

March 19, 1940.

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2,194,124

DERRICK BASE

Filed Aug. 30, 1938

2 Sheets-Sheet 1

FIG. 1.

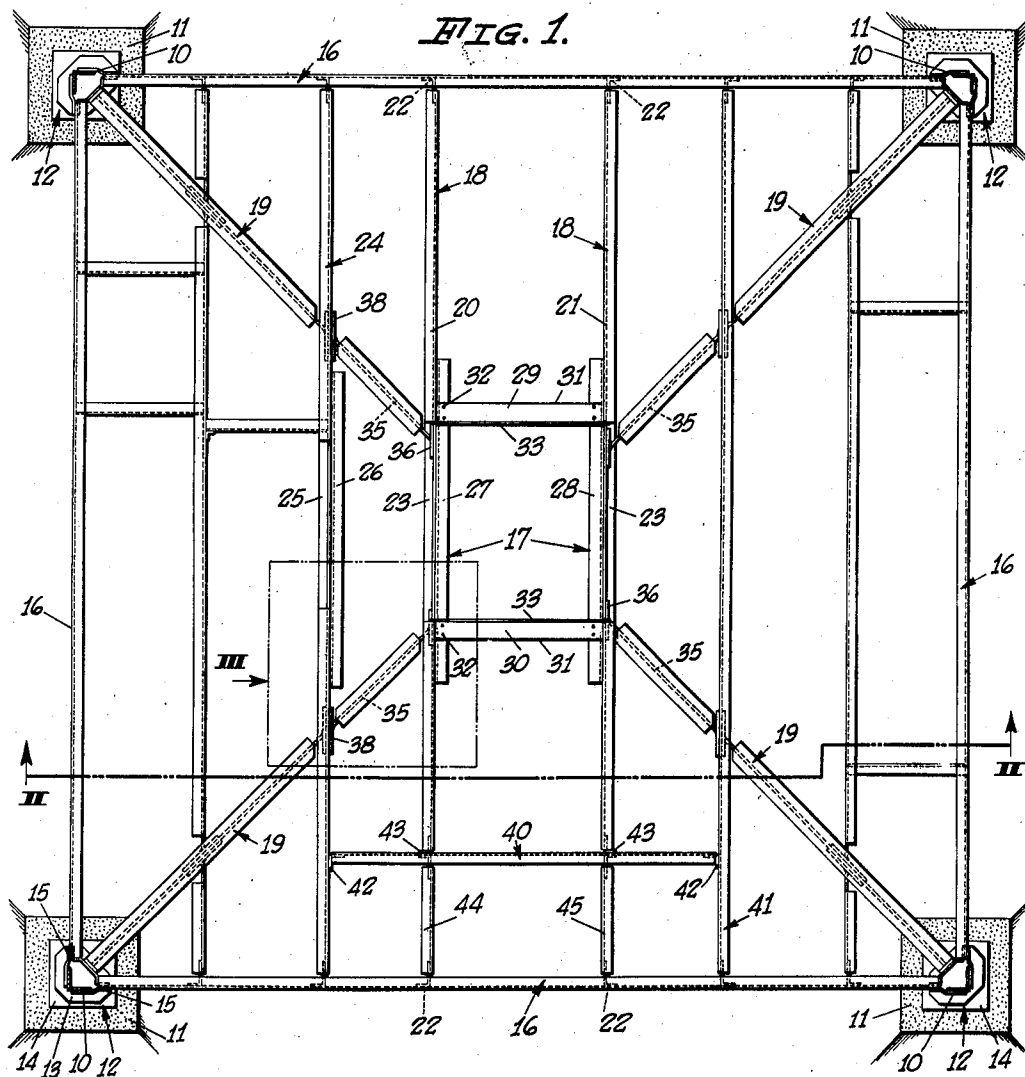
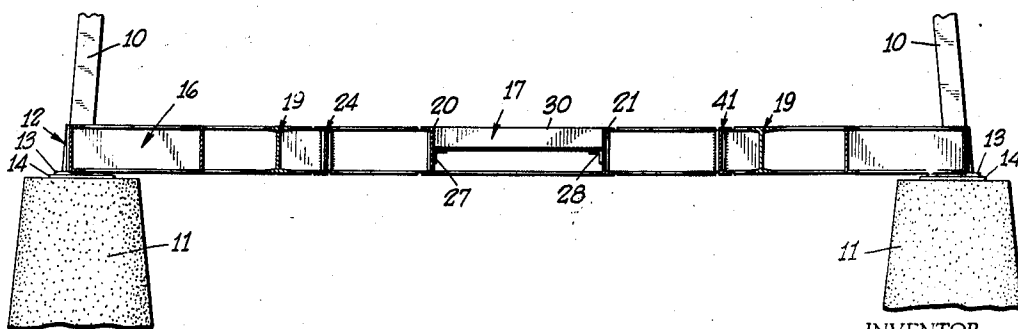


