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Fig. 1

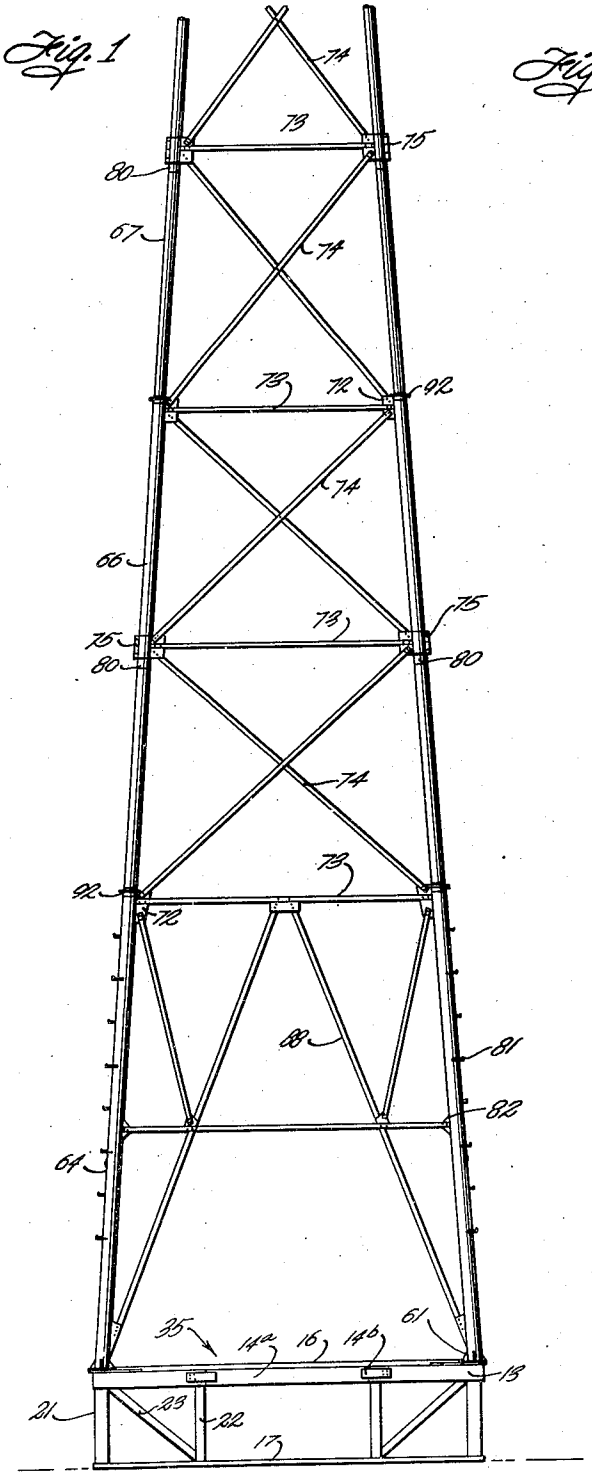
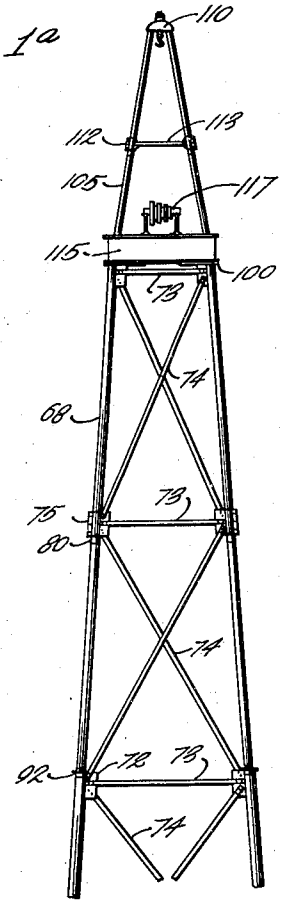


Fig. 1a



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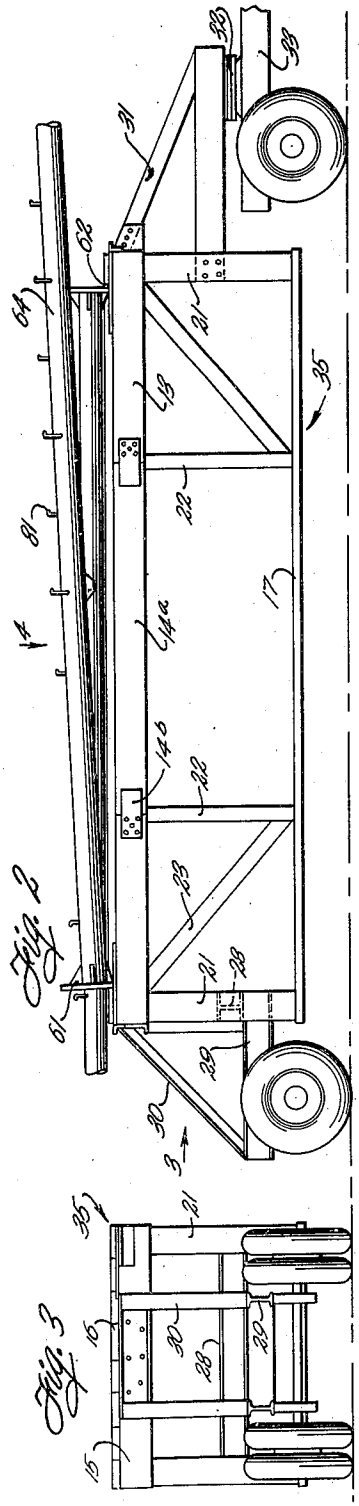


Fig. 2

Fig. 3

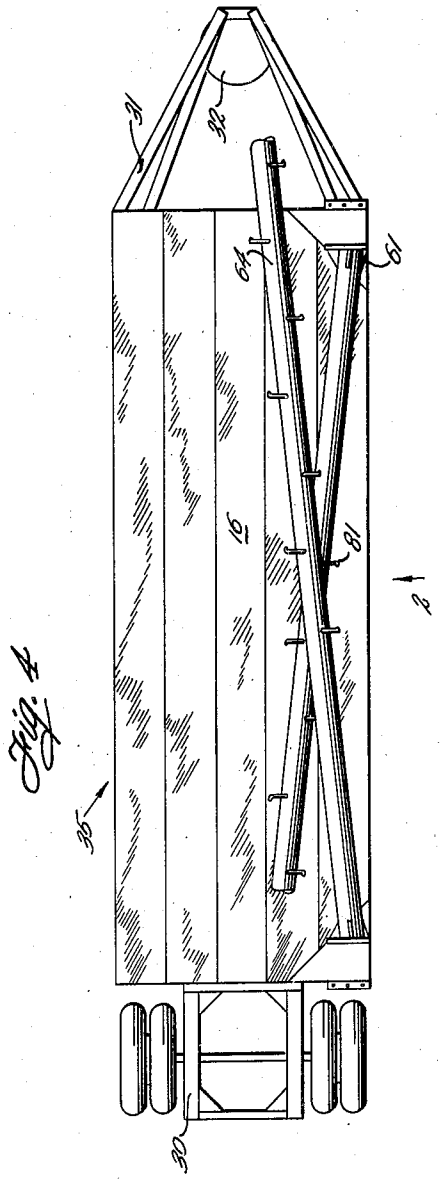


Fig. 4

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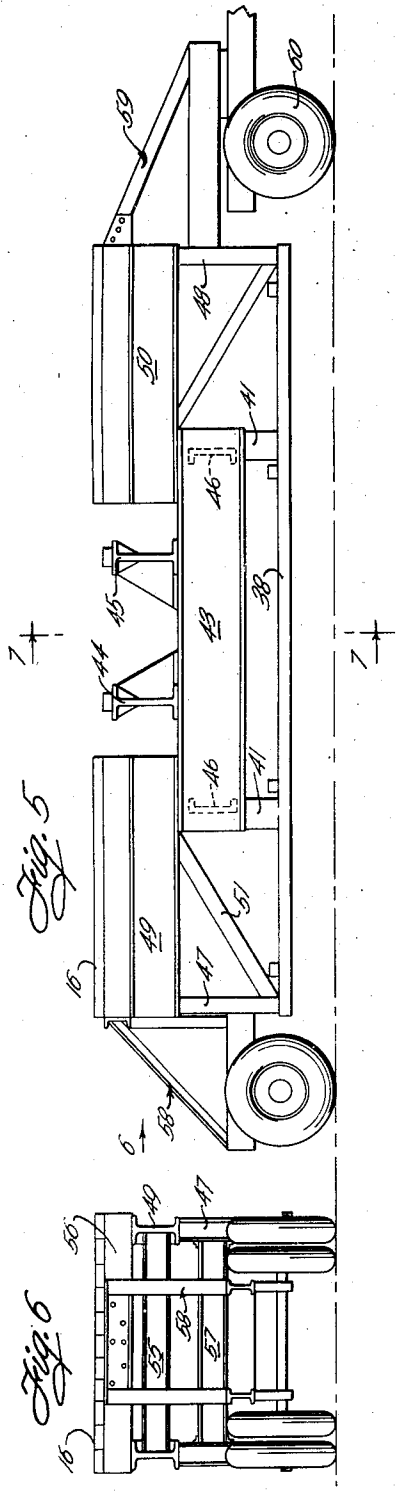


