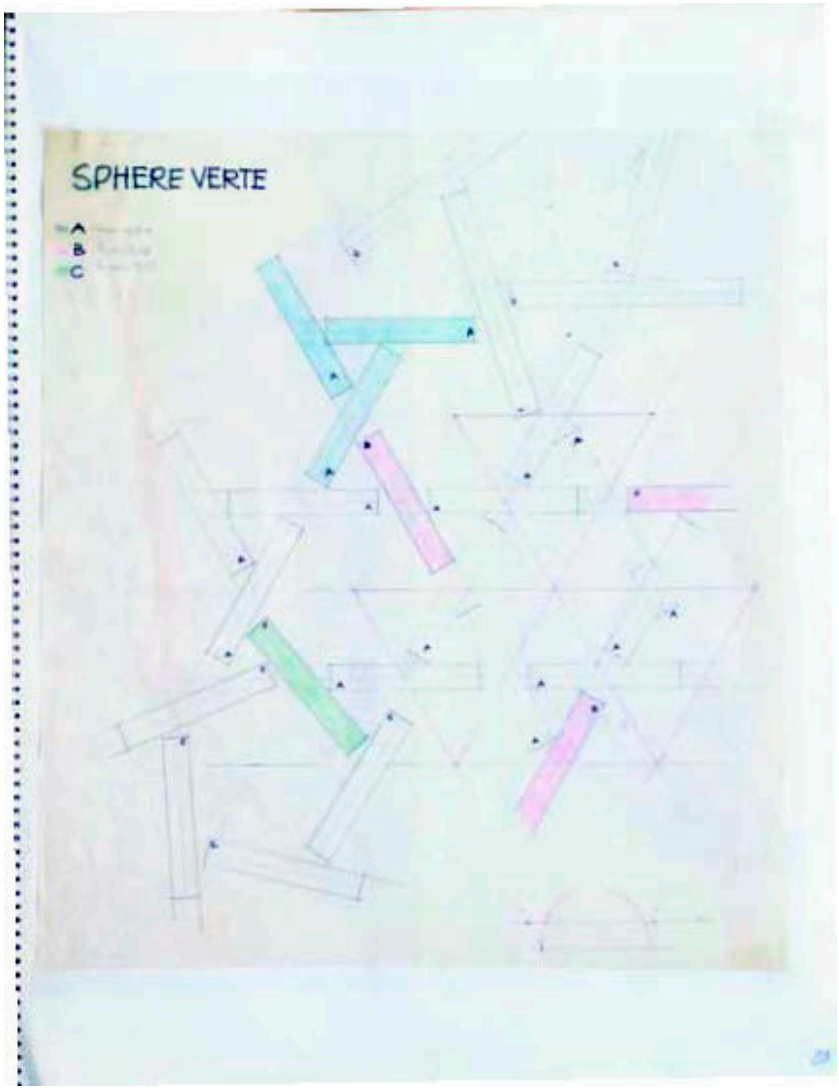
AUBERT, Jean. Cuaderno nº 5. Sección y esquemas de disposición de la estructura del Teatro. Técnica: lápiz y tinta sobre papel. Extracción de varias páginas del cuaderno de croquis. 64,5 x 50 cm.



AUBERT, Jean. Cuaderno de croquis del proyecto fin de carrera o diploma. 1966. Fuente: Documentación inédita facilitada por Jean Paul Jungmann. La documentación original se encuentra en la colección privada de Smiljan Radic, Nueva York.

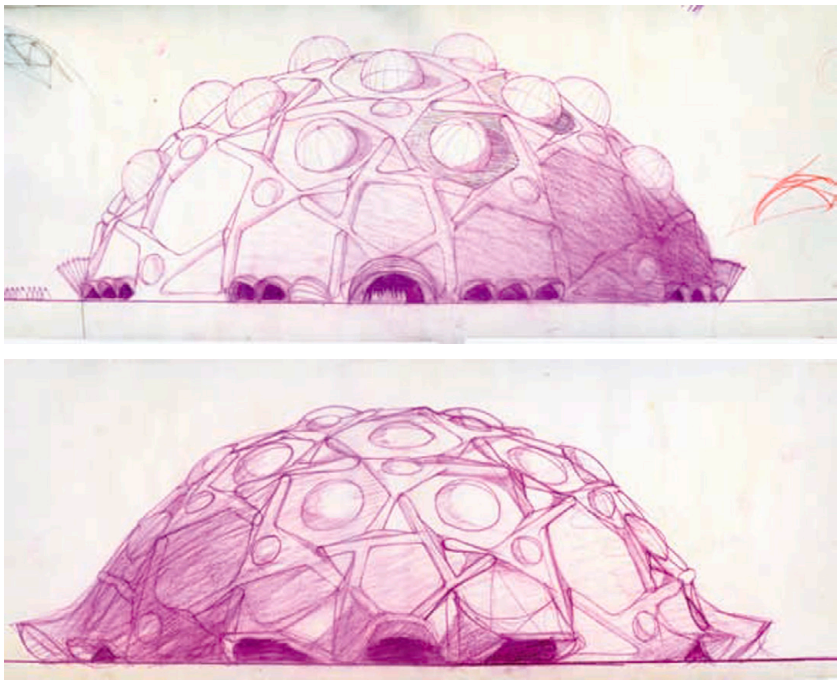
[Fig A.54]

AUBERT, Jean. Cuaderno nº 5. Alzado, sección y detalle de cubierta del Teatro. Técnica: lápiz y tinta sobre papel. Extracción de varias páginas del cuaderno de croquis. 64,5 x 50 cm.



[Fig A.55]

AUBERT, Jean. Cuaderno nº 5. Estudio detalle de la estructura del Teatro. Técnica: lápiz y tinta sobre papel. Extracción de varias páginas del cuaderno de croquis. 64,5 x 50 cm.



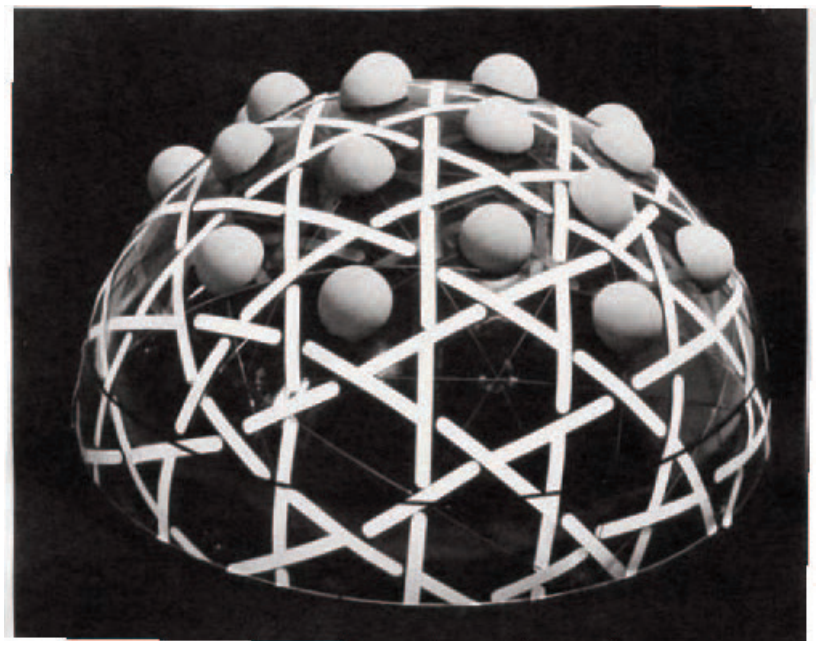
AUBERT, Jean. Cuaderno de croquis del proyecto fin de carrera o diploma. 1966. Fuente: Documentación inédita facilitada por Jean Paul Jungmann. La documentación original se encuentra en la colección privada de Smiljan Radic, Nueva York.

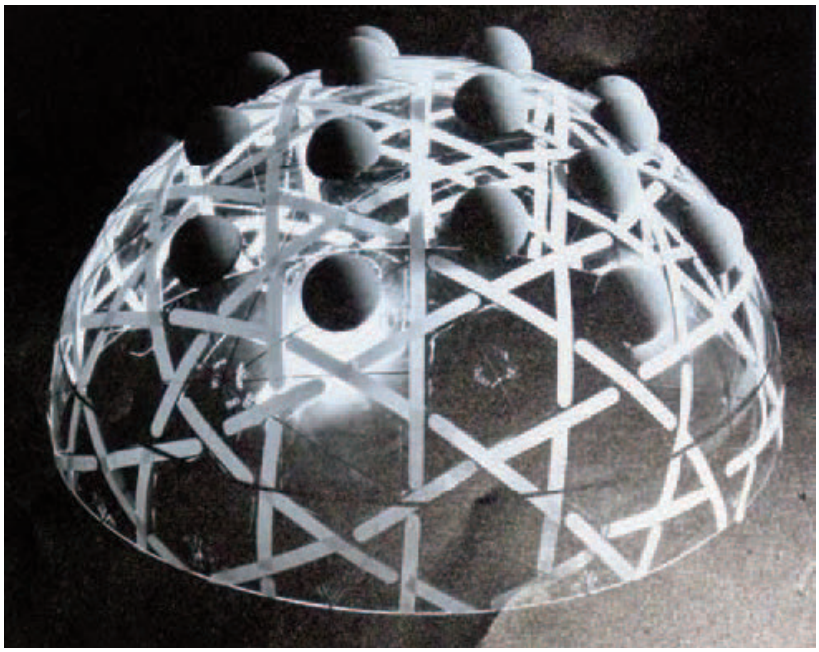
[Fig A.56]

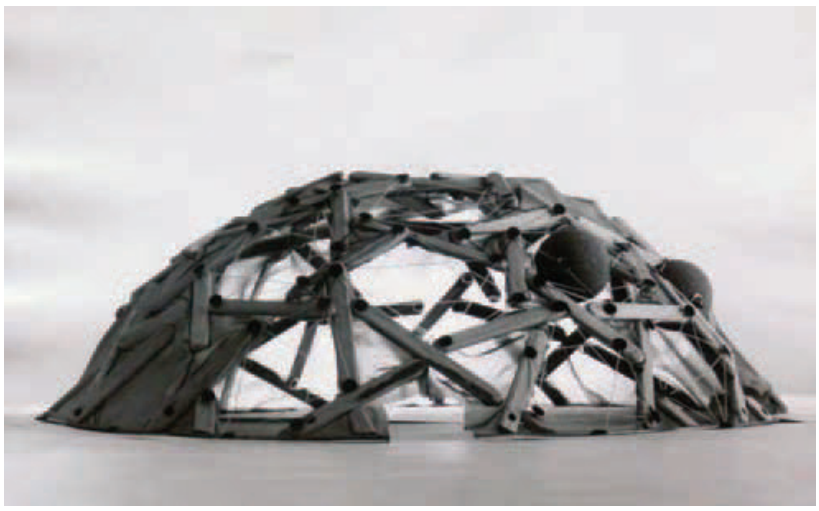
AUBERT, Jean. Cuaderno nº 5. Croquis de alzados del Teatro. Técnica: lápiz de color sobre papel. Extracción de varias páginas del cuaderno de croquis. 64,5 x 50 cm.

Teatro itinerante para 5000 espectadores, 1967.

AUBERT, Jean. Teatro itinerante para 5000 espectadores, 1967. Fuente: Documentación inédita facilitada por Jean Paul Jungmann. La documentación original fue adquirida en el año 2000 por Le FNAC de París (Fondo Nacional de Arte Contemporáneo) y desde el año 2007 se encuentra en MNAM/CCI de París (Museo Nacional de Arte Moderno/Centro Pompidou). Parte de la documentación se encuentra en la colección privada de Smiljan Radic en Nueva York"

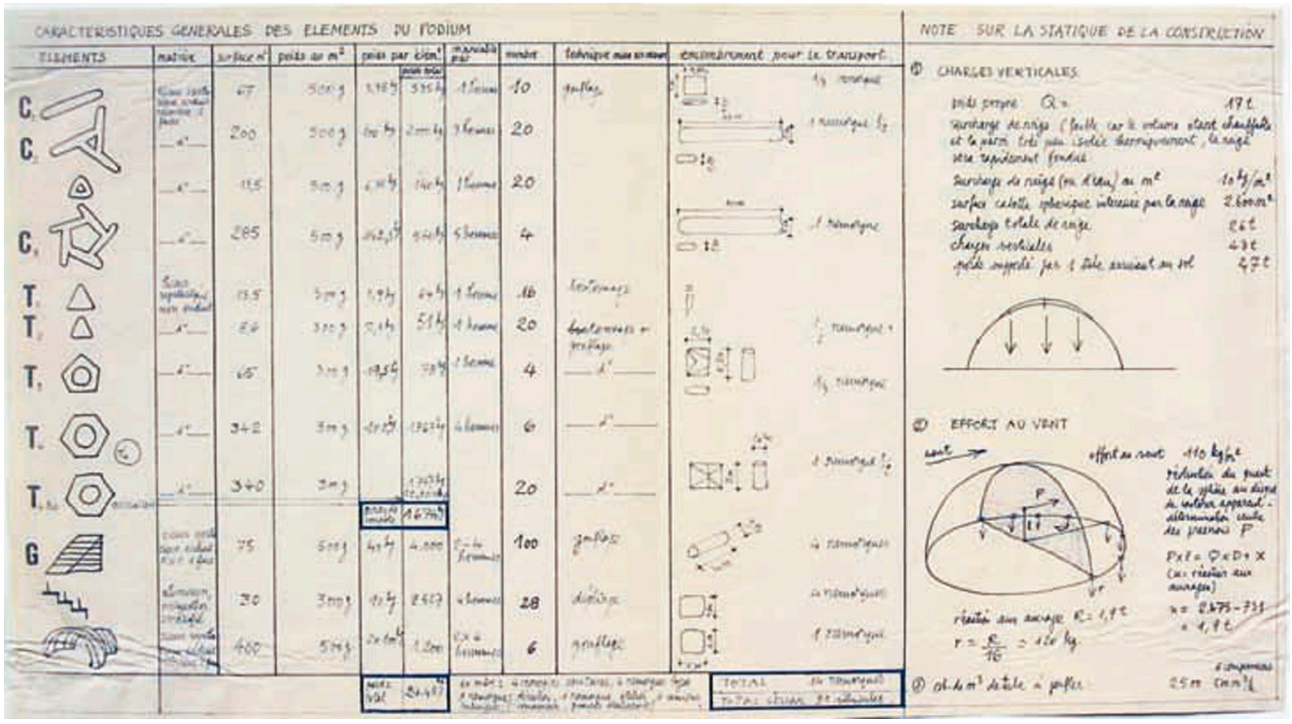






[Fig A.57]

AUBERT, Jean. Una serie de fotografías en blanco y negro de 2 maquetas.