FIG. 2.

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FIG. 3.

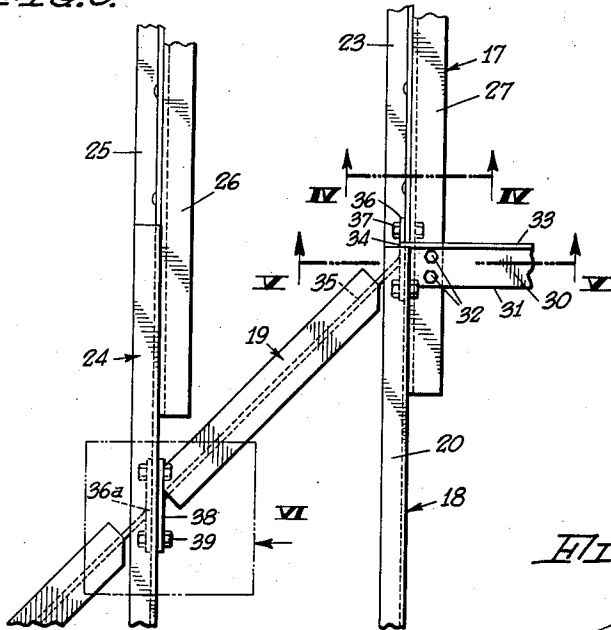


FIG. 4.

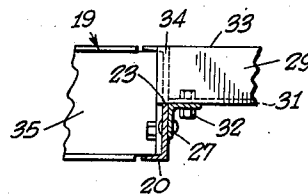


FIG. 5.

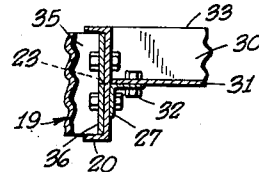


FIG. 6.

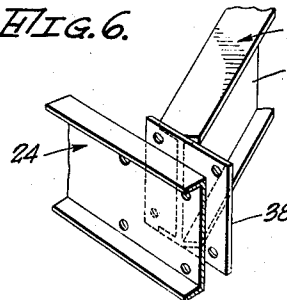
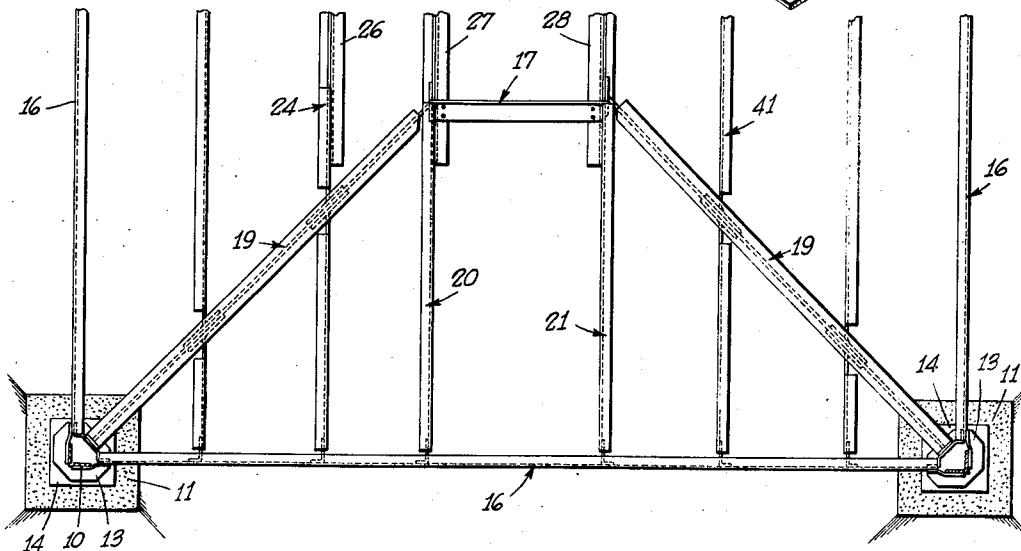


FIG. 7.

