Dec. 10, 1963 J. H. MacMILLAN, JR., ETAL 3,113,403

METHOD OF ERECTING A BUILDING

Filed April 16, 1959 10 Sheets-Sheet 1

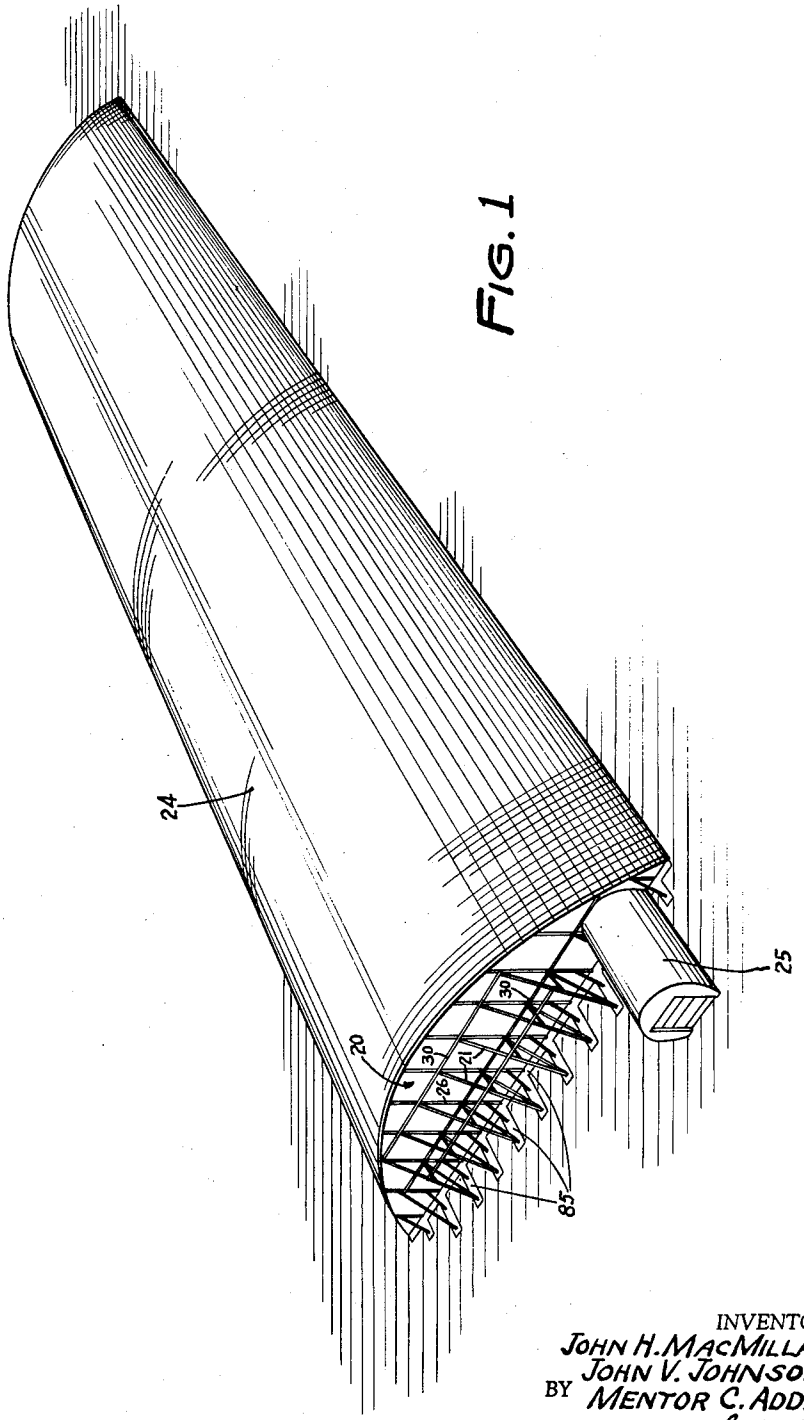


FIG. 1

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METHOD OF ERECTING A BUILDING

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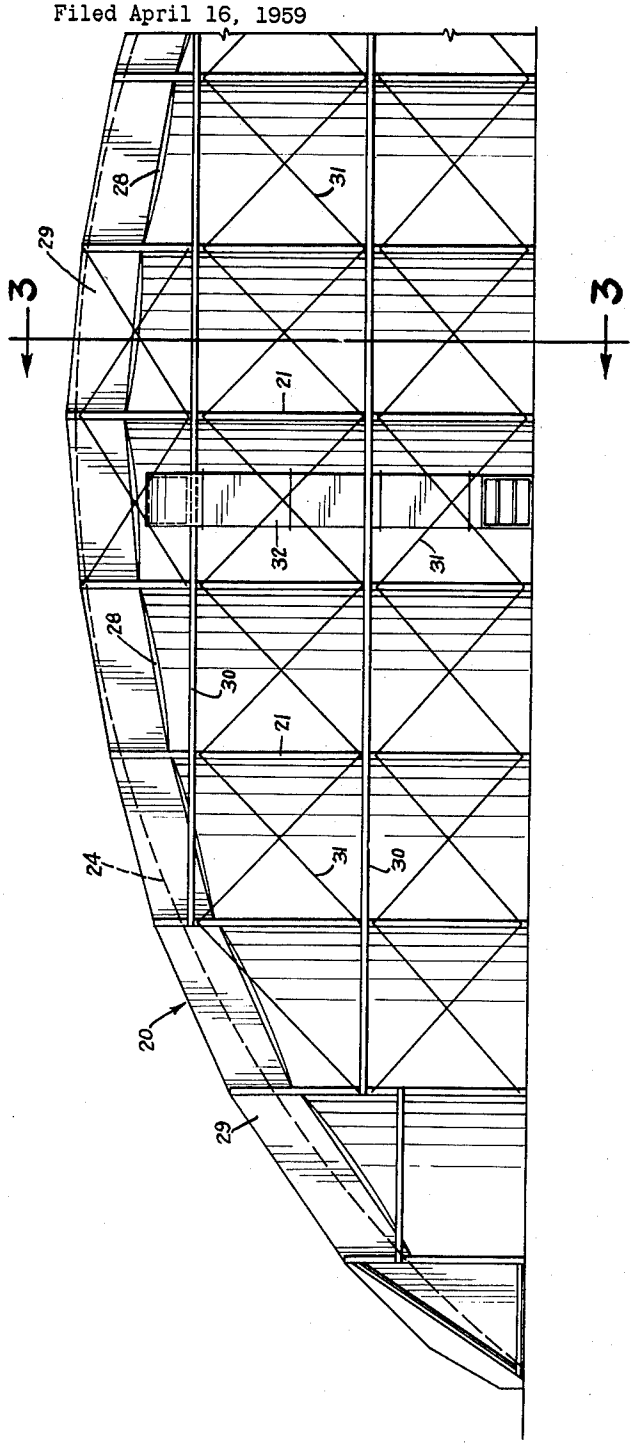


FIG. 2

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METHOD OF ERECTING A BUILDING