Fig. 5

Fig. 6

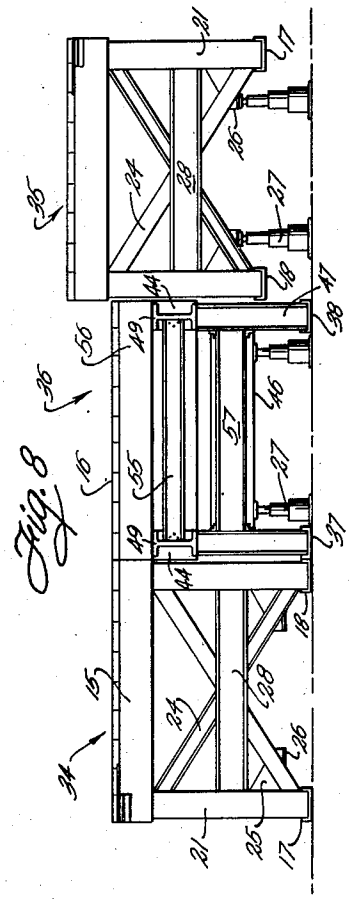


Fig. 8

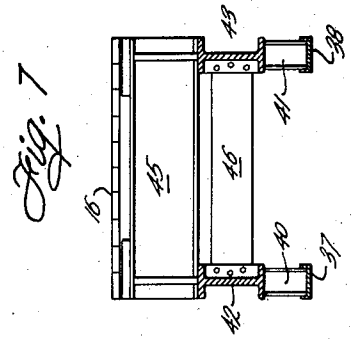


Fig. 7

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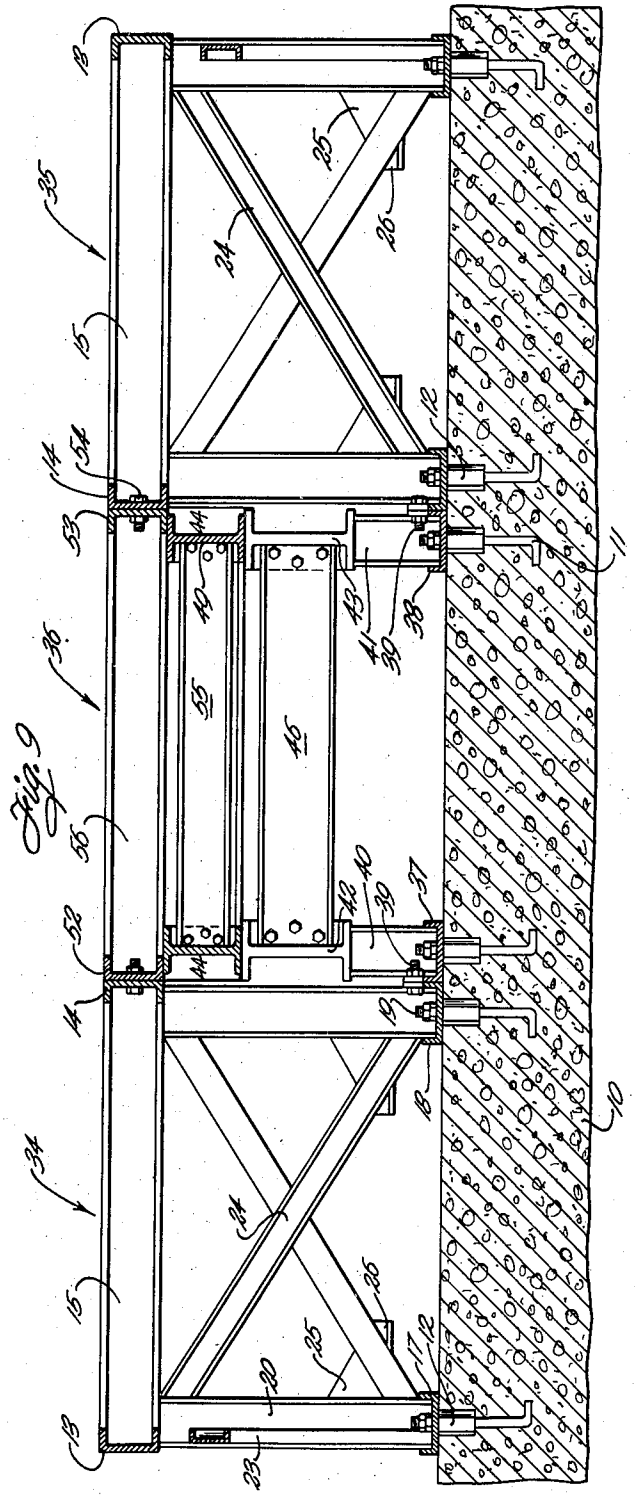


Fig. 9

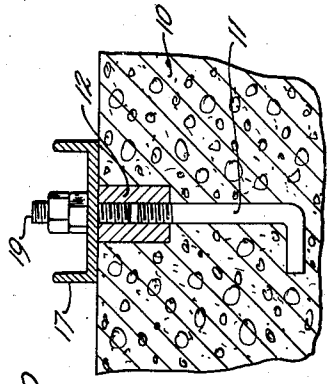


Fig. 10

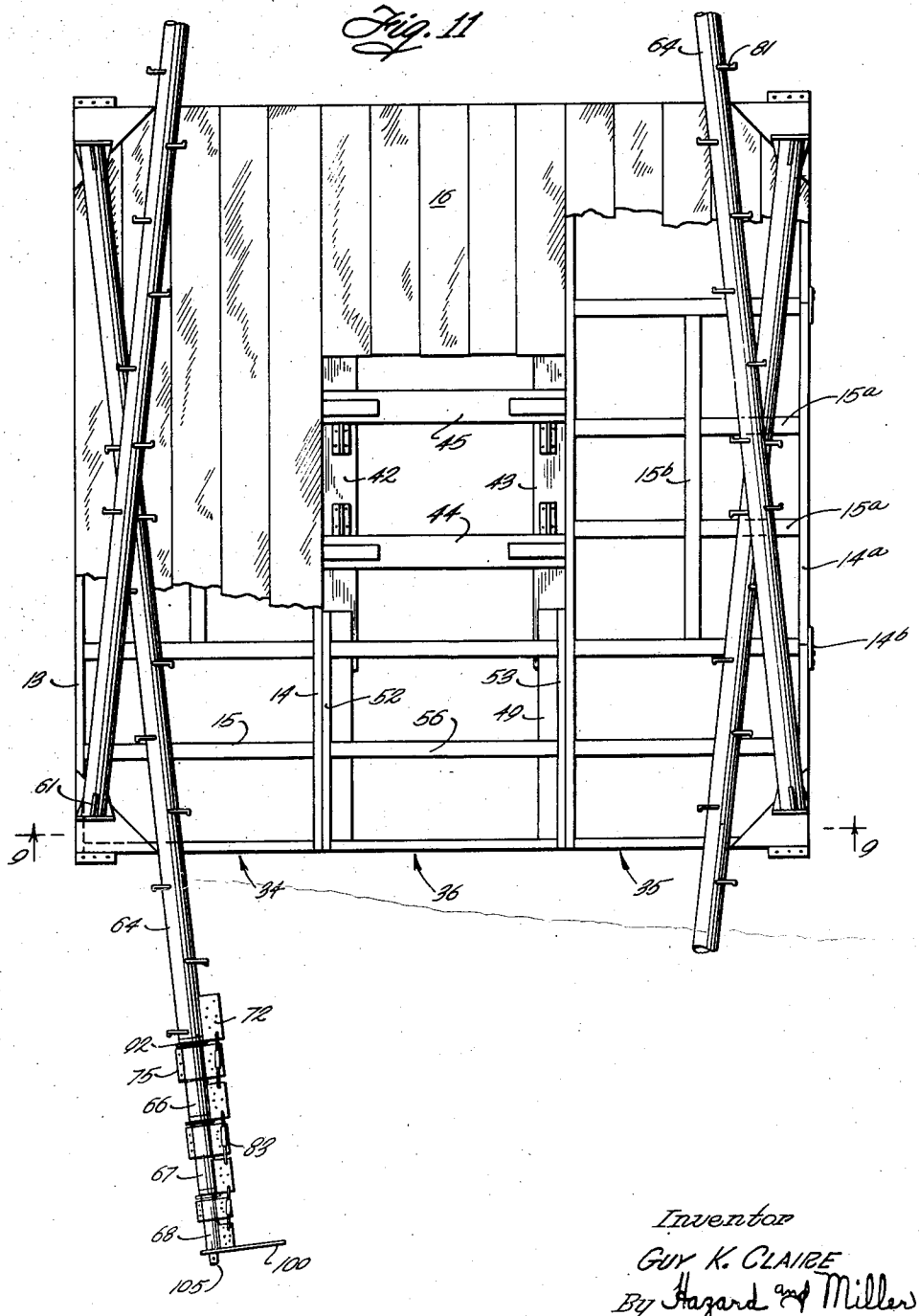
Inventor
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Fig. 11



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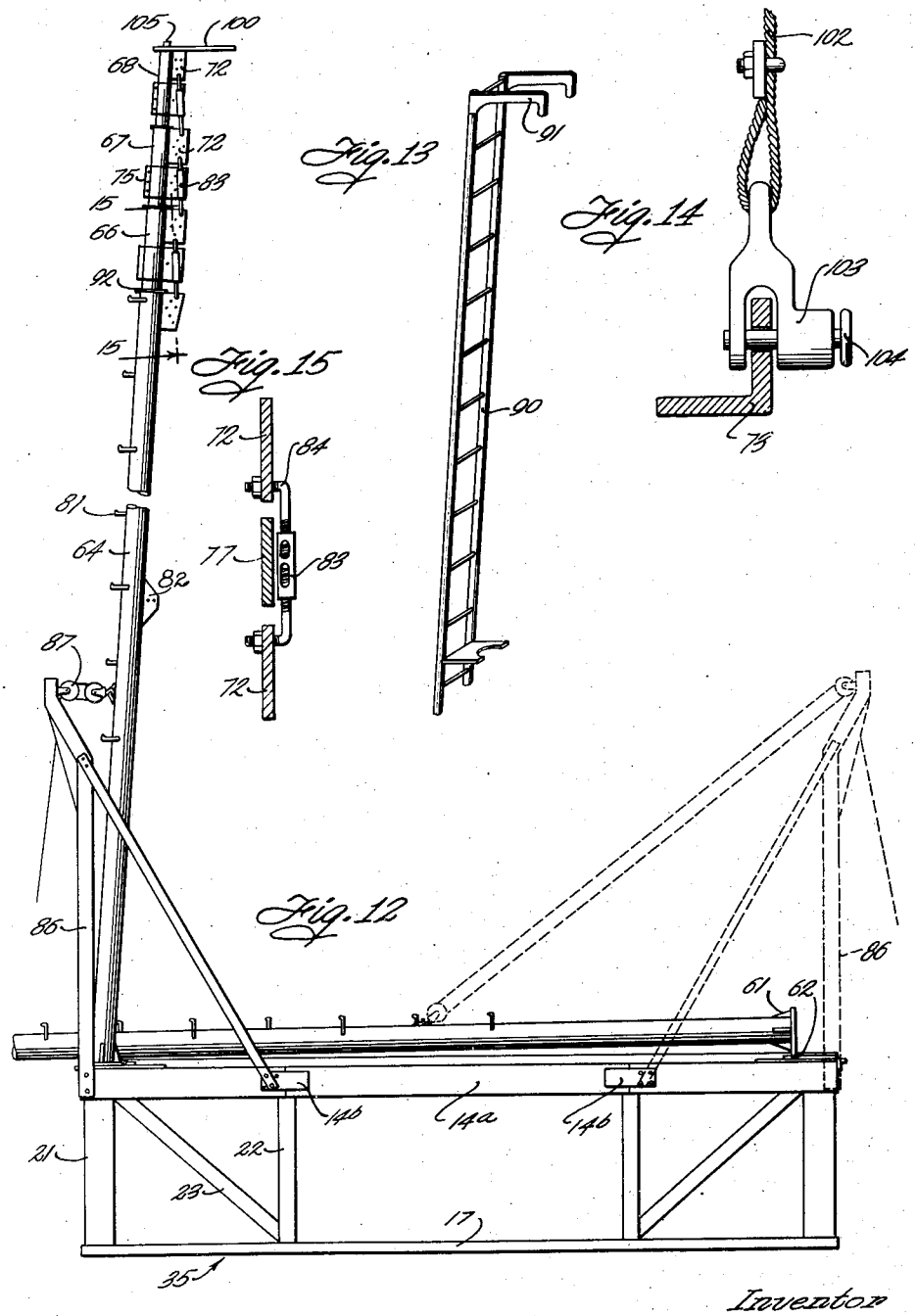


