April 17, 1928. 1,666,413

C. B. FOSTER

FABRICATED DERRICK CONSTRUCTION

Filed July 17, 1926 3 Sheets-Sheet 1

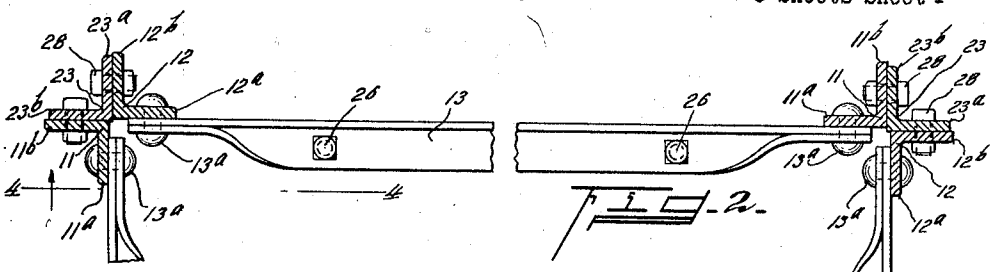


Fig. 2.

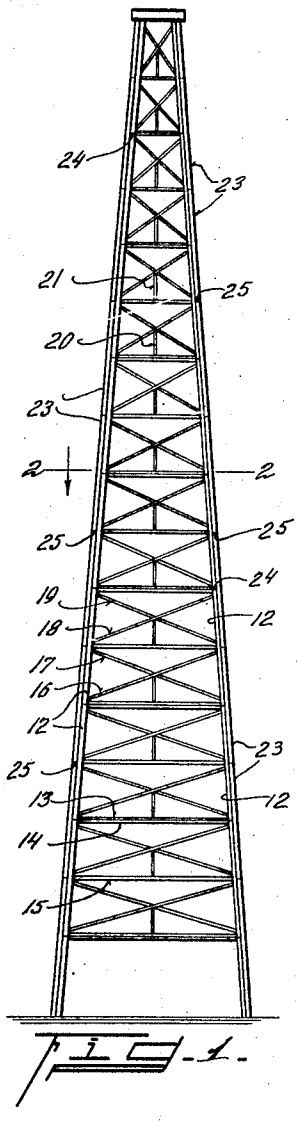


Fig. 1.

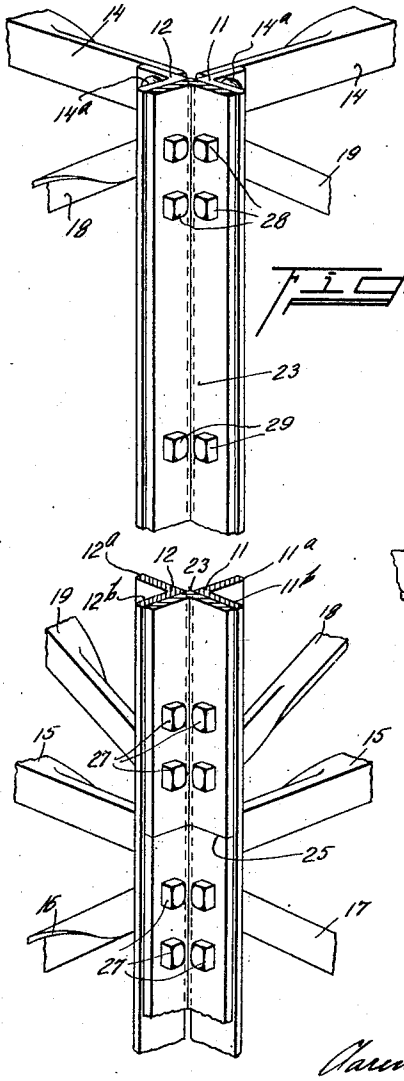
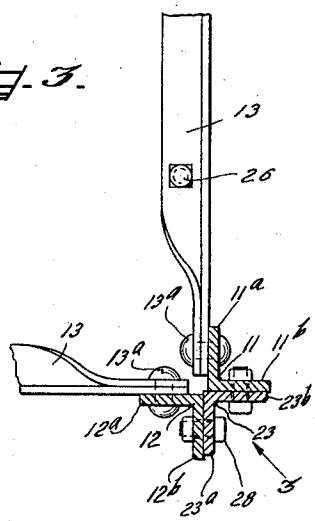


Fig. 3.



