Sept. 22, 1959 S. M. WEAVER 2,905,280

TELESCOPING OR COLLAPSIBLE BRACE CONSTRUCTION

Filed Feb. 8, 1955 4 Sheets-Sheet 1

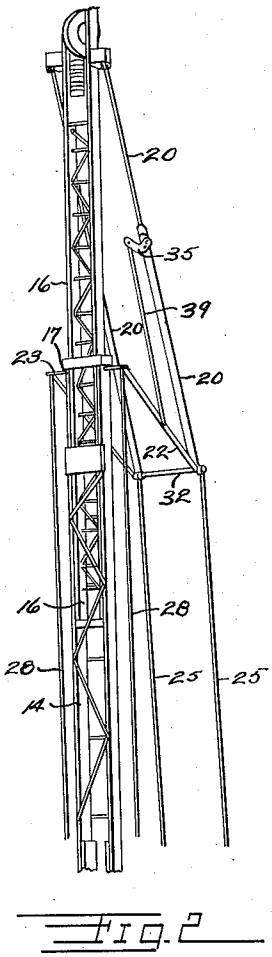

FIG. 2

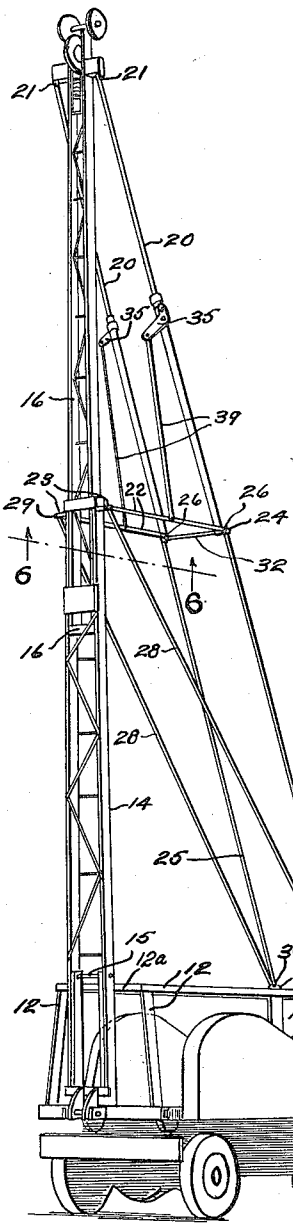

FIG. 1

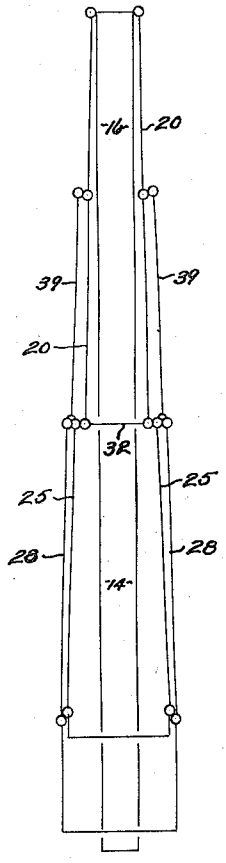

FIG. 3

INVENTOR.
STUART M. WEAVER
BY
Hyde, Meyer, Baldwin & Doran
ATTORNEYS

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TELESCOPING OR COLLAPSIBLE BRACE CONSTRUCTION

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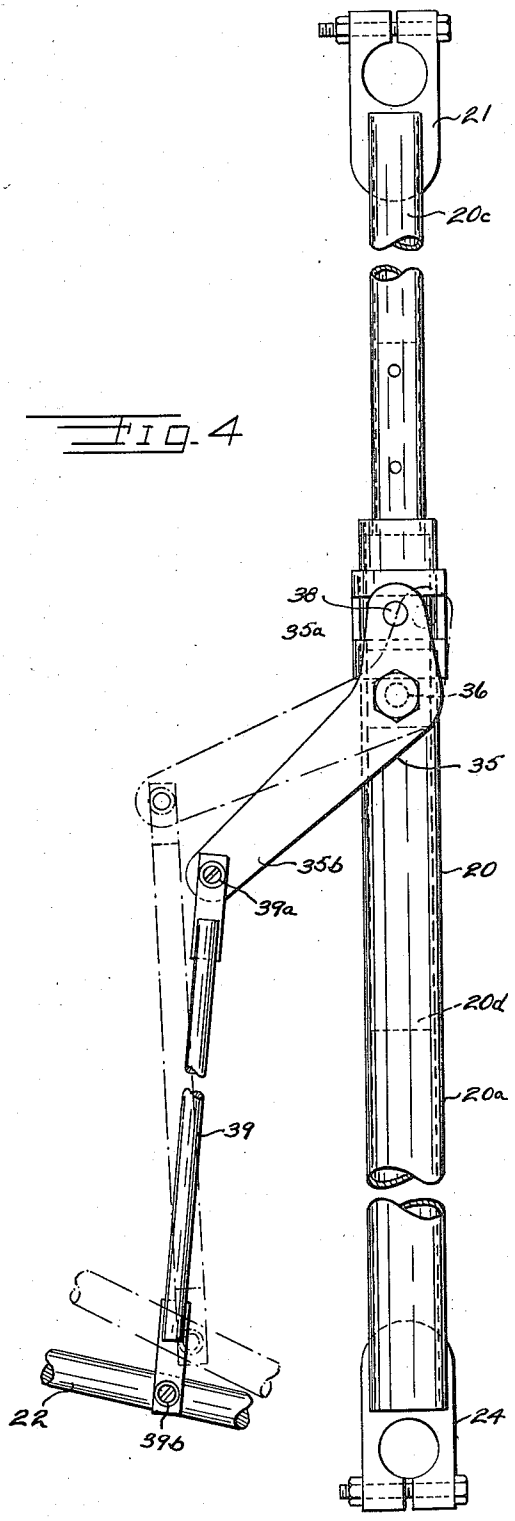
FIG. 4