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2,194,124

DERRICK BASE

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Application August 30, 1938, Serial No. 227,490

2 Claims. (Cl. 189—21)

My invention relates to the construction of a derrick base having particular utility when employed with a heavy duty derrick of the type used to drill deep wells, such as oil or gas wells.

5 The base structure provided on a derrick of this class must be so constructed as to withstand extremely heavy loads. Inasmuch as the rotary table is attached to the center of the derrick base, the base must be able to withstand the dynamic loading imposed upon it by the drilling operation. This dynamic loading is of a vibratory type and of such magnitude that unless these vibrations are isolated from the derrick tower as by transmission to the foundation piers instead
10 of directly to the tower, fatigue of the tower members and a consequent tower failure may result.

The method of constructing derrick bases in current use provides separate tension and compression members for anchoring the derrick legs to each other. These braces are not tied to the axis of the derrick legs, but are offset so that when loaded they tend to distort the entire derrick structure.

15 In this construction, the various members comprising the base structure are cut into numerous pieces and provided with bolted connections at the ends thereof of such type that the bolts are loaded in direct shear. In view of the fact that the main structural members in the present construction are not continuous, these members must, of a necessity, be heavier in construction than would be required were it possible to use a continuous member for this purpose.

20 Also, the use of bolted connections of such type that the bolts are loaded in shear, requires a larger bolt with the result, of course, that a larger hole must therefore be provided in the member to accommodate the larger bolt. The larger hole, in turn, weakens the member to such an extent that a member larger than ordinarily required must be installed.

25 Furthermore, the present method of constructing derrick bases is such that the main load bearing members of the base do not transmit the loads directly to the derrick foundations, but instead transmit these loads to auxiliary members, which in turn, in many cases, transmit the loads to the derrick leg rather than to the derrick foundation.

30 In summary, it will be seen that the disadvantages of the present method of constructing derrick bases pointed out above require the installation of a derrick base which is considerably heavier in construction than would be required were
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it possible to overcome the aforementioned disadvantages.

It is therefore a primary object of my invention to provide a derrick base in which the main structural members are the diagonals and extend essentially continuously and in a straight line from the point of loading to the foundation piers.

It is also an object of my invention to provide a method of constructing derrick bases which eliminates the points of weakness in the present designs, thereby allowing a much lighter construction without sacrificing strength and rigidity.

It is an additional object of my invention to provide a derrick base of the character described, in which the loads imposed upon the base are transmitted directly to the derrick foundations.

It is an additional object of my invention to provide a derrick base construction of such type that the main load bearing members thereof may be made continuous.

It is a further object of my invention to provide in a derrick base of the character set forth an improved system of bolted connections for reducing the shearing stress imposed upon said bolts.

It is also an object of my invention to provide in a derrick base of the character set forth a single member for each of the diagonal braces for transmitting both tension and compression loads.

In accordance with the preceding objects, it is also an object of my invention to provide a means for attaching the aforementioned diagonal braces such that the loads transmitted thereby will be applied to the foundation at the axis of the derrick leg.

It is an additional object of my invention to provide a derrick base of the character set forth which includes the necessary recesses for accommodating the drilling equipment and to provide a novel method of construction which reinforces these recesses.