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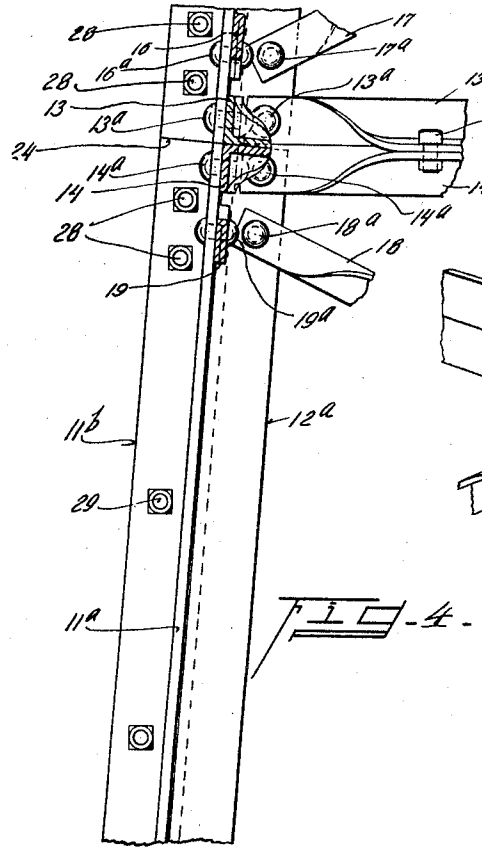


Fig. 4.

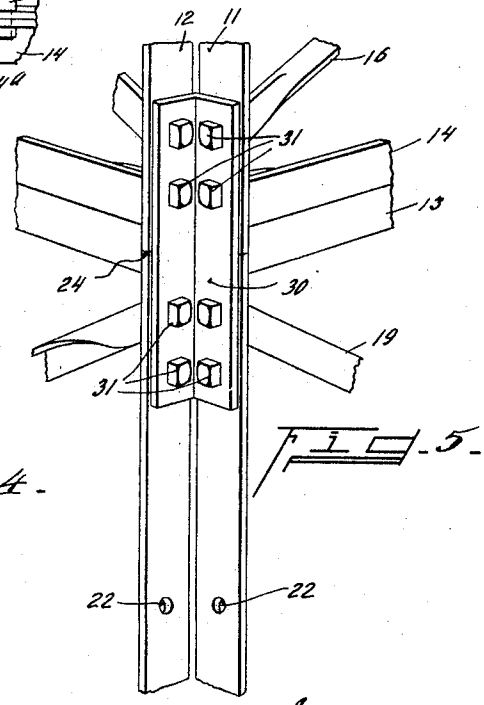
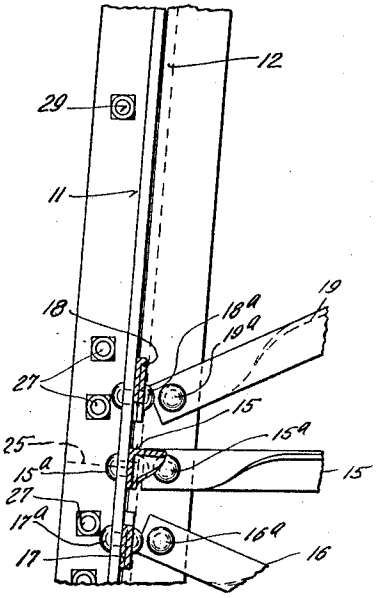
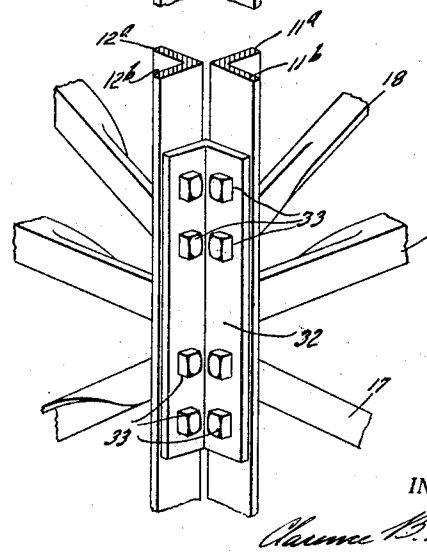


Fig. 5.