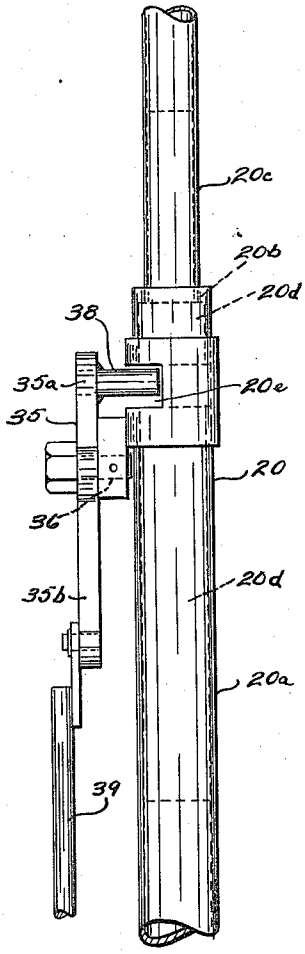


FIG. 5

INVENTOR.
STUART M. WEAVER
BY
Hyde, Meyer, Baldwin & Doran
ATTORNEYS

Sept. 22, 1959 S. M. WEAVER 2,905,280

TELESCOPING OR COLLAPSIBLE BRACE CONSTRUCTION

Filed Feb. 8, 1955 4 Sheets-Sheet 3

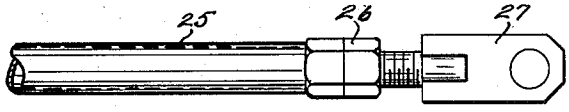


FIG. 7

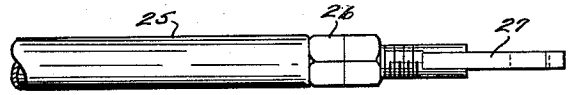


FIG. 8

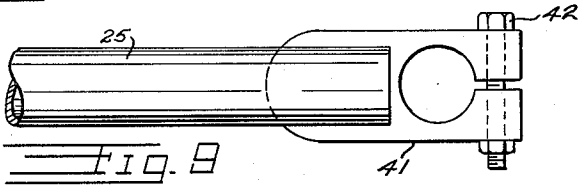


FIG. 9

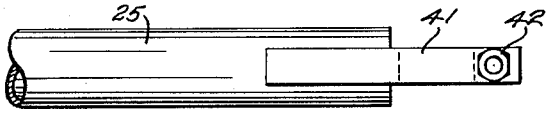


FIG. 10

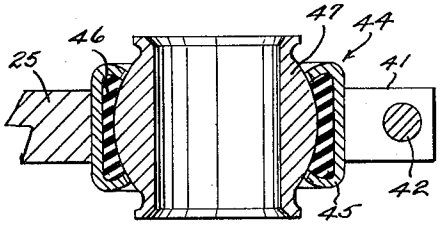


FIG. 11

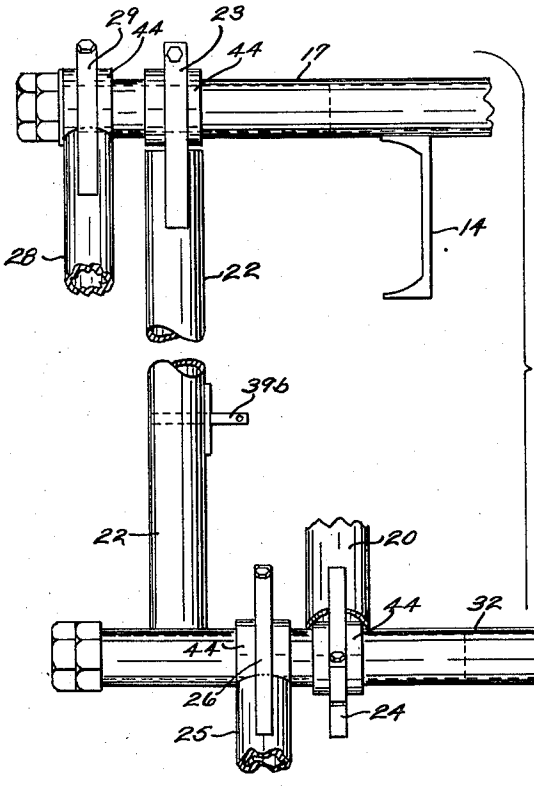


FIG. 6

INVENTOR.
STUART M. WEAVER
BY
Hyde, Meyer, Baldwin & Doran
ATTORNEYS

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TELESCOPING OR COLLAPSIBLE BRACE CONSTRUCTION

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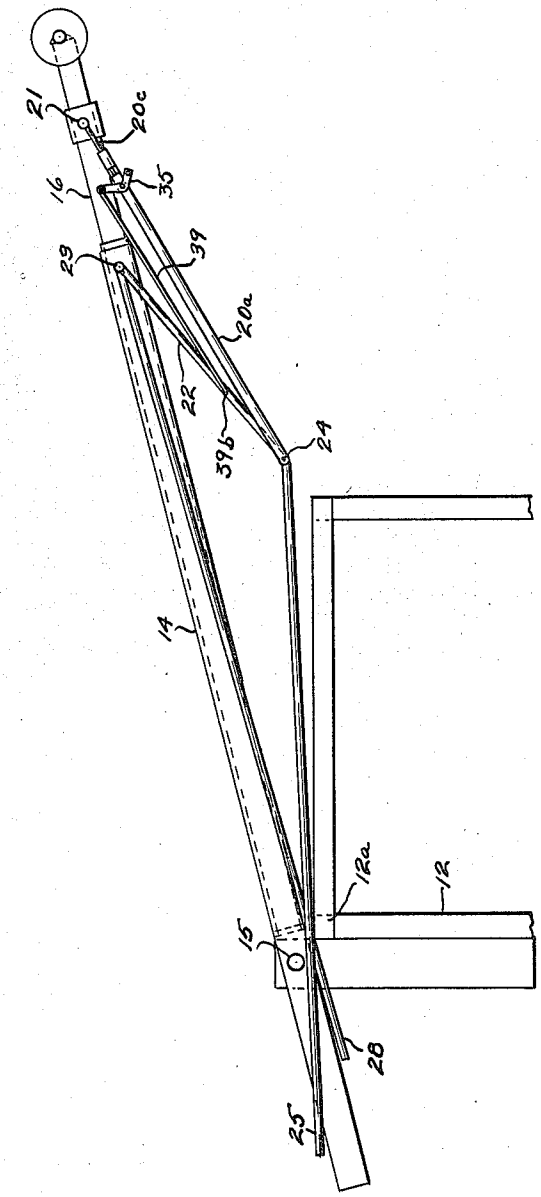

FIG. 12

INVENTOR.
STUART M. WEAVER
BY
Hyde, Meyer, Baldwin & Doran
ATTORNEYS

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2,905,280

TELESCOPING OR COLLAPSIBLE BRACE CONSTRUCTION

Stuart M. Weaver, Mansfield, Ohio, assignor, by mesne assignments, to Alten Foundry & Machine Works, Inc., Lancaster, Ohio, a corporation of Ohio

Application February 8, 1955, Serial No. 486,926

10 Claims. (Cl. 189—15)

This invention relates to new and useful improvements in folding braces, and more particularly to a folding brace of a linking brace construction used in supporting a telescopic mast or derrick, such as that for a portable drill.

One object of the present invention is to provide a supporting structure for a mast, especially a telescopic and collapsible mast, having one or more of the following advantages: (1) the supporting structure and link braces thereof being able to absorb both a compression and a tensile load, (2) at least one of the link braces in the upper portion of the mast supporting structure being collapsible but being automatically locked in extended position or unlocked for movements to collapsed position in response to relative movement of components of the mast and supporting structure, (3) the joints between link braces being always tight when the mast is in extended and erected position but permitting relative movement to collapse and telescope the mast and supporting structure to contracted and collapsed position without manual adjustment of the joints therebetween, (4) a mast and supporting structure being designed so that the mast can be moved from collapsed and contracted position to an extended and erected position or vice versa without requiring manual adjustment of the joints between the link brace components thereof, and/or (5) universal joints connecting at least some of the links of the supporting structure of a telescopic mast to permit relative movement between said links in at least two different planes at said joints during erecting and collapsing said mast.

