

June 4, 1963

F. M. TYE, JR
BUILDING STRUCTURES

3,092,216

Filed June 11, 1959

3 Sheets-Sheet 1

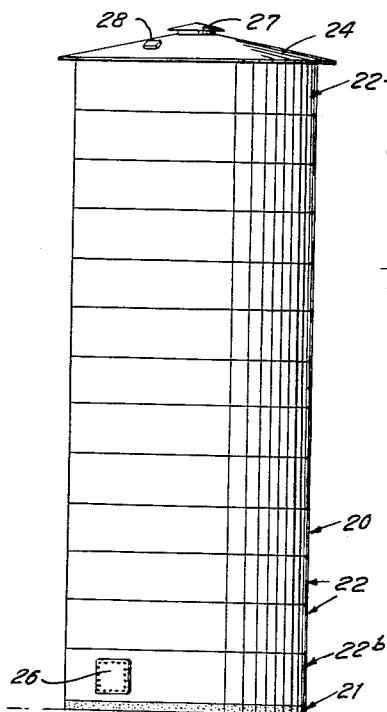


Fig. 1

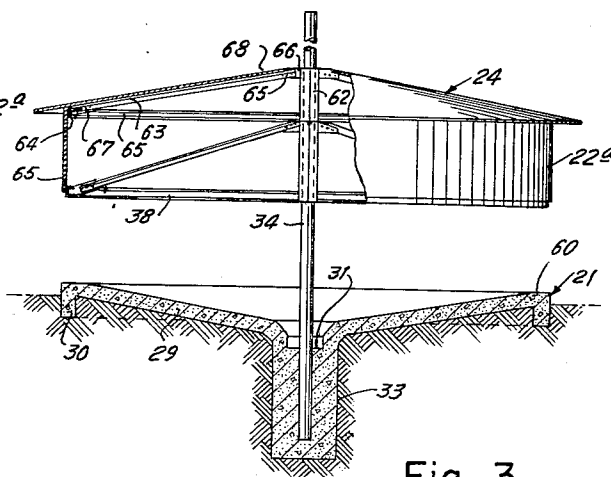


Fig. 3

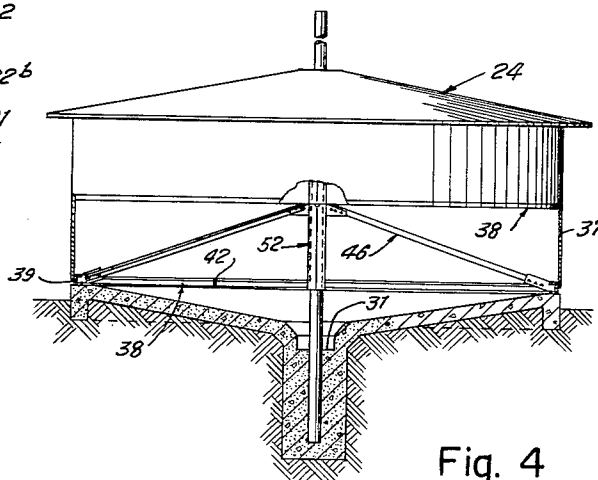


Fig. 4

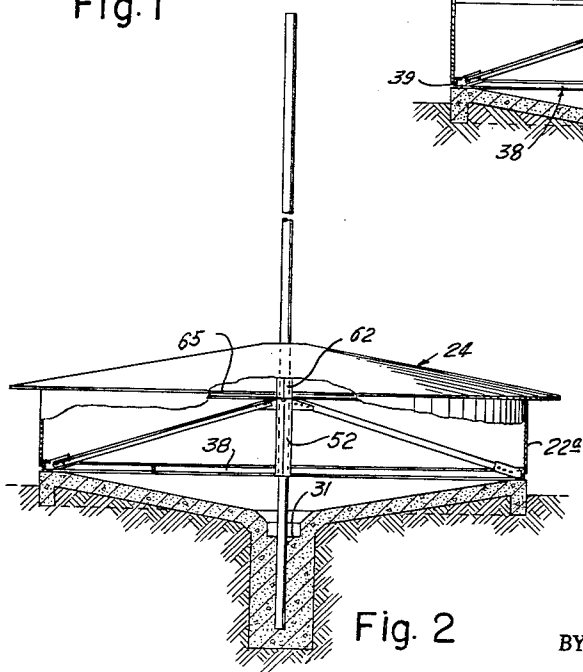


Fig. 2

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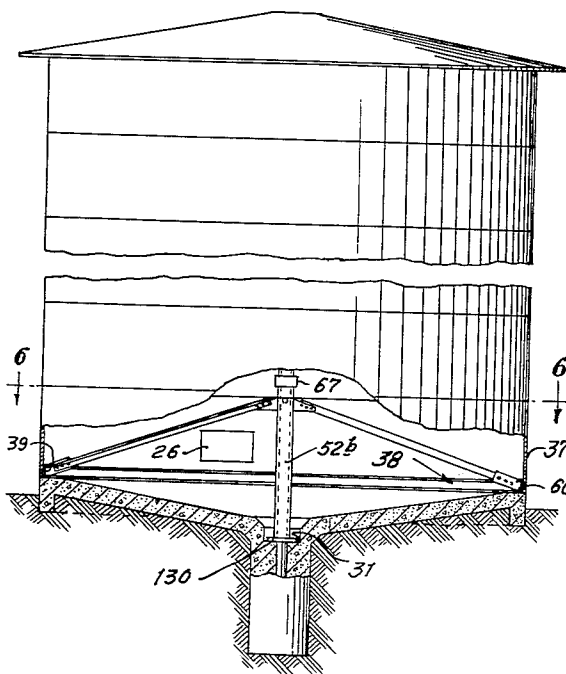