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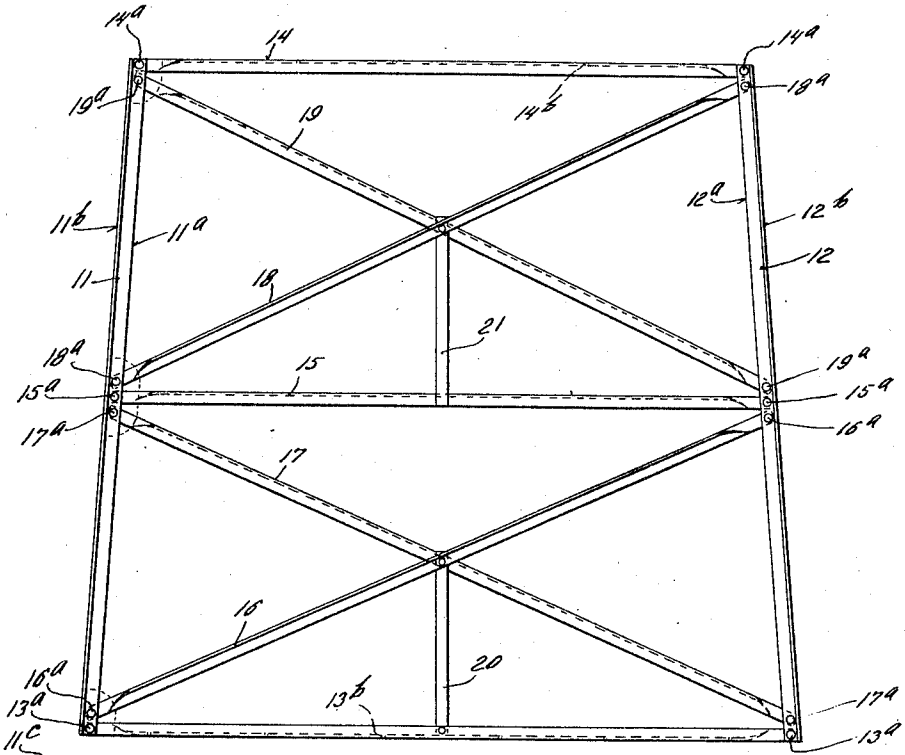


Fig. 6.

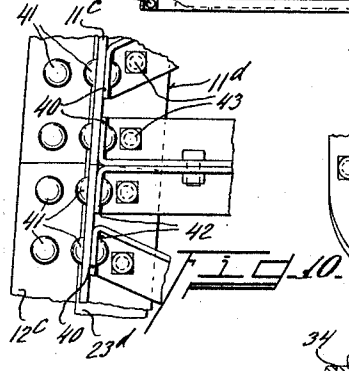


Fig. 10.

Fig. 7.

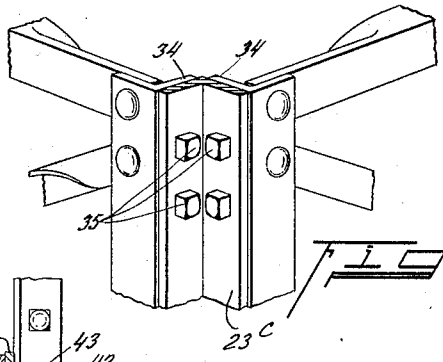


Fig. 8.

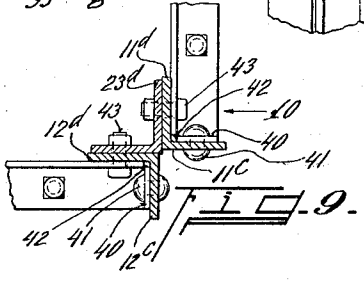


Fig. 9.

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Patented Apr. 17, 1928. 1,666,413

UNITED STATES PATENT OFFICE.

CLARENCE B. FOSTER, OF GLENDALE, CALIFORNIA, ASSIGNOR OF ONE-SIXTH TO FREDERICK L. FEISTHAMEL, ONE-SIXTH TO ARTHUR J. CARR, AND ONE-SIXTH TO THOMAS A. COLLINS, ALL OF LOS ANGELES, CALIFORNIA.

FABRICATED-DERRICK CONSTRUCTION.

Application filed July 17, 1926. Serial No. 123,136.

This invention relates to an improved type of fabricated derrick construction, and is particularly directed to the general class of derrick structures usually employed as a part of the equipment utilized in the drilling and operating of oil, gas, and like wells.

Derricks of the general character used in the oil industry comprise four upwardly converging corner posts or legs connected together around the four sides of the derrick at vertically spaced intervals by transverse girts, and braced by intermediate diagonal anti-vibration or sway braces.

When formed of structural steel these derricks are usually fabricated at the factory to be shipped to the field for erection. Such steel derricks usually have corner posts or legs each formed of an single string of several sections of pipe or angle-iron placed end on end in longitudinal alignment and rigidly secured together at their abutting ends by joint-plates and bolts or by other similar means.