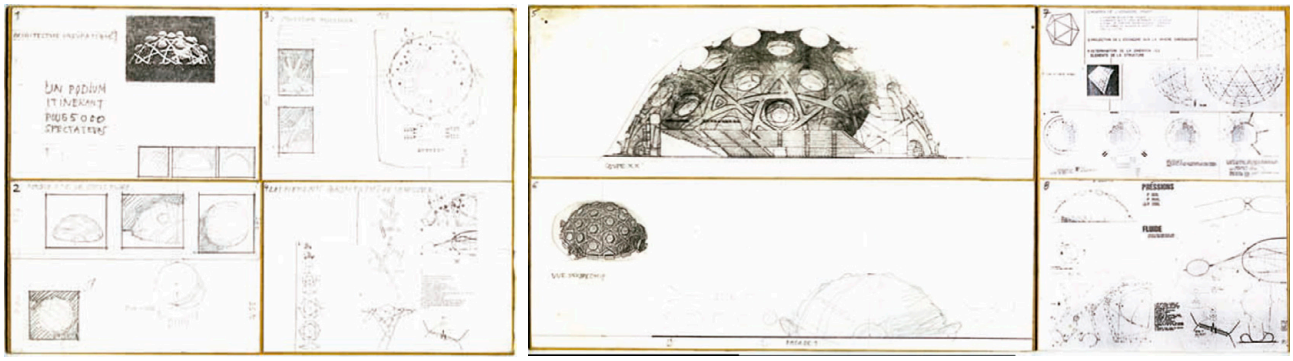
AUBERT, Jean. Teatro itinerante para 5000 espectadores, 1967. Fuente: Documentación inédita facilitada por Jean Paul Jungmann. La documentación original fue adquirida en el año 2000 por Le FNAC de París (Fondo Nacional de Arte Contemporáneo) y desde el año 2007 se encuentra en MNAM/ CCI de París (Museo Nacional de Arte Moderno/Centro Pompidou). Parte de la documentación se encuentra en la colección privada de Smiljan Radic en Nueva York"

[Fig A.58]

AUBERT, Jean. Características generales de los elementos del Teatro itinerante. Notas sobre la estática de la construcción.

[Fig A.59]

Fotografías en blanco y negro en el taller Albert durante la graduación, en las que aparece Jean Paul Jungmann.Dimensiones: 12.8 x 9 cm.



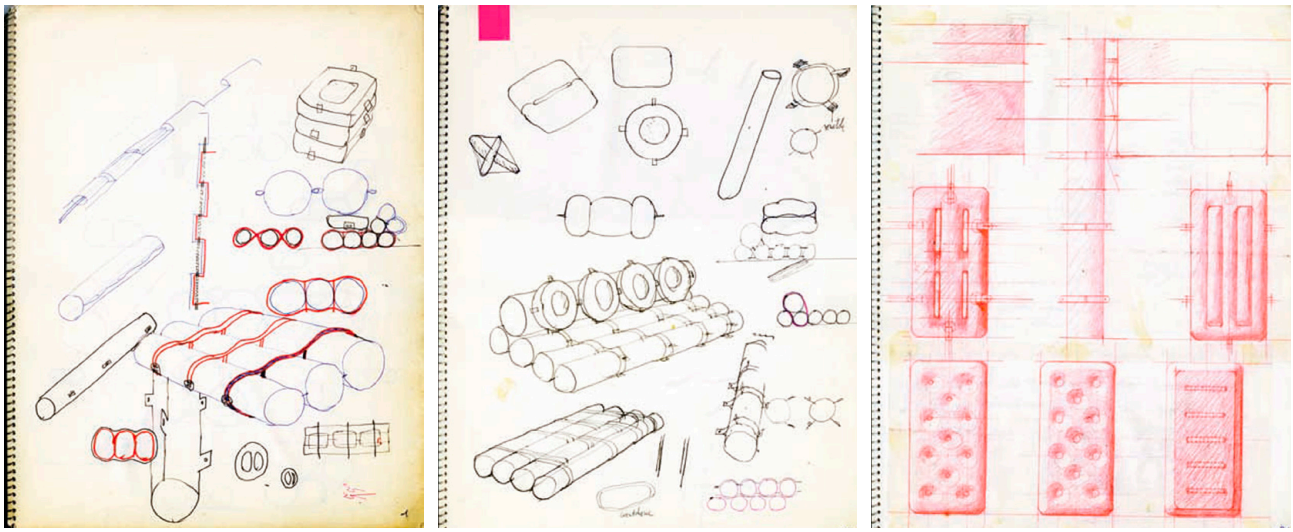
AUBERT, Jean. Teatro itinerante para 5000 espectadores, 1967. Fuente: Documentación inédita facilitada por Jean Paul Jungmann. La documentación original fue adquirida en el año 2000 por Le FNAC de París (Fondo Nacional de Arte Contemporáneo) y desde el año 2007 se encuentra en MNAM/ CCI de París (Museo Nacional de Arte Moderno/Centro Pompidou). Parte de la documentación se encuentra en la colección privada de Smiljan Radic en Nueva York"

[Fig A.60]

AUBERT, Jean. Diseño de los paneles para la exposición "*The inflatable moment*" mediante un collage de fotocopias pegadas sobre madera.

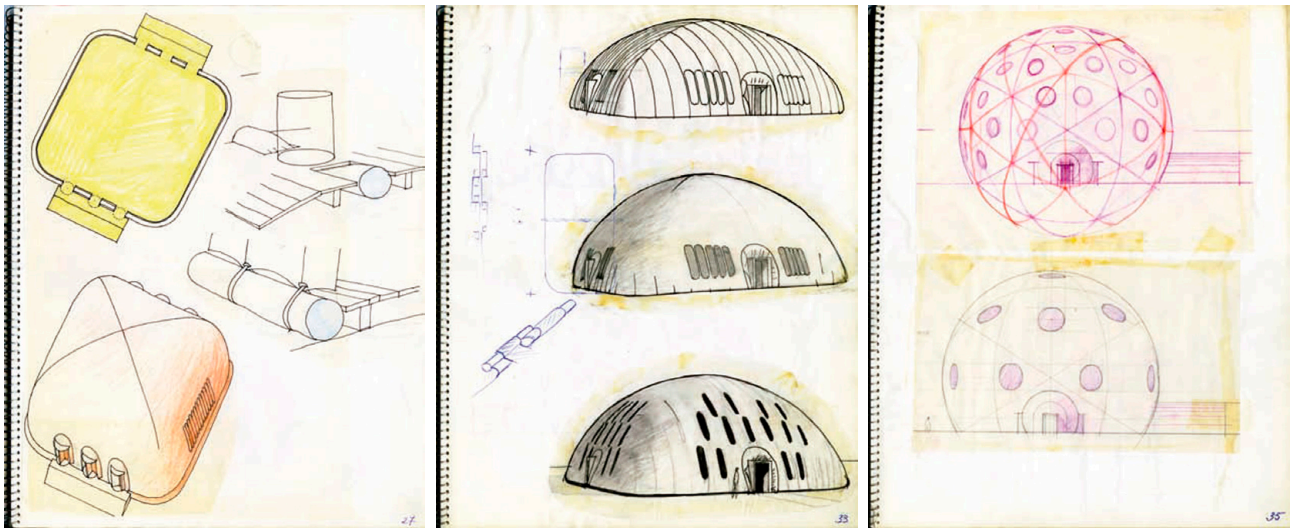
Cuaderno nº 3 de mobiliario hinchable - refugios hinchables , circa 1967.

AUBERT, Jean. Cuaderno nº 3 de mobiliario hinchable - refugios hinchables. Fuente: Documentación inédita facilitada por Jean Paul Jungmann. La documentación original se encuentra en la colección privada de Smiljan Radic, Nueva York.



[Fig A.61]

AUBERT, Jean. Croquis de unión de tubos hinchables para la configuración de mobiliario. Varias técnicas. Técnica: tinta, lápiz de color en papel y papel de calco pegado. Extracción de varias páginas del cuaderno de croquis. 34 x 27 cm.



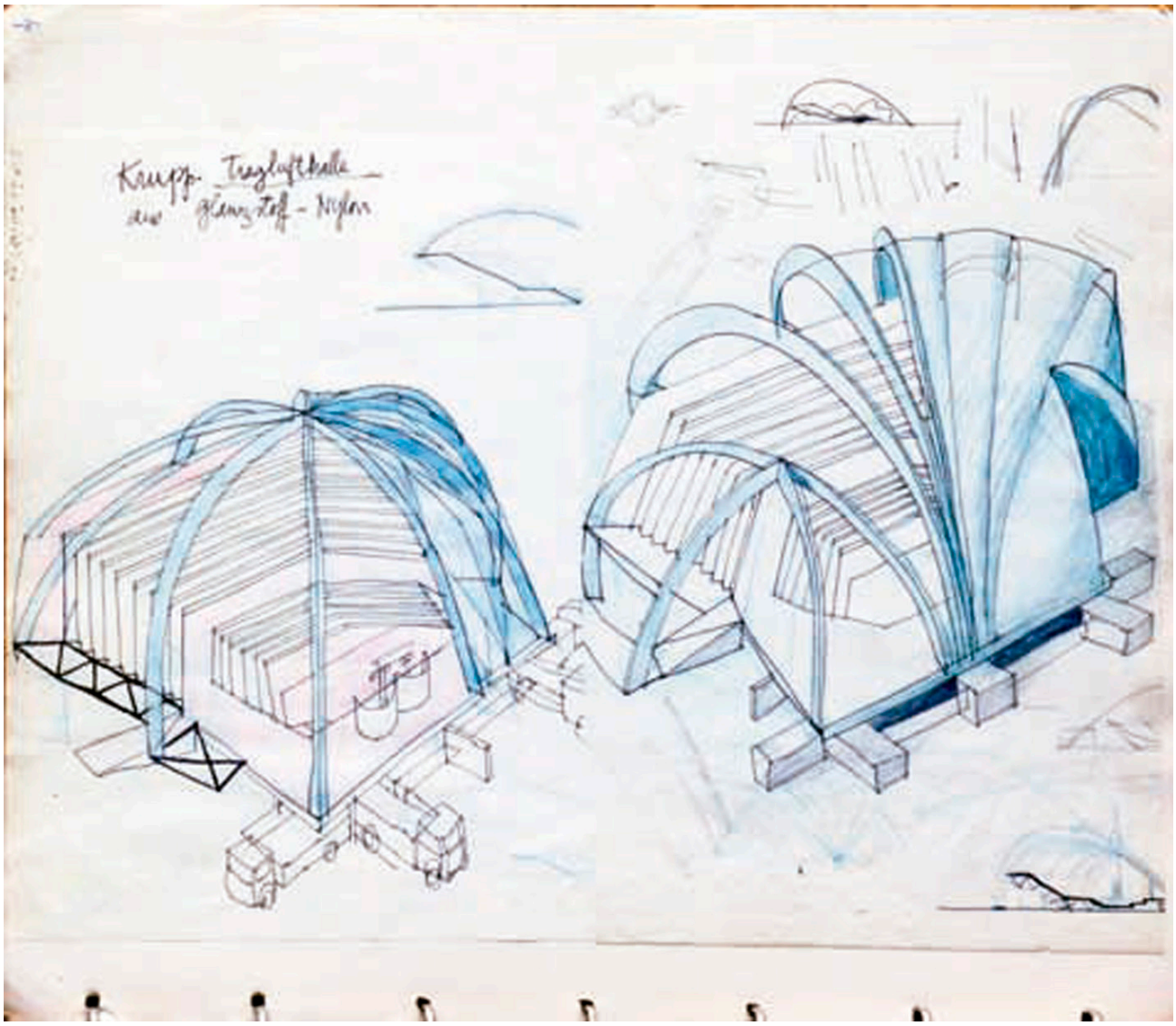
AUBERT, Jean. Cuaderno nº 3 de mobiliario hinchable - refugios hinchables. Fuente: Documentación inédita facilitada por Jean Paul Jungmann. La documentación original se encuentra en la colección privada de Smiljan Radic, Nueva York.

[Fig A.62]

AUBERT, Jean. Croquis de refugios hinchables. Varias técnicas. Técnica: tinta, lápiz de color en papel y papel de calco pegado. Extracción de varias páginas del cuaderno de croquis. 34 x 27 cm.