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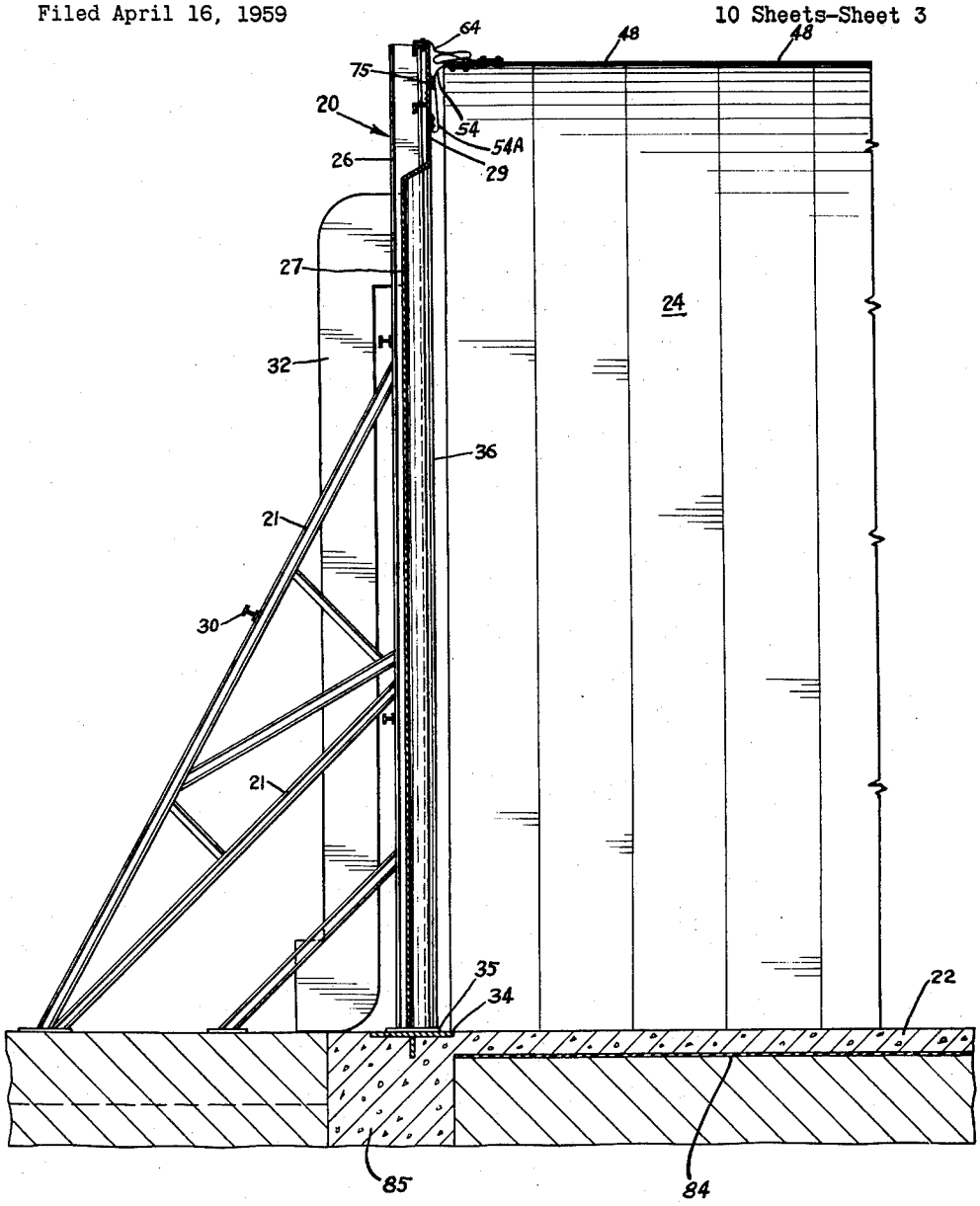


FIG. 3

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METHOD OF ERECTING A BUILDING

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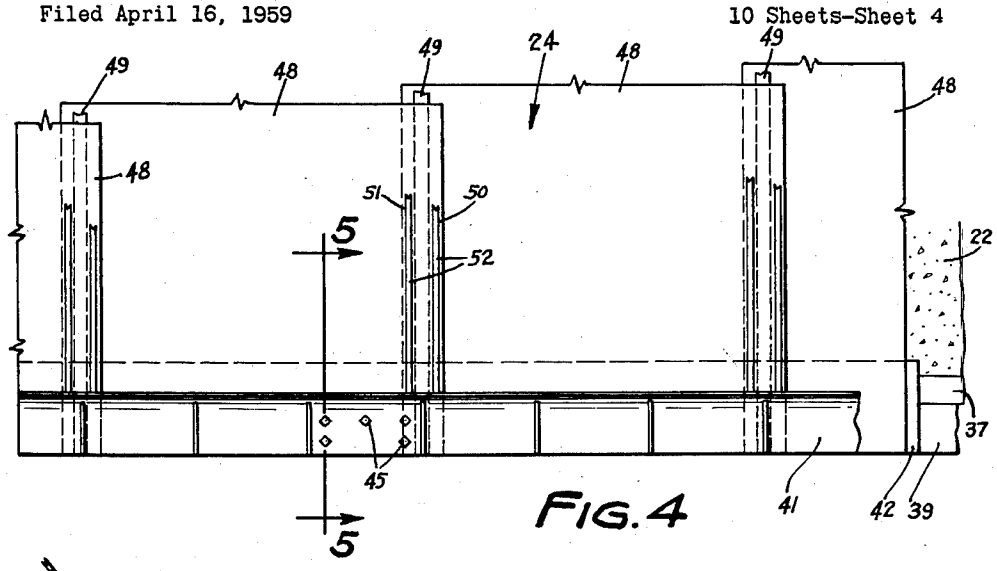