In view of the heavy expense connected with the erection of derricks in the field, certain efforts have heretofore been made to pre-assemble certain portions of steel derricks at the factory or at field shops, it being the usual practice in such instances to pre-assemble certain of the parts to form sections or panels of heights convenient to handle, but with the ordinary single leg type of construction now in use it is only possible to pre-assemble the parts in panel form for two opposite sides of a derrick thus including the four leg sections in these two panels, leaving only the braces and girts of the other two sides of the derrick to be subsequently filled in during erection of the derrick.

It has been proposed to modify this usual type of construction by constructing each corner post or leg of a double string of angle-iron leg sections so that each of the four sides of the derrick may be preassembled into panel form and to erect the derrick with the leg angles of the panels of two opposite sides nested within the leg angles of the panels of the other two sides and with the several panels of the adjacent sides in break-joint relationship vertically.

In a derrick of such construction, which is shown in the application of Burton Black, Ser. No. 68,208, only two horizontally opposite panels of the entire derrick can be of the same width, this being due to the taper of the derrick, the break-joint relationship of the panels and the intermeshing of the leg angles.

To permit a maximum standardization of parts, to minimize errors in pre-assembling and erection, to economize in the space necessary to store the fabricated parts and pre-assembled panels at the factory or distributing establishments, and for other reasons, it is very desirable to provide a derrick construction in which as many as possible of the parts and panels may be of duplicate form and size, in so far as the major portion of the derrick is concerned, it being of course realized that certain special constructions may be necessary at the bottom and top portions of the derrick.

In the drilling of wells the derrick is subjected to very heavy loads and great strains and must for this reason be of very sturdy construction, while a derrick used for operating a completed well is not subjected to such severe loads or strains and can therefore be of less sturdy construction.

A heavy derrick suitable for well drilling is quite expensive and as a matter of economy some companies have established a practice of dismantling the heavy derrick, used during drilling and of replacing it by a lighter derrick after the well is on production, the heavy derrick being assembled elsewhere for use in drilling another well.

While this practice is cheaper than providing new derricks for every well, the dismantling and assembling amounts to an item of great expense.

It is therefore of great economical importance to so design a derrick that it may be of such strength as to be first used as a drilling derrick and can subsequently be converted, at a minimum of expense, into a pumping derrick, without excessive dismantling of parts and so that such parts are fully available for replacement to quickly and easily reconvert the derrick back to a drilling derrick or may be completely salvaged for use in the building of another drilling derrick.

In the fulfilment of the above mentioned desirable characteristics, the major objects of the present invention are: to provide a der-

rick construction of the pre-assembled panel type in which the panels are arranged in tiers or stories with all of the panels of each tier horizontally aligned and of duplicate form and size; to provide a derrick construction of the panel type in which the panels of the several sides are entirely independent of those of adjacent sides and are separated by intermediate corner posts or legs to which they are separately connected; to connect the leg members to the panels in break-joint relationship in a manner permitting their replacement by individual joint-plates to convert the drilling derrick to a pumping derrick; to provide a derrick of the above type in which the corner legs each comprise a series of vertically aligned leg members joined to the adjacent panels by bolts so arranged that as said leg members are removed joint-plates may immediately be substituted and secured at the joints between the tiers by bolts engaging in the same bolt holes in the panels as previously accommodated the leg member bolts; and to provide a construction in which the several corner leg members directly contact the vertical marginal side members of the panels throughout their entire lengths.

Various other objects and advantages will be more fully apparent from the following description of the accompanying drawings which form a part of this disclosure, and which illustrate a preferred form of embodiment of the invention.

Of the drawings:

Fig. 1 is an elevation of a drilling derrick constructed in accordance with the present invention.

Fig. 2 is an enlarged plan section, partly broken, taken on line 2—2 of Fig. 1.

Fig. 3 is a fragmentary perspective view of a corner of the derrick viewed as indicated by the arrow 3 in Fig. 2.

Fig. 4 is a partial vertical section taken on line 4—4 of Fig. 2.

Fig. 5 is a perspective view similar to Fig. 3, showing the substitution of the joint-plates for the corner leg members when the construction is converted to constitute a pumping derrick.

Fig. 6 is an elevation of one of the pre-assembled panel sections.

Fig. 7 is a fragmentary plan section illustrating a modified form of construction.

Fig. 8 is a fragmentary perspective view of the construction shown in Fig. 8, and viewed as indicated by the arrow 8 therein.