Fig. 5

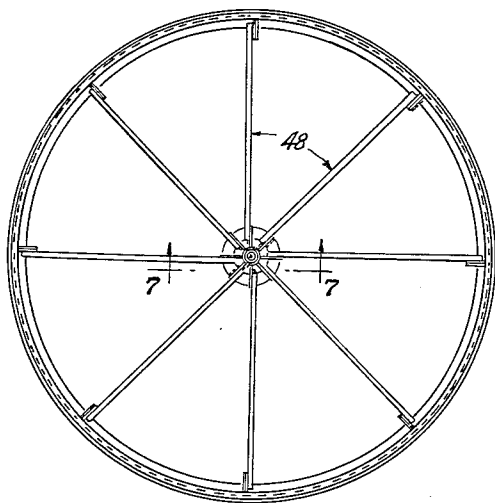


Fig. 6

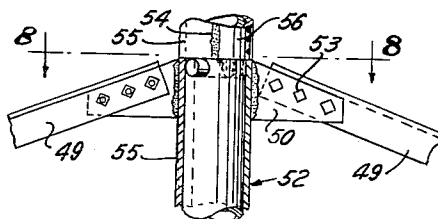


Fig. 7

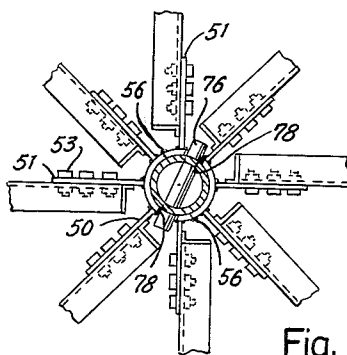


Fig. 8

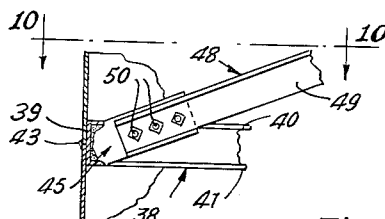


Fig. 9

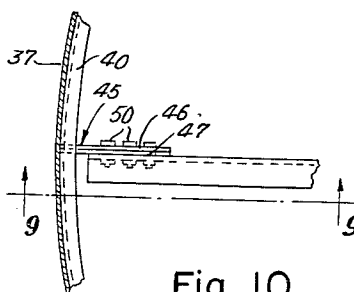


Fig. 10

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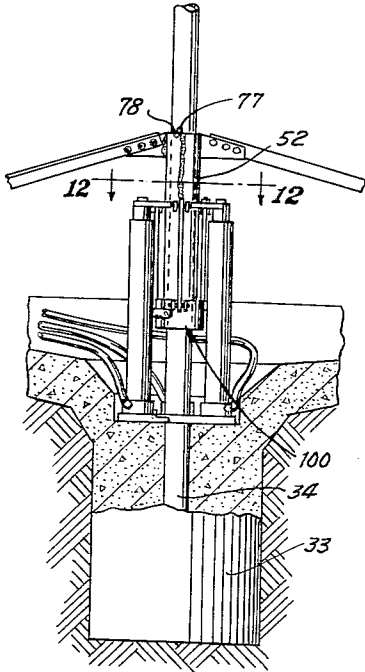