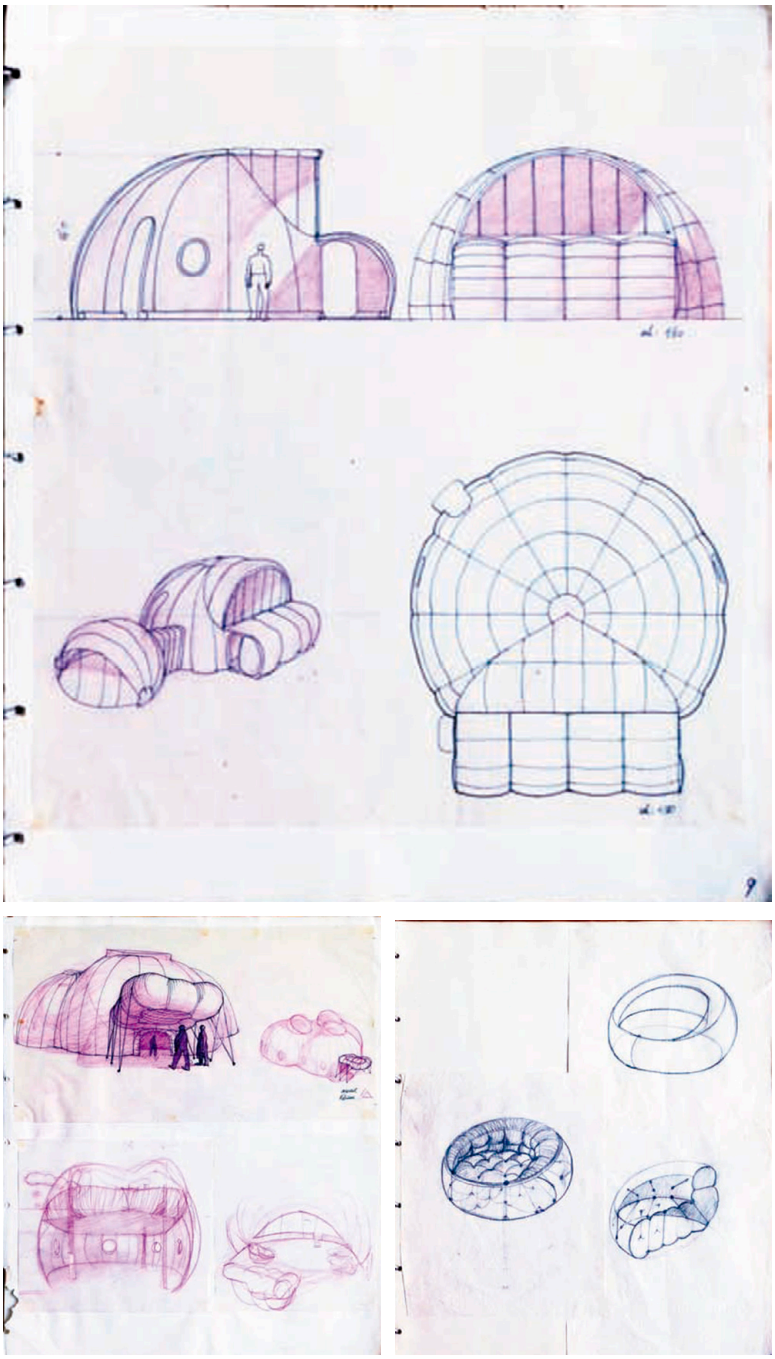
Cuaderno n°4, 1967

AUBERT, Jean. Cuaderno n° 4. Fuente: Documentación inédita facilitada por Jean Paul Jungmann. La documentación original se encuentra en la colección privada de Smiljan Radic, Nueva York.



[Fig A.63]

AUBERT, Jean. Croquis en axonometría de refugio hinchable. Varias técnicas: tinta, lápiz de color sobre papel y papel de calco pegado. Extracción de varias páginas del cuaderno de croquis. 45 x 39.5 cm.



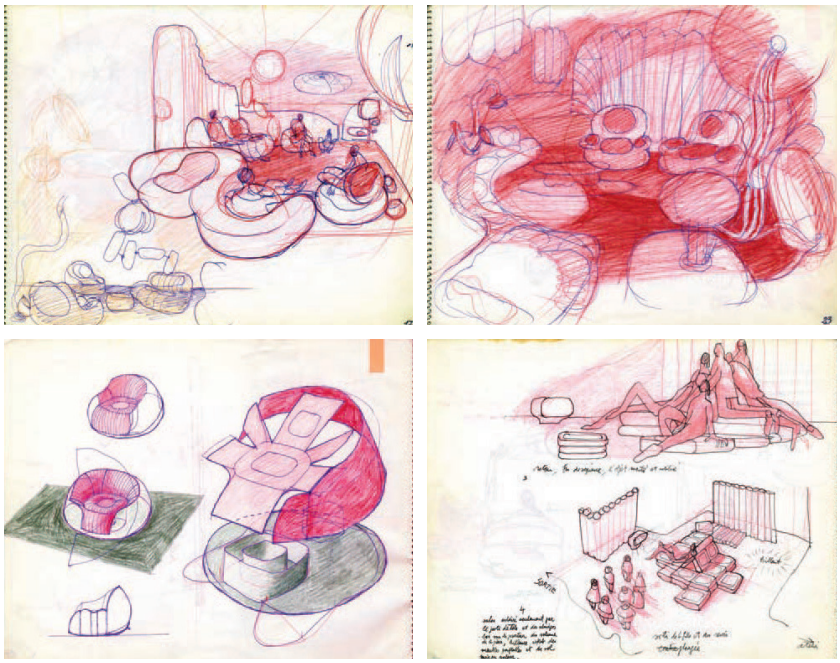
AUBERT, Jean. Cuaderno nº 4. Fuente: Documentación inédita facilitada por Jean Paul Jungmann. La documentación original se encuentra en la colección privada de Smiljan Radic, Nueva York.

[Fig A.64]

AUBERT, Jean. Croquis en planta, sección, alzado y axonometría de refugio hinchable. Varias técnicas: tinta, lápiz de color sobre papel y papel de calco pegado. Extracción de varias páginas del cuaderno de croquis. 45 x 39.5 cm.

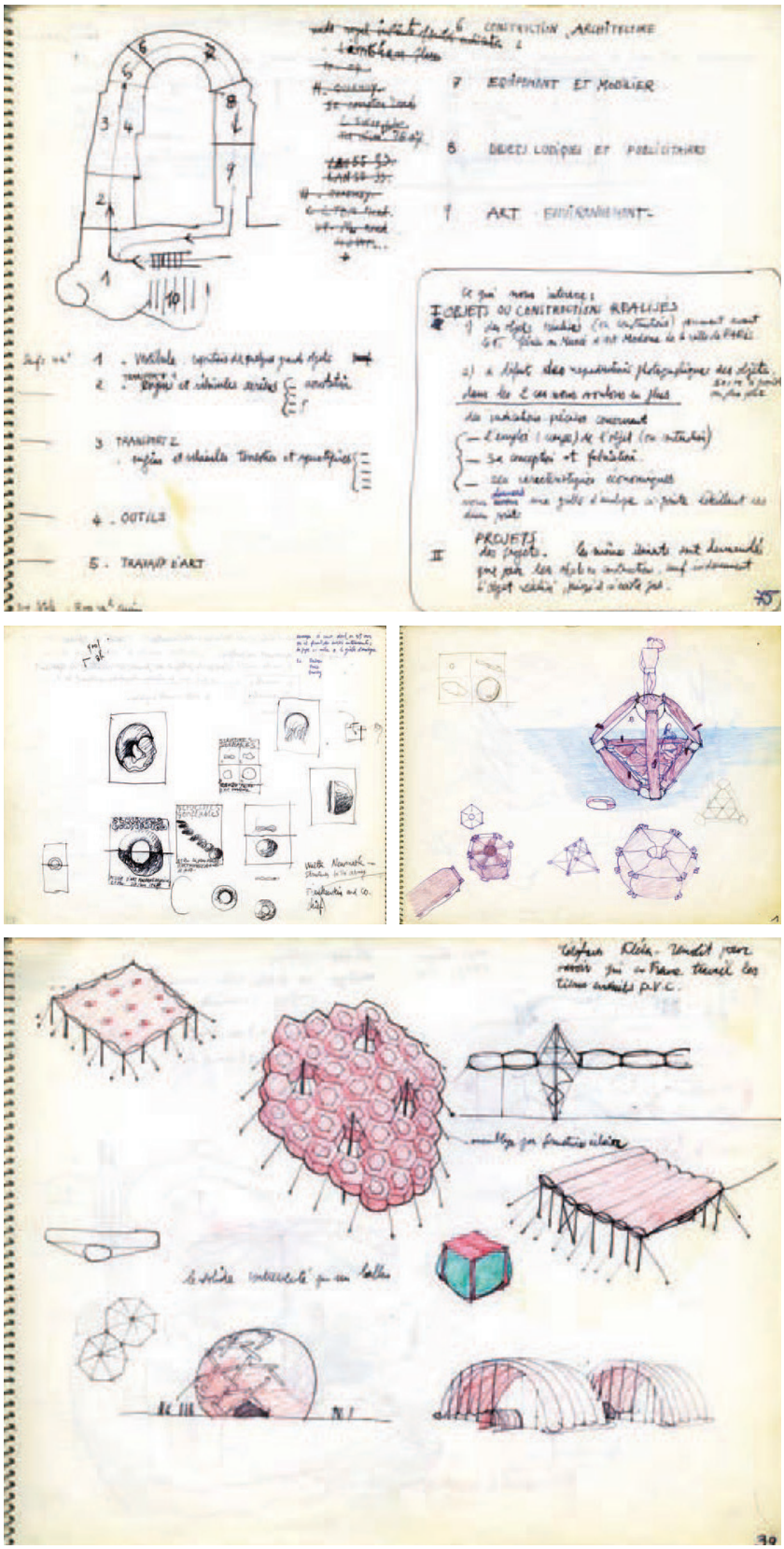
Cuaderno nº6 Exposición: estructuras hinchables en las galerías Lafeyette, 1967.

AUBERT, Jean. Cuaderno nº 6 Exposición: estructuras hinchables en las galerías Lafayette, 1967. Fuente: Documentación inédita facilitada por Jean Paul Jungmann. La documentación original se encuentra en la colección privada de Smiljan Radic, Nueva York.



[Fig A.65]

AUBERT, Jean. Croquis de perspectivas de mobiliario hinchable. Varias técnicas: tinta, lápiz de color sobre papel y papel de calco pegado. Extracción de varias páginas del cuaderno de croquis. 27 x 34 cm.



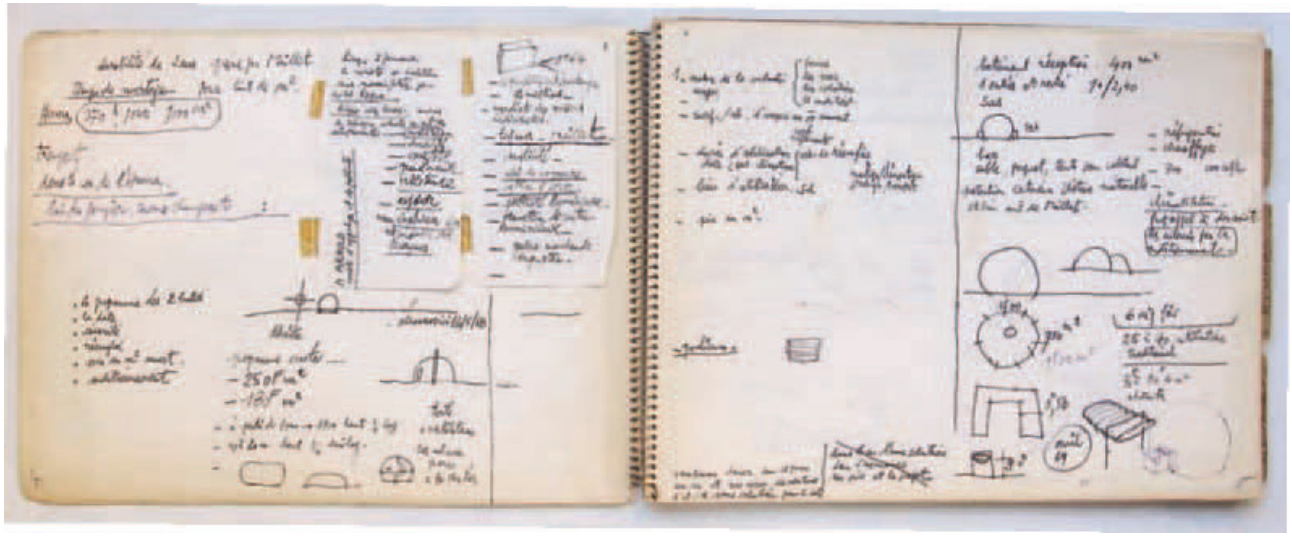
AUBERT, Jean. Cuaderno nº 6 Exposición: estructuras hinchables en las galerías Lafayette, 1967. Fuente: Documentación inédita facilitada por Jean Paul Jungmann. La documentación original se encuentra en la colección privada de Smiljan Radic, Nueva York.

[Fig A.66]

AUBERT, Jean. Croquis en axonometría de refugio hinchable. Varias técnicas. Tinta, lápiz de color sobre papel y papel de calco pegado. Extracción de varias páginas del cuaderno de croquis. 27 x 34 cm.

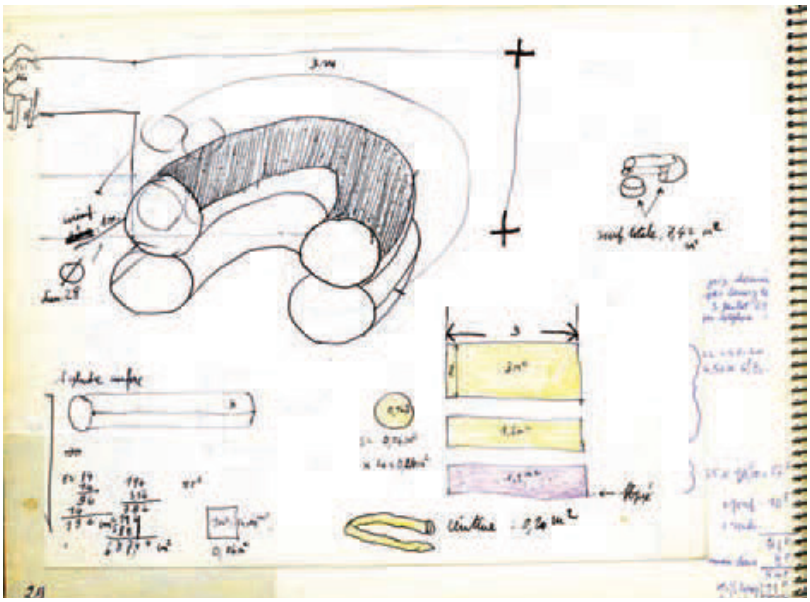
Cuaderno nº7 de croquis de mobiliario hinchable, 1968.