Fig. 9 is a fragmentary plan section illustrating another modified form of construction, and

Fig. 10 is an elevation of the construction shown in Fig. 9, viewed as indicated by the arrow 10 in Fig. 9.

The derrick illustrated in the drawings is shown as being made of structural steel shapes, but it is to be understood that the present invention in its broad aspect is not to be restricted to any particular material, the specific embodiment disclosed being primarily intended for the purpose of illustrating a practical application of the principles of construction involved.

As shown, each of the four sides of the derrick is formed of a plurality of panel sections secured together in vertical alignment, with the several panel sections of suitable dimensions to produce a completed derrick gradually tapering upwardly to the derrick top upon which will be mounted the usual crown block.

The respective panels of each side of the derrick may be exact duplicates of those of the other three sides both as to construction and size and in the erection of the derrick the panels are arranged in tiers or stories one upon the other with the four panels of each tier horizontally aligned, thus permitting all four panels of each tier being of the same relative size so that they may be interchangeable as well as readily adaptable for standardization.

With this construction each tier is finished to a horizontal level thus eliminating the necessity of providing two short panels at the bottom and top of the derrick as is required in a panel derrick in which the panels of adjacent sides are arranged in break-joint relationship.

While the several panels of the derrick are herein described as being of duplicate character, this has more particular reference to the major portion of the derrick for it will be evident to those skilled in the oil industry that the lower panels will necessarily be somewhat modified to accommodate the walking-beam, draw-works and other portions of the drilling or pumping equipment and also that suitable provisions will be made for the derrick ladder, platform, water-table, crown-block, etc.

The several panels are of the construction shown in Fig. 6 of the drawings, each panel including opposite marginal side angles 11 and 12 disposed vertically and at slightly converging angles corresponding to the general taper of the completed derrick, lower and upper transverse marginal girts 13 and 14, an intermediate transverse girt 15, a lower pair of diagonal sway braces 16 and 17, an upper pair of similar sway braces 18 and 19, and lower and upper vertical hangers 20 and 21. The marginal side angles 11 and 12 are arranged with their respective flanges 11^a and 12^a disposed towards each other in the plane of the panel and with their respective adjacent flanges 11^b and 12^b extended outwardly, and the respective lower and upper transverse marginal girts 13 and 14 are arranged with their respective vertical flanges disposed towards each other

in the plane of the panel and with their respective horizontal flanges extended inwardly. All of the girts and braces are preferably of angle form and are swaged at opposite ends to bring both flanges thereof to parallel contact to provide securing ends of double thickness, and said ends and the flanges 11^a and 12^a of the marginal side leg angles 11 and 12 are punched or bored to receive securing bolts or rivets. In the drawings, the ends of the several girts and braces are shown as engaging the inner surfaces of the flanges 11^a and 12^a of the marginal side members 11 and 12, but it will be evident that they may be connected to said flanges by gusset plates as indicated in dotted lines in Fig. 6. It will also be evident that the swaging of the ends of the girts and braces is optional and that the particular arrangement of sway braces and hangers is purely illustrative in so far as the present invention is concerned, it being understood that so long as there is provided the marginal side members 11 and 12 and the transverse marginal angle girts 13 and 14, any suitable type of intermediate bracing sufficient to maintain the panel against distortion may be employed.

While it is obvious that the several parts of the panel may be secured together by bolts I have shown such parts secured together by rivets as this is preferable in instances where the panel is pre-assembled in the factory or in a field shop. These several rivets are designated by reference characters consisting of a suffix added to the numerals designating the respective parts they secure to the side angles 11 and 12, thus the rivets 13^a secure the lower transverse marginal girt 13 to the lower ends of the marginal side angles 11 and 12, the rivets 14^a secure the upper transverse marginal girt 14 to the upper ends of the marginal side angles 11 and 12, while the rivets 15^a, 16^a, 17^a, 18^a and 19^a secure the intermediate girt 15 and the respective sway braces to said marginal side angles. To receive the bolts utilized in erecting the derrick, the flanges 11^b and 12^b of the respective marginal side angles 11 and 12 are provided with suitably spaced bolt holes, two of which are shown at 22 in Fig. 5, and the horizontal flanges of the respective lower and upper transverse marginal girts 13 and 14 are provided with suitably spaced bolt holes as indicated at 13^b and 14^b in Fig. 6.