Fig. 11

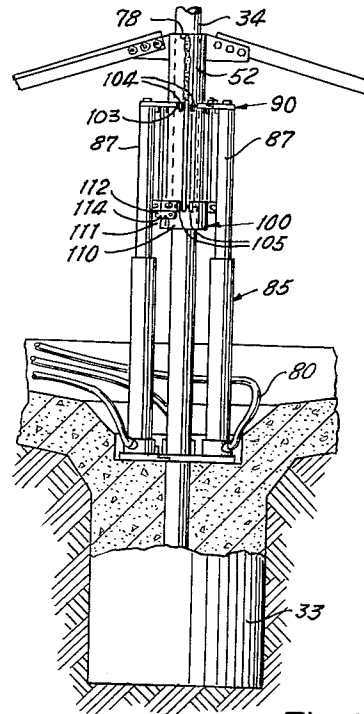


Fig. 13

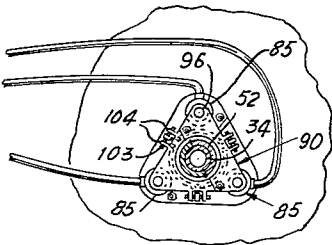


Fig. 12

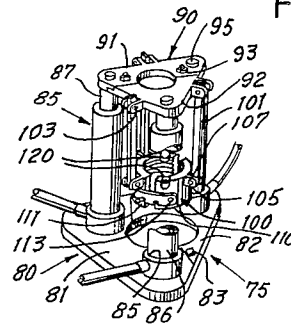


Fig. 14

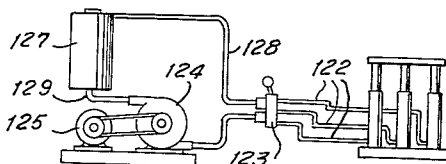


Fig. 15

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BUILDING STRUCTURES

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8 Claims. (Cl. 189-3)

This invention relates to building structures and to a method of erecting the building structure.

An object of this invention is to provide a new and improved building structure.

Another object is to provide a building structure composed of a plurality of vertically aligned sections.

Still another object is to provide a building structure which is of considerable height and which includes a plurality of vertically aligned sections having a central column which maintains the sections in alignment both during and after construction thereof.

A further object is to provide a storage elevator having a base supporting a central column which extends the height of the building and a plurality of vertically aligned sections rigidly connected to one another and having vertically aligned central sleeves which extend about the central supporting column.

A still further object is to provide a new and improved method for erecting a building structure, such as a storage elevator.

Another object of the invention is to provide a new and improved method for building a structure, such as a storage elevator, which permits all work of assembling the structure to be performed at ground level.

Still another object is to provide a new and improved method for erecting tall structures, such as grain storage elevators, which includes constructing a base for supporting a central column extending the height of the structure and sequentially assembling sections of the elevator on the base and about the supporting column, each assembled section being raised after being joined to the preceding fabricated section whereby the structure is progressively raised on the supporting column as each section is assembled on the base.

A further object is to provide a method for erecting tall structures, such as grain storage elevators, wherein the means for progressively raising the structure as it is assembled includes a hydraulic jack assembly disposable about the central supporting column of the structure and wherein each assemblage includes a sleeve slidably disposed about the supporting column, the hydraulic jack assembly engaging the sleeve of each section to raise such section and all other higher sections therewith.