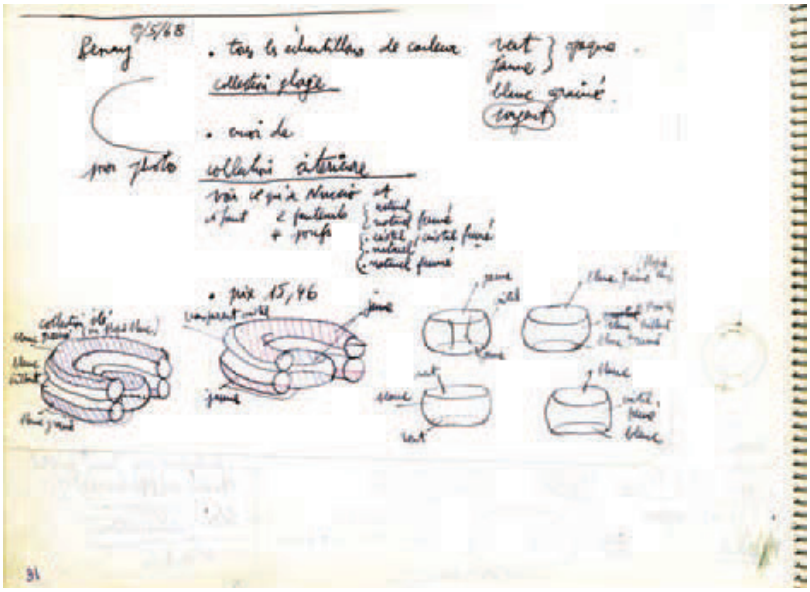
AUBERT, Jean. Cuaderno nº 7 de croquis de mobiliario hinchable, 1968. Fuente: Documentación inédita facilitada por Jean Paul Jungmann. La documentación original se encuentra en la colección privada de Smiljan Radic, Nueva York.

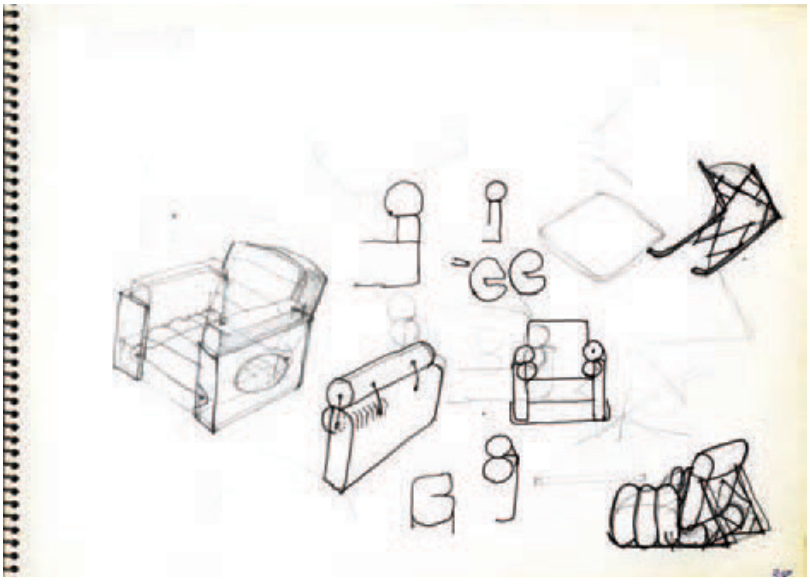


[Fig A.67]

AUBERT, Jean. Croquis de perspectivas de mobiliario hinchable y notas. Varias técnicas: tinta, lápiz de color sobre papel y papel de calco pegado. Extracción de varias páginas del cuaderno de croquis. 24 x 32 cm.







AUBERT, Jean. Cuaderno nº 7 de croquis de mobiliario hinchable, 1968. Fuente: Documentación inédita facilitada por Jean Paul Jungmann. La documentación original se encuentra en la colección privada de Smiljan Radic, Nueva York.

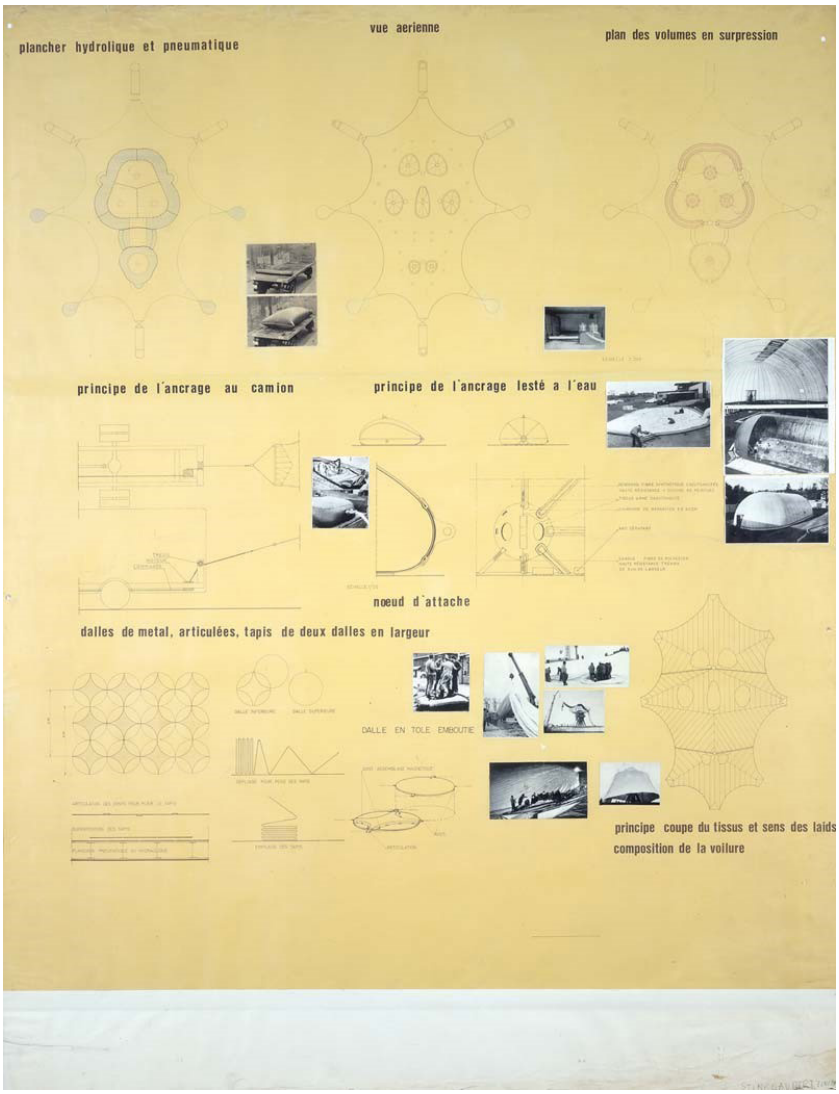
[Fig A.68]

AUBERT, Jean. Croquis de perspectivas de mobiliario hinchable y notas. Varias técnicas: tinta, lápiz de color sobre papel y papel de calco pegado. Extracción de varias páginas del cuaderno de croquis. 24 x 32 cm.

Documentación inédita de Antonie Stinco

Pabellón itinerante para la exposición de objetos cotidianos, 1967.

STINCO, Antonie. Pabellón itinerante para la exposición de objetos cotidianos, 1967. Fuente: Documentación inédita facilitada por Jean Paul Jungmann. La documentación original se encuentra en FRAC- Centre, Orleans.



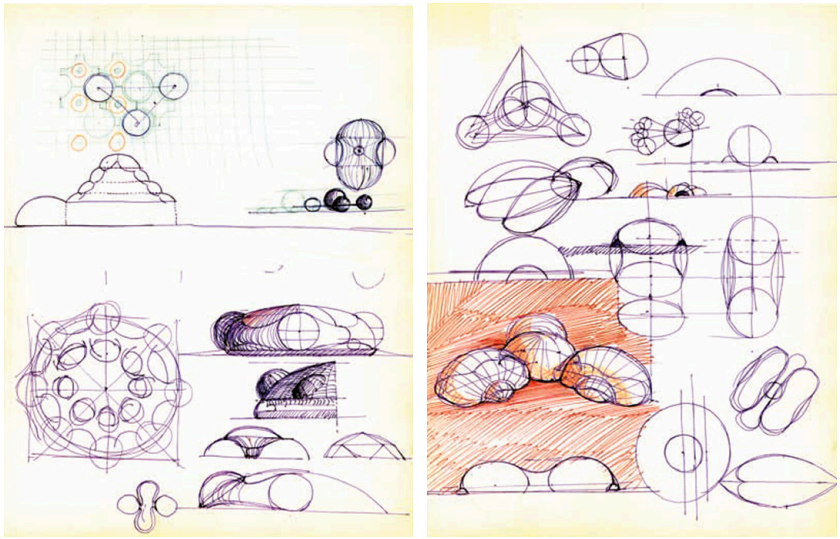
STINCO, Antonie. Pabellón itinerante para la exposición de objetos cotidianos, 1967. Fuente: Documentación inédita facilitada por Jean Paul Jungmann. La documentación original se encuentra en FRAC- Centre, Orleans.

[Fig A.69]

STINCO, Antonie. Plano del proyecto: Pabellón itinerante para la exposición de objetos cotidianos. Colección de Antoine Stinco (AJS-Aérolande). Collage sobre papel. 163 x 124 cm. nº de la colección 996 02 89 © Philippe Magnon.

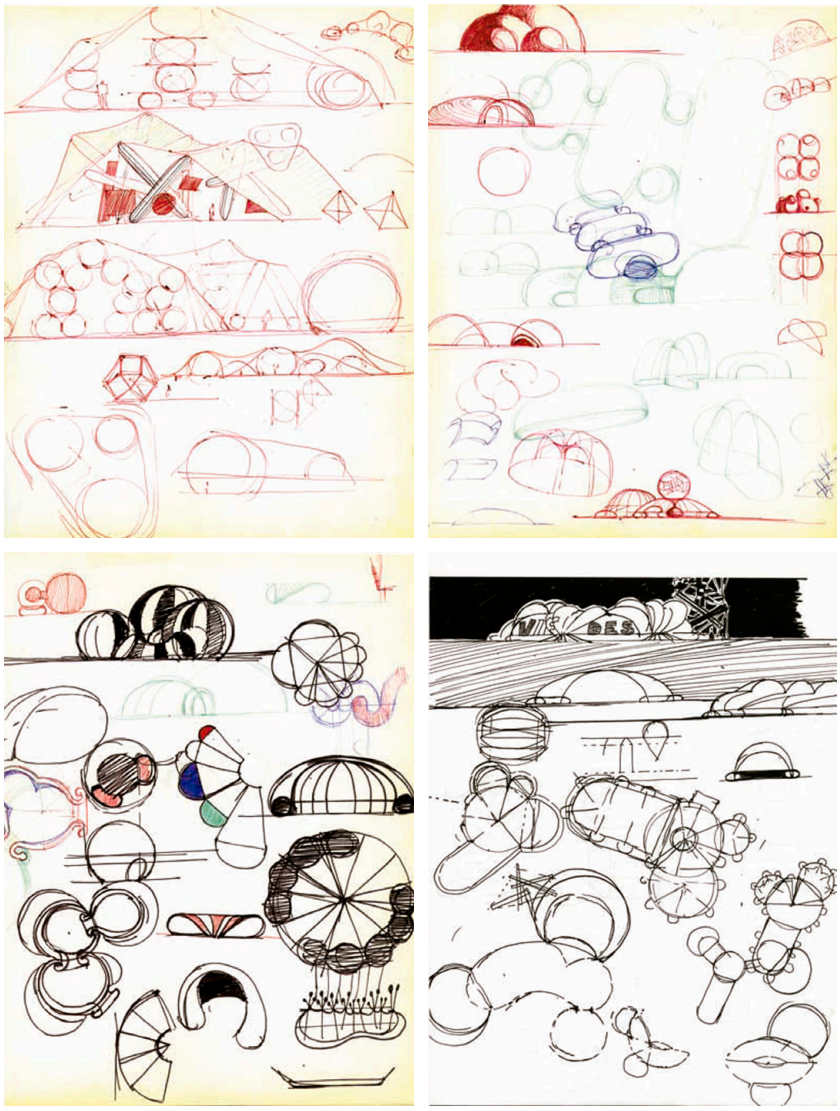
Cuaderno de croquis nº1 y nº2 de hinchables, circa 1966- 1967.

STINCO, Antonie. Cuaderno de croquis nº1 y nº2 de hinchables. Fuente: Documentación inédita facilitada por Jean Paul Jungmann. La documentación original se encuentra en la colección privada de Smiljan Radic, Nueva York.