Referring particularly to Fig. 2, it will be evident from the above that there is provided a plurality of preassembled panel sections each of which is a complete unit including the two opposite marginal side angles 11 and 12 and the two transverse marginal girts 13 and 14, associated with suitable intermediate braces, and also that all four panels of each tier are of the same character and dimensions so as to be interchangeable with each other and easily susceptible of standardization.

At each corner of the derrick there is provided an angle corner post or leg extending throughout the height of the derrick and comprising a single string of corner leg sections 23 vertically aligned in abutting relationship, the respective flanges 23^a and 23^b of said corner leg sections being suitably punched or bored to receive the securing bolts which secure the panels to the corner legs.

While it is evident and is clearly realized that the derrick may, if desired, be erected piece by piece using bolts throughout the structure, the preferred method to be followed in practice will be to pre-assemble the several panels, leaving to the field crew only the work of assembling these complete panel units and the corner legs into a completed derrick. Therefore, I will for the purpose of this disclosure limit the description of the erection, to the manner in which the several panels and the corner legs are secured together to form the completed structure, it of course being understood that the erection of the several tiers will be progressive from the bottom to the top of the derrick and further that the panels of each tier will rest upon the like panels of the next lower tier with the horizontal flanges of their lower marginal girts 13 contacting the horizontal flange of the upper marginal girt 14 of the next lower panel. (See Figs. 1 and 4.) Also at this same level the marginal side angles 11 and 12 of the panels of each tier will abut as at 24 upon those of the panels of the next lower tier so that in so far as the panels themselves are concerned those of every tier are horizontally aligned.

It will be noted that the several angle sections 23 of each corner leg are preferably of uniform length and are arranged so that they break joint with the several tiers, that is, the line 25 of abutment between vertically adjacent leg sections is opposite the intermediate girt 15 of the adjacent tier. This brings the corner leg sections in vertically staggered relationship with the marginal side angles of the panels, it of course being understood that the corner leg angles at the bottom and top of the derrick will necessarily be of suitable lengths to provide a level base and top to the structure.

In the process of erection the four panels of a tier will be positioned upon those of the next lower completed tier and the horizontal flanges of their lower transverse marginal girts 13 will be secured at suitable intervals to the horizontal flanges of the upper transverse marginal girt 14, of the panels of said next lower tier by bolts 26. (See Figs. 2 and 4.) Four of the angle corner leg sections 23 will then be positioned between the

panels in the relationship illustrated in Figs. 2 and 3, the flange 23^a of each corner leg section closely contacting the flange 12^b of one panel and its flange 23^b closely contacting the flange 11^b of the horizontally adjacent panel. Each of said leg sections are then bolted to said panels adjacent their intermediate girts 15 by bolts 27, also at the level of the tier by bolts 28 and at intermediate intervals by bolts 29.

This method of procedure will be followed throughout the erection of the derrick, the corner leg sections being progressively applied as the tiers are completed as is necessary by reason of the fact that the panels of each side have no direct connection or engagement with those of the other sides.

The panels alone are not sufficient to constitute a complete derrick since without connecting members such as the corner leg sections 23 each side of the derrick would be separate from the others and the structure would not have sufficient stability, but when the panels are joined by the corner leg sections 23, said sections, together with the marginal side angles of the panels, produce a corner column of great strength which will support heavy loads without subjecting the securing bolts to shear strains, this being due in part to the vertical abutting relationship of the parts and in part to the close contact of the corner leg sections with the panel side angles throughout their lengths.

In a structure of the above described type similar parts of all four panels of each tier are exact duplicates of each other and can therefore be fabricated with the same dies and templets or other special manufacturing equipment. This materially reduces the number of different kinds and sizes of parts necessary to carry in stock and eliminates the possibility of error in pre-assembling, and the fact that all four panels of each tier of the derrick are exact duplicates renders it practically impossible to assemble the panels in a wrong manner. These advantages are of great importance in the economical production of the structure and also in the erection thereof as contributing to the possibility of erection by unskilled labor.

The construction above described provides a heavy sturdy structure suitable for use as a drilling derrick and which, due to the column construction of its corner legs, can be made of lighter material than other types of drilling derricks.