Additional objects and advantages of the invention will be readily apparent from the reading of the following description of a device constructed in accordance with the invention, and reference to the accompanying drawings thereof, wherein:

FIGURE 1 is a plan view of a building structure embodying the invention;

FIGURES 2, 3, 4 and 5 are vertical, partly sectional views, with some parts broken away, showing successive steps in the assembly of the building structure illustrated in FIGURE 1;

FIGURE 6 is a horizontal sectional view taken on line 6-6 of FIGURE 5;

FIGURE 7 is an enlarged fragmentary sectional view taken on line 7-7 of FIGURE 6;

FIGURE 8 is a fragmentary sectional view taken on line 8-8 of FIGURE 7;

FIGURE 9 is a vertical sectional view taken on line 9-9 of FIGURE 10 showing the manner in which the outer ends of the radially extending stay braces of each section of the building structure illustrated in FIGURE 1 are secured to a reinforcing outer channel ring;

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FIGURE 10 is a sectional view taken on line 10-10 of FIGURE 9;

FIGURE 11 is a fragmentary, partly sectional view, of a hydraulic jack assembly for raising the assembled sections of the building structure showing the hydraulic jack assembly and the sleeve of a section prior to the raising of the section on the central support column of the building structure;

FIGURE 12 is a cross-sectional view taken on line 12-12 of FIGURE 11;

FIGURE 13 is a view similar to FIGURE 11 showing the building section raised on the central support column by the jack assembly;

FIGURE 14 is a perspective view, with some parts broken away, of the hydraulic jack assembly; and,

FIGURE 15 is a schematic illustration of the hydraulic system for actuating the hydraulic jack assembly.

Referring now to the drawings, the building structure 20, which is in the form of a cylindrical grain storage elevator, includes a base 21, a plurality of intermediate cylindrical sections 22, a top cylindrical section 22a, bottom cylindrical section 22b which are rigidly connected together at adjoining ends, and a roof 24 assembled on the top section. The roof may be provided with a ventilator 27 and a hatch 28.

The base 21 is preferably formed of concrete and includes a disk-shaped floor 29 which slopes downwardly and inwardly from the dependent annular beam 30 to a flat central circular surface 31. The base 21 also includes a central pier 33 which extends downwardly below the central flat surface of the floor and which supports in a vertical position a central support column 34 whose lower portion is embedded in the central pier.

Each of the sections 22 includes an outer wall 37 which is cylindrical in shape and may be formed of metal sheets whose adjacent ends are rigidly secured together in any suitable manner, as by welding or riveting, to form a continuous vertical annular wall section. Each of the sections 22 is provided with an annular outer channel ring 38 having a horizontal outwardly facing web 39 and vertically spaced inwardly extending upper and lower flanges 40 and 41 integral with the side edges of the web. The channel or reinforcing ring 38 is also preferably formed as a split ring and after its assembly about the central post its adjacent ends are rigidly secured to each other in any suitable manner as by welding as indicated at 42. The annular wall of each section has a lower end portion telescoped over the upper half portion of its reinforcing ring and is rigidly secured thereto in any suitable manner as by welds. The upper end portion of each wall 37 telescopes over a lower half portion of the reinforcing ring of the next upper adjacent section and is also secured thereto in any suitable manner, as by welding. The abutting upper and lower edges of the walls 37 of adjacent wall sections are rigidly secured together in any suitable manner, as by welds 43, FIGURE 9.

Each of the reinforcing rings 38 is provided with a plurality of radially inwardly and upwardly projecting arms 45, which may be formed of two plates 46 and 47 whose lower ends are reduced to extend between the flanges 40 and 41 of the reinforcing ring and are rigidly secured thereto by any suitable means, as by welding. Radially inwardly and upwardly extending angle stay braces 48 have their vertical flanges 49 abutting the arms 45 and are secured thereto by means of the bolts 50.

The upper ends of the stay braces 48 extend to the outwardly projecting arms 51 of a sleeve 52 slidably disposed on the central support column 34. The vertical flanges 49 of the stay braces 48 abut the sides of the arms 51 and are secured thereto by bolts 53 which extend through aligned apertures in the vertical flanges and the sleeve arms 50. The sleeves 52 of the structure sections 22 are

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formed of semi-cylindrical sections 55 which are connected along their adjacent longitudinal edges in any suitable manner, as by the welds 56, after the sleeve sections are disposed about the central support column 34.

It will thus be apparent that each structure section 22 includes a cylindrical wall or skin 37 which is rigidly held along its lower edge by a bracing and supporting structure which includes the outer reinforcing ring 38 and the inner central sleeve 52 joined together by the stay braces 48.