Fig. 12

Fig. 13

Fig. 14

Fig. 15

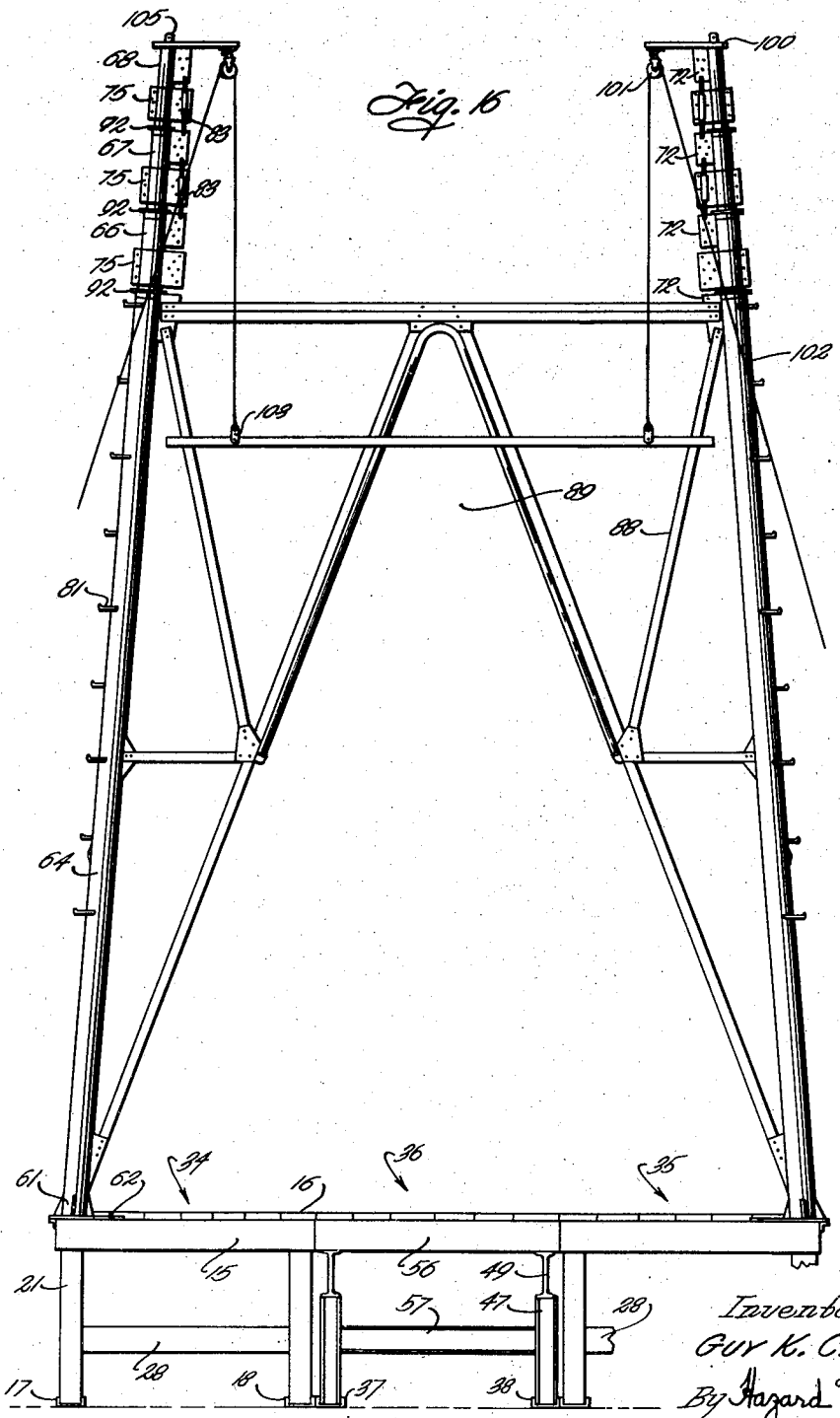
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Fig. 16



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Fig. 21

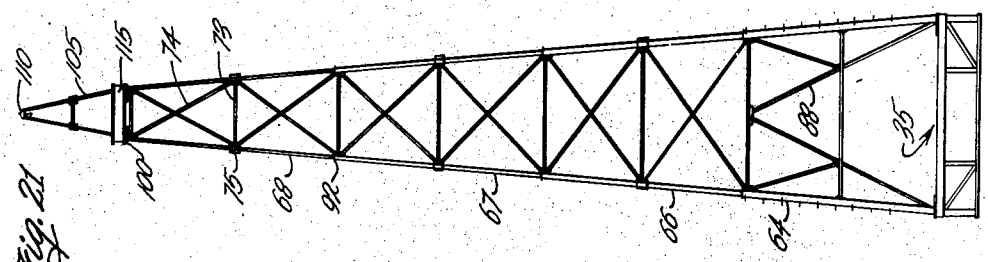


Fig. 20

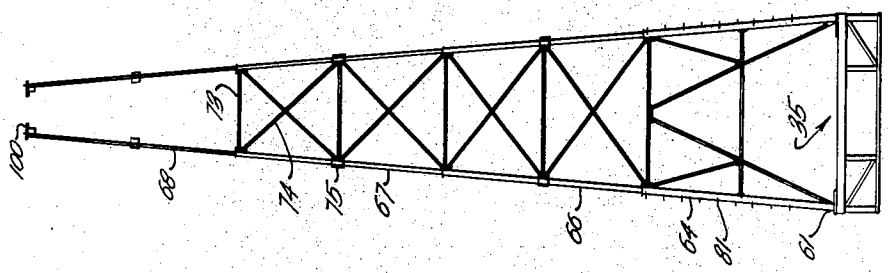


Fig. 19

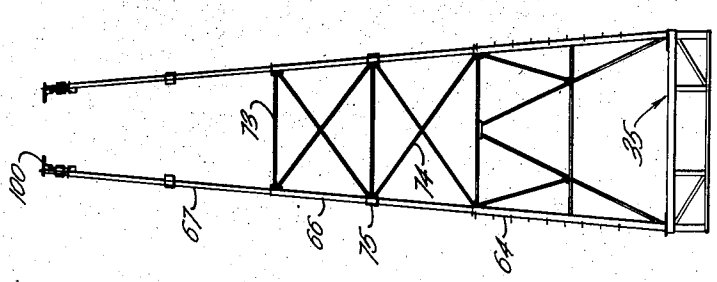


Fig. 18

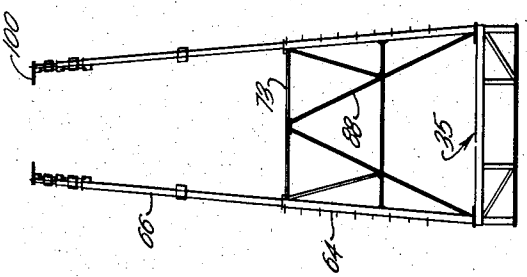
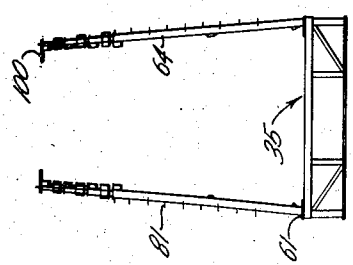


Fig. 17



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Fig. 22

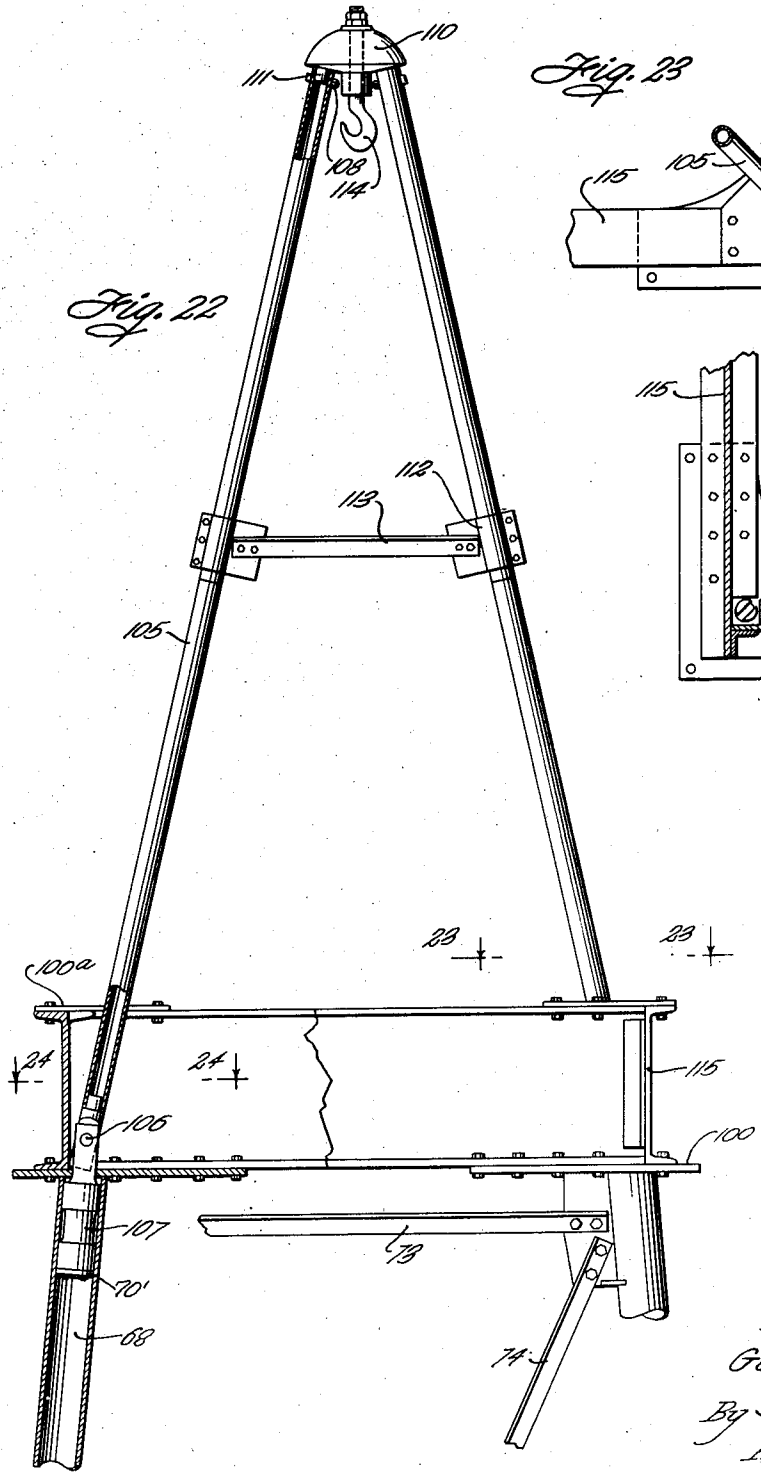
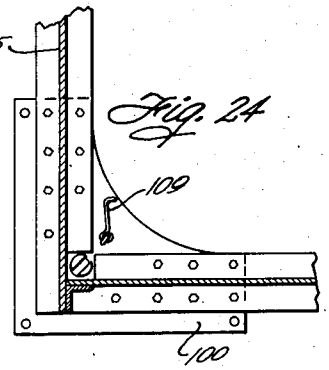