Other objects and advantages of my invention will be apparent from a study of the following specifications, read in connection with the accompanying drawings, wherein

Fig. 1 is a plan view of the derrick base of my invention with the flooring removed to show the relative location of the members;

Fig. 2 is a vertical section taken on the line II—II of Fig. 1 showing the vertical relationship of the various members;

Fig. 3 is an enlarged plan view of the portion III indicated by dotted lines in Fig. 1;

Fig. 4 is a vertical section taken on the line

IV—IV of Fig. 3 showing the method of reinforcing a recess provided for a rotary table;

Fig. 5 is a vertical section on the line V—V showing the connection details employed at the corner of an inner frame;

Fig. 6 is a fragmentary exploded perspective view showing the connection details employed at point VI indicated by dotted lines in Fig. 3; and

Fig. 7 is a partial plan view similar to Fig. 1 showing an alternative method of construction of the draw-works portion of the derrick base of my invention.

Referring to Fig. 1 I have illustrated the bottom portion of a derrick employing the base construction of my invention. The derrick includes up-standing legs 10 which rest upon foundations 11 and are anchored thereto by means of derrick leg footings 12, which are described in my co-pending application, Serial No. 221,947, filed July 29, 1933, now Patent No. 2,164,428.

Briefly, the footings 12 include a footing plate 13 which rests upon skid plates 14 of the foundation 11 and upon which rests the derrick leg 10. Secured to the footing plate 13 and the derrick leg 10 are footing side plates 15.

The derrick base of my invention includes perimetric members 16 which extend between adjacent legs so as to define a rectangle and are attached to the foundations 11 by means of suitable connections to the footing side plates 15. I also provide a structure for securing and supporting a rotary table (not shown) including an inner perimetric frame 17 which is rectangular in shape and disposed with its sides parallel to the perimetric members 16. Since the inner perimetric frame 17 is the location of the origin of the dynamic and vibratory forces which must be transmitted to the foundations 11, I extend the main structural members comprising diagonal braces 19 of the base of my invention in a straight line between the inner perimetric frame 17 and the foundation 11. The main members 19 may be additionally braced with a system of transverse members 20 as illustrated in Fig. 1 which are also employed as floor supporting members for supporting a derrick floor (not shown).

As best illustrated in Figs. 1 and 3, two of the sides of the inner perimetric frame 17 are formed by transverse braces 20 and 21. The braces 20 and 21 are preferably of channel shape and extend from one of the perimetric members 16, to which they may be attached as by means of suitable clips 22, to another of the perimetric members 16 located on the opposite side of the derrick base. The channels 20 and 21 have a portion of the upper flange thereof removed as indicated at 23 in Fig. 1. An adjacent transverse member 24 lying parallel to the transverse members 20 and 21 also has the upper flange thereof removed as indicated at 25 in a position corresponding to the inner perimetric frame 18. The recess thus formed in the channel members 20, 21 and 24 are ordinarily employed as a socket into which the rotary table employed for drilling the well is inserted.

In order to reinforce the transverse members 20, 21 and 24 at the point where the upper flange is removed, I provide reinforcing members 26, 27 and 28, which are preferably of angle shape and placed with the upper leg of said angle extending horizontally. I carry the angles 26, 27 and 28 well past the ends of the recess portions so as to provide the required additional strength and rigidity. The horizontally extending upper legs 25 of the angles 26, 27 and 28 form a base upon

which the under side of the rotary table may rest.

The sides of the inner perimetric frame 17, opposite to those just described, include a member 29 at one side thereof and a member 30 at the other. As illustrated in Figs. 3, 4 and 5 the members 29 and 30 are preferably of angle shape and are so disposed as to place the upper edge of said angle in the vertical plane, while the horizontal leg extends away from the opening in the inner perimetric frame 17. I prefer to form the ends of the members 29 and 30 in such a manner that the horizontal leg 31 thereof will lie in abutting relation with the web of the channel member 20 and rest upon the horizontal leg of the angle iron 27, to which it may be secured as by bolts 32, while the vertical leg 33 thereof is extended beyond the end of the horizontal leg 30 so as to extend beyond the web of the channel 20 as indicated at 34 of Fig. 3.