The uppermost section 22a is similar in all respects to the intermediate sections 22 except that the upper edge portions of its wall 37 are secured to the roof 24. The roof 24 includes a sleeve 62 formed, if desired, of two longitudinal semi-cylindrical sections welded along their adjacent longitudinal edges or it may be an integral cylindrical member. The roof braces 63 are secured to the outer reinforcing ring 65 of the roof, which is identical in all respects to the outer reinforcing rings 38 of the intermediate sections, and to the outwardly extending arms 66 of the sleeve 62 by means of the bolts 67. Appropriately shaped sheets 68 of metal are then secured to the roof braces 63 and to the reinforcing ring 65 in any suitable manner, as by welding. The uppermost intermediate section 22 has upper edge portions of its wall 37 telescoped over substantially the full width of the outer reinforcing ring 65 of the roof which is rigidly secured thereto in any suitable manner, as by welds. The lowermost intermediate section has external stop 67 provided on its sleeve 52 intermediate its ends.

The bottom building section 22b differs from the structure sections 22 in that the sleeve 52b thereof is longer so that its lower end abuts the flat circular surface 31 of the base and in that its wall 37b telescopes over the full width of the web 39 of its outer channel ring 38 which rests on the outer annular flat surface 60 of the base. If desired, the sleeve 52b may be of the same length as the sleeve 52 in which case a spacer sleeve, not shown, is positioned about the central support column between the flat surface 31 of the sleeve 52b.

The method of erecting the building structure 20 includes casting the base 21 and embedding a lower portion of the central support column 34 therein so that the column 34 is rigidly supported in its upright position. When the concrete of which the base 21 is made has set, the roof 24 is assembled on the base and about the central post by first telescoping the sleeve 62 over the central support column 34. Alternatively, the sleeve 62 may be formed of two semi-cylindrical sections which are first disposed about the central support column 34 and then have their adjacent edges welded together. The outer split reinforcing ring 65 is then placed on the outer annular longitudinal flat surface 60 of the base and its adjacent free ends are rigidly secured to one another, as by welding. The roof braces 63 are then secured to the arms 64 of the outer reinforcing ring 65 and to the outwardly extending arms 66 of the sleeve 62 by means of the bolts 67. The sheets 68 of metal are then secured to the roof braces 63 and to the reinforcing ring 65. Since the outer reinforcing ring 65 of the roof now rests upon the annular horizontal peripheral surface 60 of the base and since the central flat surface 31 is disposed below the outer annular flat surface 60, a hydraulic jack assembly 75 may be disposed thereon to lift the sleeve 62 and therefore the roof upwardly on the central support column until the lower end of the sleeve is disposed above a pin 76 which is insertable through aligned apertures 77 in the central support column whereby the pin 76 may support the roof on the support column in a raised position. After the hydraulic jack assembly has raised the roof to this upper position. The roof is then left supported on the pin 76 in its upper position and the top section 22a is then similarly assembled on the base by placing its outer reinforcing ring 38 on the base and then joining its adjacent ends by welding, placing the semi-cylindrical

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sections 55 of the sleeve 52 about the central support column and then rigidly securing the adjacent abutting edges thereof by welding and then connecting the stay braces 48 to the arms 45 of the outer ring to the arms 50 of the sleeve 52 by means of the bolts 50 and 53, respectively. A plurality of sheets of metal may then be wrapped around the outer ring 65 of the roof and the outer ring 38 of the top section 22a, as shown in FIGURE 2, to form the wall 37 with the upper portions of the wall telescoped over the full width of the outer ring of the roof and lower portions thereof telescoped over the upper half portion of the top section ring 38. The wall is then rigidly secured to the outer rings in any suitable way, as by welds.