FIG. 4

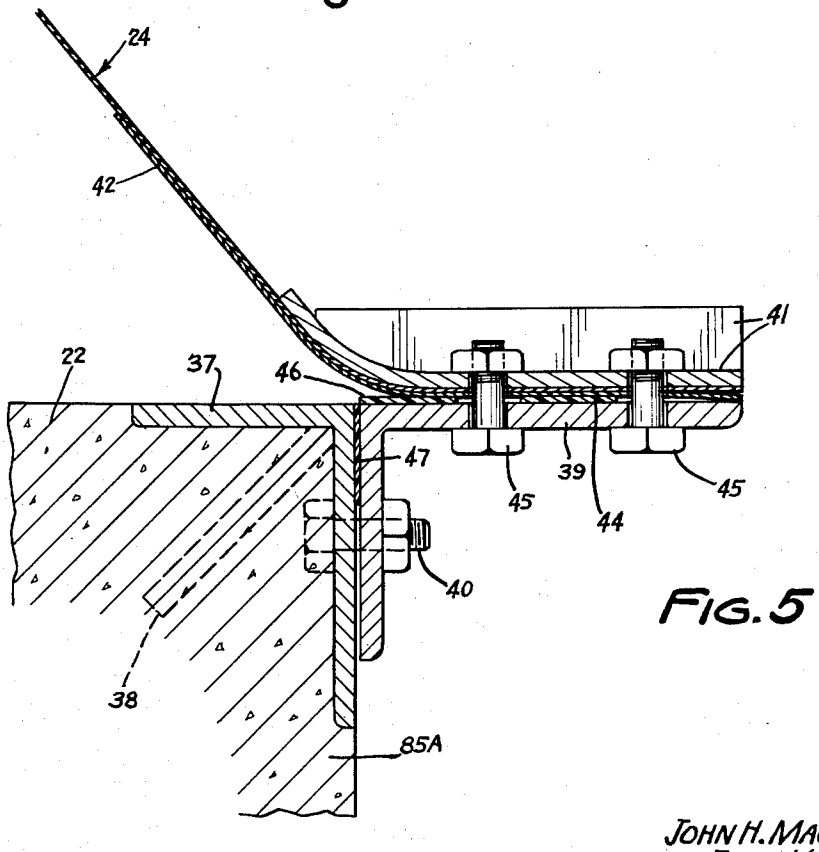


FIG. 5

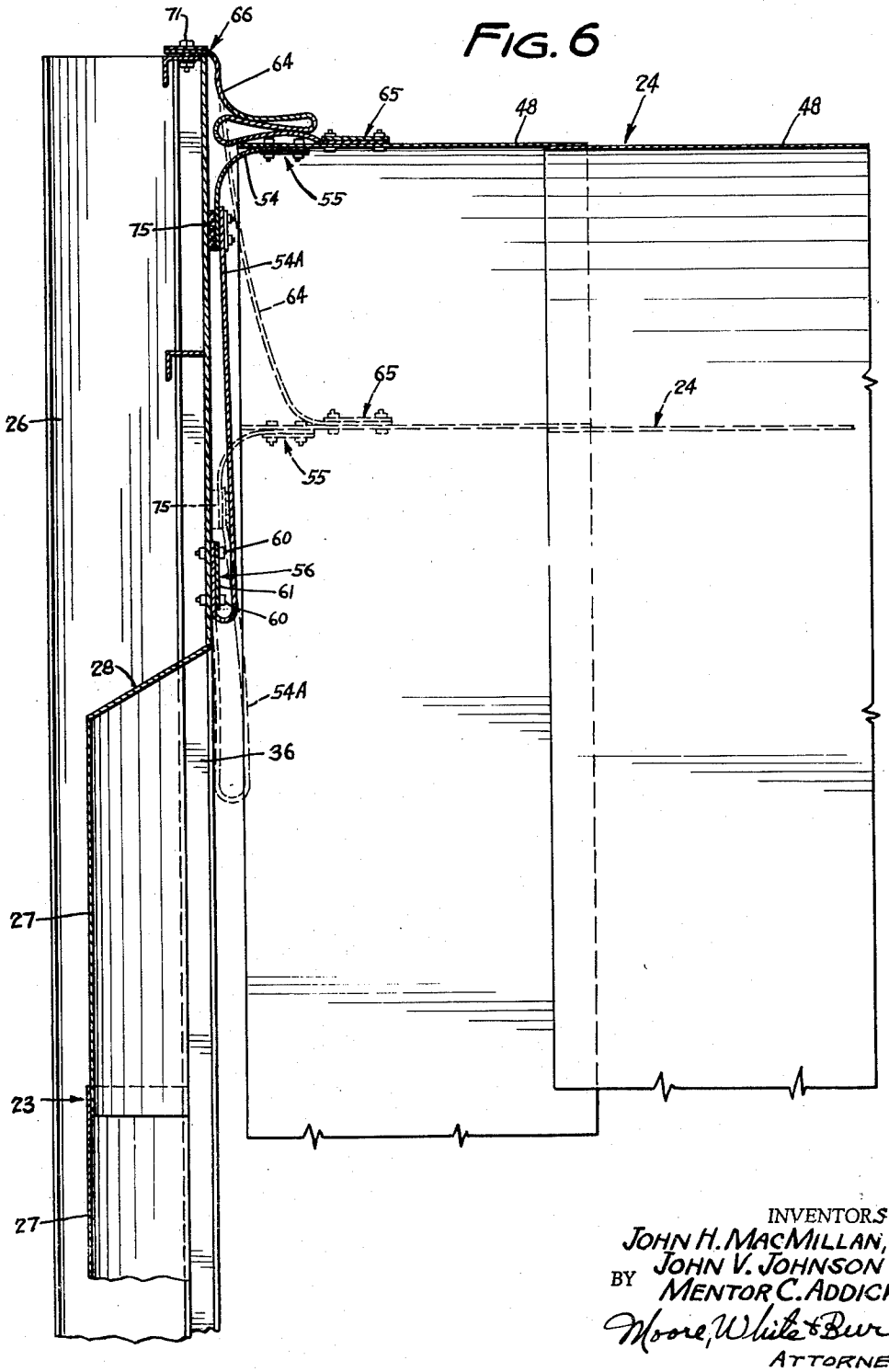
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FIG. 6



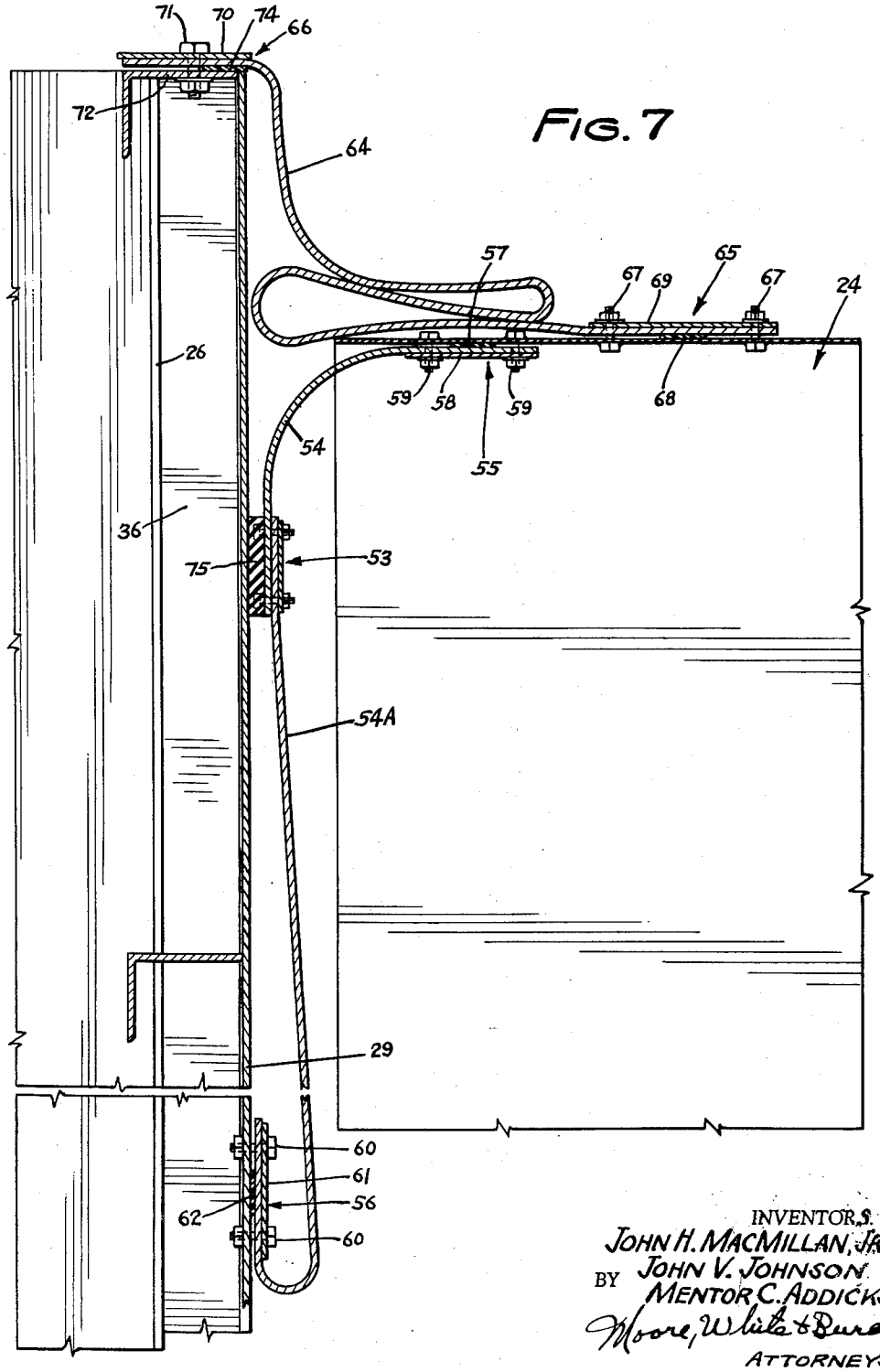
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FIG. 7



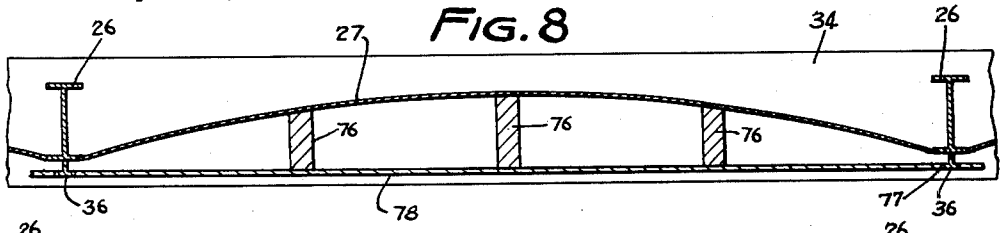
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FIG. 8