A further object of the present invention is to provide a collapsing brace construction for a telescoping mast characterized by its structural simplicity, its operating efficiency, its strong and sturdy nature, its unique mode of operation, and its ease of operation.

Other features of this invention reside in the arrangement and design of the parts for carrying out their appropriate functions.

Other objects and advantages of this invention will be apparent from the accompanying drawings and descriptions and the essential features will be set forth in the appended claims.

In the drawings:

Fig. 1 is a perspective view as applied to a drill rig having a telescoping mast with the mast shown in extended and erected position on its supporting frame;

Fig. 2 is a perspective view of the upper portion of Fig. 1 with the mast partially contracted in length;

Fig. 3 is a line diagram of the mast and supporting construction looking directly at the mast from the left in Fig. 1;

Fig. 4 is an enlarged side elevational view of an extensible and collapsible link brace in said mast with locking means locking the link brace section in the extended position in the solid line position of the parts and showing the locking means in a partially unlocked position in dot-dash lines;

Fig. 5 is an enlarged, partial, side elevational view of the locking means and link brace construction looking toward the left from the right side of Fig. 4;

Fig. 6 is an enlarged sectional view taken along the line 6—6 of Fig. 1 through the far side of the mast and supporting structure thereof;

Figs. 7 and 8 are two different, enlarged elevational views of the operative connection between the lower end of each link brace and the supporting frame;

Figs. 9 and 10 are two different, enlarged side elevational views of the other end connections on the link braces;

Fig. 11 is a universal joint type end connection with an insert adapted to be held in the end connection shown in Figs. 9 and 10; while

Fig. 12 is a schematic side elevational view of the mast partially tilted about the horizontal axis between its vertical, erected position and its horizontal, collapsed position with the mast sections telescoped toward but just short of contracted position for clarity of illustration.

While this invention might be adapted to various types of machines, it has been chosen to show the same as applied to a folding brace construction for a telescopic drill mast.