[Fig A.70]

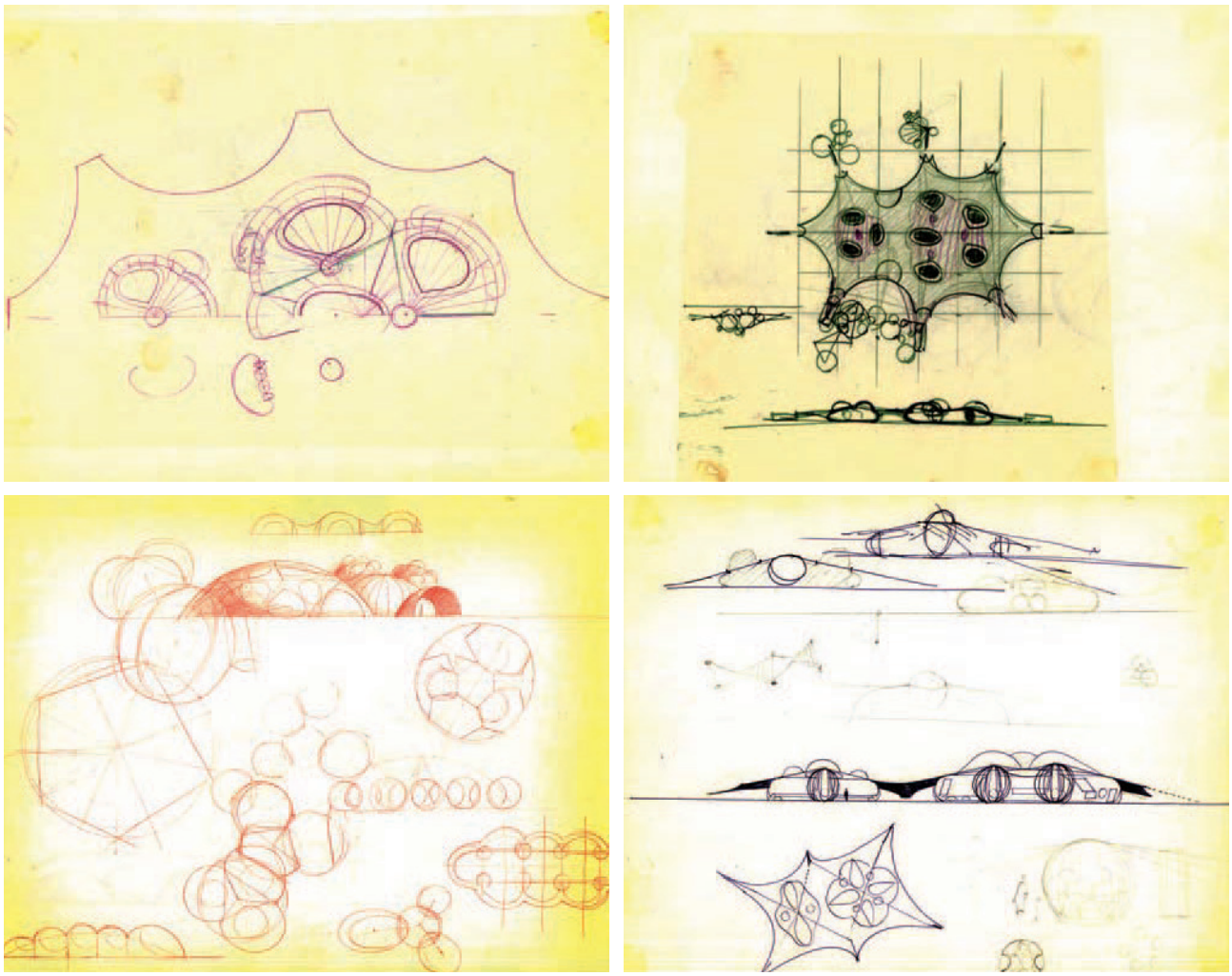
STINCO, Antonie. Cuaderno nº 1 con croquis de hinchables. Técnica: lápiz, lápices de colores y rotuladores sobre papel o papel de calco pegado. Extracción de varias páginas del cuaderno de croquis. 38,5 x 27 cm.



STINCO, Antonie. Cuaderno de croquis nº1 y nº2 de hinchables. Fuente: Documentación inédita facilitada por Jean Paul Jungmann. La documentación original se encuentra en la colección privada de Smiljan Radic, Nueva York.

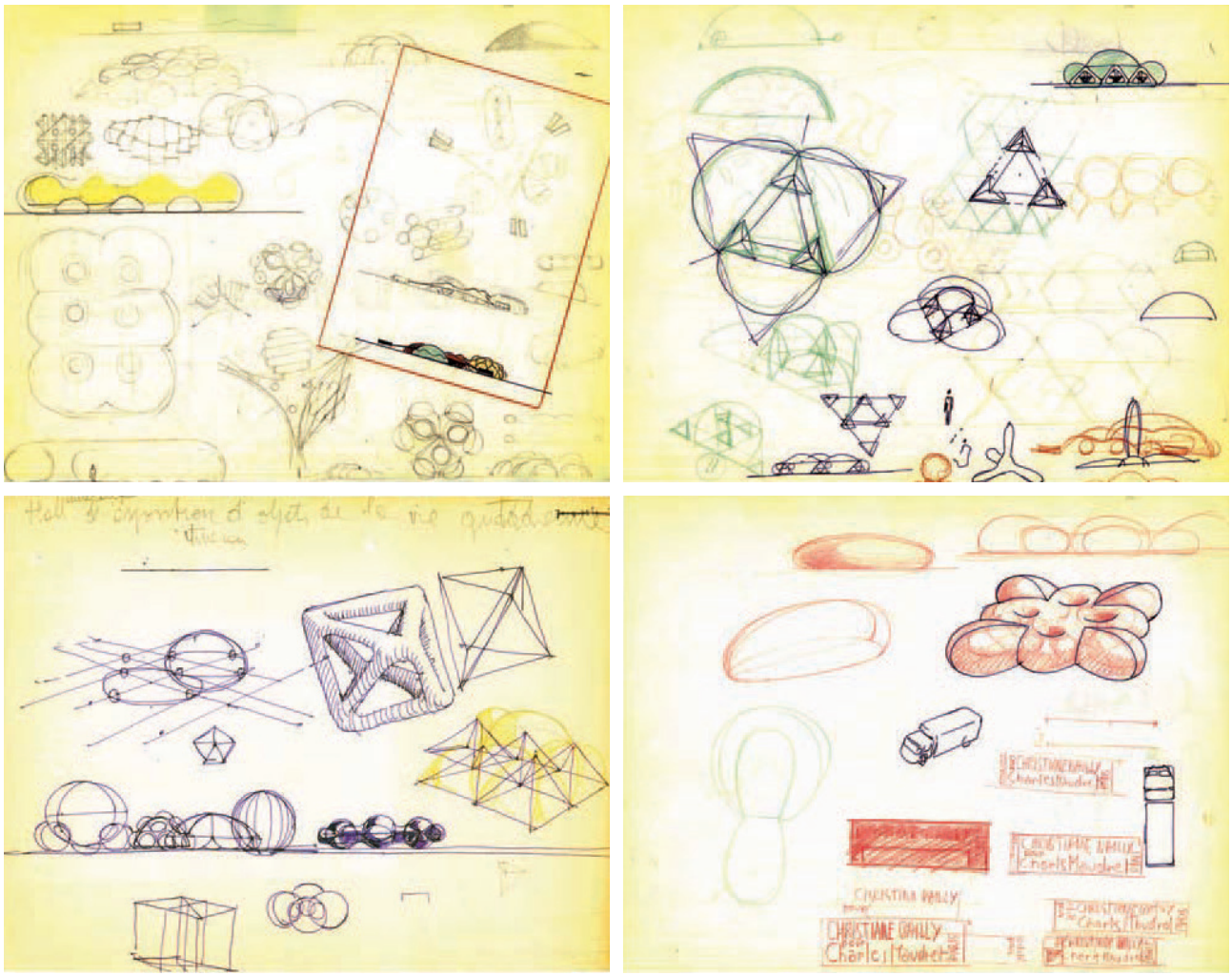
[Fig A.71]

STINCO, Antonie. Cuaderno nº 1 con croquis de hinchables. Técnica: lápiz, lápices de colores y rotuladores sobre papel o papel de calco pegado. Extracción de varias páginas del cuaderno de croquis. 38,5 x 27 cm.



[Fig A.72]

STINCO, Antonie. Cuaderno n° 2 con croquis del proyecto: Pabellón itinerante para la exposición de objetos cotidianos. Técnica: lápiz, lápices de colores y bolígrafo sobre papel o papel de calco pegado. Extracción de varias páginas del cuaderno de croquis. 27x 33 cm.



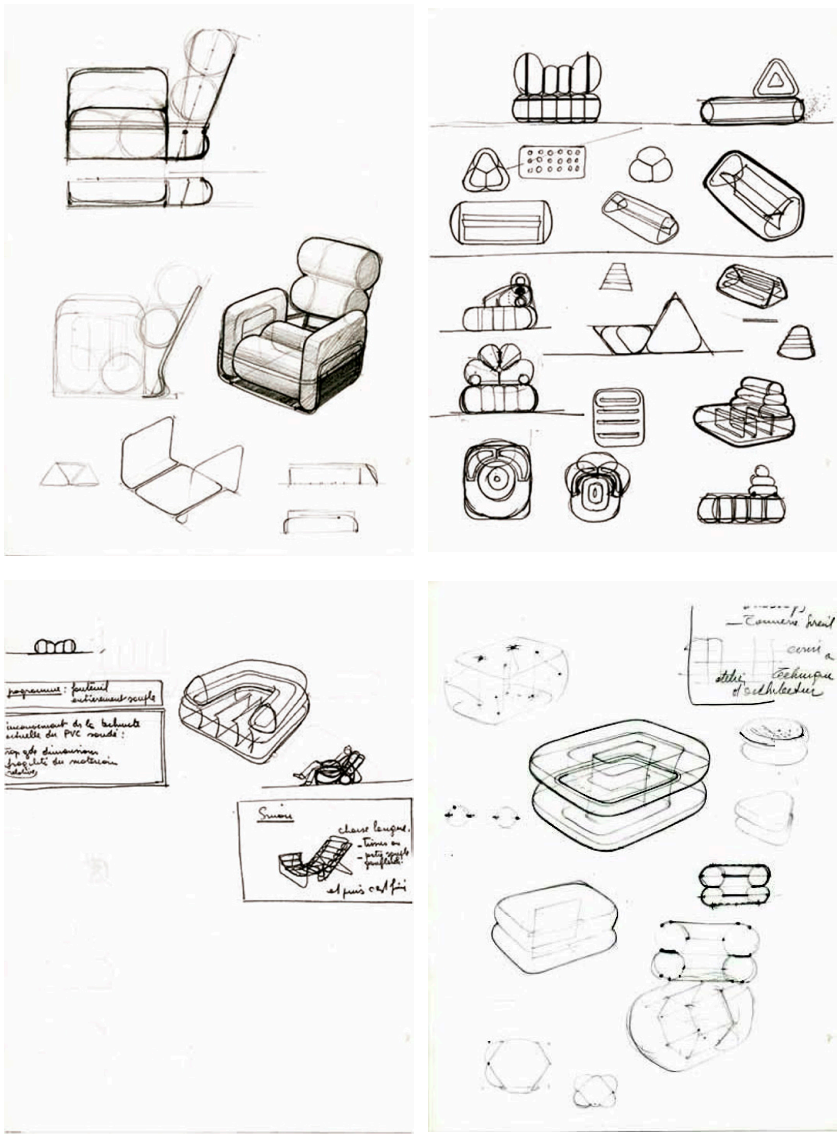
STINCO, Antonie. Cuaderno de croquis nº1 y nº2 de hinchables. Fuente: Documentación inédita facilitada por Jean Paul Jungmann. La documentación original se encuentra en la colección privada de Smiljan Radic, Nueva York.

[Fig A.73]

STINCO, Antonie. Cuaderno nº 2 con croquis de hinchables. Técnica: lápiz, lápices de colores y bolígrafo sobre papel o papel de calco pegado. Extracción de varias páginas del cuaderno de croquis. 27x 33 cm.

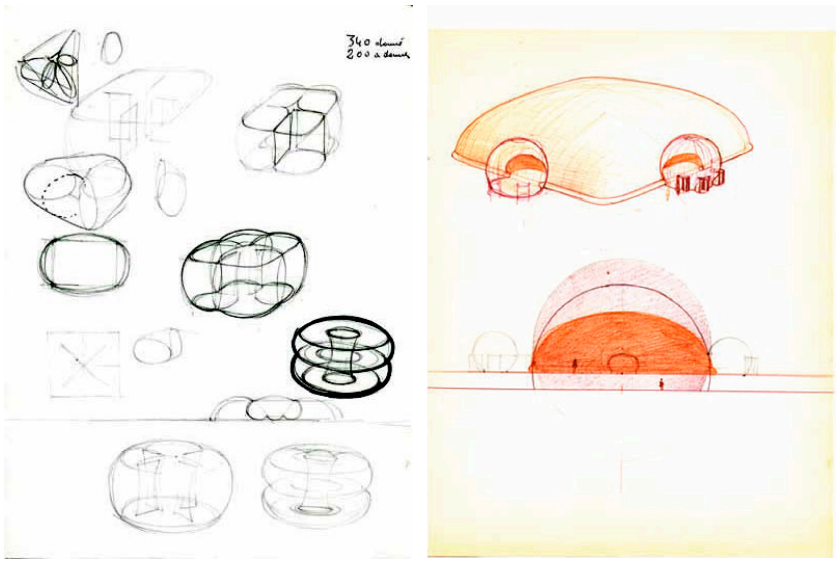
Cuaderno de croquis nº 4 de refugios hinchables, 1969.

STINCO, Antonie. Cuaderno de croquis nº 4 de refugios hinchables, 1969. Fuente: Documentación inédita facilitada por Jean Paul Jungmann. La documentación original se encuentra en la colección privada de Smiljan Radic, Nueva York.



[Fig A.74]

STINCO, Antonie. Croquis de mobiliario hinchable. Varias técnicas: lápiz, rotulador y bolígrafo sobre papel. Extracción de varias páginas del cuaderno de croquis. 33.5 x 27 cm.



STINCO, Antonie. Cuaderno de croquis nº 4 de refugios hinchables, 1969. Fuente: Documentación inédita facilitada por Jean Paul Jungmann. La documentación original se encuentra en la colección privada de Smiljan Radic, Nueva York.