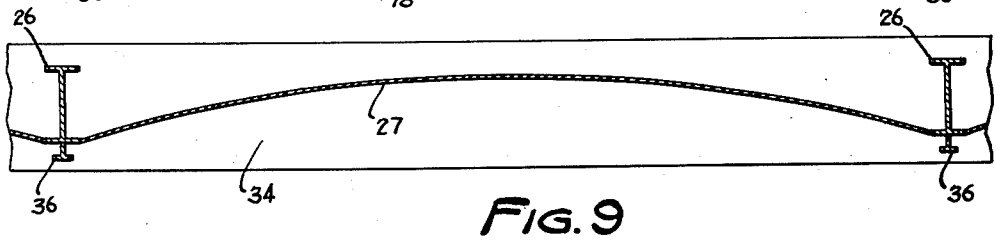


FIG. 9

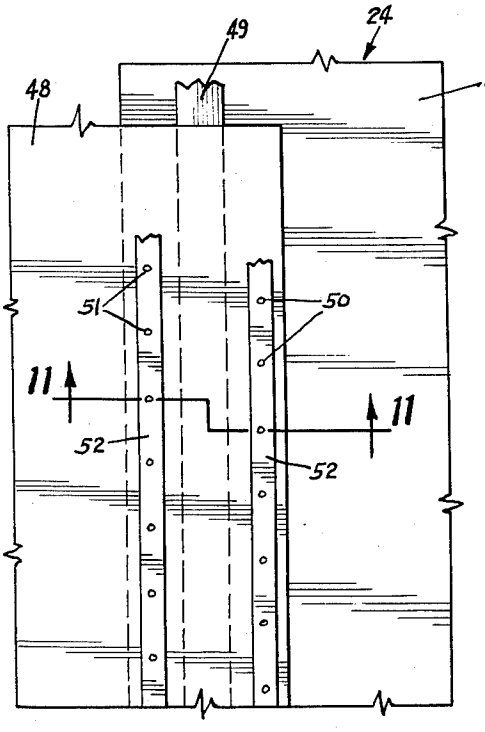


FIG. 10

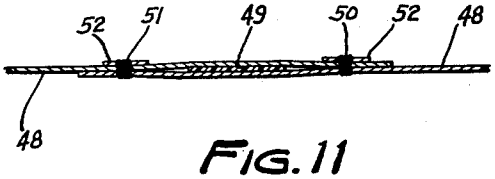


FIG. 11

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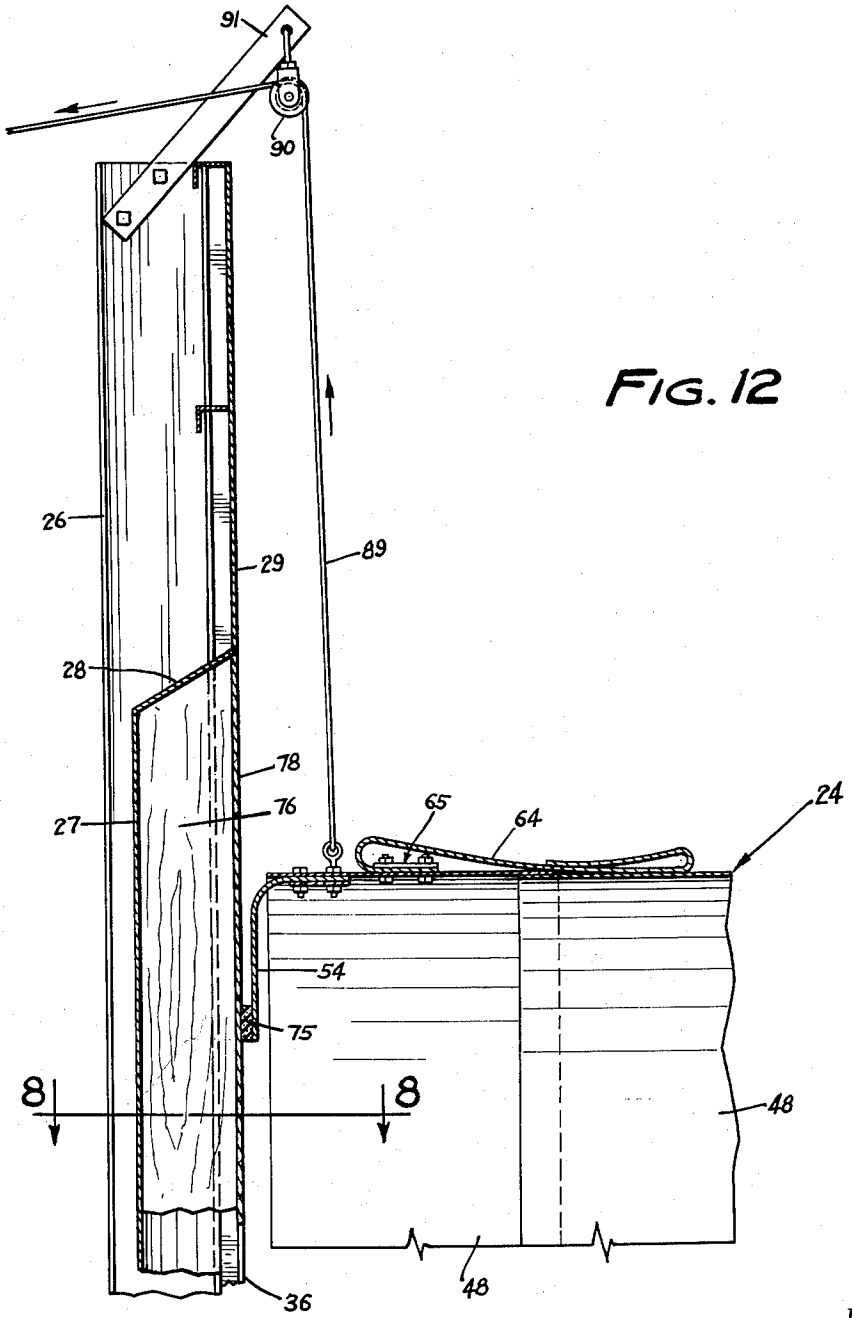


FIG. 12

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METHOD OF ERECTING A BUILDING

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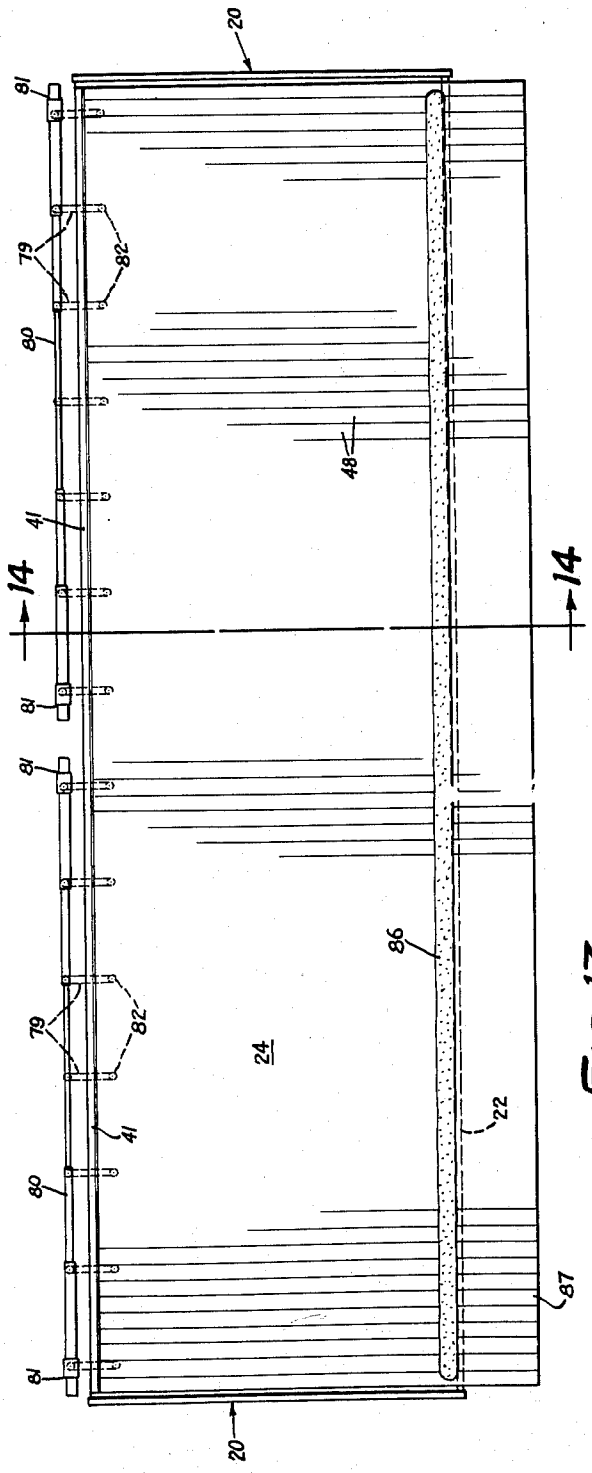