Fig. 1 discloses a truck 11 having a base or main supporting frame 12 secured thereto and formed by interconnected structudal members. This main frame 12 contains the drilling machinery (not shown), and supports the telescopic mast and supporting structure therefor to be described in detail hereinafter. This frame or base 12, the means for its support, and drilling machinery are of conventional design and the details thereof do not constitute any part of the present invention. In accordance with the usual design, the foot or base member 14 of the mast is pivotally mounted by pivot 15 to one end of the frame 12 to permit tilting the mast between a substantially vertical, erected position shown in Fig. 1 and a substantially horizontal, collapsed position lying across the top of the supporting frame 12. The mast is, in its preferred form, made up of two rigid telescopic sections, namely the foot or base member 14 and the extensible member 16 with the latter extensible longitudinally or vertically by relative movement along the foot member 14 between contracted and extended positions with the extending or lifting force thereof provided by the power of the machinery or any other suitable means.

The mast is braced in its vertically extended position by the improved supporting structure with collapsible folding braces of which the construction shown and described herein is merely an illustrative form. This supporting structure comprises a pair of generally symmetrical formations (right and left halves on the opposite sides of a plane seen in edge view as a vertical center line in Fig. 3) with each formation including a plurality of link braces arranged in generally a common plane and including means operatively connecting the link braces together, to the mast members, and detachably to the supporting frame 12. Hence, the supporting structure includes a plurality of pairs of supporting link braces with the link braces in each pair being identical in shapes and correspondingly aligned. Each symmetrical formation includes a first or upper link brace 20, a second or horizontal link brace 22, a third or lower link brace 25 and a diagonal link brace 28. The links 22 in both symmetrical formations are welded or otherwise secured to a spacer rod 32, as shown in Figs. 1, 2, 3 and 6. These links are operatively connected together and to the mast by any suitable operative connections, here specifically shown as pivots 21, 23, 24, 26 and 29. Pivot 21, located at the upper end of link brace 20, connects brace 20 to the distal end of the extensible mast member 16 a sufficient distance from the top of the foot member 14, at

least equal to the extension length therefrom, so that the pivot 21 will not interfere with the telescopic contraction of the mast members 14, 16. Pivot 23 forms the operative connection between the left end of link brace 22 and a cross bar 17 carried by the top of the mast foot member 14 while pivot 24 operatively connects links 20 and 22 together by cross bar 32 at their ends most remote from pivots 21 and 23 so that relative extension and contraction movement of mast members 14 and 16 will cause relative angular movement of link braces 20, 22 in opposite directions for a purpose to be described more in detail hereinafter. Link braces 25 and 28, also respectively called third and fourth links, are pivotally connected by pivots 26 and 29 to cross bars 32 and 17 respectively to form the pivots on opposite ends of horizontal link brace 22. Link braces 25 and 28 have detachable connections 27 and 30 respectively for detachable connection to the supporting frame 12 to support the mast in the extended and erected position shown in Fig. 1 but to permit detachment from supporting frame 12 for contracting and collapsing the mast structure. Each is of a turnbuckle construction adjustable in length to tighten the mast in its erected position and having an eye and bolt connection of the type shown in Figs. 7 and 8.

Diagonal link braces 28 are not absolutely essential but are desirable to provide support intermediate the mast ends. Also, diagonal link braces 28 may be reversed in orientation so that each connects pivot 24 and the left end of the supporting frame 12 in Fig. 1 adjacent pivots 15, if so desired.

Each of the first link braces 20 includes a lower and an upper link section 20*a*, 20*c* interconnected by a locking type slip joint. The link sections 20*a* and 20*c*, having respectively pivots 24 and 21, can telescope endwise and move with respect to each other so that the pivotal connections 21 and 24 can move relatively between an extended first position when the mast is erected in Fig. 1 and a second, collapsed or contracted position with pivotal conections 21 and 24 spaced closer together. Link section 20*a* is tubular in form with a constricted neck 20*b* formed at its upper end through which telescopes the upper link section 20*c*. A head 20*d* is secured to the lower end of link section 20*c* and entrapped within the tubular portion of lower link section 20*a* by the neck 20*b* with this head 20*d* extending for some distance within the tubular portion to serve as a pilot member to strengthen link 20 against lateral deflection. Head 20*d* coacts with the stop shoulder portion provided by neck 20*b* so that coacting stop portions are provided to determine the extended position of link brace 20 and to prevent overextension thereof so as to resist the major or tensile load on the mast. This slip joint construction with the coacting stop portions is located a sufficient distance from the oposite end pivot connections 21 and 24 so that during telescopic relative movement to the contracted or collapsed position, head 20*d* and neck 20*b* are still located betwen these pivotal connections 21 and 24 without causing any interference between the parts.