A feature of major importance incident to this construction is its adaptability for conversion into a derrick of lighter construction suitable for use as a pumping derrick. In the accomplishment of this object the corner leg angle sections 23 are unbolted from the panels and separately removed from one tier at the time preferably commencing from the top of the derrick, and substituting for said corner leg sections relatively short angle-iron joint plates 30 (see Fig. 5) each positioned to span the respective joint 24 between adjacent tiers, said joint plates being bolted to the adjacent panels by bolts 31 which engage in the same bolt holes in the marginal side angles of the panels as did the bolts 28 previously used to secure the corner leg sections 23 in place. It will be of importance to note that as one set of corner leg angles 23 is removed a set of the joint plates 30 must be applied before another set of said corner leg angles 23 are removed so that at no time will the panels of any one tier be entirely disconnected from the adjacent corner leg sections. If thought desirable, additional angle-iron tie plates 32 may be positioned adjacent the respective intermediate girts 15 and secured to the respective panels by bolts 33 which engage in the same bolt holes in the panel side angles as did the bolts 27 previously used to secure the corner leg sections 23 at these points.

The structure converted in this manner provides a derrick of suitable strength for use as a pumping derrick, and the corner leg sections 23 so removed will constitute a very appreciable amount of salvage which can be subsequently utilized in the erection of a new drilling derrick.

It will thus be evident that I have provided a sturdy heavy duty drilling derrick which can readily be converted into a lighter pumping derrick, and in which the four sides of the derrick are constructed of pre-assembled panel units arranged in horizontal tiers and connected to intermediate corner legs, the construction being such that neither the panels by themselves nor the leg sections by themselves constitute a complete self-supporting structure but are dependent upon each other to form a drilling derrick, or the panels are dependent upon substituted joint plates to form a pumping derrick.

In Figs. 7 and 8 there is illustrated a modified form of construction in which the angle marginal side members of the panels have their flanges 34 extended inwardly and joined to the corner leg angles 23^c or joint plates, as the case may be, by bolts 35. This construction may in some instances be desirable but is not believed to provide such a sturdy corner leg column as the arrangement previously described.

In Figs. 9 and 10, there is illustrated another modified type of structure in which the corner leg angles 23^d are positioned inside the derrick, that is, said leg angles engage the inner surfaces of the flanges 11^d, 12^d of the respective panel side angles 11^c, 12^c, so that they must be applied or removed from the inside of the derrick instead of from the outside thereof as in the previously described constructions.

In constructing the panels for this form of structure, the ends of the grits and braces are not swaged as in the previously described structure and are not initially secured to the respective flanges 11^a, 12^a of the panel side angles. As clearly shown in Figs. 9 and 10 the girts and braces have the end portions of their vertical flanges cut away and the end portions 40 of their horizontal flanges bent back to a substantially vertical plane, such end portions 40 being secured by rivets 41 to the respective panel side angles. The inner edges of the portions 40 may be welded to the ends of the vertical flanges, as indicated at 42, thus providing a very rigid box-like end structure for each of the several girts and braces. In assembling this particular type of construction bolts 43 which secure the corner leg angles 23^a and the panels together, extend through aligned bolt holes in said leg angles and in the respective flanges 11^a and 12^a of the panel side angles and also in the vertical flanges of the respective girts or braces.

While the structure herein illustrated and described is fully capable of fulfilling all of the objects primarily stated it is to be understood that I do not wish to restrict the present invention to the specific embodiment herein disclosed for it is susceptible of embodiment in various other forms, all coming within the scope of the claims, which follow.

I claim as my invention:

1. In a derrick of the nature disclosed, the combination of: adjacent sides each formed of a plurality of vertically aligned complete pre-assembled panel sections, with the panel sections of each side laterally spaced from those of the adjacent sides; intermediate corner legs disposed at the respective corners of the derrick and positioned between the horizontally adjacent panel sections; and means for securing said legs to said panel sections to connect the sides of the derrick together.

2. In a derrick of the nature disclosed, the combination of: adjacent sides each formed of a plurality of vertically aligned complete pre-assembled panel sections, with the panel sections of each side laterally spaced from those of the adjacent sides and with the panel sections of the several sides horizontally aligned in superposed stories or tiers; intermediate corner legs disposed at the respective corners of the derrick and positioned between the horizontally adjacent panel sections; and means for securing said legs to said panel sections to connect the sides of the derrick together.

3. In a derrick of the nature disclosed, the combination of: adjacent sides each formed of a plurality of vertically aligned complete pre-assembled panel sections, with the panel sections of each side laterally spaced from those of the adjacent sides and with the panel sections of the several sides horizontally aligned in superposed stories or tiers; intermediate connecting corner elements disposed at the respective corners of the derrick and positioned between the horizontally adjacent panel sections and in break-joint relationship thereto; and means for securing said elements to said panel sections to connect the sides of the derrick together.