Fig. 23

Fig. 24



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Fig. 25

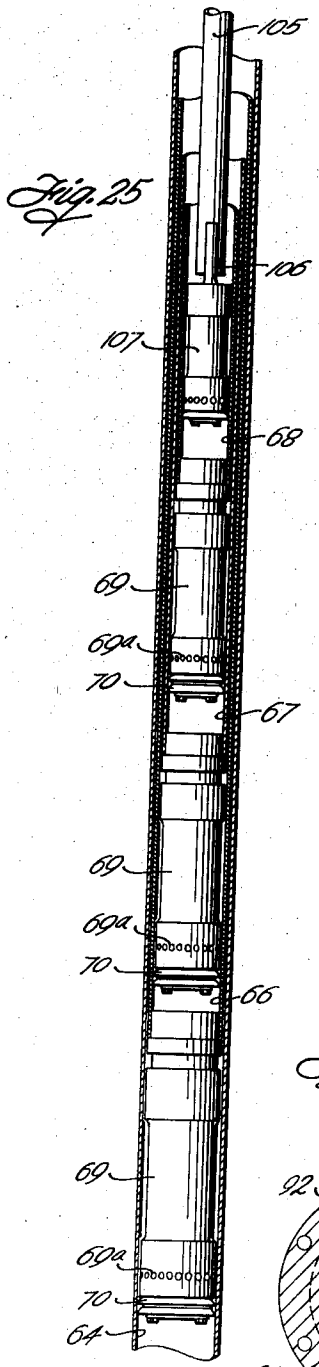


Fig. 26

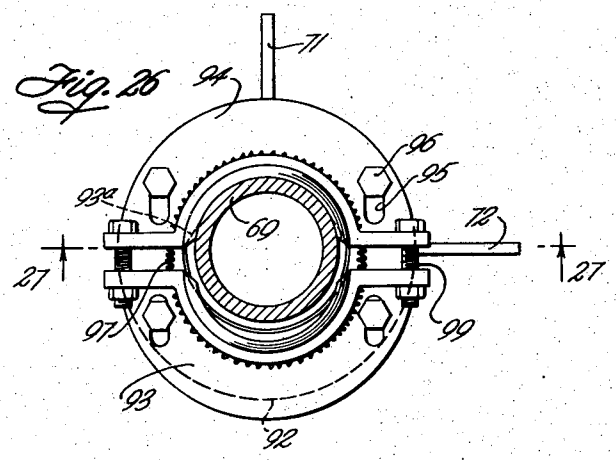


Fig. 27

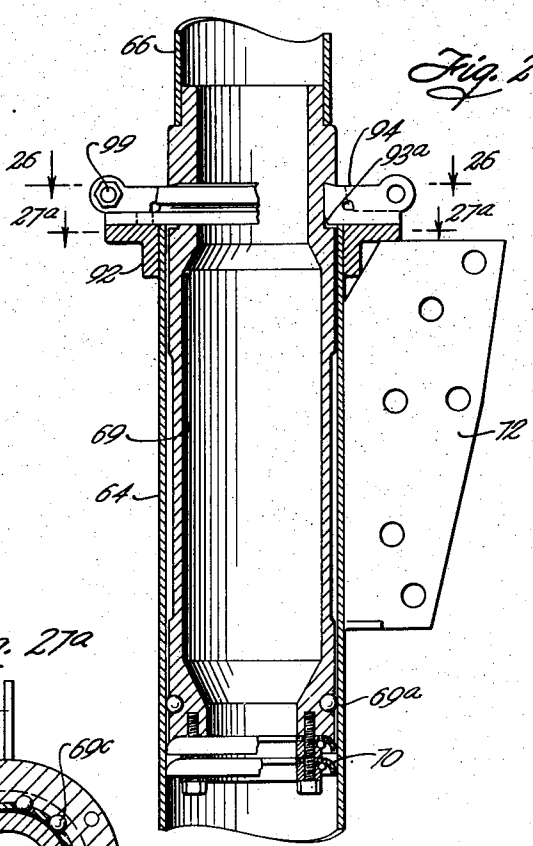
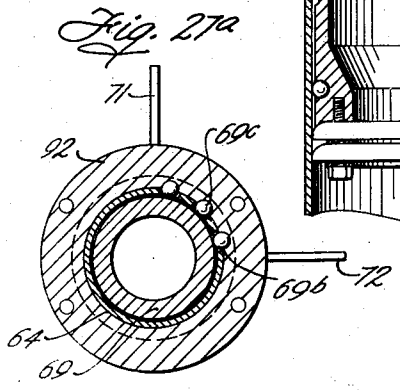


Fig. 27a



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Fig. 28

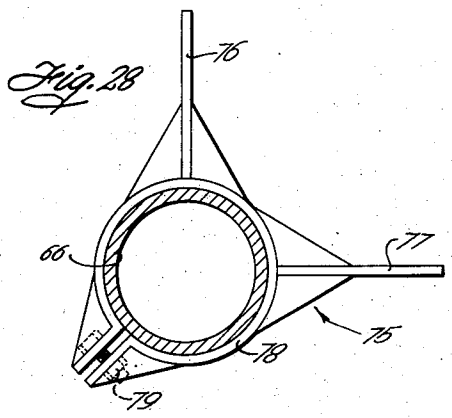


Fig. 30

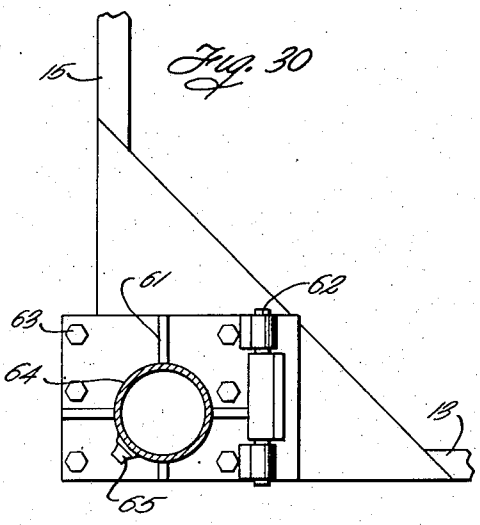


Fig. 29

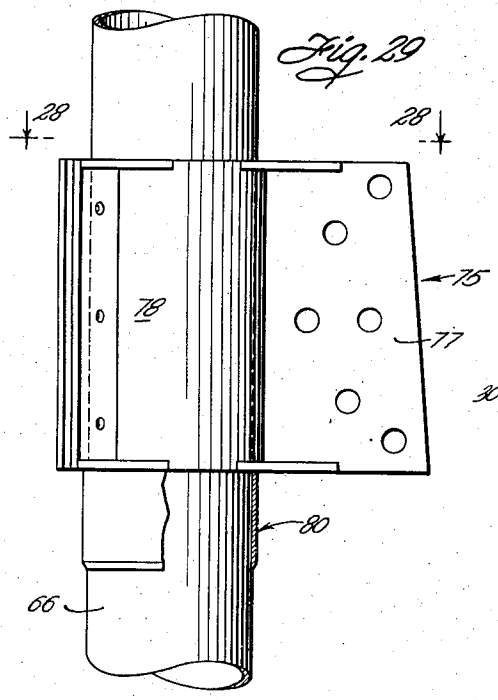
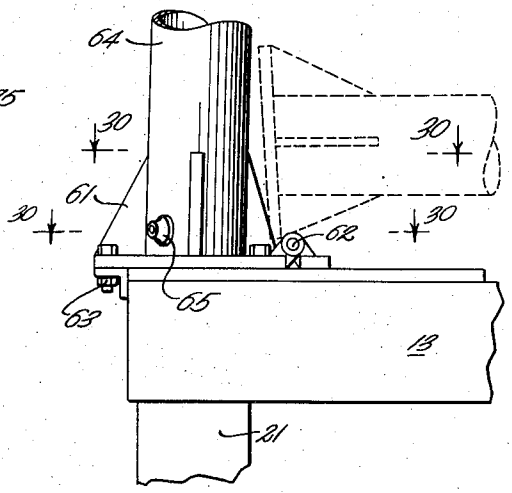


Fig. 31



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Fig. 32

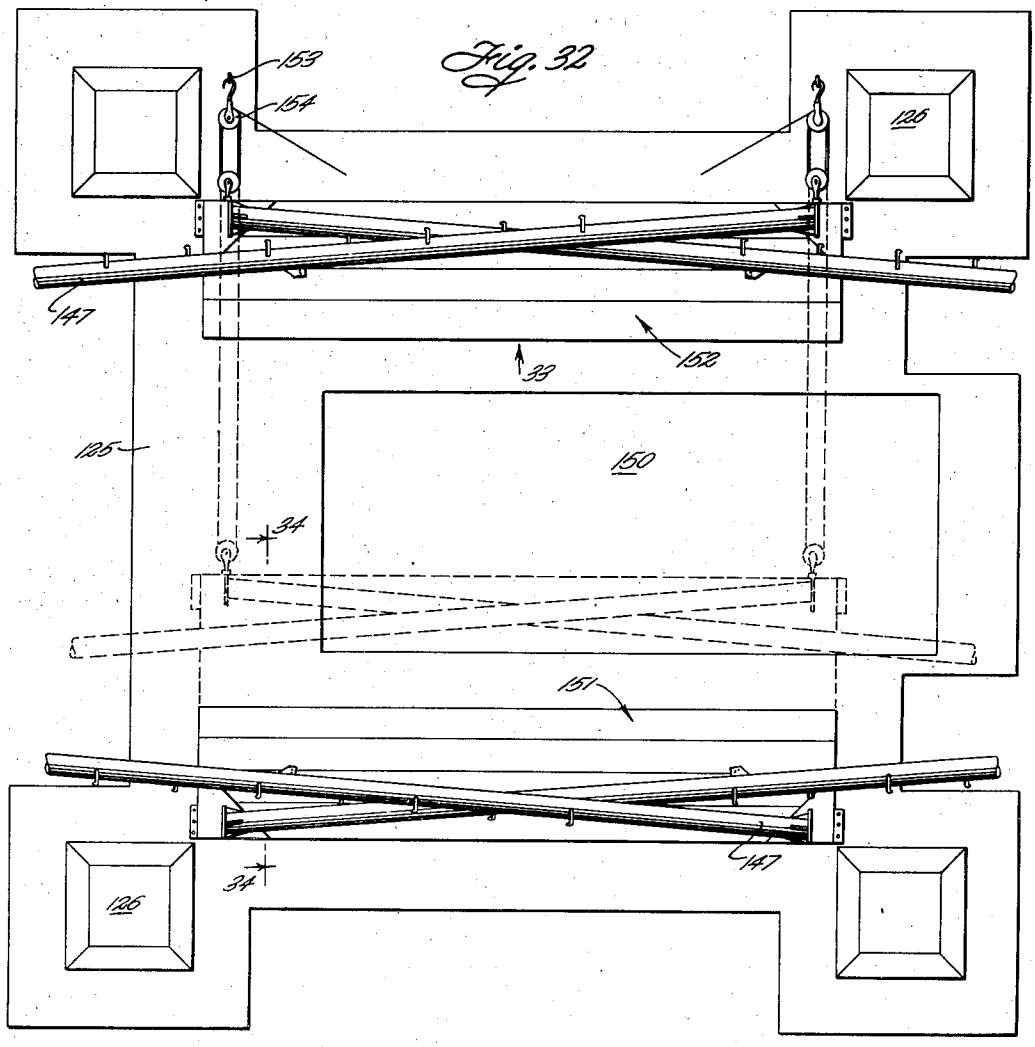
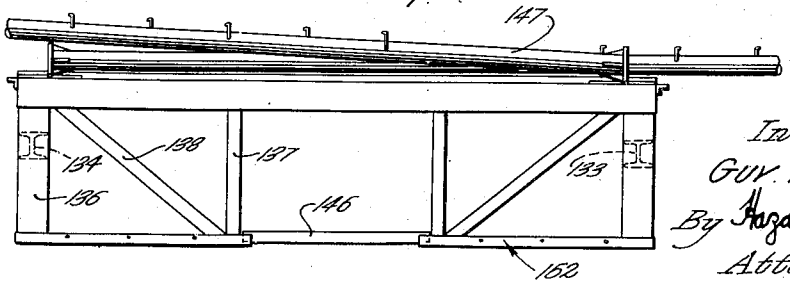


Fig. 33



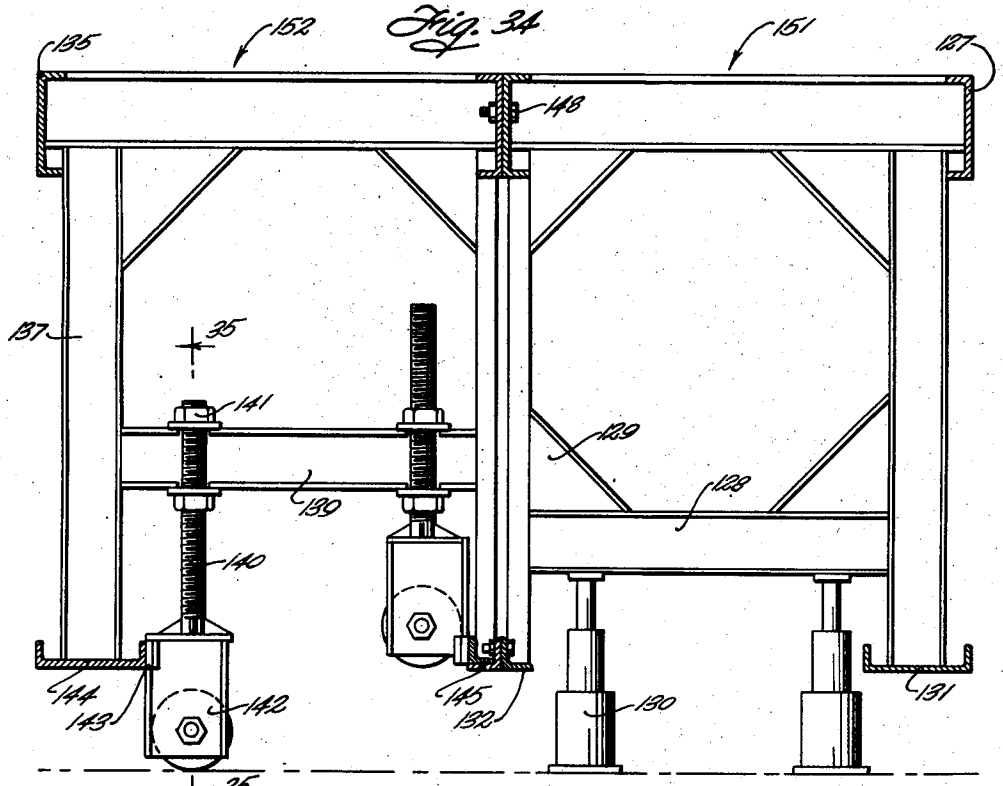
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Fig. 34