During raising or lowering of this drill mast, it should be apparent that the mast members 14 and 16 as well as the link braces move relative to each other. A novel locking means is provided to lock each pair of link sections 20*a*, 20*c* in their extended position so that each link brace 20 is capable of taking a compressive load or to unlock these link sections to permit movement to the contracted position for collapsing the mast. The automatic operation of this locking means may be responsive to any one or more of these relative movements but is here shown as being responsive to the relative angular movement between link braces 20 and 22 in the manner shown in Figs. 4 and 5. Since this relative angular movement takes place in opposite directions during relative movement of the mast members between extended and contracted positions, this locking means can lock and unlock these link sections accordingly. This locking means includes for each pair of link sections a locking member comprising a bell crank 35 pivotally connected at 36 to lower link section 20*a*. One arm 35*a* of said bell crank has a pin 38 connected thereto to provide a stop or locking portion movable respectively into or out of a notch 20*e* in upper link section head 20*d* and in the tubular wall of link lower section 20*a* for locking link sections 20*a*, 20*c* against contracting, telescopic movement or for unlocking them to permit said movement. Bell crank pivot 36 is located generally between and a spaced distance away from both pivotal connections 21, 24, on link 20 so that relative movement between the links 20, 22 will cause proper operation of lock pin 38. Lock pin 38 not only prevents contraction of the link sections 20*a*, 20*b* but also prevents overextension thereof if neck 20*b* should fail or excessively wear in service.

The other arm 35*b* of bell crank 35 may be actuated in any suitable manner during relative movement of the component parts of the drilling mast during erection and collapsing thereof. This actuation is provided in the present disclosure by a connecting link 39 connected at opposite ends by pivots 39*a*, 39*b* respectively to bell crank arm 35*b* and horizontal link brace 22 with the pivot 39*b* being out of longitudinal alignment with the pivotal connections 21, 24 and located between pivotal connections 23 and 24 to provide proper operation. This connecting or operating link 39 may extend either generally parallel to the link brace 20, as shown in the drawings in Fig. 4, or may cross over said link brace if bell crank arm 35*b* extends downwardly to the right from its pivot 36.

The operation will now be described. When the drilling mast is in the operating or erected position, the mast is fully extended with the brace links in the position in Fig. 1 and in the solid line position of Fig. 4. Link brace sections 20*a*, 20*c* are locked in their extended position so that link brace 20 will withstand both compression and tensile forces. The two symmetrical link brace formations in Fig. 3 diverge in the downward direction to a wide base to provide adequate support for the mast.

When it is desired to telescope the mast and collapse the mast structure, the drill operator merely removes the detachable bolts in the detachable clevis connections 27, 30 to disconnect link braces 25 and 28 from the supporting frame 12, and swings the lower ends of these four link braces laterally outwardly of the supporting frame 12 to permit telescoping of the mast members. Then, the operator telescopes the extensible mast member 16 down into the foot mast member 14 from its extended position in Fig. 1 into a contracted position (not shown) by any suitable power means of the type generally used on a rig of this nature.

As the mast telescopes, the link braces fold. When link braces 25 and 28 are disconnected at their lower ends from the supporting frame 12, they are supported by the pivots at the opposite end of the horizontal link braces 22. As the mast telescopes, the link braces 20 lower crossbar 32 by pivoting link braces 22 about pivots 23 on the crossbar 17 of foot mast member 14. The relative angular movement between each pair of link braces 20 and 22 causes links 39 to rotate bell cranks 35 clockwise about their pivots in Fig. 4 to withdraw the lock pins 38 from slots 20*e*, as is shown by movement from the solid line to the dot-dash line positions in Fig. 4, so that these locking pins 38 are automatically withdrawn from the slots during the first interval of mast telescoping action. During this entire first interval, the upper mast link braces 20 are at full length while the horizontal mast braces 22 swing about pivots 23 from their horizontal positions to their pendant positions. When the horizontal link braces 22 reach their lowest pendant positions, further telescoping of the mast members occurs simultaneously with the telescoping of the link sections 20*a*, 20*c*. This construction permits the necessarily long upper link braces 20 to travel down with the telescoping top mast member 16 and

at the same time permits maintaining a connection between link braces 20, 22, 25 and 28. After the mast is fully telescoped to its contracted position, link braces 22 support the weight of the other link braces from the top of the foot member 14 and the component parts are generally coplanar. Then, mast foot member 14 may be swung clockwise about pivots 15 in Fig. 12 until the whole mast structure, including mast members and link braces, lies in a generally coplanar, horizontal and collapsed position over the top of the supporting frame 12 for transportation to a new drilling location. Link braces 25 and 28 may be swung outwardly and over the top, rear transversely extending crossbar 12*a* of supporting frame 12, as shown in Fig. 12, either before or after the mast is swung clockwise about pivot 15 in Fig. 12 to its resting position on frame 12.

When the operator wishes to erect this drill mast for operation, the above procedure is merely reversed. Raising the mast member 16 will cause the lock pins 38 to automatically lock together both pairs of link sections 20*a*, 20*c* when mast member 16 reaches the Fig. 1 position so that link braces 20 can take both tensile and compression forces.

Although a connecting link 39 has been used in each half of the present construction to automatically operate its associated bell crank 35 and lock pin 38, other constructions may be used to operate this bell crank automatically in response to the relative movement between component parts as the drilling rig moves between the collapsed and erected positions. For example, when the top mast member 16 is telescoping into the lower mast member 14, bell crank arm 35*b* in its travel downwardly and toward the mast foot member 14 could engage a tripping means attached to the upper end of foot member 14 so that the actuating connecting link 39 would not be needed and the locking means would be actuated in response to the relative movement between link brace 20 and mast foot member 14. Bell crank 35 could be controlled by an over center spring arrangement so as to snap into either the locking or unlocking positions. Also, bell crank actuating arm 35*b* preferably could be of bifurcated construction so that movement by the tripping means of one fork thereof during movement of mast member 16 in one direction would position the other fork thereof for actuation by the tripping means during movement in the opposite direction.