FIG. 13

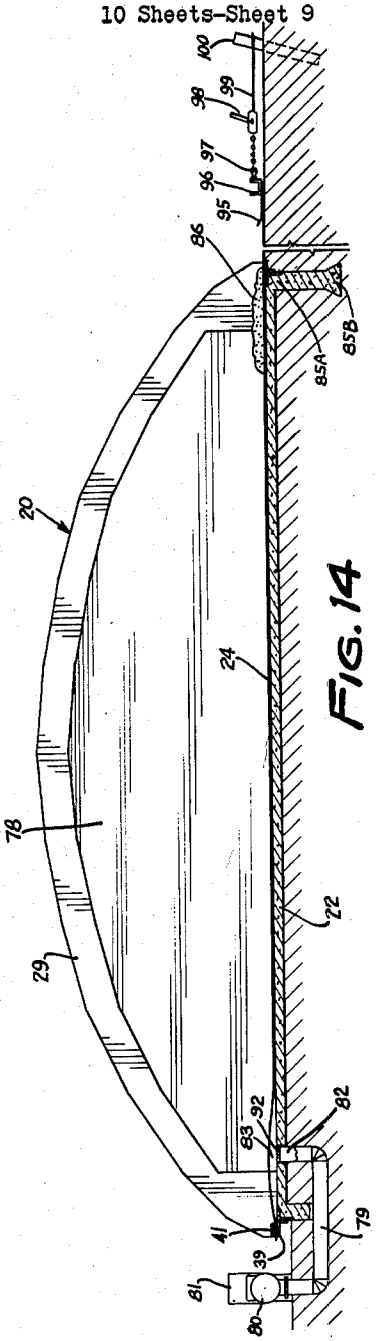


FIG. 14

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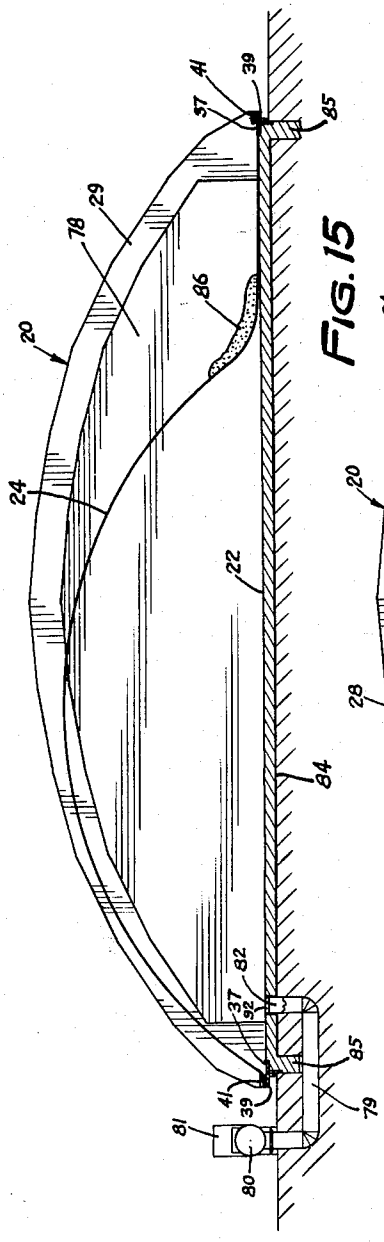


FIG. 15

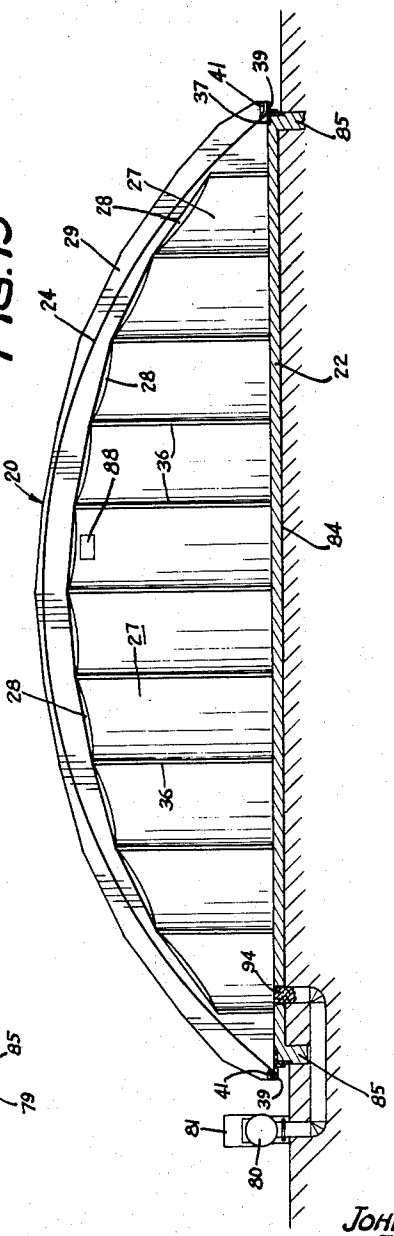


FIG. 16

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United States Patent Office 3,113,403 Patented Dec. 10, 1963

3,113,403

METHOD OF ERECTING A BUILDING

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Filed Apr. 16, 1959, Ser. No. 810,521
7 Claims. (Cl. 50—532)

This invention is a building of a class generally known as air-supported structures and features a roof and side walls consisting of sheets of steel extending uninterrupted from one side of the building to the other with their edges secured together to form a fluid impervious, unbroken side wall and roof sheet of great strength. Also included in the invention is the method of securing this sheet to its foundation and raising it without creasing or otherwise damaging this enormous sheet of flexible steel. The method consists of securing one edge of this sheet while the other edge is temporarily left free to extend out over the foundation; weighting the sheet between the two ends of the foundation to hold it down in close proximity to the foundation; introducing fluid such as air between the fluid impervious base and the roof side wall sheet until the free side of the sheet is drawn to the foundation side; securing the free edge; removing the weight and introducing more fluid under pressure.

Another featured structure of the building is the irregularly surfaced end walls that are valuable for strength with flanges included to aid in mounting a temporary bulkhead thereon to provide a flat surface against which to seal the flexible roof element as it is being raised by fluid pressure. Also thought to be novel structure are the seals used both in the raising of the flexible fluid impervious steel roof and side wall sheet and to secure it to the end walls; the seals must provide for substantial movement. The final seals consist of rubberized fabric secured to the roof side wall element and the end walls, using resilient fluid impervious sealing strips between them so that there can be relative movement between the air-supported roof and the end walls which are rigid. A resilient fluid impervious block is employed as a portion of the slipping seal used in the erection of roof and side wall sheet.

Air-supported buildings have been known for a substantial period of time although their use for nonmilitary purposes is relatively recent. Before this invention, the material used for air-supported buildings was usually fluid impervious fabric such as a polyethylene film or a woven fabric that has been made fluid impervious by impregnating it with artificial rubber or other plastic. Although these fluid imprevious fabrics made it possible to construct air-supported buildings of substantial size, they were definitely limited in strength and size. Furthermore, most of the treated fabrics used for these buildings are of such a nature that their life span is short. Many of them also are easily punctured or pierced; and once an opening is started in them, they tear very easily. In general, they have met with resistance, because they are fragile and easily subject to destruction. The present invention provides structure that will avoid most of the shortcomings of the prior art as set out above and provide a steel-roofed building that will last indefinitely and is not readily subject to be punctured by sharp objects.