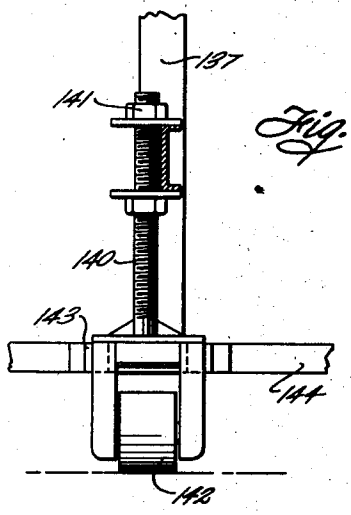


Fig. 35

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Fig. 36

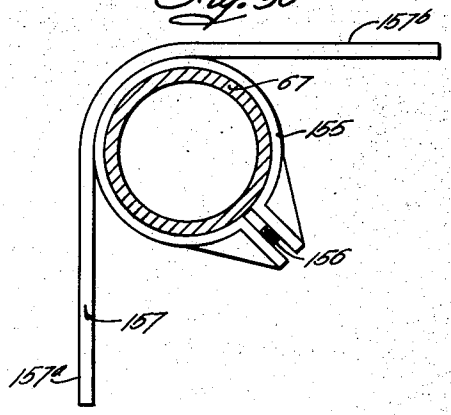


Fig. 38

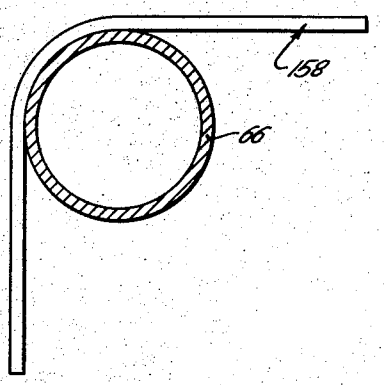


Fig. 37

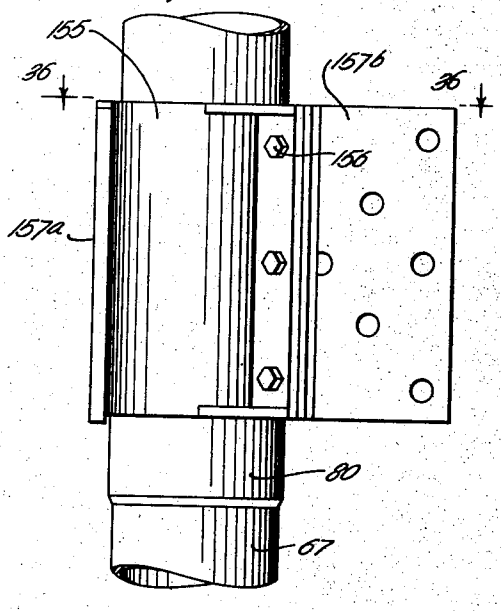
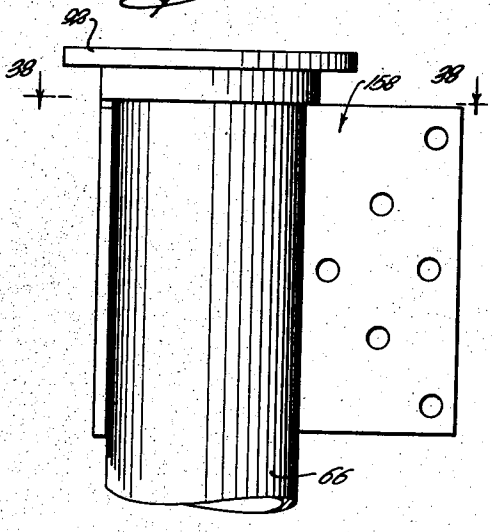


Fig. 39



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Patented Aug. 19, 1941 2,253,487

UNITED STATES PATENT OFFICE

2,253,487

PORTABLE WELL DERRICK

Guy K. Claire, Los Angeles, Calif., assignor of one-third to Arthur L. Armentrout, one-third to Elwin B. Hall, and one-third to Virgil P. Baker, Los Angeles, Calif.

Application February 27, 1940, Serial No. 321,058

21 Claims. (Cl. 189—11)

This invention relates to improvements in well derricks, and primarily concerns the construction of a well derrick used for drilling wells but may be advantageously used as hereinafter set forth in derricks used for servicing wells.

An object of the invention is to provide a well derrick designed for use with well drilling equipment which may be either the rotary type of well drilling equipment or cable tools, the derrick being so constructed that it is readily portable and yet when set up will be of the conventional size and arrangement enabling conventional items of equipment such as a draw-works, rotary table, crown block, travelling blocks, band wheels, bull wheels, etc., to be installed therein at their conventional locations. The standard or conventional steel derrick that is now generally erected for oil or gas well drilling purposes has a base or substructure substantially 24 feet square. It has long been desirable, however, to have a well drilling derrick that is readily portable from place to place so that the derrick may be used for drilling a well at one location and thereafter transported to another location for drilling another well. Certain difficulties, however, are presented with respect to constructing a derrick which is readily portable and which at the same time is of such design that it will accommodate the items of equipment conventionally employed and have them arranged at their conventional locations.

In many states there are laws prohibiting the transportation of equipment over the state highways where the equipment exceeds 8 feet in width without the securing of a special permit for this purpose and complying with certain specified regulations. Consequently, it is impracticable to attempt to bodily transport a conventional well drilling derrick over any considerable distance for the reason that the span of the substructure is frequently as great as the width of the average highway. It is of course common practice to "skid the rig" but this practice usually has been restricted to situations where the derrick may be transported from place to place without requiring transportation across or via highways.

It is a more specific object of the present invention to provide a portable well derrick which can be divided into sections any of which may be transported via highway, each section being of such a width that it will not exceed the maximum width regulations imposed by the above-mentioned state laws. At the same time, the derrick is so designed that when parts thereof are assembled it conforms in size and shape and in arrangement to the standard or conventional well drilling derrick that is now generally assembled part by part at the well site.

Another object of the invention is to provide a well drilling derrick construction of improved design which materially reduces the number of parts required in its construction, and particularly the number of parts that must be assembled together at the site of its erection. In the standard or conventional well drilling derrick the legs of the derrick are joined together by means of gusset plates, girts, and braces, these being assembled and bolted together during the process of erection of the derrick. The vertical distance between adjacent girts has generally been approximately 7 feet, this being the maximum vertical spacing of girts that is generally regarded permissible within the limits of economic leg weights, and further because of the fact that it is about the distance at which a man standing on one girt can bolt on a girt to the legs of the derrick thereabove. By means of the present invention the derrick is so constructed that the limitation on vertical girt spacing greatly exceeds 7 feet and the manner of assembling the parts during erection of the derrick eliminates any limitation arising from the relationship between girt spacing and the height of an average man.

Another object of the invention is to provide a portable well drilling derrick wherein the base or substructure is divided into a plurality of parts, each of which is susceptible of being separately transported to the site of the erection of the derrick and there assembled together to form the completed base or substructure. The outer corners of the assembled or completed base or substructure are designed to have the derrick legs mounted and erected thereon and the central part or section has certain of the members forming its construction readily removable from adjacent its center to one end so that this center section can be moved onto or off of a well hole without disturbing pieces of equipment therein.

A still further object of the invention is to provide a well drilling derrick wherein the legs are in the form of telescoped sections which may assume collapsed positions or may be independently hydraulically extended, and to provide means for mechanically locking each section in its extended position against collapse within its supporting section.

It is also an object of the invention to provide a derrick having telescopic legs wherein gusset plates are permanently attached to the tops of

the telescopic sections and additional gusset plates are adjustable along the length of said sections so as to be capable of either assuming positions near the permanently attached gusset plates when the legs are collapsed or positions intermediate the ends thereof when the sections forming the legs are extended.

Still another object of the invention is to provide an improved gin pole construction wherein the gin pole legs are capable of telescoping within their respective derrick legs or assuming positions projecting therefrom, the gin pole legs being jointed to permit of their being swung inwardly from the tops of the derrick legs and suitably connected together.

An additional object of the invention is to provide a water table for a well derrick with plates positioned at each of the corners thereof both above and below the water table beams thereby providing a construction which is adequately braced and which adequately braces the derrick against deformation by torsional forces or forces which would tend to warp the derrick from a rectangular cross section into a diamond cross section.

Many of the features embodied in the present invention have been designed primarily for use with portable derrick constructions but may be adopted and employed in the construction of the conventional or standard derrick which may be generally regarded as a permanent installation.

With the foregoing and other objects in view, which will be made manifest in the following detailed description and specifically pointed out in the appended claims, reference is had to the accompanying drawings for an illustrative embodiment of the invention, wherein:

Figure 1 is a view in side elevation of the lower portion of a portable derrick embodying the present invention, the derrick being shown in assembled and erected position;

Fig. 1*a* is a partial view in elevation illustrating the top of the derrick shown in Fig. 1;

Fig. 2 is a view in side elevation of one of the outer sections of the derrick substructure, the derrick legs being illustrated in collapsed and in reclining position thereon and the section of the substructure being shown as having been suitably mounted so as to be susceptible of being readily transported to the desired new location;

Fig. 3 is a view in rear elevation of the section shown in Fig. 2 and may be considered as taken in the direction of the arrow **3** upon Fig. 2;

Fig. 4 is a top plan view of the section shown in Fig. 2;

Fig. 5 is a view in side elevation of the central section of the derrick base or substructure, the same being shown in position wherein it may be transported;

Fig. 6 is a view in end elevation of the same taken in the direction of the arrow **6** upon Fig. 5;

Fig. 7 is a vertical transverse section taken substantially upon the line **7—7** upon Fig. 5;

Fig. 8 is a view in end elevation of the derrick substructure illustrating the manner in which the sections thereof are assembled together to form a completed base or substructure;

Fig. 9 is a transverse section taken through the base or substructure and may be considered as having been taken substantially upon the line **9—9** upon Fig. 11;

Fig. 10 is a sectional view illustrating a preferred form of anchoring means for anchoring the assembled substructure in position;

Fig. 11 is a top plan view of the assembled substructure, the legs being illustrated as in their folded and collapsed position thereon;

Fig. 12 is a view in side elevation illustrating the manner in which the legs of the derrick are erected into their substantially upright positions;

Fig. 13 is a perspective view of a suitable ladder that may be employed to facilitate the assembling of the various parts of the derrick in the course of its erection;

Fig. 14 is a view of a clamp that may be employed to hoist girts and braces;

Fig. 15 is a sectional view illustrating the manner in which the sections of the legs are held together so that upon being extended the sections will be progressively extended so that the top section is the last to be projected into its extended position;