Any suitable type operative connections may be used on the opposite ends of the link braces but they have been here described in the aforegoing description as pivotal connections for simplicity of explanation. However, pivots 21, 23, 24, 26 and 29 may take the form of conventional eyebars, universal joints, etc. An eyebar is formed by an aperture in the end of a link brace with a stud of a bolt and nut connection extending through said aperture for clamping.

Prior to the development of automatic positioning braces of the type disclosed herein, it was not necessary to use ball or universal joint connections at the brace ends, since the operator always had to climb the mast and bracing in setting up and taking down the mast. He could, therefore, screw up and tighten the eyebar and stud forming joint connections at the pivot points after each raising, and loosen them or actually remove them before each lowering. This drawing tight of the studs prevented the eyebars from "chucking" on the stud with each stroke of the drill during the drilling operation. This term "chucking" is a term used in the trade to designate the mechanical deformation or enlargement of the slot as it is hammered against the stud when the forces on the associated brace link change in magnitude or direction.

With the advent of self-positioning braces not requiring a man to climb the mast during setup and tear-down, it became necessary to leave these eyes slightly loose on the stud. If they were locked up tight enough to prevent chucking, this tightness would prevent folding in the automatic raising and lowering operation. The folding process requires sufficient looseness not only for pivoting in a plane for folding but also for some movement at right angles to the plane since relative movement between the parts occurs at each connection in at least two different intersecting planes. This is true for two reasons. First, the lower ends of link braces 25 and 28 must be free to swing laterally of the supporting frame to clear it while the mast is being contracted in length. Second, when the sections of upper link braces 20 telescope and when the mast is being contracted in length, the angle between the corresponding brace links of each pair changes due to the fact that the points of attachment at the top are closer together than at the bottom, as shown in the schematic diagram in Fig. 3. Hence, the plane formed by the two symmetrical link brace formations and the links of each pair diverge in the direction of mast contracting movement, i.e., toward the supporting frame 12. Hence, brace links at these connections must also swinging laterally during mast telescopic action.

The two types of lateral or out of plane movements of the brace links formerly were not much of a problem with the old type of eyebar connections requiring manual loosening at the joints. However, with the automatic positioning bracing, the joints must be loose enough to accommodate such movement all the time or must be manually tightened after setup and loosened before teardown. This necessity for tightening and loosening naturally largely defeats many of the advantages of the automatic positioning braces. If the eyebar connections were left loose enough to fold and to misalign slightly when required, they would also be loose enough to chuck with each stroke of the drill. Then, the holes of these eyebar connections are soon elongated from their original circular formations into elongated slots so that the whole assembly becomes noisy and misaligned.

Applicant has found that a universal joint provided at connections 21, 23, 24, 26 and 29 will eliminate these problems with these joints being preferably ball and socket type. The link brace at each of these pivoting connections has secured thereto a split socket clamp plate 41 having clamped therein a ball type universal joint socket 44 by a bolt and nut connection 42 in the manner shown in Figs. 9 to 11 inclusive. Socket 44 includes a housing 45 with an insert 46 having a hemispherical inner surface and being formed of fiber, rubber or the like. A universal joint ball 47 is entrapped in said socket and has universal movement along said surface. The insert 46 is preferably a socket lining formed by compressing with considerable pressure fiber material impregnated with lubricant over the ball 47 to provide a tight fit so that movement will not occur during drilling to cause chucking. This lubricant permanently lubricates the joint so that it has no tendency to lock up in folding and it will fold smoothly. The universal feature of the connection permits both types of aforementioned lateral or out of plane movement during collapsing and erecting of the drilling mast. The ball and socket type universal joint construction also assures that there will be no relative movement between the component joint parts or relative endwise movement between the link braces during drilling with the mast erected and extended even when forces of different magnitude or forces exerted in different directions act thereon. Chucking cannot occur; the joint is as solid as if it were an integral construction on both interconnected members. No chucking, rattle or wear occurs during drilling. No metal to metal contact exists to wear rapidly, to corrode, or to score at the exposed joint surface since insert 46 is non-metallic.

This folding brace has numerous advantages. First, the rig may be erected to a vertical position and collapsed to a horizontal position very easily. Second, it is not necessary to climb the mast after erection and prior to collapsing thereof so that the operator is not subject to

the hazards of climbing (the height, limited footing and limited hand holds) and the operator does not have to take extra time to prepare the drilling rig for the next operation. Third, all link braces, including the contractible link brace **20**, can take both a compression and a tensile load. Fourth, collapsible and extensible link brace **20** automatically locks and unlocks and moves between extended and contracted positions in responsive to relative movement between component parts of the drilling rig during erection and collapsing thereof. Fifth, the operative connections at opposite ends the link braces are always tight enough to prevent chucking, rattle, and rapid wear; will not rattle when the mast is collapsed or erected; do not require manual tightening and loosening while the mast is erected; provide universal joint movement to permit swinging the free lower end braces **25**, **28** outwardly of the supporting frame **12**; permit free contraction of mast members **14**, **16** without twisting the link braces by permitting free pivoting thereof in a vertical plane and permitting lateral swinging required by the diverging link brace construction in Fig. 3; and are permanently lubricated with no chance of corrosion in Fig. 3; and are permanently lubricated with no chance of corrosion or scoring because socket inserts **46** are nonmetallic material impregnated with lubricant.