Accordingly, it is the main object of this invention to provide a novel building structure having air-supported side walls and roof with rigid end walls and foundation; such a building providing a large unobstructed covered area of improved strength and size. This invention provides such a building of a permanent nature and erected at a much lower cost than a building providing comparable span built by conventional methods.

It is the further object of this invention to provide a flexible fluid impervious sheet to comprise the side walls and roof of this air-supported building that is much stronger than any nonmetallic sheet and, hence, much longer lasting to the point of being a permanent building. In fact, the sheet provided in this invention is strong enough to withstand a differential air pressure of 30 pounds per square foot at least.

Still another object of this invention is to provide a method for raising rapidly and securing this flexible metallic sheet to the foundation and rigid end walls of the building without creasing or otherwise damaging the metallic sheet during its raising. The method also requires a minimum of temporary supports and other structure used solely for purposes of erecting the building and removed after the building is completed.

This invention also has as an object the provision of an end wall structure that is exceedingly strong, rigid, and provides for temporary structures necessary for the execution of the method of erecting it set out in the preceding paragraph.

A still further object of this invention is to provide seal structures that will allow relative movement between the air-supported roof and the rigid end walls while maintaining differential air pressure between the inside and the outside of the structure.

To the accomplishment of the foregoing and related ends, this invention then comprises the features hereinafter fully described and particularly pointed out in the claims, the following description setting forth in detail certain illustrative embodiments of the invention, these being indicative, however, of but a few of the various ways in which the principles of the invention may be employed.

The invention is illustrated by the accompanying drawings in which the same numerals refer to corresponding parts and in which:

FIG. 1 is a perspective view of the invention.

FIG. 2 is a fragmentary, enlarged, end elevation view of the invention; broken lines illustrate hidden parts.

FIG. 3 is a vertical section taken on the line 3—3 of FIG. 2, but drawn to a larger scale than FIG. 2; broken lines illustrate hidden parts.

FIG. 4 is a fragmentary plan view of edge of the foundation and side wall and roof sheet; broken lines illustrate hidden parts, and portions of the device are broken away to illustrate its construction more fully; the scale used is larger than that of FIG. 3.

FIG. 5 is a vertical section on the line 5—5 of FIG. 4 and drawn to a larger scale than FIG. 4; broken lines illustrate hidden parts.

FIG. 6 is a fragmentary view of the same structure shown in FIG. 3 but drawn to a scale between those of FIGS. 4 and 5; broken lines illustrate adjusted positions of elements as well as hidden parts.

FIG. 7 is a fragmentary view of a portion of the structure shown in FIG. 6 drawn to a scale larger than that of FIG. 5.

FIG. 8 is a horizontal section taken on the line 8—8 of FIG. 12 and drawn to a smaller scale than that figure.

FIG. 9 is a view identical to that shown in FIG. 8 except that the temporary bulkhead used in raising the roof and side wall sheet is not shown.

FIG. 10 is an enlarged fragmentary plan view of a segment of the roof side wall sheet; the scale used is that of FIG. 7.

FIG. 11 is a horizontal sectional view taken on the line 11—11 of FIG. 10 and drawn to the same scale as that figure.

FIG. 12 is a view similar to that shown in FIG. 6 but showing the temporary seal; it illustrates the interaction

of the temporary bulkhead with the slipping roof raising seal; FIG. 12 is drawn to a smaller scale than FIG. 6.

FIG. 13 is a plan view of the foundation, end walls, and roof sheet assembled but prior to raising; the scale used in approximately that of FIG. 1.

FIG. 14 is a vertical section taken on the line 14—14 of FIG. 13 and drawn to one half the scale of FIG. 2.

FIG. 15 is a view similar to FIG. 14 except that the roof side wall sheet has been partilly raised.

FIG. 16 is similar to FIGURES 14 and 15 with the roof side wall sheet completely raised and exposing the interior of the end wall from which the temporary bulkhead has been removed.

In the drawings and specifically in FIG. 1 the invention is seen to consist of the rigid end walls 20 one of which is shown braced by buttresses 21 and secured to a concrete slab 22. Between the end walls is a flexible fluid tight sheet, generally designated 24, that comprises both the side walls and the roof of the building. The flexible fluid impervious side wall and roof sheet is raised to a position shown and held there by differential air pressure between the inside and the outside of the building. Access to the building is through one or more airlocks such as the one shown at 25 on end wall 20. In FIG. 1, also, the end wall may be seen to consist of vertical I-beam elements 26 rising from the foundation and joined in fluid impervious relationship by means of sheet steel elements 27. In FIG. 2 where the structure of the end wall is shown in greater detail, it may be seen that the sheet steel joining the I-beams to form the end walls is convex outward from the foundation to a point near the top of the wall where fillets 28 bridge the gap between the convex lower side wall and the faceplates 29 which form a flat-surfaced arch across the top of the end wall. The buttresses 21 may be cross braced by suitable means such as the horizontal I-beams 30 and the diagonal rods 31. When in completed position, the side wall roof sheet 24 assumes an arched position from each side of the foundation up to the approximate top center of faceplates 29. An air duct 32 may be seen in FIG. 2, also. It is used as an entrance means for fluid under pressure after the building is erected.

Rigid end wall 20 is shown in section in FIG. 3 which illustrates clearly how the anchor plate 34 is buried in foundation 85. The anchor plate serves as a means for fastening base plate 35 to foundation 85 in fluid impervious relation as by welding. Vertical I-beams 26 are also suitably secured to the base plate as by welding. Sheets 27, that form the irregularly surfaced convex outward portion of end wall 20, are joined to base plate 35 as well as to I-beams 26 in fluid impervious relation as by welding. The faceplate elements 29 are set in from the inside edges of the vertical I-beams by means of T's 36 welded thereto. For this reason, the faceplates 29 are inset in relation to the convex lower side wall and there is a channel created between the flanges of the I-beams and the flanges of the T's at the inside edges of each of the I-beams. This double flange is used to prevent lateral movement of a temporary bulkhead that is used in raising the flexible fluid impervious roof and side wall sheet that will be described below.

Along each side of the grade beam 85A are the angle plates 37, in FIG. 5. These side angle plates have inwardly extending anchor elements designated 38 which secure the plates to the edge of the grade beam 85A. An anchor plate 39 is secured to the angle plate 37 by suitable means such as the nut and bolt assembly 40, extending through the angle plate. A flexible fluid impervious roof and side wall sheet generally designated 24 is secured to the foundation at its sides by means of the anchor plate 39 and a cove plate 41 which rests on top of the flexible fluid impervious side wall and roof sheet 24. A reinforcing extra layer of the roof steel as shown at 42 extends a short distance up each side of the flexible fluid impervious roof and side wall sheet, and is welded thereto. Cove plate 41 is curved up at its inside edge to provide a smooth stress spreading surface against which a flexible fluid impervious roof and side wall sheet 25 is pressed by differential pressure or materials placed in the building. A resilient fluid impervious seal of any suitable material such as neoprene or butyl rubber appears at 44 between the bolts 45 holding the anchor plate and the cove plate together. Only one group of bolts 45 is shown in FIG. 4 to illustrate how they are placed between each two stiffeners of cove plate 41. At 46 and 47 respectively are additional seals between anchor plate and sheet 24 inside of the inside series of bolts and between the anchor plate and the angle plate respectively. When nut and bolt assembly 40 is tightened to secure anchor plate 39 to angle plate 37, the seal 47 is compressed to form a fluid impervious joint. The same is true of seals 44 and 46 whenever the bolts 45 are tightened pulling the anchor and cove plates together.