The hydraulic jack assembly 75 is then placed beneath the sleeve 52 of the top section 22a to raise the top section and the roof section. The sleeve 52 is provided with oppositely disposed upwardly opening slots 78 in its upper end in which the pin 76, which may be of suitable substance of great shear strength, may be received in order that the upper end of the sleeve 52 may be moved into contact with the lower end of the sleeve 62 of the roof so that when the hydraulic jack assembly is caused to lift the sleeve 62 upwardly on the central column a very short distance, the weight of the roof section is removed from the pin which may then be easily withdrawn from the central column. The hydraulic jack assembly then raises the top section and the roof section as a unit upwardly on the central support column until the lower end of the sleeve 52 of the top section is disposed above the slots 77 of the central support column whereupon the pin 76 is again inserted therethrough and the roof and top section assembly is lowered to be supported by the pin. The hydraulic jack assembly is again moved downwardly and the next uppermost intermediate section 22 is then assembled in a similar manner on the base with its wall 37 having upper edge portions telescoping over the lower half portion of the ring 38 of the top section 22a and its lower edge portions telescoping over the upper half portions of its own reinforcing outer ring 38. When the wall is secured to the rings by welding, the intermediate section is then raised in the same manner by the hydraulic jack assembly which causes the assembly of the roof section, the top section and the intermediate section 22 to move upwardly above the aperture 77 of the central support column to again be supported by the pin 76. Each of the intermediate sections is thus sequentially and consecutively assembled on the base and connected to the next upper intermediate section with the connected groups of sections being progressively raised by the hydraulic jack assembly after each section is assembled on the base and about the central support column 34. After the lowermost intermediate section 22 has been assembled and raised, the bottom section 22b is assembled on the base and its sleeve 52b, which is longer than the sleeves 52 of the intermediate sections, rests on the central flat surface 31 of the base and its cylindrical wall 37b extends over the full width of the outer ring. The wall is secured to its outer ring 38 and to the outer ring of the lowermost intermediate section 22 in the usual manner, as by welding. The wall 37b is provided with the escape or unloading hatch 26 so that the workmen who erect the bottom section may move between the interior and the exterior of the structure through this hatch.

It will thus be seen that the method of constructing the building structure 20 comprises the construction of a base 21 having a central support column 31 extending vertically upwardly therefrom, assembling a roof section on the base and about the support column, raising the roof section a predetermined distance above the base and supporting it on the column in its raised position, building a section on the base and about the column, securing the section to the roof, raising the assembly of the roof section and the section upwardly on the column a predetermined distance, supporting the assembly on the col-

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umn in such raised position, consecutively assembling a plurality of similar sections on the base and securing them to the preceding sections, progressively raising the assembly of previously connected sections of the structure upwardly on the support column and above the base until the building structure is completely assembled.

The roof and each section of the building structure may be painted immediately upon its assembly on the base and prior to its raising so that the painting of the structure also may take place at the ground level.

The hydraulic jack assembly 75 for progressively raising assembled portions of the building structure upwardly on the central support column 34 includes a flat base 80 formed of sections 81 and 82 which have overlapping portions provided with aligned apertures through which bolts 83 may extend to secure the two base sections rigidly to one another. A plurality of hydraulic jacks 85 are mounted on the base 80, two of the jacks being mounted on the section 81 and the other on the section 82. Each of the jacks includes a hydraulic cylinder 86 and a piston 87 slidably telescopic in the hydraulic cylinder.

A lift plate 90 is formed of two sections 91 and 92 having overlapping adjacent edge portions provided with registering apertures through which the bolts 93 may extend to rigidly secure the two sections of the lift plates to one another. The lift plate is supported on the upper ends of the pistons, each piston having a reduced upper end portion 95 which extends through a suitable aperture in the lift plate, the reduced upper portions providing annular upwardly facing support shoulders 96 adjacent the upper ends of the pistons upon which the lift plate rests. The lift plate section 91 is supported on the piston of the hydraulic jack of the base section 82 and on one of the pistons of one of the hydraulic jacks on the base section 81. The lift plate section 92 rests on the piston of the other hydraulic jack on the base section 81.

A split lift sleeve 100 is suspended from the lift plate by a plurality of links 101. The upper ends of the links 101 are secured to the lift plate by means of pins 104 which extend through suitable aligned apertures in the upper ends of the links and in the laterally outwardly extending lugs provided on the lift plate. The lower ends of the links 101 are similarly connected to the lift sleeve by pins 105 which extend through aligned apertures in the lower ends of the links and in the outwardly extending lugs 107 of the sleeve. The split sleeve is formed of two sections 110 and 111 which may be secured together by means of the latches 112. Each of the latches 112 has one end pivotally connected to one of the sections by means of a pin 113 and is provided with a pair of downwardly opening slots in which is receivable a latch pin 114 laterally outwardly extending from the other lift sleeve section.