Although the disclosed construction is preferred, the opposite link braces of any pair (such as link braces **20**, **20**) may be parallel instead of diverging in the manner shown in Fig. 3. Then, the end connections thereof may be pivotal connections permitting movement in only one plane instead of universal joints permitting movement in two different planes. The automatic locking and collapsing action of the mast and brace link sections **20***a*, **20***c* will still operate in the same manner.

Various changes in details and arrangement of parts can be made by one skilled in the art without departing from the spirit of this invention or the scope of the appended claims.

What I claim is:

1. Supporting structure for a telescoping mast, which mast includes a base member and an extensible member extensible longitudinally by movement relative to the base member between contracted and extended positions; said supporting structure comprising a first link pivotally connected to said extensible member a distance from said base member at least the extension length therefrom, a second link pivotally connected to said base member, said links being pivotally connected together remote from the other aforementioned connections thereon so that extension and contraction relative movement of said mast members will cause relative angular movement of said links in opposite directions, said first link including two relatively endwise movable link sections with each section having one of said aforementioned pivotal connections for said first link so that said connections are relatively movable between first and second positions with said connections being spaced apart farther in said first position, and locking means responsive to said relative angular movement of said links during movement between extended and contracted mast positions for respectively locking said first link sections in said first position and unlocking said sections to permit relative movement to said second position, said locking means including a locking member operatively connected to one of said sections and including an actuating link pivotally connected at opposite ends to said locking member and to said second link between its aforementioned pivotal connections.

2. Supporting structure for a telescoping mast, which mast includes a base member and an extensible member extensible longitudinally by movement relative to the base member between contracted and extended positions; said supporting structure comprising a first link pivotally connected to said extensible member, a second link pivotally connected to said base member, means pivotally connecting together said links remote from the other aforementioned connections thereon so that extension and contraction relative movement of said mast members will cause relative movement of said links in opposite directions, said first link including two relatively endwise movable link sections with each section having one of said aforementioned pivotal connections for said first link so that said connections are relatively movable between first and second positions with said connections being spaced apart farther in said first position, and locking means responsive to said relative movement of said links during movement between extended and contracted mast positions for respectively locking said first link sections in said first position and unlocking said sections to permit relative movement to said second position, said locking means including a locking member operatively connected to one of said sections for locking and unlocking said sections and including an actuating member operatively connected at opposite ends to said second link between its aforementioned pivotal connections and to said locking member.

3. Supporting structure for a telescoping mast, which mast includes a base member and an extensible member extensible longitudinally by movement relative to the base member between contracted and extended positions; said supporting structure comprising a first link pivotally connected to said extensible member, a second link pivotally connected to said base member, means pivotally connecting together said links remote from the other aforementioned connections thereon so that extension and contraction relative movement of said mast members will cause relative movement of said links in opposite directions, said first link including two relatively endwise movable link sections with each section having one of said aforementioned pivotal connections for said first link so that said connections are relatively movable between first and second positions with said connections being spaced apart farther in said first position, and locking means responsive to relative movement between positions for respectively locking said first link sections in said first position and unlocking said sections to permit relative movement to said second position, said locking means including a locking member operatively connected to one of said sections for locking and unlocking said sections and including an actuating member for moving said locking member between locked and unlocked positions, said actuating member being operatively connected to the mast and supporting structure out of longitudinal alignment with the aforementioned pivotal connections on said first link in mast extended position.

4. Supporting structure for a telescoping mast, which mast includes a base member and an extensible member extensible longitudinally by movement relative to the base member between contracted and extended positions; said supporting structure comprising a first link pivotally connected to said extensible member, a second link pivotally connected to said base member, means pivotally connecting together said links remote from the other aforementioned connections thereon so that extension and contraction relative movement of said mast members will cause relative movement of said links in opposite directions, said first link including two relatively endwise movable link sections with each section having one of said aforementioned pivotal connections for said first link so that said connections are relatively movable between first and second positions with said connections being spaced apart farther in said first position, and locking means responsive to relative movement between positions for respectively locking said first link sections in said first position and unlocking said sections to permit relative movement to said second position, said locking means including a locking member located generally between said pivotal connections on said first link in at least one of said positions.

5. Supporting structure for telescoping mast, which mast includes a base member and an extensible member extensible longitudinally by movement relative to the

base member between contracted and extended positions; said supporting structure comprising a first link pivotally connected to said extensible member, a second link pivotally connected to said base member, means pivotally connecting together said links remote from the other aforementioned connections thereon so that extension and contraction relative movement of said mast members will cause relative movement of said links in opposite directions, said first link including two telescopically endwise relatively movable link sections with each section having one of said aforementioned pivotal connections for said first link so that said connections are relatively movable between first and second positions with said connections being spaced apart farther in said first position, said sections having coacting stop portions to determine said first position, said sections being constructed so that both said stop portions are always located between said pivotal connections during movement between said first and second positions, and locking means responsive to relative movement between positions for respectively locking said stop portions together in said first position and unlocking said sections to permit relative movement to said second position.