Fig. 16 is a view in side elevation of the derrick illustrating the legs as having been erected into upright positions and the first girts and braces installed; this view also illustrates the manner in which additional braces and girts may be elevated to their desired positions;

Figs. 17 to 21, inclusive, are views in side elevation of the derrick illustrating the progressive steps that are accomplished in the erection of the completed derrick;

Fig. 22 is a view in side elevation, parts being broken away and shown in section, illustrating the top of the derrick and the construction of the gin pole thereon;

Fig. 23 is a horizontal section taken substantially upon the line **23—23** upon Fig. 22;

Fig. 24 is a horizontal section taken substantially upon the line **24—24** upon Fig. 22;

Fig. 25 is a sectional view through a portion of the derrick leg when in fully collapsed position illustrating the constructions of the lower portions of the sections of the leg;

Fig. 26 is a horizontal section taken substantially upon the line **26—26** upon Fig. 27, illustrating the locking means preferably employed for locking each section in its extended position both against collapse and clamping the same against rotation;

Fig. 27 is a vertical section taken substantially upon the line **27—27** upon Fig. 26;

Fig. 27*a* is a horizontal section taken substantially upon the line **27*a*—27*a*** on Fig. 27;

Fig. 28 is a horizontal section taken through one of the sections of the derrick legs and illustrating the construction of one of the adjustable gussets which is adjustable along the length thereof;

Fig. 29 is a view in side elevation of the same;

Fig. 30 is a horizontal section through the bottom of one of the derrick legs illustrating the manner of its attachment to the substructure;

Fig. 31 is a view in side elevation of the bottom of the derrick leg, the derrick leg being shown in upright position in full lines and in reclining position in dotted lines;

Fig. 32 is a top plan view illustrating the assembly of sections of a modified form of derrick construction that may be employed, this form of construction being primarily designed for the erection of a derrick for pumping purposes and for servicing a producing well;

Fig. 33 is a view in side elevation of one of the sections and may be considered as having been taken in the direction of the arrow **33** upon Fig. 32;

Fig. 34 is a sectional view taken substantially upon the line **34—34** upon Fig. 32;

Fig. 35 is a sectional view taken substantially upon the line 35—35 upon Fig. 34;

Fig. 36 is a horizontal section through one of the derrick legs illustrating an alternative form of adjustable gusset construction that may be employed and may be considered as taken on the line 36—36 upon Fig. 37 in the direction indicated;

Fig. 37 is a view in side elevation of the same;

Fig. 38 is a horizontal section through a derrick leg illustrating an alternative form of stationary or permanent gusset construction that may be optionally employed and may be considered as taken on the line 38—38 upon Fig. 39; and

Fig. 39 is a view in side elevation of the same.

Referring to the accompanying drawings wherein similar reference characters designate similar parts throughout, the improved derrick comprises a base or substructure divided longitudinally into preferably three independent unitized structures separately transportable from place to place. When the site for a well has been selected a concrete mat indicated at 10, see Fig. 9, is first poured to provide an adequate foundation on which the derrick may be erected In pouring this concrete mat the so-called cellar is dug so as to be arranged around the well hole and is preferably lined with the concrete. Also, provision is made for the conventional rat hole to receive the kelly. A timber or metal mat may be used when desired in place of the concrete mat but as a concrete mat will usually be found the most suitable, the invention will be described in connection with the use of that type of mat.

In the concrete mat as shown in Fig. 9, there are embedded suitable anchor bolts 11, those being shown having angular lower ends and threaded upper ends which receive internally threaded sockets 12. These anchor bolts are so positioned in the mat that the sockets 12 will line up with bolt holes in the bottom frame members of the base or substructure of the derrick.

As the conventional well drilling derrick has a base or substructure 24 feet square and it is the purpose of the present invention to provide a derrick that will conform thereto in size, shape, and arrangement, each section of the substructure is preferably made 8 feet wide by 24 feet long so that the three sections when assembled together will provide a derrick floor 24 feet by 24 feet. It will be understood, however, that the present invention is in no way restricted to these dimensions but it should be noted that when the individual sections do not exceed 8 feet that they may be transported via highway without special permit in those states which have existing regulations prohibiting the transportation of equipment via highway where the equipment exceeds 8 feet in width.

The two outer sections of the substructure are in the main counterparts of each other consisting of an upper rectangular frame formed of channel irons 13 and 14 connected by cross members 15 which serve to support the planks 16 of the derrick floor. The cross members 15 that connect the channel irons 13 and 14 are preferably welded or otherwise rigidly and permanently fastened thereto. Each outer section of the substructure also includes a pair of lower channel irons 17 and 18 having bolt holes formed therein which receive threaded studs 19 adapted to be screwed into the sockets 12 on the anchor bolts 11 to firmly fasten each section of the substructure to the concrete mat 10. Supporting posts serve to support the upper frame on the lower channels 17 and 18, there preferably being four supporting posts on each side, as shown in Fig. 2, the end supporting posts being indicated by the reference character 21 and the intermediate supporting posts being indicated by the reference character 22. The end supporting posts may be connected to their adjacent intermediate supporting posts 22 as by diagonal braces 23 welded or otherwise permanently fastened in place. Diagonal bracing 24, see Fig. 9, may connect intermediate supporting posts 22 across the section of the substructure. This cross bracing preferably is in the form of channel irons arranged back to back with gusset plates 25 connecting the lower ends of the braces to their adjacent supporting posts 22. On the undersides of the braces there are welded or otherwise fastened sections of either angle iron or I-beam as indicated at 26 to provide rests or footings for jacks 27, see Fig. 8. The rear pair of end supporting posts 21 are connected together by means of an I-beam 28, see Fig. 2, which provides footing for the forward ends of rails 29 of a wheeled dolly. This dolly preferably has upwardly and forwardly inclined members 30 connected to the rear ends of the rails and these members are designed to be detachably fastened as by bolts to the top frame of the substructure at the rear thereof. The forward ends of the rails are adapted to be positioned beneath the I-beam 28 and bolted or otherwise fastened thereto to support the section above the ground surface so that it may be transported from place to place. At the forward end of the section there is detachably mounted a suitable frame generally designated at 31 which likewise serves to support the forward end of the section in transporting position on the pivot plate 32 of a truck or tractor 33.

The above-described construction is applicable generally to the two outer sections generally indicated at 34 and 35 of the substructure of the derrick as these two sections are largely counterparts of each other. There is one difference that should be noted with respect to the two outer sections 34 and 35. At least one of these sections in the preferred form of construction has one of its channel irons forming a part of the top frame provided with a readily removable portion as indicated at 14*a*, see Fig. 11. This readily removable portion of the channel iron is normally bolted in place through brackets 14*b*. Portions of the cross members indicated at 15*a* which connect this removable section with longitudinal braces 15*b* are also readily removable. These parts are made readily removable by merely having them bolted in place. The purpose of having this portion of one of the outer units of the base or substructure readily removable is to provide space for moving in a draw-works where the draw-works is supported at a level below that of the derrick floor. If there is no occasion for installing a draw-works in this manner then these portions are allowed to remain in place. The central or intermediate section generally indicated at 36 and illustrated in detail in Figs. 5, 6, 7, and 9 comprises bottom channel irons 37 and 38 equipped with bolt holes for the reception of studs adapted to be screwed into the sockets 12 of its corresponding anchor bolts that are embedded in the concrete mat 10. These channel irons are adapted to assume positions side by side with the channel irons of the outer sections 34 and 35 and to be bolted thereto as by bolts 39. In this section of the substruc-

ture the intermediate supporting posts indicated at 40 and 41 serve to support relatively heavy I-beams 42 and 43 on which are supported transversely extending rotary table supports 44 and 45 which are designed to support the conventional rotary table of a rotary well drilling apparatus. The I-beams 42 and 43 are connected by transverse members 46, at least one of which is readily removable for a purpose hereinafter to be explained.

In order to render the mentioned transverse member removable it is preferably bolted in place as distinguished from riveting or welding. The end supporting posts of the central section indicated at 47 and 48 cooperate with the tops of the I-beams 42 and 43 to support upper I-beams 49 and 50 and these supporting posts may be braced as by diagonal braces 51. The I-beams 49 and 50 extend from their respective ends of the central section inwardly onto the I-beams 42 and 43 but terminate short of the rotary table supports 44 and 45. On these upper I-beams 49 and 50 there are rigidly and permanently secured sections of channel irons 52 and 53 adapted to assume abutting relationship with the channel irons 14 of the two outer sections 34 and 35, and to be bolted thereto as by bolts 54. The upper I-beams 49 and 50 are connected together by means of transverse members 55 and at least from the center of the section to one end thereof all of these transverse members are readily removable, being merely bolted in place rather than riveted or welded. These transverse members as well as the transverse members 46 are readily removable so that on completion of the well they may be taken out to permit of the central section being drawn off of the mat 10 without interfering with the structure that may be affixed to the well head such as for example the "Christmas tree." Usually the "Christmas tree" will not be arranged so high as to interfere with parts disposed at the level of the channel irons 52 and 53, and consequently if desired, the transverse members 56 which connect the channel irons 52 and 53 and serve to support the derrick floor on opposite sides of the rotary table need not be made removable unless desired.

In the construction of this center section the rear supporting posts 47 are preferably connected by a removable transverse I-beam 57 which provides a footing for the forward ends of a welded dolly 58 which is similar in construction to the welded dolly heretofore described in connection with the outer sections 34 and 35. The forward end of the central section 36 is likewise equipped with a removable framework 59 by which it may be supported on the pivot plate of a truck or tractor 60 whereby the central section may be supported in elevated position for transporting it from place to place.

When the concrete mat has hardened the three sections 34, 35, and 36 may be moved thereon by means of their tractors and dollies and lowered into proper position with respect to the anchor bolts. The studs may then be inserted into the sockets and the three sections tightened in place and bolted to each other as by means of the bolts 39 and 54. The lowering of the sections in place is accomplished by means of the jacks 27, see Fig. 8. These jacks may be placed beneath the respective sections and the sections elevated sufficiently to permit of detachment of the dollies and of the frameworks 31 and 59 so as to release these parts for transportation of other derricks. When the dollies and tractors have been detached the jacks 27 are used to lower the sections in place following which the jacks may be removed.

With the sections of the substructure thus assembled and installed on the concrete mat the construction is then ready for the erection of the derrick itself.

Adjacent each outer corner of the outer sections 34 and 35 there is hingedly mounted a footing 61 for a derrick leg, the hinge therefor being indicated at 62, see Figs. 30 and 31. These footings when swung into the full line position shown in Fig. 31 are adapted to be rigidly fastened in this position such as by bolts 63. Each footing has mounted thereon a tubular section 64 which constitutes the lowermost and outermost section of a telescopic leg adapted to be hydraulically extended or projected. To this end the outermost section is preferably equipped with a suitable fitting 65 providing for the attachment of a tubular means that will convey liquid under pressure to the interior of the telescopic leg. The construction of the footing 61 is such that when it is in the full line position shown in Fig. 1 that the leg will not be vertically arranged but instead will be merely upright inclining somewhat inwardly over the derrick floor in conformance with conventional derrick construction.

Adjacent the corners of the outer sections 34 and 35 of the substructure suitable provision is made for mounting thereon a gin pole construction 86 which can be used to swing the telescopic legs from their reclining positions into their upright positions, see Fig. 12. This gin pole construction may be equipped with block and tackle 87 adapted to be connected to the lowermost section 64 of each leg. The gin pole construction 86 may be moved from corner to corner to erect each leg and following the bolting down of the footing 61 the leg is in a position to be extended.