The flexible fluid impervious sheet which forms both the side walls and the roof of the structure, a fragment of which is shown in FIG. 4, consists of joined sheets of steel, preferably aluminized. They are also preferably long enough to extend continuously along one dimension of the finished sheet and most advantageously from one side of the building to the other in a continuous arch. These sheets, however, are much narrower than the other dimension of the sheet, in this case the building length, and hence must be joined together to form the continuous fluid impervious roof and side wall sheet. As shown in FIG. 4, the separate steel sheets 48 which form this roof and side wall sheet are overlapped and doubly secured to form seams 50 and 51 between which is provided a sealing strip of resilient fluid impervious material 49 which may be artificial rubber such as neoprene or other resilient fluid impervious material. This structure is shown in more detail in FIGS. 10 and 11 wherein the sealing strip 49 will be seen to lie between the seams formed by welds 50 and 51. Each of these seams consists of a portion of each of the aluminized sheets to be joined plus an overlay strip 52 which is spot welded along with the two aluminized sheets into a seam. The overlay strips which are either chrome steel or copper assure very consistent fluid impervious spot welds. Since the individual steel sheets that comprise the roof extend entirely from one side of the foundation to the other, the forces generated in raising the roof and side wall sheet into its finished arch are absorbed by continuous ribbons of steel extending transversely across the building arch. It should be noticed as clearly shown in FIG. 10 that the spot welds forming seam 50 on one side of sealing strip 49 are misaligned or offset obliquely in relation to the spot welds forming seam 51 on the opposite of the sealing strip 49.

In FIG. 6 an enlarged section of the end wall is shown in which the sheets 27 that form the convex outward portion of end wall 20 clearly are shown to be overlapped with the lower edges of the upper sheets inside of building when a horizontal joint is used. When the sheets are thus overlapped, even the slight ledge that would be on the inside of the building if the reverse were true is eliminated. This overlapping arrangement of the sheets 27 is disclosed clearly at number 23 in FIG. 6. In that figure, also, is shown the manner in which the flexible or yielding seal between the end wall 20 and the side wall roof sheet 24 permits relative movement between the rigid end wall and flexible roof and side wall sheet, as can be expected when a building of this type, filled with loose grain, for example, has pressure exerted against its side walls. An inner seal can be seen as consisting of the flexible fluid impervious band 54 and 54A which is joined to the side wall roof sheet on the inside at 55 and to the end wall 20 at 56. The detail structure of these joints appears more clearly in FIG. 7 wherein it can be seen that the band 54 underlies the roof and side wall element and there is a resilient air fluid impervious strip 57 in between them. The plate 58 underlies the band and is secured to the roof and side

wall sheet on both sides of the resilient element in any suitable manner as by the bolts 59. Band 54A is joined to band 54 by suitable means such as bolt and plate assembly 53. Block 75 appearing in FIG. 7 will be described in connection with FIG. 12. Joint 56 is substantially the same as joint 55 with the bolts 60 extending through plate 61, band 54A, and faceplate 29 on both sides of resilient element 62. Band 54A is thereby compressed tightly against the resilient fluid impervious strip and the faceplate to form a fluid impervious seal therebetween. A second and similar flexible seal between the roof side wall sheet and end wall 20 is illustrated in FIG. 6 also where the band 64 may be seen joined to the roof side wall sheet at 65 and to the top of end wall 20 at 66. The seals for these joints are similar to those for the inside seal and are shown in detail in FIG. 7 where bolts 67 extending through the roof side wall 24 and band 64 on both sides of resilient strip 68 engage and hold tightly compressed thereagainst plate 69. Joint 66 differs from the preceding joints in that its plate 70 has only one series of bolts 71 to hold resilient strip 74 in substantially air impervious relationship with band 64 and flange 72. As shown in FIG. 6, these flexible substantially fluid impervious seals permit the roof sheet 24 to rise and fall as shown by the broken lines as compared to the solid lines in that figure.

While the seals illustrated in FIGS. 6 and 7 are adequate when the building is once erected, they do not provide for the raising of the flexible fluid impervious roof side wall sheet. In order to provide a slipping seal while the roof and side wall sheet are being raised, the structure illustrated in FIG. 12 is used. In that figure the band 54 is shown secured to the side wall roof sheet in the usual manner described in connection with FIGS. 6 and 7. At the end of band 54 that is adjacent to the end wall, however, a resilient block 75 of fluid impervious material such as sponge rubber is secured to band 54 to provide a slipping fluid impervious seal between the end wall and the roof and side wall sheet during the raising process. Also illustrated in that figure as well as in FIG. 8 is the temporary bulkhead that is constructed to make a temporary flat surface over the convex irregular end wall portion formed by sheets 27. As shown in FIG. 8, bracing stiffeners 76, of varying dimensions depending on their position relative to sheets 27, extend inward from sheets 27 to stiffen suitable planar bulkhead sheets 78, such as plywood, and prevent them from yielding when pressure is applied to them. T's 36 engage sheets 78 as at 77 to stabilize sheets 78 laterally. Thus, as shown in FIG. 12, the bock 75 has a substantially flat surface against which to form a slipping fluid impervious seal during the roof side wall raising process. As shown in FIG. 9, the temporary bulkhead is removed after the roof side wall sheet is raised and sealed to the end walls as shown in FIGS. 6 and 7.

FIGS. 12 through 16 illustrate the balance of the techniques used in raising the flexible fluid impervious sheet without creasing or otherwise damaging this very large but relatively thin roof and side wall sheet. In preparation for erecting the building, a series of air ducts 79 shown in elevation in FIGS. 15 and 16 are placed in a ground area. The duct ends extend above the ground, each having one end in communication with a manifold or header 80. The header is provided with a series of blowers 81 which provide fluid under pressure to the manifold. As seen in FIG. 13, the manifold decreases in size as the distance from the blower increases whereby substantially equal fluid pressure is maintained throughout the manifold. Duct ends 82 are also aligned at a spaced distance from the header 80. These duct ends 82 are within the area in which the building is to be erected. Over this ground area is placed a fluid impervious membrane 84 of any suitable material such as polyethylene film or the like. At each duct end 82, the film is opened and secured to the upper end of the duct opening. With this preparation and the customary excavating and forms for foundation 85, comprising grade 85A and bell-bottom footings 85B, the foundation 85 and slab 22 are poured on and around the membrane up to duct ends 82. Angle plates 37, of course, are in position before the slab is poured so that they are firmly anchored in the concrete, as it hardens. FIG. 13 shows the sheet 24 arranged flat over the foundation slab 22 which is achieved by fabricating it in this position with one side of the sheet 24 matching one side of the foundation slab. The matching side of the roof and side wall sheet 24 is anchored to the side of the slab adjacent duct openings 82. The roof sheet, of course, must be supplied with the slipping fluid impervious seal described in connection with FIG. 12 above. Another preparatory step in getting ready to raise the roof and side wall sheet consists of yieldingly restraining the sheet in order to prevent fluid pressure that is raising the sheet from escaping at its free edge. A most satisfactory type of yielding restraint consists of weighting sheet 24 with a suitable comminuted material such as sand 86 extending the entire length of the sheet. By, thus, yieldingly restraining sheet 24 by weighting it with sand 86, a slipping or temporary joint is formed between the foundation slab 22 and the the roof and side wall sheet at the edge of the former remote from that to which the latter is anchored at the beginning of the raising process. As seen in FIG. 13, the roof and side wall sheet 24 must extend beyond the slab when it is lying flat to provide for the arch of the roof and side wall sheet when it is raised. As shown in FIG. 14 only, means are provided to control movement of sheet 24, comprising an extra piece of sheet steel 95 secured to side 87 of sheet 24 during the raising of the sheet. Piece 95 has a channel 96 welded to it which carries eyes 97, only one of which is shown in FIG. 14. Eyes 97 provide means for securing the hooks of hoists 98, of the type known as come-alongs, to the sheet 24. The hoists 98 are also secured by suitable means, such as cables 99, to appropriate anchors, such as railroad ties 100. As fluid pressure raises sheet 24, tending to draw side 87 toward the slab 22, come-alongs 98 are eased off appropriately as determined by sightings taken longitudinally of the building. As shown, also, in FIG. 14, the blowers 81 have barely raised a slight bubble 83 under the roof sheet and the free end of the roof and side wall sheet 24 is being drawn toward the edge of the foundation slab 22 to which it must be secured. In FIG. 15 the process is shown much farther along in which a sheet has been drawn across the foundation slab 22 far enough for the free side 87 of the roof sheet to have been aligned with the side of the foundation slab that is remote from the raising header. At this point the introduction of fluid under pressure is interrupted while the free edge 87 of roof sheeting 24 is secured to the edge of the foundation slab 22 in the same manner as the first edge was anchored. Piece 95 is cut off after side 87 of sheet 24 is anchored. Once both sides of the roof sheet 24 have been anchored, weighting 86 may be removed from the sheet which allows the roof and side wall sheet to assume its completely raised configuration, as illustrated in FIG. 16. At this point the final seals between the roof and side wall sheet and the end walls may be accomplished which will then make possible the removal of the temporary bulkhead used during the raising. The final appearance of the end wall interior also is illustrated in FIG. 16 where the air inlet for the permanent air pressure duct 32 may be seen at 88. A pressure differential necessary to raise the roof and side wall sheet is rather low, being something under 5 pounds per square foot.