With this method of construction it will be seen that forces imposed upon the angle members 30 tending to move these members away from the opening in the perimetric frame 17 will place the bolts 32 in shear. By extending the vertical leg 33, however, into such a position that it bears an overlapping relation to the web of the channel member 20, a part of the load imposed on the angular member 30 will be carried by the vertical leg 33 thereof so as to materially reduce the shearing stresses in the bolts 32. The vertical legs 33 of the angle iron 30 also operate as guides for securing the rotary table in position in the center of the derrick base and operate as load bearing elements to transmit the horizontal reactions on the rotary table to the diagonal braces 19, which are attached at the corner of the inner perimetric frame 17 in a manner which will now be described.

As illustrated in Fig. 3, the diagonal braces 19 are preferably of I-beam shape so that they may effectively transmit compression and tension loads. At the point of attachment of the I-beam 19 to the corner of the inner perimetric frame 17, I remove the upper and lower flanges of the I-beam 19 and allow the web 35 to project beyond. To the web 35 I securely attach, as by welding, a connection plate 36 which is disposed at the proper angle to lie parallel to the channel member 20. The connection plate 36 may be attached to the web of the channel member 20 and the downwardly extending leg of the angle member 27 as by bolts 37.

As best shown in Fig. 6 the connection between that portion of the I-beam 19 lying between the transverse members 20 and 24 to the web of the member 24 is accomplished by welding a connection plate 38 to the web and flanges of the I-beam 19 at the proper angle to cause the connection plate 38 to lie parallel to the transverse member 24. The connection plate 38 and the I-beam attached thereto are secured to the transverse member 24 as by bolts 39 which may also attach a connection plate 38a on the remaining portion of the I-beam 19 which is similar to that just described as being used at the corner of the inner perimetric frame 17.

It will be noted that in this type of connection detail, forces transmitted from the inner perimetric frame 17 to the diagonal brace member 19, place the bolts 37 primarily in tension, although a relatively small shear component is present. In the previous methods of construction this connection was made by the use of angle clips which were bolted to the webs of the members 19 and 20.

It is obvious that with a clip type of connection, although the bolts attaching the angle clip to the web of the member 20 are stressed in the same manner as the bolts 37, the bolts which are used to attach the clip to the web 35 of the I-beam 19 are stressed in direct shear.

As is well known in the art, bolts are capable of transmitting much heavier loads in either compression or tension than they are in shear. It will be readily understood, therefore, that the method of construction employed in the connections at the corner of the perimetric frame 17, namely the method of attaching the I-beam 19 so as to reduce the shearing stress in the bolts, and the method of overlapping the vertical leg 33 of the angle members 30, provides a corner connection which is materially stronger and more rigid than the methods of connection at present used. The use of a stronger and more rigid method of construction allows the substitution of lighter elements without sacrificing strength and rigidity, thereby materially reducing the cost of a structure of this type.

In order that the derrick base of my invention may be fabricated in the shops as a standard or stock unit, it is necessary to provide means whereby the draw-works employed in the operation of drilling a well may be extended into the space enclosed by the derrick base if such construction is required. For this purpose I provide a short longitudinal member 40 which is disposed parallel to the perimetric member 16 located on the draw-works side of the derrick and spaced inwardly therefrom a sufficient distance to allow the draw-works to be extended sufficiently far into the derrick base structure to meet the requirements of any specific application.

The member 40 is made as long, or longer, than the width of the draw-works to be employed. I attach the longitudinal member 40 to the transverse member 24 and to a corresponding transverse member 41 located on the opposite side of the inner perimetric frame 17 by means of suitable clips 42. The transverse members 20 and 21 are cut at the member 40 and are attached thereto as by suitable clips 43. Extensions 44 and 45 of the members 20 and 21 span the space between the longitudinal member 40 and the draw-works. The perimetric member 16 is attached in any suitable manner to these members.

It will be seen that in case it is required to move the draw-works toward the center of the derrick beyond the side of the derrick base defined by the perimetric member 16, it is only necessary to remove the extensions 44 and 45 and to cut free and remove that portion of the perimetric member 16 extending between the transverse members 24 and 41. The removal of these three parts will thereupon provide a notch-shaped recess in the draw-works side of the derrick base, into which the draw-works may be extended. Inasmuch as cutting the perimetric member 16 requires that the portion of the member 24 lying on the draw-works side of the diagonal braces 19 carry any vertical loads imposed thereon while essentially unsupported at its end, I prefer to extend the member 24 continuously from one side of the derrick to the other so that the aforementioned draw-works portion thereof may operate as a cantilever beam.