Each leg is preferably formed of four telescopic tubular sections indicated respectively at 64, 66, 67, and 68 capable of assuming collapsed positions one within the other. At the lower end of each section there is provided a suitable tubular type piston, the pistons being generally designated at 69, which are preferably equipped with annular packing leathers 70. The packing leather 70' on piston 107 may be of the cup type as the projecting fluid need not pass therethrough. Each piston is designed to snugly fit within the section of the leg in which it is disposed so that when hydraulic pressure is forced into the lower leg 64 through fitting 65 the sections may be extended upwardly. At the upper end of each leg section 64, 66, 67, and 68 there are welded or otherwise rigidly or permanently fastened angular gussets, the wings of which are indicated at 71 and 72. These gussets are designed to have attached thereto girts 73 and braces 74. Adjustable gussets 75 are also disposed on the sections 66, 67 and 68. These adjustable gussets, as shown in Fig. 28, have wings 76 and 77 which are rigid with a body 78 which may be loosened or tightened by means of a bolt 79. The sections 66, 67, and 68 of each leg are equipped with small collars 80 which are equal in diameter to the pistons 69 on these sections. It will be understood that each section 66, 67, and 68 is somewhat smaller than the diameter of the section in which it is disposed so that there will be a minimum of frictional engagement between each section and the

next outer section within which it is telescoped. When the legs are in collapsed position the adjustable gussets shown in Fig. 28 are loosened and occupy positions adjacent the permanent gussets 72. However, when the legs are projected the adjustable gussets may slide down on their respective sections until they encounter the collars 80 and may then be tightened in place providing for attachment of some of the girts 73 and braces. The lowermost leg is preferably provided with step spikes 81 permanently attached thereto and this section of the leg preferably has gussets 82 permanently fastened thereto intermediate its ends.

It is desirable in extending each leg to have the sections progressively extended, that is to have sections 66 extended from section 64 while sections 67 and 68 remain in their collapsed positions. Then, when section 66 has been extended to extend section 67 with section 68 remaining in its collapsed position, and finally, to extend section 68 after section 67 has been fully extended.

To this end a series of ties or connectors are provided as illustrated in Fig. 15. These ties or connectors are in the form of turnbuckles 83 having angular ends as at 84 which may be inserted in bolt holes formed in the permanently attached gussets of the sections of the telescopic legs. Thus, when a leg is erected and is about to be extended the lowermost connector may be disconnected permitting section 66 to be extended from section 64 while the remaining sections remain fastened together. Then the additional connectors can be progressively detached and removed. Prior to the extension of the leg it is customary to install the lower girt 73 and the various lower braces 88 leaving the conventional opening or window 89 as illustrated in Fig. 16. The lowermost connectors or turnbuckles 83 are then removed and section 66 extended from section 64 by introducing hydraulic pressure through fitting 65. On extension of the section 66 the adjustable gussets 75 slide downwardly thereon until they encounter the collar 80. A ladder 90, see Fig. 13, equipped with hangars 91 may be hooked over the stationary gussets at the top of section 66 enabling a man to climb the ladder to the location of collar 80 to tighten the adjustable gussets in place against the collars.

Provision is made for locking the projected or extended sections of the telescopic legs against collapse and clamping them against rotation relatively to each other. To this end the top of each of sections 64, 66, and 67 of the legs are equipped with collars 92, see Figs. 26, 27, and 27*a*. On each collar there is positioned a split collar, the sections of which are indicated at 93 and 94. The sections of the split collar are equipped with slots 95 through which bolts 96 extend. These sections may be expanded as indicated by the section 93 on Fig. 26 to permit the extension of the inner section of the leg. When the inner section has been fully extended by the hydraulic pressure the sections 93 and 94 which have been loosened by the unscrewing of the bolts 96 are urged to slide toward each other or to contract by means of a tension spring 97. When the inner section reaches its fully extended position the sections of the split collar that are on the outer section of the leg contract and enter a groove located on the piston of the inner section. These sections 93 and 94 have upwardly inclined shoulders which fit in the undercut top of the groove as shown in Fig. 27, thereby resisting outward movement of the sections of the split collars when the leg is subjected to loading. Bolts 99 extend loosely through holes in ears formed on the sections of the split collar and can then be tightened to clamp the sections of the split collar about the extended section and hold it against rotation. Following this the bolts 96 are tightened, to fasten the split collar firmly on collar 92.

The sections 93 and 94 must be capable of passing over the collars 80 and any other minor shoulders that may be present on the leg sections. To this end, the bottom internal corners of the sections 93 and 94 are beveled off as indicated at 93*a* so that as a leg section is being extended when the collar 80 or any other corresponding shoulder thereon encounters these beveled corners it will merely separate the sections 93 and 94 overcoming the contracting action of the tension spring 97. When the groove is encountered these sections snap into the groove to prevent the leg sections from being extended too far.

As clearly shown on Figs. 27 and 27*a* each piston 69 has a circumferential row of sockets formed therein within which balls 69*a* are disposed. These sockets may be formed with a round-ended boring tool to the proper depth and when the balls are disposed therein the balls are intended to snugly fit and roll against the interior of the outer leg section thus forming a type of anti-friction bearing facilitating the telescopic movement of the leg sections. The balls may be retained in their respective sockets by slightly peening over the metal of the piston adjacent each socket. In a similar manner, sockets 69*b* may be formed in the top of each outer section extending into the collar 92 and balls 69*c* may be positioned therein and retained by peening the metal adjacent the sockets. These balls need only be arranged opposite that portion of the leg section that is to be innermost as clearly shown in Fig. 27*a*, it being understood that the legs of the derrick incline inwardly over the substructure. Balls located at these points will ordinarily suffice as the inclination of the legs that are being projected causes the load to be concentrated in this direction. These balls likewise serve to reduce friction during extension of the legs.

On top of each uppermost section 68 of the telescopic legs there is disposed a top plate 100 which is angular in plan (see Figs. 23 and 24) and which is welded not only to the top of the uppermost section 68 but also to the top permanent gussets thereon. The angle is located adjacent the top of the leg so that the top plate extends in two directions at substantially right angles from the leg. Mounted preferably on these top plates on the derrick legs are suitable clevises for the attachment of blocks 101 which enable the various braces and girts to be hoisted by means of lines 102 as illustrated on Fig. 16. The lines employed preferably have clevises 103 having spring actuated plungers 104 thereon as illustrated in Fig. 14. These plungers are adapted to be inserted into bolt holes in the braces and girts and being urged by means of springs into closed position, there is little danger of the bracing or girts becoming loosened and dropped during the hoisting thereof.

In Figs. 17 to 21, inclusive, I have illustrated the various steps of erecting the derrick progressively from the initial position wherein the telescopic legs are erected into upright positions

hile collapsed and then progressively extended. t will be appreciated that the derrick progresses pwardly section by section, each section being qual in height to one of the telescopic sections hat form the legs. In erecting a derrick em- odying the invention it will be understood that he distance between adjacent derrick girts may xceed considerably the distance of 7 feet. In ddition the present invention permits efficient ssembly of derrick girts spaced well in excess f 10 feet apart inasmuch as the ladder illustrated n Fig. 13 may be progressively shifted from ower to upper sections to enable the tightening f the adjustable gussets on the sections and the olting of girts and braces thereto. The pre- erred manner of using the ladder is to position he ladder against the outer side of a leg section, ooking its hangers over the tops of the wings f the permanent plates of a leg section telescoped herein. This results in the ladder being raised with the telescoped leg section as that section is extended or elevated and permits workmen climb- ng thereon to tighten the adjustable gusset plate n the extended section and to attach the girts nd braces **73** and **74** to the gusset plates. When he girts are attached to the permanent gusset plates at the top of the extended leg section workmen may stand on such girts and left ladder nd hang its hangers on the wings of the perma- nent gusset plates of the leg section that is to be next extended so as to be raised therewith.

In the uppermost section **68** of each leg there is telescoped a gin pole member, see Fig. 22. Each gin pole member comprises a tubular sec- tion **105** capable of telescoping within the upper section and having a pivoted or hinged joint at **106** connecting it to a piston **107** similar in con- struction to the pistons on the telescopic leg sections. On the upper ends of the tubular sec- tions **105** there are eyes **108** or the equivalent en- gageable by latches **109** on the top plates **100** to hold these sections in collapsed position until the latches are released. These gin pole members can then be hydraulically extended from the tops of the derrick legs and when they reach their fully extended position the tubular sections **105** can be swung inwardly by means of the pivoted joint **106** so that their upper ends will be dis- posed adjacent each other. A cap **110** having studs **111** capable of entering the tops of the gin pole members is then applied and the adjustable gussets **112** are attached thereon and tightened in a position intermediate the ends of the gin pole members and are thereafter connected by braces **113**. The cap **110** is equipped with a hook **114** enabling the water table beams **115** to be brought up and placed on the top plates **100**. These water table beams are bolted to the top plates **100** and as the top plates are angular they serve to resist deformation of the derrick by torsional forces, or in other words, they resist the derrick becoming diamond-shaped in cross section when under load.

On top of the water table beams there are ad- ditional angular plates **100***a* which cooperate with the angular plates **100** in resisting warping or deformation of the derrick from its correct rectangular shape.

As clearly shown in Fig. 22, it is unnecessary to provide any particular locking means for locking the gin pole members in their uppermost posi- tions in asmuch as the lower ends of the sections **105** when they are swung out of alignment with the legs will have their lower ends shouldering on the top plates **100**. With the water table beams installed and bolted to the top plates and angular corner plates **100***a* bolted thereto, the crown block **117** may be elevated and installed which completes the erection of the derrick.

It will be noted from the above-described con- struction that although the derrick is portable in three separate sections these may be assembled together and the derrick erected in such a man- ner as to employ conventional cable tool or rotary well drilling equipment such as the conventional rotary table, draw-works, etc., and as the floor plan is of the same size and shape of the conven- tional derrick the various positions of the equip- ment may be arranged at the same locations as in the conventional derrick.

When the well has been completed the derrick can be transported, where the configuration of the ground and other conditions will permit, to a new location without dismantling as all of the sections of the substructure may be allowed to remain fastened together and the substructure with the derrick thereon may be bodily lifted by means of jacks onto the dollies and tractors and the entire structure moved as desired. On the other hand, if conditions are such that the der- rick need be transported via highway, or it is otherwise unfeasible to transport the derrick in its erected position, it may be easily and quickly dismantled by unbolting girts and braces and allowing the gin pole members to collapse within the legs and the leg sections to collapse within each other. When the legs are fully collapsed they may be swung downwardly by means of the gin pole construction **86** into positions lying lengthwise along the outer sections. These re- clining collapsed legs occupy only a small por- tion of the floor space on the outer sections **34** and **35** and the remaining space may be utilized to carry various girts and braces and other pieces of equipment while the sections of the substruc- ture are being individually transported from place to place. Usually the derrick will not be removed from the well until after the installation of the "Christmas tree" which, as above ex- plained, is positioned normally below the top channel members of the center section **36** of the substructure. As all transverse members of the center section from its center to one end below these upper channel members are readily remov- able the center section can be easily withdrawn from the well over the installed "Christmas tree" without disturbing the "Christmas tree." It will thus be appreciated that by means of the im- proved derrick the total number of parts re- quired for the construction of the derrick is greatly reduced from that of the conventional derrick and in addition there is present the im- portant advantage of having the construction readily portable and capable of being easily and quickly erected.