The base and lift plates are provided with central apertures through which the central support column and the sleeves may extend. The hydraulic jack assembly is so positioned on the central circular flat surface 31 of the base that the lift sleeve 100 is disposed below the lower end of the sleeve of a section being assembled on the base when the pistons are in their lower retracted positions in the cylinders since the lift sleeve is then disposed below the flat peripheral horizontal flat surface 60 of the base and thus is below the lower end of such sleeve section. Individual sections of the sleeves may be inserted downwardly through the aperture in the lift plate to rest upon the upper surface of the lift sleeve during the construction so that the hydraulic jack assembly need not be disassembled during the actual assembly of the structure but only upon the completion thereof.

It will thus be apparent that the hydraulic jack assembly 75 may be assembled about the central support column 34 to rest on the central flat circular portion surface 31 of the base and that after the erection of the building is completed, save for the bottom section 22b thereof, the hydraulic jack assembly may be disassembled and removed

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from the base. The lift sleeve is provided with a pair of oppositely disposed upwardly opening slots 120 through which the support pin 76 of the central support column may extend so that the pin may be inserted through the aperture 77 of the central support column and through the slots 120 below the lower end of a sleeve 52 of a structure section 22 while the sleeve is being supported in its upper raised position by the hydraulic jack assembly, as illustrated in FIGURE 13.

Each of the hydraulic jacks is supplied with hydraulic fluid under pressure through conduits 122 through a control valve 123 from a pump 124 driven by a motor 125. The control valve may selectively connect the conduits 122 either to the pump or to the fluid reservoir 127, the fluid reservoir being connected to the control valve by a conduit 128 and to the pump by the conduit 129.

The walls 37 of the various sections may increase in thickness progressively from the top to the bottom of the structure since the lower walls of course have to bear proportionately greater loads even though the sleeves 52 also bear a portion of the load. For example, the thickness of the walls of an eighty foot high grain storage elevator may increase from .065 inch in the top sections to .120 in the lowest intermediate section. The bottom wall 37b may be .250 inch thick since it is subject to being accidentally engaged forcibly by trucks and other vehicles.

The central support column 34 may be considerably shorter than the height of the building since the abutting ends of adjacent sleeves are welded to from a solid sleeve whose upper portions may extend rigidly upwardly of the support column.

If desired, the sleeve 52b of the bottom section 22b may be provided with an annular foot piece 130 to distribute the load over a larger portion of the flat surface 31 of the base. It is necessary to lift the lowermost intermediate section and all other structure sections secured thereto slightly to permit the insertion of the sleeve sections of the sleeve 52b beneath the sleeve 52 of the lowermost intermediate section 22 so that the sleeve 52b may be placed under compression by the weight of the sections positioned thereabove on the central support column after it is properly positioned about the central support column and on the central flat surface 31 of the base. Such lifting of the lowermost intermediate section is accomplished by moving the sections of the split sleeve apart so that the split sleeve may slide over the sleeve 52 of the lowermost intermediate section until it engages the stop 67. The latches 112 hold the split sleeve sections in proper position by receiving the pins 111 in their slots which are farthest from the points of pivotal connection of the latches.

It will now be apparent that a new and improved building structure has been illustrated and described which is formed of a plurality of sections, each section having a central sleeve and an outer ring which are connected by stay braces to form a rigid support for an annular wall 37 of each section.

It will further be seen that the sleeve of each section is disposed about a central support column on which it may be raised and on which it may be supported in raised position by means of a support pin 76 insertable through aligned apertures in the central support column.

It will further be seen that the adjacent ends of the sleeves of adjacent sections may be rigidly connected together by welding or other suitable means in the same manner as the walls 37 of adjacent sections are rigidly connected so that the resultant assembled structure is of unitary construction and rigidly connected throughout its length.

It will further be seen that the sections are of the same diameter from top to bottom.

It will also be seen that the walls need not be of excessive thickness since they are not required to support any equipment or men during the construction of the structure.

It will also be apparent that no scaffolding is required for the construction of the structure since each section is assembled at the ground level.