4. In a derrick of the nature disclosed, the combination of: adjacent sides each formed of a plurality of vertically aligned complete pre-assembled panel sections, with the panel sections of each side laterally spaced from those of the adjacent sides, each panel section having opposed marginal side angles and transverse girts connecting said side angles; intermediate angle corner legs disposed at the respective corners of the derrick and positioned between the side angles of the horizontally adjacent panel sections; and means for securing said angle corner legs to the associated panel sections to connect the sides of the derrick together, the side angles of the adjacent panel sections and the associated angle corner legs being arranged in back-to-back relationship to form at each corner of the derrick, a corner column substantially cross-shape in cross section.

5. In a derrick of the nature disclosed, the combination of: adjacent sides each formed of a plurality of vertically aligned complete pre-assembled panel sections, with the panel sections of each side laterally spaced from those of the adjacent sides and with the panel sections of the several sides horizontally aligned in superposed stories or tiers, each panel section having opposed marginal side angles and transverse girts connecting said side angles; intermediate corner legs disposed at the respective corners of the derrick and positioned between the side angles of the horizontally adjacent panel sections, each corner leg being comprised of a plurality of vertically aligned leg angles arranged in break-joint relationship to the respective stories or tiers; and means for securing the leg angles to the associated panel sections to connect the sides of the derrick together, the side angles of the adjacent panel sections and the associated corner leg angles being arranged in back-to-back relationship to form at each corner of the derrick, a corner column substantially cross-shape in cross section.

6. In a derrick of the nature disclosed, the combination of: adjacent sides each formed of a plurality of vertically aligned complete pre-assembled panel sections, with the panel sections of each side laterally spaced from those of the adjacent sides, each panel section having opposed marginal side angles and transverse girts connecting said side angles with said girts secured at opposite ends to

one flange of each of said side angles; intermediate angle corner legs disposed at the respective corners of the derrick and positioned between the side angles of the horizontally adjacent panel sections; and means for securing said angle corner legs to the other flanges of the associated panel sections to connect the sides of the derrick together, the side angles of the adjacent panel sections and the associated angle corner legs being arranged in back-to-back relationship to form at each corner of the derrick, a corner column substantially cross-shape in cross section.

7. In a derrick of the nature disclosed, the combination of: adjacent sides each formed of a plurality of vertically aligned complete pre-assembled panel sections, with the panel sections of each side laterally spaced from those of the adjacent sides and with the panel sections of the several sides horizontally aligned in superposed stories or tiers, each panel section having opposed marginal side angles and transverse girts connecting said side angles with said girts secured at opposite ends to one flange of each of said side angles; intermediate corner legs disposed at the respective corners of the derrick and positioned between the side angles of the horizontally adjacent panel sections, each corner leg being comprised of a plurality of vertically aligned leg angles arranged in break-joint relationship to the respective stories or tiers; and means for securing the leg angles to the other flanges of the associated panel sections to connect the sides of the derrick together, the side angles of the adjacent panel sections and the associated angle corner legs being arranged to form at each corner of the derrick, a corner column substantially cross-shape in cross section.

8. In a derrick of the nature disclosed, the combination of: adjacent sides each formed of a plurality of vertically aligned complete pre-assembled panel sections, with the panel sections of each side laterally spaced from those of the adjacent sides and with the panel sections of the several sides horizontally aligned in superposed stories or tiers each extended to a horizontal level, each panel section having opposed marginal side angles and lower and upper transverse marginal girts connecting said side angles with said lower transverse girt secured at opposite ends to the respective lower ends of said side angles and with said upper transverse grit secured at opposite ends to the respective upper ends of said side angles; intermediate angle corner legs disposed at the respective corners of the derrick and positioned between the side angles of the horizontally adjacent panel sections; means for connecting the lower transverse girt of each panel section of each side of the derrick to the upper transverse girt of the next lower panel section; and independent means for securing the angle corner legs to the associated panel sections to connect the sides of the derrick together, the side angles of the adjacent panel sections and the associated angle corner legs being arranged in back-to-back relationship to form at each corner of the derrick, a corner column substantially cross-shape in cross section.

9. In a derrick of the nature disclosed, the combination of: four independent sides each formed of a plurality of superposed panel sections with each panel section secured to the vertically adjacent panel sections; and a separate corner leg at each respective corner of the derrick, disposed between the adjacent sides thereof and secured to the several panel sections comprising said adjacent sides to join said sides to each other.

In testimony whereof, I have hereunto set my hand at Los Angeles, California, this 8th day of July, 1926.

CLARENCE B. FOSTER.