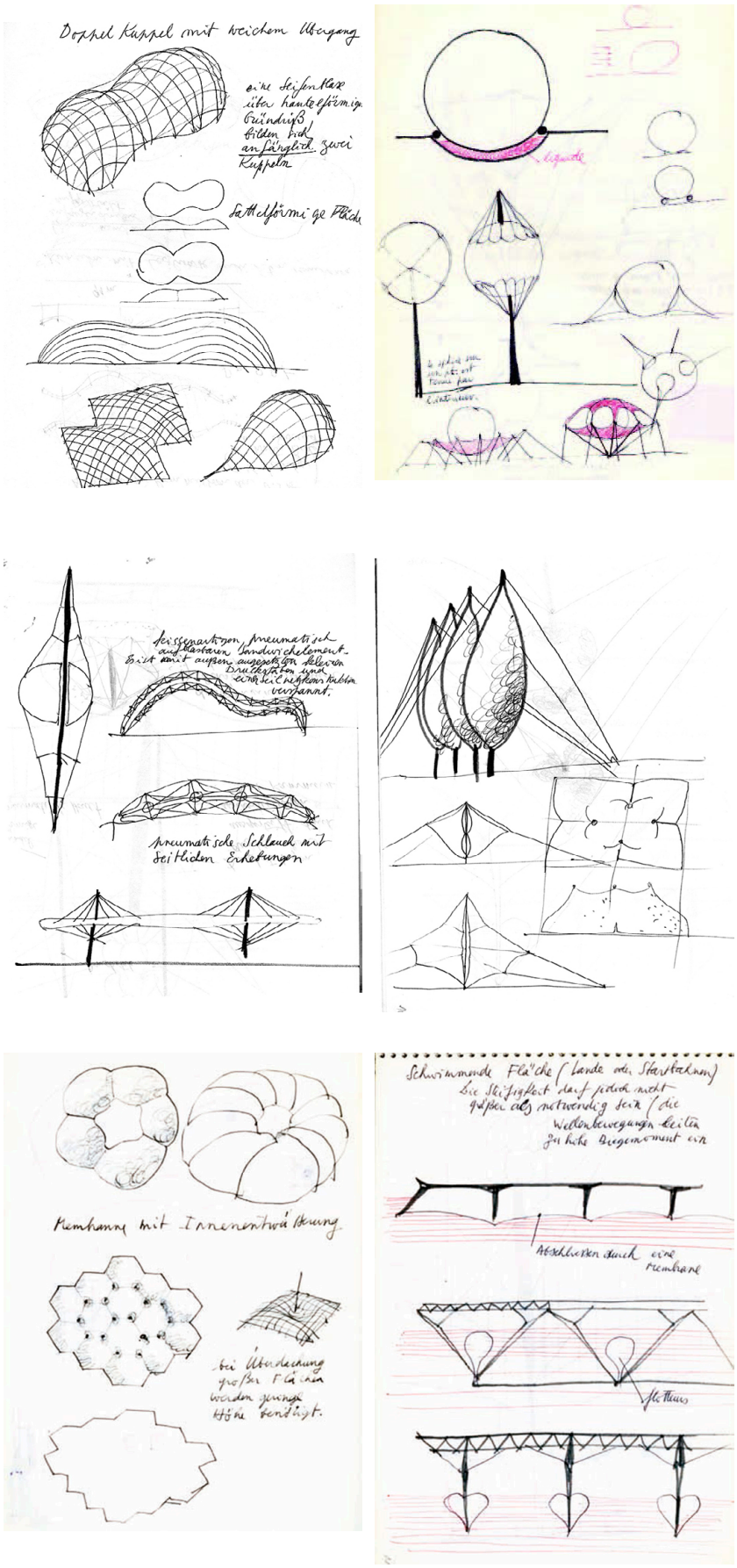
[Fig A.75]

STINCO, Antonie. Imagen izquierda: croquis de mobiliario hinchable. Imagen derecha: croquis de refugio hinchable. Varias técnicas: lápiz, rotulador y bolígrafo sobre papel. Extracción de varias páginas del cuaderno de croquis. 33.5 x 27 cm.

Documentación inédita de Jean Paul Jungmann

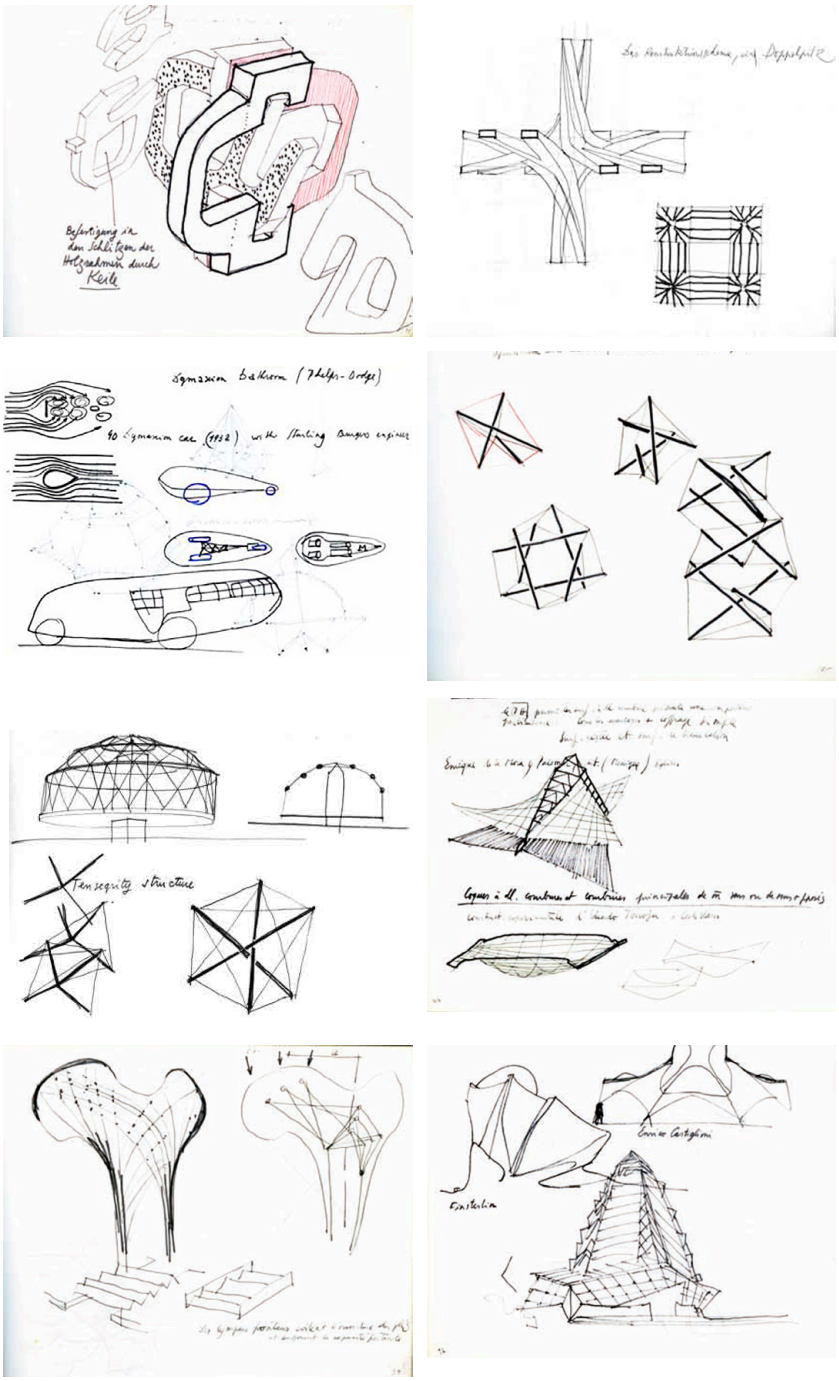
Dos cuadernos de croquis sobre estructuras neumáticas, 1966.

Jungmann, Jean Paul. Croquis de varias estructuras neumaticas de Frei Otto. 1966. Fuente: Documentación inédita facilitada por Jean Paul Jungmann. La documentación original se encuentra en la colección privada de Smiljan Radic, Nueva York.



[Fig A.76]

JUNGMANN, Jean Paul. Notas y croquis de varios proyectos neumáticos. Extracción de varias páginas del cuaderno 16 x 24,5 cm.



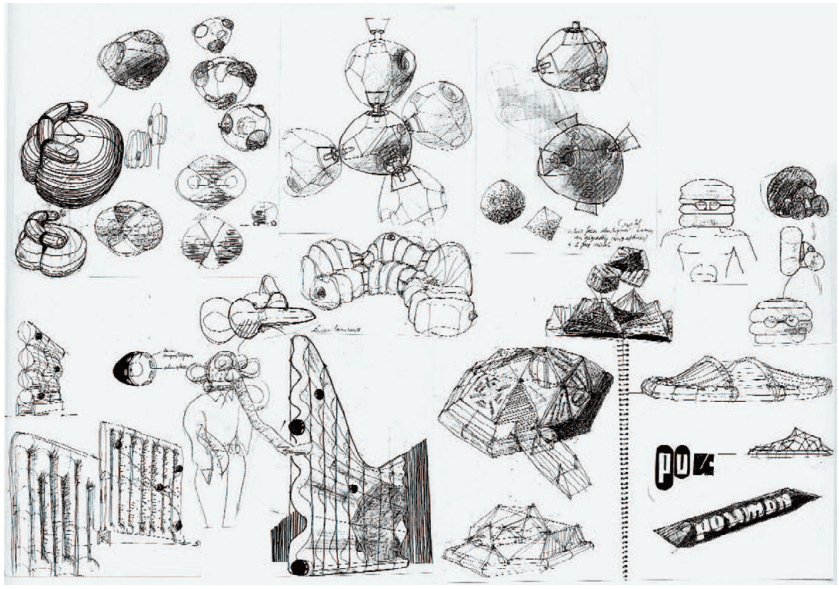
Jungmann, Jean Paul. Croquis de varias estructuras neumaticas de Frei Otto. 1966. Fuente: Documentación inédita facilitada por Jean Paul Jungmann. La documentación original se encuentra en la colección privada de Smiljan Radic, Nueva York.

[Fig A.77]

JUNGMANN, Jean Paul. Notas y croquis de conferencias. Extracción de varias páginas del cuaderno 23 x 31 cm.

Cuaderno de croquis para la Bienal de París de 1967.

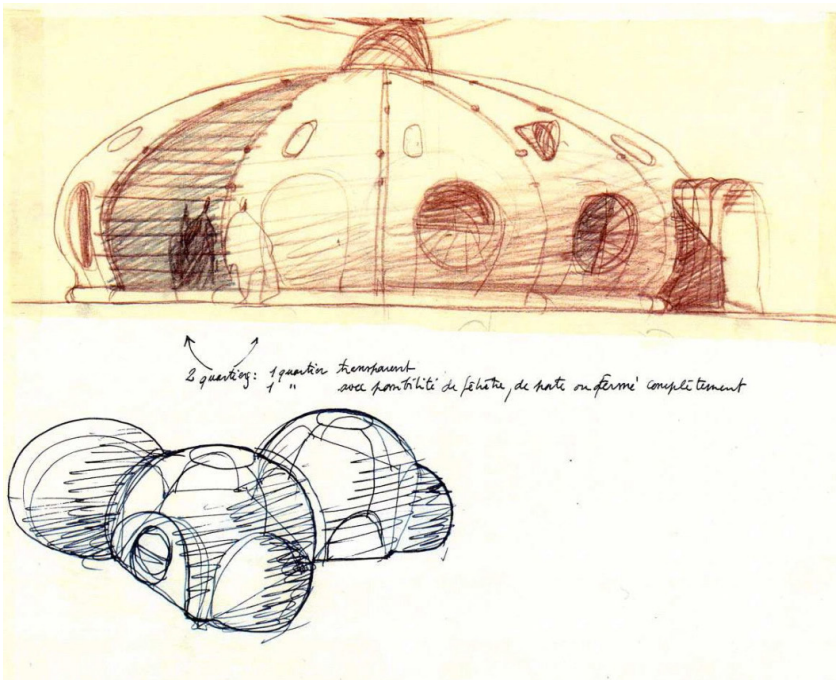
JUNGMANN, Jean Paul. Cuaderno de Croquis para la Bienal de París de 1967. Fuente: Documentación inédita facilitada por Jean Paul Jungmann. La documentación original se encuentra en la colección privada de Smiljan Radic, Nueva York. Parte de la documentación fue adquirida en el año 2000 por Le FNAC de París (Fondo Nacional de Arte Contemporáneo) y desde el año 2007 se encuentra en MNAM/CCI de París (Museo Nacional de Arte Moderno/Centro Pompidou).

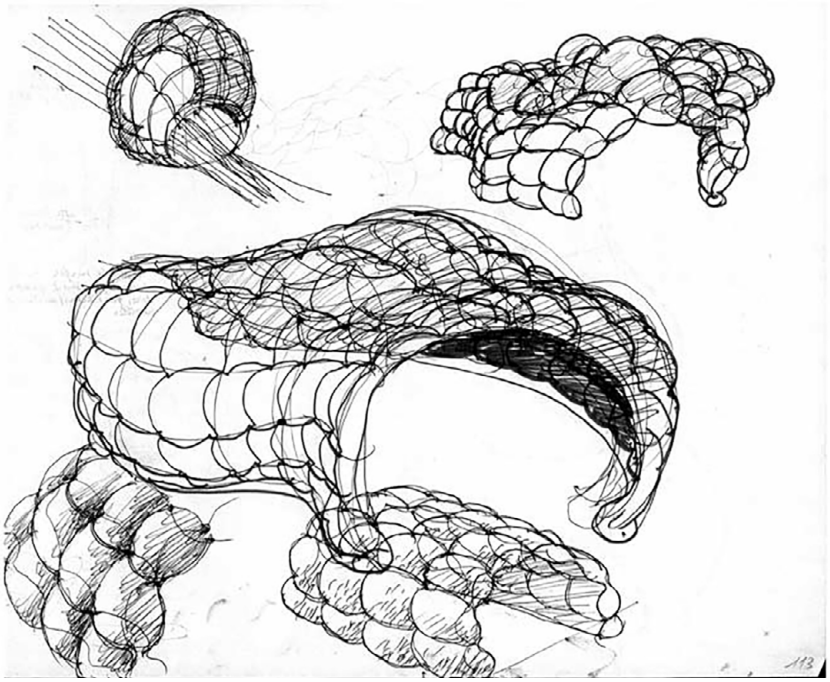


JUNGMANN, Jean Paul. Cuaderno de Croquis para la Bienal de París de 1967. Fuente: Documentación inédita facilitada por Jean Paul Jungmann. La documentación original se encuentra en la colección privada de Smiljan Radic, Nueva York. Parte de la documentación fue adquirida en el año 2000 por Le FNAC de París (Fondo Nacional de Arte Contemporáneo) y desde el año 2007 se encuentra en MNAM/CCI de París (Museo Nacional de Arte Moderno/Centro Pompidou).