Once the building is thoroughly sealed, however, the pressure is raised to about 20 pounds per square foot to provide stability.

During the raising process where fluid under pressure from header 80 is the main source of raising roof and side wall sheet 24, it is sometimes necessary to aid in raising the roof and side wall sheet with mechanical means

in order to overcome any friction between block 75 and the temporary bulkhead surface 78, and any excess weight of the ends of sheet 24. Any suitable means such as tackle illustratively shown by cable 89 and the block 90 supported by boom 91 may be used to accomplish this purpose.

The blowers (conventional and not shown) that provide fluid under pressure via duct 32 to maintain the differential pressure once the building is erected, peak out at 20 pounds per square foot. Since these blowers cannot create a pressure higher than 20 pounds per square foot, there is no danger of creating excess pressures. Duct openings 82 are, in the case of an extremely large building, substantial in diameter, perhaps on the order of 2 feet or more. It is advisable, therefore, to have a temporary support arranged over the duct ends 82 while roof sheet 24 is being fabricated. To this end a grille 92 is provided. With grilles in the duct openings, workers who are fabricating the roof sheet will not fall into the duct openings while they are working on the roof and side wall sheet; and after the roof sheet has been laid over the duct openings, a worker will not innocently damage the roof by stepping on an open duct bridged only by the thin roof and side wall sheet. As soon as the permanent blowers are operating, the header 89, duct openings 82, and blowers 81 are no longer necessary for the continued maintenance of air pressure inside the building. The ducts 82 are therefore sealed in any suitable manner and preferably by pouring them partially full of concrete to form a plug 94.

It is apparent that many modifications and variations of this invention as hereinbefore set forth may be made without departing from the spirit and scope thereof. The specific embodiments described are given by way of example only, and the invention is limited only by the terms of the appended claims.

What is claimed is:

1. A method of erecting side walls and a roof for an enclosure comprising, providing a fluid impervious base, providing fluid impervious upright, spaced end walls, securing them to said base in fluid impervious relation, providing a flexible fluid impervious sheet large enough to comprise the side walls and roof for said enclosure, anchoring one side of the flexible fluid impervious sheet to one side of the fluid impervious base in fluid impervious relation, movably sealing the fluid impervious flexible sheet to the fluid impervious end walls on the two edges adjacent to the side to which the fluid impervious flexible sheet is anchored, extending the flexible fluid impervious sheet flat across and beyond the other side of the fluid impervious base, holding portions of the flexible fluid impervious sheet between its point of anchor and the other edge of the base in sliding and sealing contact with the base along the entire length of said fluid impervious flexible sheet, providing conduits extending from outside said base beneath and up through the surface of said base, introducing fluid under pressure through said conduits for a time, interrupting the introduction of fluid under pressure between the fluid impervious elements when the other side of said fluid impervious sheet reaches the other side of the base securing the other side of the flexible fluid impervious sheet member to the fluid impervious base member, and terminating the holding of said fluid impervious flexible sheet.

2. The method of claim 1 in which the holding portions of said flexible fluid impervious sheet member in sliding and sealing contact with the base comprises placing a mass of comminuted material on said flexible fluid impervious sheet from one end thereof to the other within the area defined by the fluid impervious base.

3. The method of claim 1 further characterized by lifting the ends of the flexible fluid impervious sheet adjacent to the fluid impervious end walls by means in addition to the introduction of fluid under pressure.

4. A method of erecting a building comprising putting fluid-tight ducts in an earth area with the ends thereof extending above the surface of the earth, laying a fluid impervious membrane over an earth area excluding one and including the other end of each duct, opening the membrane over each duct, sealing the edge of the duct to the membrane adjacent thereto, pouring concrete on top of said fluid impervious membrane, providing rigid, fluid impervious end walls, anchoring, upright, said rigid fluid impervious end walls to the ends of said concrete in fluid impervious relationship, providing a flexible fluid impervious sheet extending from a point near one end wall to a point near the other end wall, anchoring one edge of said flexible fluid impervious sheet to one side of said concrete between the end walls in fluid impervious relationship, providing a slipping substantially fluid impervious seal between said flexible fluid impervious sheet and both of said end walls, holding consecutive portions of said flexible fluid impervious sheet intermediate its anchored side and the other side thereof against said concrete in sliding sealed relationship, pumping fluid under pressure through said ducts until the other end of said fluid impervious sheet aligns with the other side of said concrete, interrupting the pumping of fluid through said ducts, anchoring the other end of said fluid impervious sheet to the other side of said concrete in fluid impervious relationship, resuming pumping of fluid under pressure through said ducts, sealing the top of said flexible fluid impervious sheet to the tops of said end walls in fluid impervious relation, and sealing said ducts at their inner ends.

5. The method of claim 4 in which said holding comprises placing a mass of sand on said flexible fluid impervious sheet.

6. The method of claim 4 in which sealing the ducts comprises pouring them full of concrete at the inner ends thereof.

7. A method of erecting some of the walls and roof in cooperation with a building enclosure fragment comprising a fluid impervious base having fluid impervious vertical irregularly surfaced end walls in spaced relation to each other secured to the fluid impervious base in fluid impervious relationship, comprising providing a flexible fluid impervious sheet nearly long enough to reach between the vertical irregularly surfaced end walls and longer than the distance from one side of the fluid impervious base to the other, anchoring one side of the flexible fluid impervious sheet to one side of the base in fluid tight relationship, allowing the flexible fluid impervious sheet to lie flat across on the base and extend beyond it, weighting the flexible fluid impervious sheet in an area above the flexible fluid impervious base and spaced from its anchored side to form a slipping seal, providing a temporary, fluid impervious bulkhead adjacent said irregular end walls, providing a slipping fluid impervious seal between the temporary fluid impervious bulkhead at the edges of said sheet, providing ducts leading from outside said fluid impervious base beneath and through the top thereof near the side of said fluid impervious base to which said flexible fluid impervious sheet is anchored, introducing fluid under pressure through said ducts between the fluid impervious base and the fluid impervious flexible sheet between the points of anchoring and weighting said flexible fluid impervious sheet, mechanically lifting the edges of said flexible fluid impervious sheet at the point of the slipping seal therebetween and the temporary fluid impervious bulkhead, interrupting said mechanical lifting and said introduction of fluid under pressure when the free edge of the flexible fluid impervious sheet is adjacent to the other side of the fluid impervious base, anchoring the free side of the flexible fluid impervious sheet to the other side of the fluid impervious base, removing the weight from the flexible fluid impervious sheet, reintroducing fluid under pressure between the fluid impervious base and the flexible fluid impervious sheet until the flexible fluid impervious sheet is near the top of the tem-

porary, fluid impervious bulkhead, making a flexible joint between the top of the end walls and the ends of said flexible fluid impervious sheet, and removing the temporary fluid impervious bulkhead.

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