In Fig. 7 I have illustrated an alternative method of construction which is preferred in cases where it is definitely known that the draw-works will not be inserted into the side of the derrick

base. As clearly shown in Fig. 7, in this case I prefer to carry the diagonal members 19 continuously from the derrick foundations 11 to the inner perimetric frame 17 to where they are attached in the manner previously set forth. Inasmuch as the perimetric member 16 is, in this case, left intact, the transverse member 24 may be cut to allow the continuation of the diagonal brace 19 without weakening the structure, inasmuch as loads imposed upon that portion of the member 24 which is disposed between the diagonal brace 19 and the outer perimetric member 16 will be transmitted by a simple beam action to the diagonal braces 19 and the perimetric member 16.

Referring to Fig. 2, it will be noted that all of the members comprising the derrick base of my invention are preferably of the same vertical dimension and so connected that the lower surfaces thereof lie in the same plane. This entire structure may then rest as a unit upon the footing plates 13 so that any vertical loads imposed upon the derrick base may be transmitted directly to the foundations.

The attachment of this unit structure to the footing, in contradistinction to attachment to the derrick leg as in current practice, provides for the direct transmission to the foundation of horizontal loads and vibrations. This prevents vibrations resulting from the drilling operation from being transmitted to the derrick tower and avoids the danger of a tower failure due to fatigue from vibration of its members.

It will therefore be seen that I have provided a novel method of constructing a base for a derrick of such type that the main structural members extend essentially continuously and in a straight line from the point of origin of the loads to be carried to the foundations. This is a fundamental improvement over the present method of construction in which these loads are transmitted over discontinuous members disposed at angles to each other to the derrick tower.

For the purpose of convenience in understanding the foregoing specification and the appended claims, I have employed the expression "essentially continuous" to describe the main structural members; by which I mean that these members may be actually a single member or a member comprising a pair of interconnected parts, as desired, provided, however, that the parts are so interconnected (in the manner taught hereinbefore for example) that the resulting member functions as a single unit and operates structurally in my derrick base construction as though such interconnections did not exist and a single member were employed. This is in contradistinction to previous constructions in which the various interconnected members, although cooperating with each other, nevertheless functioned as separate units rather than as a single continuous member.

I have also provided a novel construction for a derrick base such that the points of weakness existing in the present base designs have been eliminated, thereby allowing a lighter and less expensive structure to be employed for the same load conditions.

It will further be noted that the derrick base of my invention provides means for accommodating the various pieces of machinery employed in the drilling of wells of this character and also includes novel means for reinforcing the recesses or openings provided for this accommodation.

While I have shown and described the preferred embodiment of my invention, I do not wish to be limited to the details of construction previously described herein, except as defined in the appended claims.

5 I claim:

1. In a derrick base, the combination of: an outer rectangular perimetric frame including outer perimetric members secured together at the adjoining ends thereof; transverse members extending parallel to one pair of said perimetric members and extending between the other pair of said perimetric members and attached thereto; notches formed in said transverse members by removing a portion of the upper part thereof, whereby derrick machinery may be confined in said notches; reinforcing members disposed parallel to said transverse members and lying below the bottom of said notches, said reinforcing members extending beyond each end of said notches and being attached to said transverse members; cross ties attached to said reinforcing members with the ends thereof abutting

the sides of said transverse members; and means on the ends of said cross ties protruding through said notches for preventing movement of said cross ties beyond the ends of said notches.

2. In a derrick base, the combination of: an outer rectangular perimetric frame; an inner rectangular perimetric frame; transverse members extending between opposite sides of said outer perimetric frame and attached thereto; diagonal members extending between corresponding corners of said inner and outer perimetric frames and attached thereto; a longitudinal member disposed in the plane of said transverse members and parallel to one of the sides of said outer perimetric frame for inter-tying a plurality of said transverse members; and means for removably attaching to said outer perimetric frame and to said longitudinal member the parts of said transverse members included between said longitudinal member and said outer perimetric frame for permitting their removal to admit a portion of a well rig draw-works.

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