[Fig A.87]

JUNGMANN, Jean Paul. Collage realizado a partir de varios croquis extraídos de los cuadernos de muebles hinchables. Técnica: realizado con tintas y lápices de colores.





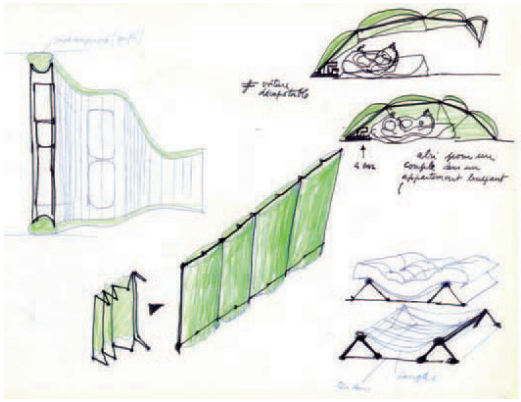
JUNGMANN, Jean Paul. Cuaderno de Croquis para la Bienal de París de 1967. Fuente: Documentación inédita facilitada por Jean Paul Jungmann. La documentación original se encuentra en la colección privada de Smiljan Radic, Nueva York. Parte de la documentación fue adquirida en el año 2000 por Le FNAC de París (Fondo Nacional de Arte Contemporáneo) y desde el año 2007 se encuentra en MNAM/CCI de París (Museo Nacional de Arte Moderno/Centro Pompidou).

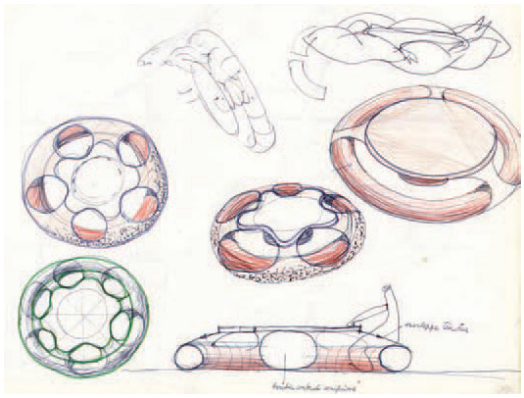
[Fig A.78]

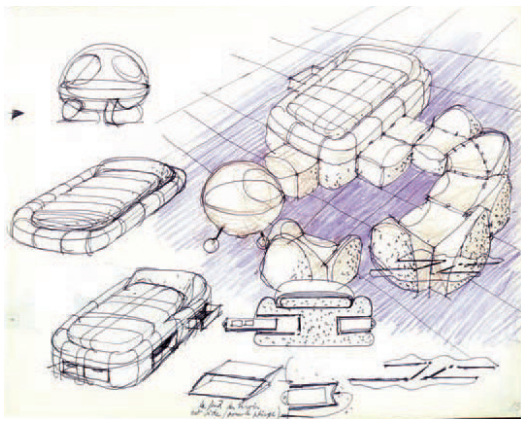
JUNGMANN, Jean Paul. Hábitat neumático experimental, primera versión. Varias técnicas: tinta, rotulador, bolígrafo y lápices de colores. Extracción de varias páginas del cuaderno de croquis. 27 x 34 cm.

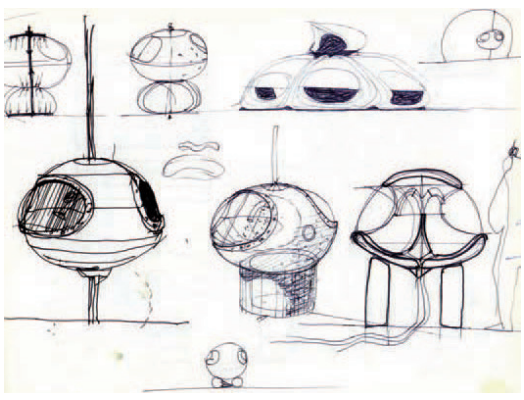
[Fig A.79]

JUNGMANN, Jean Paul. Envolvente hinchable: Técnica: bolígrafo. Extracción de varias páginas del cuaderno de croquis. 27 x 34 cm.









[Fig A.80]

JUNGMANN, Jean Paul. Estructura neumática transformable y apta para distintos usos. Varias técnicas: tinta, rotulador, bolígrafo realzado con rotulador y lápices de colores. Extracción de varias páginas del cuaderno de croquis. 27 x 34 cm.

[Fig A.81]

JUNGMANN, Jean Paul. Mesa neumática. Varias técnicas: tinta, rotulador, bolígrafo realzado con rotulador y lápices de colores. Extracción de varias páginas del cuaderno de croquis. 27 x 34 cm.

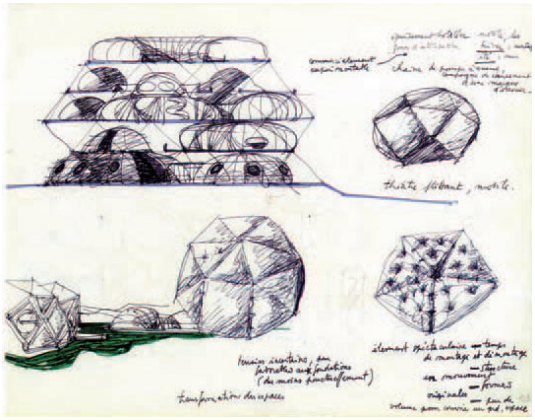
[Fig A.82]

JUNGMANN, Jean Paul. Mobiliario hinchable. Varias técnicas: tinta, rotulador, bolígrafo realzado con rotulador y lápices de colores. Extracción de varias páginas del cuaderno de croquis. 27 x 34 cm.

[Fig A.83]

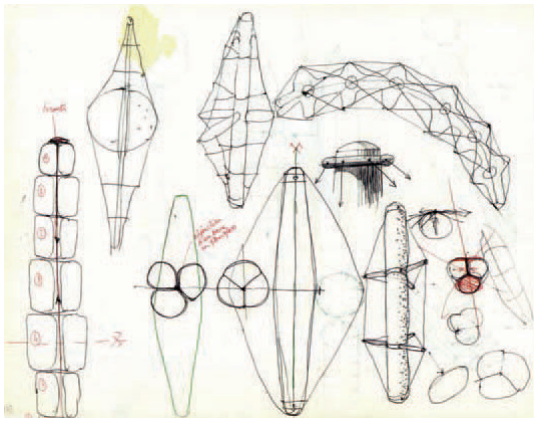
JUNGMANN, Jean Paul. Sillón neumático. Varias técnicas: tinta, rotulador, bolígrafo realzado con rotulador y lápices de colores. Extracción de varias páginas del cuaderno de croquis. 27 x 34 cm.

JUNGMANN, Jean Paul. Cuaderno de Croquis para la Bienal de París de 1967. Fuente: Documentación inédita facilitada por Jean Paul Jungmann. La documentación original se encuentra en la colección privada de Smiljan Radic, Nueva York. Parte de la documentación fue adquirida en el año 2000 por Le FNAC de París (Fondo Nacional de Arte Contemporáneo) y desde el año 2007 se encuentra en MNAM/CCI de París (Museo Nacional de Arte Moderno/Centro Pompidou).



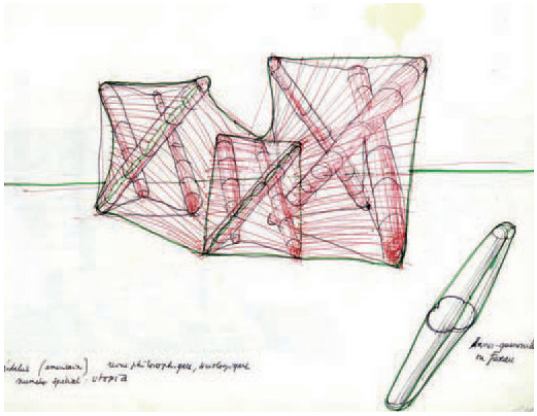
[Fig A.84]

JUNGMANN, Jean Paul. Croquis de una construcción neumática en varios niveles. Varias técnicas: tinta, rotulador, bolígrafo realzado con rotulador y lápices de colores. Extracción de varias páginas del cuaderno de croquis. 27 x 34 cm.



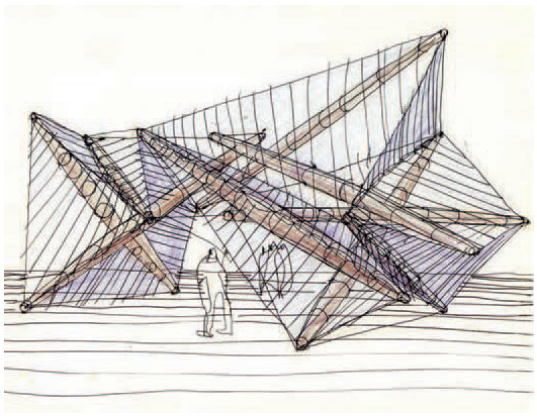
[Fig A.85]

JUNGMANN, Jean Paul. Croquis de una estructura neumática realizada a partir de la repetición de un elemento neumático tensado con cables de acero. Varias técnicas: tinta, rotulador, bolígrafo realzado con rotulador y lápices de colores. Extracción de varias páginas del cuaderno de croquis. 27 x 34 cm.



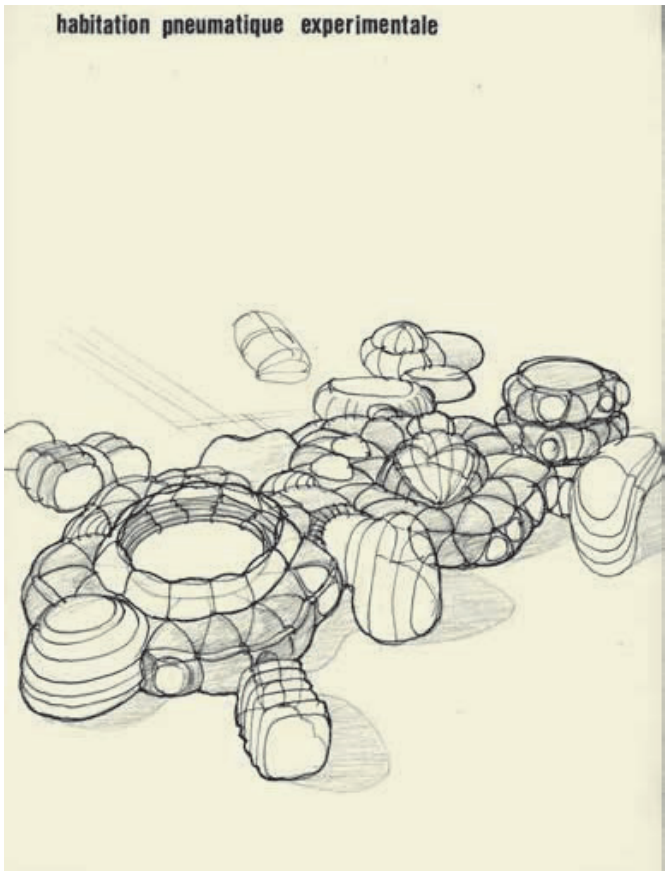
[Fig A.86]

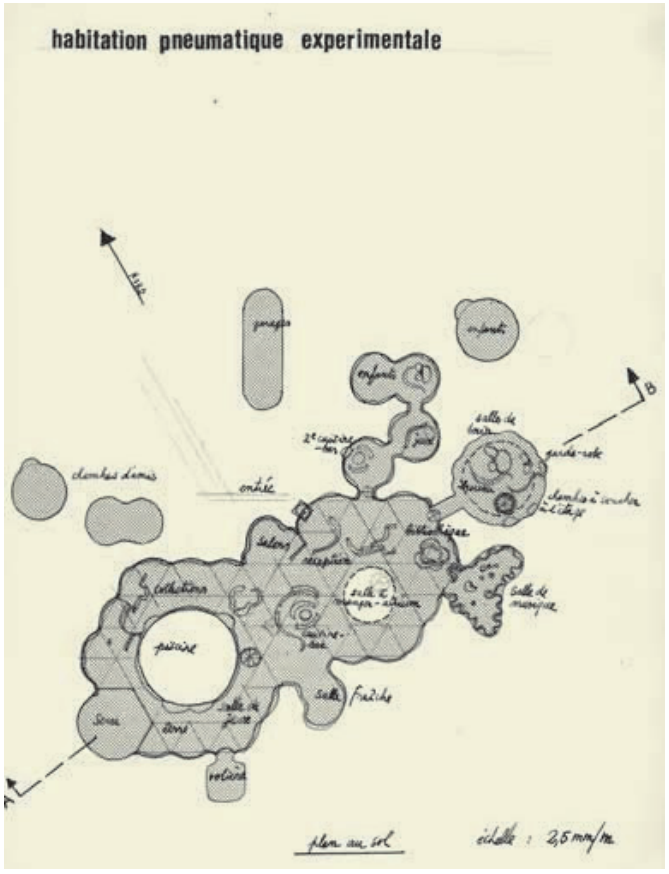
JUNGMANN, Jean Paul. Croquis de una estructura tensada a partir de tubos neumáticos. Varias técnicas: tinta, rotulador, bolígrafo realzado con rotulador y lápices de colores. Extracción de varias páginas del cuaderno de croquis. 27 x 34 cm.