6. Supporting structure for a telescoping mast, which mast includes a base member and an extensible member extensible longitudinally by movement relative to the base member between contracted and extended positions; said supporting structure comprising a first link pivotally connected to said extensible member, a second link pivotally connected to said base member, means pivotally connecting together said links remote from the other aforementioned connections thereon so that extension and contraction relative movement of said mast members will cause relative movement of said links in opposite directions, said first link including two relatively endwise movable link sections with each section having one of said aforementioned pivotal connections for said first link so that said connections are relatively movable between first and second positions with said connections being spaced apart farther in said first position, and locking means responsive to relative movement between positions for respectively locking said first link sections in said first position and unlocking said sections to permit relative movement to said second position, said locking means including a locking member having a stop portion thereon and being pivotally connected to one of said sections with said pivot located generally between said pivotal connections on said first link in at least one of said positions.

7. Supporting structure for a telescoping mast, which mast includes a base member and an extensible member extensible longitudinally by movement relative to the base member between contracted and extended positions; said supporting structure comprising a first link pivotally connected to said extensible member, a second link pivotally connected to said base member, means pivotally connecting together said links remote from the other aforementioned connections thereon so that extension and contraction relative movement of said mast members will cause relative angular movement of said links in opposite directions, said first link including two relatively endwise movable link sections with each section having one of said aforementioned pivotal connections for said first link so that said connections are relatively movable between first and second positions with said connections being spaced apart farther in said first position, and locking means responsive to relative movement between positions for respectively locking said first link sections in said first position and unlocking said sections to permit relative movement to said second position, said locking means including a locking member pivotally connected to one of said sections a spaced distance away from said pivotal connection on said first link with said second link.

8. Supporting structure for a telescoping mast, which mast includes a base member and an extensible member extensible longitudinally by movement relative to the base member between contracted and extended positions; said supporting structure comprising a first link pivotally connected to the distal end of said extensible member, a second link pivotally connected to said base member, means pivotally connecting together said links remote from the other aforementioned connections thereon so that extension and contraction relative movement of said mast members will cause relative angular movement of said links in opposite directions, said first link including two telescopically endwise relatively movable link sections with each section having one of said aforementioned pivotal connections for said first link so that said connections are relatively movable between first and second positions with said connections being spaced apart farther in said first position, one of said sections being tubular and telescopically connected over an enlarged head on the other of said sections, said one section having an inwardly extending stop shoulder portion located between said pivotal connections on said first link for engaging said head to determine said first position, said sections being constructed with said stop shoulder portion and said head always located between said pivotal connections during movement between said first and second positions, and locking means responsive to said relative angular movement of said links during movement between extended and contracted mast positions for respectively locking said first link sections in said first position and unlocking said sections to permit relative movement to said second position, said locking means including a locking member comprising a bell crank having a stop portion on one arm thereof and including an actuating link pivotally connected at opposite ends to said second link between its aforementioned pivotal connections and to said bell crank, said bell crank being piovtally connected to one of said sections between a spaced distance away from both said pivotal connections on said first link.

9. Supporting structure for a collapsing and telescoping mast, which mast includes a foot member of the mast pivoted on a supporting frame for tilting between a substantially horizontal, collapsed position and a substantially vertical, erected position, and includes an extensible member extensible vertically by relative movement along the foot member between contracted and extended positions; said supporting structure comprising a pair of generally symmetrical formations, each formation including a first structural link pivotally connected at one end to the distal end of said extensible member, including a second structural link pivotally connected at one end to said foot member, including means pivotally connecting together said links at their ends most remote from the other aforementioned connections thereon so that extension and contraction relative movement of said mast members will cause relative angular movement of said links in opposite directions, said first link including two telescopically endwise relatively movable link sections with each section having one of said aforementioned pivotal connections for said first link so that said connections are relatively movable between first and second positions with said connections being spaced apart farther in said first position, one of said sections being tubular and telescopically connected over an enlarged head on the other of said sections, said one section having an inwardly extending stop shoulder portion located between said pivotal connections on said first link for engaging said head to determine said first position, said sections being constructed with said stop shoulder portion and said head always located between said pivotal connections during movement between said first and second positions, including locking means responsive to said relative angular movement of said links during movement between extended and contracted mast positions for respectively locking said first link sections in said first position and unlocking said sections to permit relative

movement to said second position, said locking means including a locking member comprising a bell crank having a stop portion on one arm thereof and including an actuating link pivotally connected at opposite ends to said second link between its aforementioned pivotal connections and to the other arm of said bell crank, said bell crank being pivotally connected to one of said sections between and a spaced distance away from both said pivotal connections on said first link, including a third structural link at opposite ends pivotally connected to said pivotal connection between said first and second links and in mast extended position detachably connected to said supporting frame, including a fourth link at opposite ends pivotally connected to one of said connections of said second link and in mast extended position detachably connected to said supporting frame with acute angular orientation with respect to said third link, whereby said third and fourth link connections to said supporting frame are disconnectable therefrom to permit moving said mast members to contracted and collapsed position, and including ball and socket type universal joints forming all of said pivotal connections between said structural links, and means operatively connecting said formations together so that corresponding links having said universal joints at opposite ends diverge toward the supporting frame in mast erected and extended position, said universal joints permitting swinging the free ends of the links detachable from said frame laterally outwardly beyond said supporting frame during contraction and collapsing of said mast members, permitting free contraction of said mast members without twisting said links, and preventing excessive relative generally endwise end movement between said links when in erected and extended position.

10. A drilling mast structure, as set forth in claim 1, wherein all of said pivotal connections include a pivot member and a socket therefor with coacting annular surfaces therebetween, one of said surfaces comprising material capable of keeping the joint tight against lateral movement in all pivot positions and during drilling while permitting free pivotal movement and minimizing wear.

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