It will further be apparent that while a particular hydraulic jack assembly has been illustrated and described for raising the assembled sections of the structure on the support column that other raising means may be employed. For example, a block and pulley arrangement supported from the top of the support column 34 might well be utilized for this purpose.

The foregoing description of the invention is explanatory only, and changes in the details of the construction illustrated may be made by those skilled in the art within the scope of the appended claims, without departing from the spirit of the invention.

What is claimed and desired to be secured by Letters Patent is:

1. A building structure including: a base; a support column extending vertically upwardly from the base; and a plurality of vertically aligned sections disposed about said column and supported on said base, each section other than the lowermost being supported by an adjacent lower section, said lowermost section resting on said base, each of said sections comprising a wall and a supporting frame, said frame including an outer ring abutting and being secured to lower edge portions of the wall and a sleeve adapted to be slidably disposed about said central support column.

2. A building structure including: a base; a support column extending vertically upwardly from the base; and a plurality of vertically aligned sections disposed about said column and resting on said base, each of said sections comprising a wall and a supporting frame, said frame including an outer ring abutting and being secured to lower edge portions of the wall, a sleeve adapted to be slidably disposed about said central support column, and stay braces extending between said outer ring and said sleeve.

3. A building structure including: a base; a support column extending vertically upwardly from the base; and a plurality of vertically aligned sections disposed about said column and supported on said base, each of said sections other than the lowermost being supported by an adjacent lower section, said base having an outer annular flat surface, an intermediate downwardly inwardly sloping surface and a central flat surface, the lowermost of said sections having portions abutting and resting on said central flat surface and said annular flat surface of said base.

4. A building structure including: a base; a support column extending vertically upwardly from the base; and a plurality of vertically aligned sections disposed about said column and resting on said base, each of said sections comprising a wall and a supporting frame, said frame including an outer ring abutting and being secured to lower edge portions of the wall and a sleeve adapted to be slidably disposed about said central support column, the wall of each section extending downwardly about its outer ring and upwardly over a lower portion of the outer ring of an adjacent section disposed thereabove.

5. A building structure including: a base; a support column extending vertically upwardly from the base; and a plurality of vertically aligned sections disposed about said column and resting on said base, each of said sections comprising a wall and a supporting frame, each

of said frames including an outer ring abutting and being secured to lower edge portions of the wall, a sleeve adapted to be slidably disposed about said central support column, and stay braces extending between said outer ring and said sleeve, the wall of each section extending downwardly about its outer ring and upwardly over a lower portion of the outer ring of an adjacent section disposed thereabove.

6. A building structure including: a base; a support column extending vertically upwardly from the base; and a plurality of vertically aligned sections disposed about said column and supported on said base, each of said sections other than the lowermost being supported by an adjacent lower section, said lowermost section resting on said base, each of said sections comprising a wall and a supporting frame, each of said frames including an outer ring abutting and being secured to lower edge portions of the wall, a sleeve adapted to be slidably disposed about said central support column; and braces extending upwardly and inwardly from said ring to said sleeve.

7. A building structure including: a base; a support column extending vertically upwardly from the base; and a plurality of vertically aligned sections disposed about said column and resting on said base, each of said sections comprising a wall and a supporting frame, each of said frames including an outer ring abutting and being secured to lower edge portions of the wall, a sleeve adapted to be slidably disposed about said central support column, and braces extending upwardly and inwardly from said ring to said sleeve, the wall of each section extending downwardly about its outer ring and upwardly over a lower portion of the outer ring of an adjacent section disposed thereabove.

8. A building structure including: a base; a support column extending vertically upwardly from the base; and a plurality of vertically aligned sections disposed about said column and resting on said base, each of said sections comprising a wall and a supporting frame, said frame including an outer ring abutting and being secured to lower edge portions of the wall and a sleeve slidably disposed about said central support column; and braces extending upwardly and inwardly from said ring to said sleeve, the wall of each section extending downwardly about its outer ring and upwardly over a lower portion of the outer ring of an adjacent section disposed thereabove, said base having an outer annular horizontal surface, an intermediate downwardly inwardly sloping surface and a central flat surface, the lowermost of said sections having portions abutting and resting on said central flat surface and said annular surface of said base.

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