Hábitat neumático experimental. Primera versión, 1967.

JUNGMANN, Jean Paul. Hábitat neumático experimental. Primera versión, 1967. Fuente: Documentación inédita facilitada por Jean Paul Jungmann. La documentación original se encuentra en la colección privada de Smiljan Radic, Nueva York.



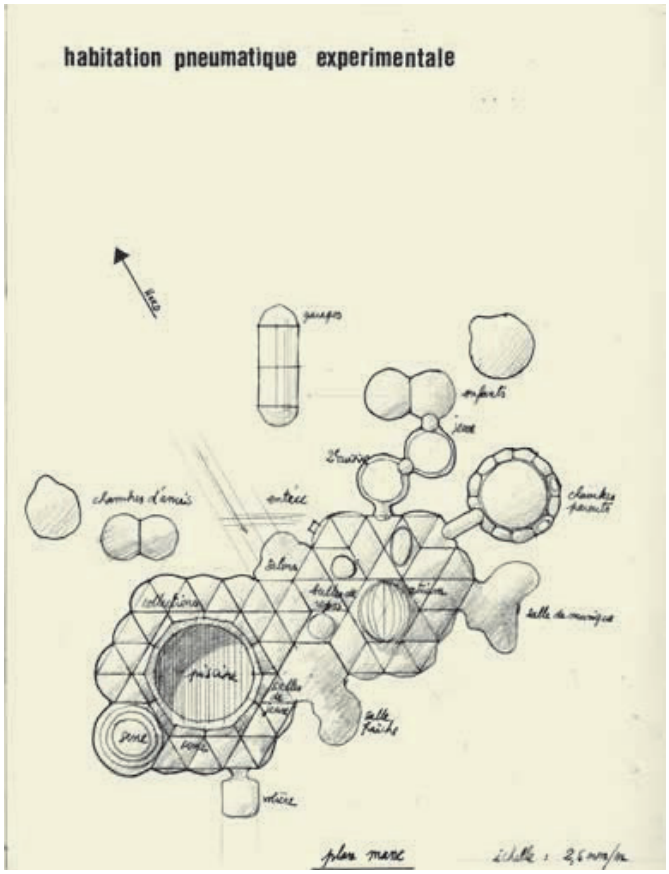


[Fig A.88]

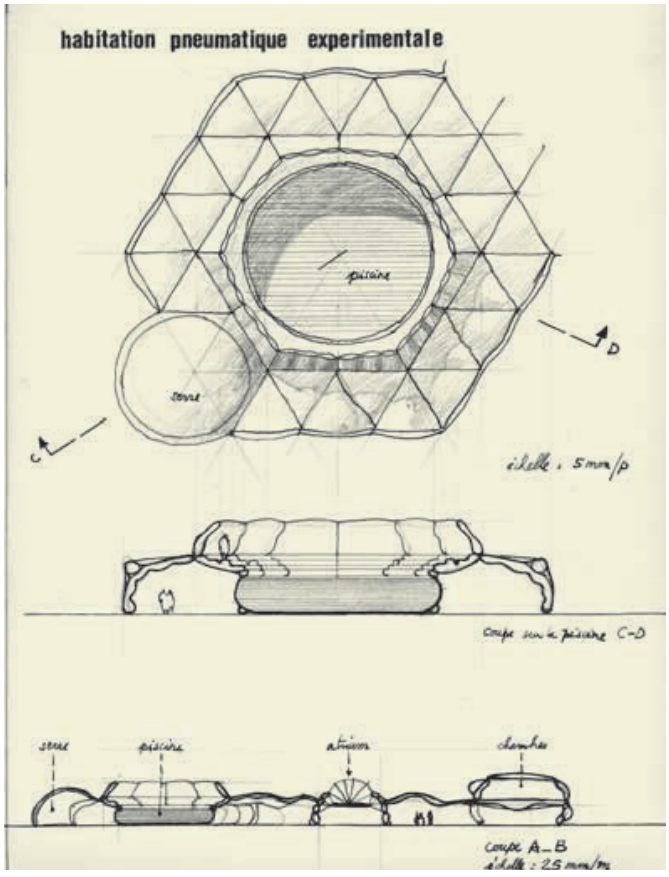
JUNGMANN, Jean Paul. Croquis de axonometría de Hábitat neumático experimental, primera versión. Técnica: tinta, tramas, letras transferidas en papel de calco. 33x23cm.

[Fig A.89]

JUNGMANN, Jean Paul. Planta de Hábitat neumático experimental, primera versión. Técnica: tinta, tramas, letras transferidas en papel de calco. 33x23cm.



JUNGMANN, Jean Paul. Hábitat neumático experimental. Primera versión, 1967. Fuente: Documentación inédita facilitada por Jean Paul Jungmann. La documentación original se encuentra en la colección privada de Smiljan Radic, Nueva York.



[Fig A.90]

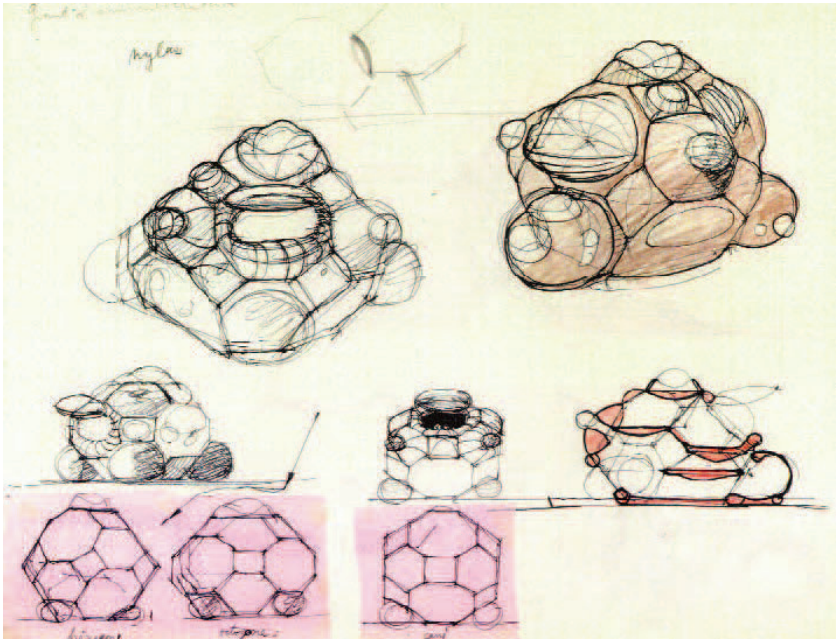
JUNGMANN, Jean Paul. Planta de cubierta de Hábitat neumático experimental, primera versión. Técnica: tinta + lápices + letras transferidas en papel de calco. 33x23cm.

[Fig A.91]

JUNGMANN, Jean Paul. Planta y secciones de la piscina de Hábitat neumático experimental, primera versión. Técnica: tinta + lápiz + letras transferidas en papel de calco. 33x23cm.

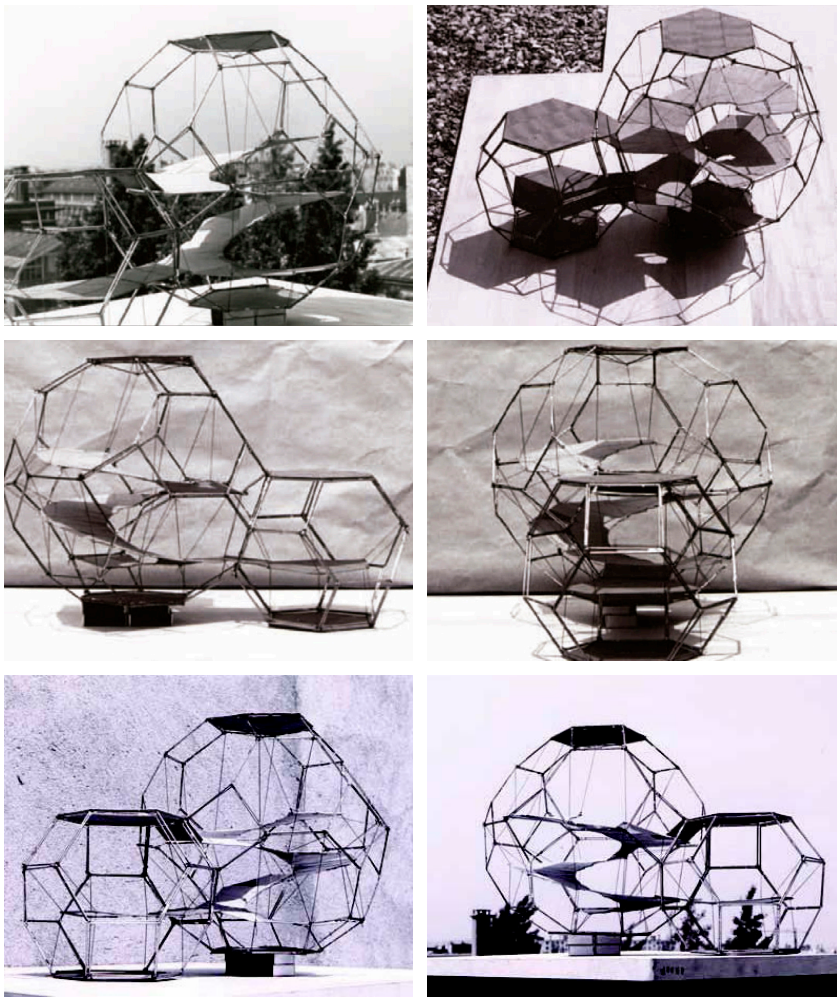
Dyodon. Hábitat neumático experimental, 1967.

JUNGMANN, Jean Paul. Dyodon. Hábitat neumático experimental, 1967. Fuente: Documentación inédita facilitada por Jean Paul Jungmann. La documentación original fue adquirida en el año 2000 por Le FNAC de París (Fondo Nacional de Arte Contemporáneo) y desde el año 2007 se encuentra en MNAM/CCI de París (Museo Nacional de Arte Moderno/Centro Pompidou). Parte de la documentación se encuentra en la colección privada de Smiljan Radic en Nueva York"



[Fig A.92]

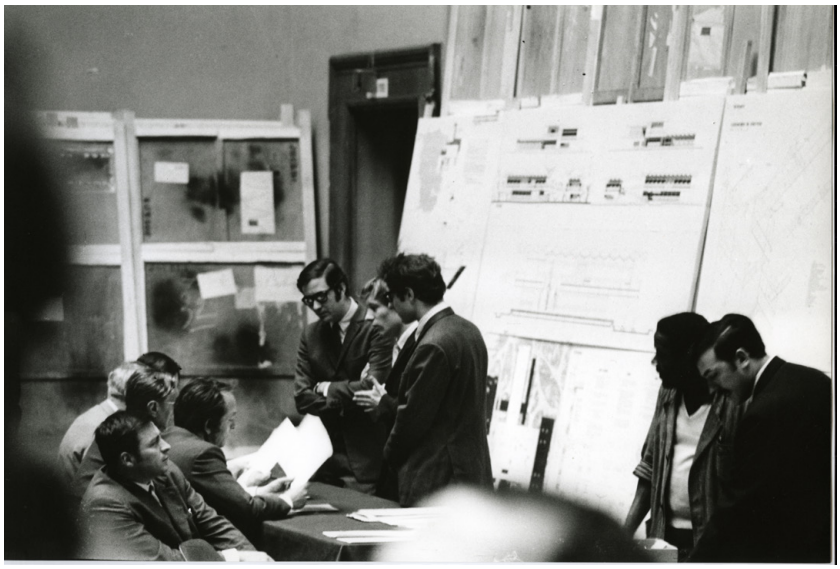
JUNGMANN, Jean Paul. Cuaderno de croquis Yougy Poumon, con croquis de Dyodon - Hábitat neumático experimental. Técnica: tinta, y lápices de colores sobre el papel y en papel de calco pegado en las páginas del cuaderno. Dimensiones del cuaderno: 27x34cm



JUNGMANN, Jean Paul. Dyodon. Hábitat neumático experimental, 1967. Fuente: Documentación inédita facilitada por Jean Paul Jungmann. La documentación original fue adquirida en el año 2000 por Le FNAC de París (Fondo Nacional de Arte Contemporáneo) y desde el año 2007 se encuentra en MNAM/ CCI de París (Museo Nacional de Arte Moderno/Centro Pompidou). Parte de la documentación se encuentra en la colección privada de Smiljan Radic en Nueva York"

[Fig A.93]

JUNGMANN, Jean Paul. Una serie de 6 impresiones fotográficas en blanco negro de la maqueta de estructura geométrica de Dyodon. Dimensiones: 18 x 27 cm



JUNGMANN, Jean Paul. Dyodon. Hábitat neumático experimental, 1967. Fuente: Documentación inédita facilitada por Jean Paul Jungmann. La documentación original fue adquirida en el año 2000 por Le FNAC de París (Fondo Nacional de Arte Contemporáneo) y desde el año 2007 se encuentra en MNAM/ CCI de París (Museo Nacional de Arte Moderno/Centro Pompidou). Parte de la documentación se encuentra en la colección privada de Smiljan Radic en Nueva York"

[Fig A.94]

Joseph Zetaloni. Fotografías durante la defensa y la deliberación del jurado. Dimensiones: 20 x 30 cm.

Anexo 4: Contextualización. Síntesis de las estructuras neumáticas realizadas entre 1948 hasta 1970.

La elaboración de esta síntesis se ha realizdo a partir de la publicación *Pneumatic Structures* de Thomas Herzog. Ver: HERZOG, Thomas. *Pneumatic Structures: A Handbook of inflatable architecture*. Nueva York: Oxford Unversity Press, 1976.