In Figs. 32 to 35, inclusive, I have illustrated a modified or alternative form of construction pri- marily designed for servicing a well which has been drilled and once placed on production. In Fig. 32 there is illustrated a concrete mat **125** which may have had thereon concrete pillars **126** which serve as foundations for a conventional well drilling derrick which on completion of the well was torn down and removed. The inven- tion has been illustrated as applied to this type of mat to illustrate that this form of derrick may be used either where the well has been drilled by means of a portable well drilling derrick as previ- ously described, or in situations where the well has been drilled by a conventional well drilling

derrick which has since been removed. The servicing derrick comprises a substructure divided into only two sections, as shown in Fig. 34. One section comprises an upper rectangular frame made up of channel irons indicated at 127 supported upon either supporting posts or columns. The intermediate supporting posts or columns are connected by means of transverse braces 128 which may be braced by means of gusset plates 129, and these braces provide footings or rests for jacks 130. The lower ends of the supporting posts may be connected by channel irons and angle irons 131 and 132 constituting sills. Between the end supporting posts there may be disposed I-beams such as are indicated at 133 and 134 enabling the attachment of a wheeled dolly and a frame for supporting the section on the pivot plate of a truck or tractor in substantially the same manner as that previously described. The other section of the substructure is similarly constructed having a top frame 135 supported on end and intermediate support posts or columns 136 and 137. Both sections of the substructure may be equipped with diagonal braces 138. This section of the substructure may likewise have the intermediate columns or posts 137 connected by transverse braces 139. These braces, however, have jack screws 140 extending therethrough equipped with nuts 141 and equipped with casters or rollers 142. The housings for the casters or rollers are guided as indicated at 143 so that they will be held against rotation upon turning the nuts 141. The rollers are so arranged as to be rotatable about axes extending longitudinally of the section. In this section of the substructure the channel and angle irons 144 and 145 terminate adjacent the intermediate posts or columns 137 and may be connected by readily removable sections 146 of the sills.

On the outer corners of the two sections there are mounted the collapsible derrick legs 147 which are similar in construction to the derrick leg constructions previously described. In this form of construction the two sections of the substructure are preferably approximately 4 feet in width so that when the two sections are assembled together as shown in Fig. 34, and are bolted together as by bolts 148 they may be transported from place to place as a combined unit when the dollies are applied and the structure towed by a truck or tractor. The sections as a combined unit are moved onto the mat 125 together on one side of the cellar 150. The jacks 130 are then installed beneath the transverse braces of the section 151 and the rollers 142 of section 152 are lowered by means of the jack screws into mat-engaging position. The bolts 148 are then removed so as to separate the sections and if the path of the rollers 142 is such as to pass over the cellar 150, beams may be applied across the cellar on which the rollers may roll to support the section 152 as it is moved thereacross. Suitable anchors 153 may be installed in the mat 125 and blocks and tackle 154 may be employed to bodily shift section 152 across the mat into the position shown in Fig. 32. The two sections may then be lowered, the section 151 being lowered by means of jacks 130 and the section 152 lowered by retracting the jack screws 140. The legs of the derrick can then be erected and the derrick constructed in the manner previously described.

If desired, suitable anchor bolts may be set in the concrete mat 125 to enable firmly anchoring thereto the channel irons and angle irons that form the sills of the sections of the substructure. In this form of construction it will be noted that the entire cellar and a substantial portion of the concrete mat 125 is left exposed in accordance with what is now becoming common practice in servicing a producing well. The derrick, when erected, may be used for pulling sucker rods or tubing or for performing other operations. The removable sections 146 of the sills of the substructure section 152 permit the substructure section 152 to readily pass over the "Christmas tree" which may be projecting above the top surface of the mat 125.

When the servicing of the well is completed, the section 152 may be drawn back into adjoining relationship with section 151 and the two sections bolted together by means of the bolts 148. As each section is only four feet wide the combined sections have an overall width of only 8 feet permitting this portable derrick structure to be readily transported via highway without requiring the securing of a special permit or complying with any special regulations imposed when equipment exceeding 8 feet in width is transported via highway.

From the above-described constructions it will be appreciated that an improved portable derrick is provided having numerous advantages enabling the derrick to be easily and quickly moved to a desired location and erected.

On Figs. 36 to 39, inclusive, I have illustrated an alternative form of gusset construction that may be optionally employed with either form of portable derrick heretofore described. In Figs. 36 and 37 there is illustrated an adjustable gusset consisting of a split collar 155 which can be tightened into clamping position by means of screws or bolts 156. This split collar encircles the leg section on which it is mounted. The gusset 157 is bent around the outside of the collar and is welded thereto, such as by welding through holes in the body of the gusset to the back of the collar and by bead welding adjacent the top and bottom. In this form of construction the wings of the gusset indicated at 157*a* and 157*b* are arranged at substantially right angles as before, but instead of having the gusset plates arranged radially with respect to the derrick leg they are arranged substantially tangent to the outer side thereof. The girts and braces are attached to the gusset plates as previously described, but they will be arranged on the outer sides of the derrick legs. This construction has the advantage that to this extent the interior space or the interior dimensions within the derrick are increased. In drilling deep wells the available space for racking drill pipe and the like is somewhat limited and the arrangement of the girts and braces afforded by this type of gusset makes some increase in this racking space which frequently is advantageous. When the type of adjustable gusset shown in Figs. 36 and 37 is employed the permanent or stationary gussets should likewise be arranged substantially tangent to the outside of the derrick legs as shown in Figs. 38 and 39 wherein the gusset 158 is bent around the outside of the derrick leg section beneath the collar 92 thereon and is welded thereto both through the body of the gusset and at the top and bottom thereof.

Various changes may be made in the details of construction without departing from the spirit or scope of the invention as defined by the appended claims.

I claim:

1. A portable well derrick having a substructure ivided into individually portable separate secons adapted to be assembled together in side by de relationship to form a complete substructure, errick legs mounted upon the sections adjacent ie outer corners of the sections, said legs comrising telescopic members arranged to be indidually extended and collapsed, and means on ie legs enabling the connecting of the legs toether when extended.

2. A portable well derrick having a substrucire divided into individually portable separate ections adapted to be assembled together in ide by side relationship to form a complete ubstructure, derrick legs hingedly mounted upon he sections adjacent the outer corners of the ections and adapted to be erected into substanially upright positions thereon and extended, and ieans enabling the connecting of the legs toether when they have been erected and exended.

3. A portable well derrick having a base structure longitudinally divided into separately port.ble sections adapted to be assembled together in ide by side relationship to form the completed ase structure, derrick legs mounted upon at least ome of the said sections adjacent the outer orners thereof, said legs comprising telescopic nembers arranged to be collapsible and exensible.

4. A portable well derrick having a base structure longitudinally divided into separately portible sections adapted to be assembled together n side by side relationship to form the completed ase structure, and telescopic tubular legs nounted upon at least some of said sections adjacent the outer corners thereof adapted to be independently extended.

5. A portable well derrick having a base structure longitudinally divided into separately portable sections adapted to be assembled together in side by side relationship to form the completed base structure, and collapsible and extensible derrick legs hingedly mounted upon at least some of the said sections to be capable of folding downwardly over the lengths of their respective sections during transport.

6. In a portable well derrick, a leg formed of a plurality of collapsible and extensible sections, gusset plates permanently attached adjacent the tops of the sections, and gusset plates slidable along the lengths of the sections adapted to assume positions adjacent the first-mentioned gusset plates when the legs are collapsed and positions intermediate the ends of said sections when the legs are extended.

7. In a well derrick, legs, and a gin pole telescopically arranged in the top of at least one of the legs, the gin pole being adapted to be projected therefrom and being jointed for bending movement out of line with its respective leg.

8. In a well derrick, legs, and gin pole members telescopically arranged in the tops of the legs of the derrick, the gin pole members being adapted to be projected from the legs and being jointed so that their upper ends may be inclined toward each other and connected together.

9. In a well derrick, derrick legs, gin pole members telescopically arranged in the tops of the legs of the derrick, said gin pole members being adapted to be projected from the legs and being jointed so that their upper ends may be inclined toward each other and connected together, a part of the lower portion of each gin pole member being engageable with the top of its respective leg when the gin pole member is bent, thereby preventing the gin pole members from collapsing into the legs.

10. A portable well derrick comprising a base structure divided into individually portable sections, each section providing a substantial portion of the floor of the derrick, said sections being adapted to be assembled together in side by side relationship to form the complete base structure of the derrick and to provide the complete floor thereof, collapsible and extensible legs hingedly mounted upon the outer corners of the outermost sections of said base structure so as to be capable of being erected thereon into upright positions and extended, and means for connecting adjacent legs together when extended.

11. A portable well derrick comprising a base structure divided into individually portable sections, each section having longitudinally extending members at the sides thereof, means for connecting the adjacent longitudinal members of each section in side by side relationship so that the sections when assembled provide the complete base structure, and collapsible and extensible legs mounted at the outer corners of the outermost sections.

12. In a portable well derrick, a collapsible and extensible leg made up of telescopic sections, fluid pressure means for projecting inner sections from the tops of the outer sections, each inner section having a groove adjacent its lower end and each outer section having automatically contractible jaws adapted to be contracted into the groove to lock the inner sections against upward or downward movement relative to their respective outer sections when the inner sections reach their fully projected positions, and means for tightening the jaws in the groove to clamp the inner sections against rotation.

13. In a portable well derrick, a collapsible and extensible leg made up of telescopic sections, and gusset plates permanently fastened to the tops of each section independently of the connection of the gusset plates to any braces of the derrick, and braces attachable to the gusset plates, and adjustable gusset plates on the sections to which braces may be connected, said adjustable gusset plates being slidable along the length of their respective sections and having clamping means for clamping the adjustable gusset plates on their respective sections independently of any connection with said braces.

14. In a portable well derrick, a leg made up of telescopic sections, and a gin pole telescopically mounted in the uppermost section and jointed for lateral movement relative thereto when the gin pole is projected therefrom.

15. In a portable well derrick, a leg made up of telescopic sections, a gin pole telescopically mounted in the uppermost section and jointed for lateral movement relative thereto when the gin pole is projected therefrom, a fluid pressure operated means for projecting said sections from their respective outer sections and projecting the gin pole from the uppermost section.

16. In a portable well derrick, legs formed of telescopic sections, means for projecting the sections by fluid pressure, and locking means attached to each supporting section for locking its projectable section in its projected position against collapse into the supporting section and for clamping each projectable section against rotation relatively to its supporting section, said

locking means being directly attached to the supporting section by means that prevent rotation of the locking means relative to the supporting section.

17. In a portable well derrick, a leg formed of more than two telescopic sections, means by which the sections may be extended one from within the other by fluid pressure, and detachable means for independently connecting adjacent pairs of sections together whereby any projectable section may be held against projection until detachment of said means.

18. A portable well derrick base, comprising a base structure for supporting the derrick legs at the corners of the base, said base being composed of three individually portable sections, each section consisting of longitudinal upper members and lower members connected by cross members so that each section is an independently rigid frame, said sections when assembled with upper and lower members in side by side adjacent relation forming the complete derrick base, the center section having from adjacent its center to one end thereof readily removable cross members whereby said cross members may be removed to clear well structures in moving the center section relatively to a well.

19. A portable well derrick base, comprising a base structure for supporting the derrick legs at the corners of the base, said base being composed of two or more individually portable sections, each section consisting of longitudinal upper members and lower members connected by cross members so that each section is an independently rigid frame, said sections when assembled with upper and lower members in side by side adjacent relation forming the complete derrick base.

20. A portable well derrick base, comprising a base structure for supporting the derrick legs at the corners of the base, said base being composed of two or more individually portable sections, each section consisting of longitudinal upper members and lower members connected by cross members so that each section is an independently rigid frame, means for attaching wheels to each section, wheels for said attaching means to enable the section to be transported thereby, said sections when assembled with upper and lower members in side by side adjacent relation forming the complete derrick base.

21. A portable well derrick base, comprising a base structure for supporting the derrick legs at the corners of the base, said base being composed of two or more individually portable sections, each section consisting of longitudinal upper members and lower members connected by cross members so that each section is an independently rigid frame, said sections when assembled with upper and lower members in side by side adjacent relation forming the complete derrick base, and means for connecting longitudinal members of the sections when the sections are assembled to form the base.

GUY K. CLAIRE.