Aug. 12, 1958 G. HEINISH 2,847,098

PORTABLE WELL DRILLING MACHINE AND TELESCOPING TRIPOD MAST THEREFOR

Filed July 14, 1954 4 Sheets-Sheet 1

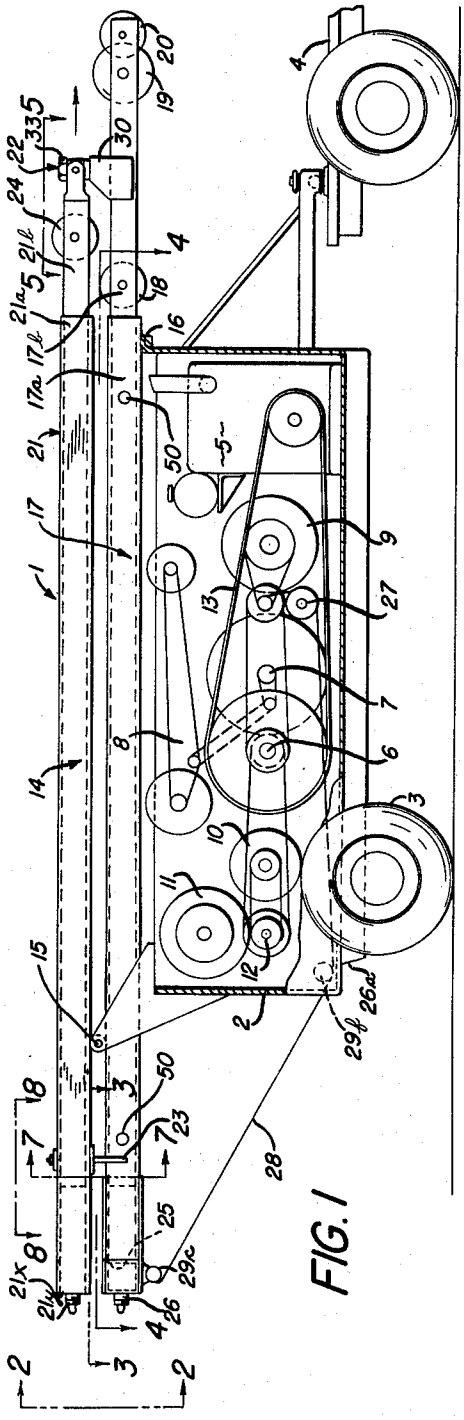


FIG. 1

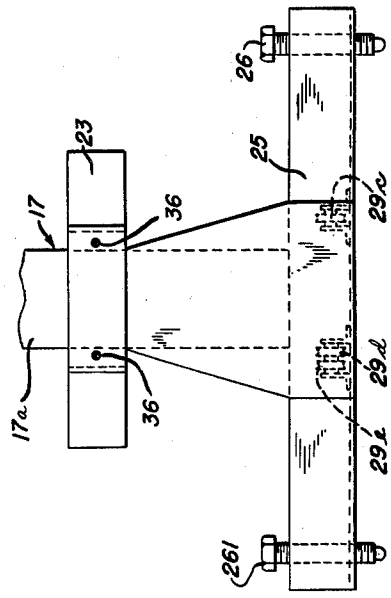


FIG. 3

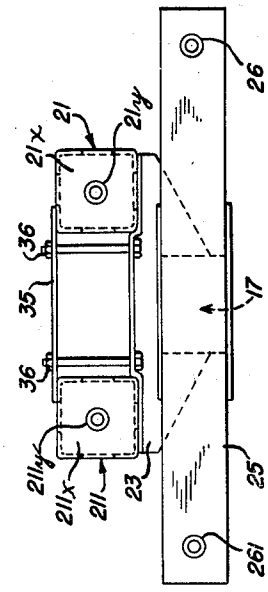


FIG. 2

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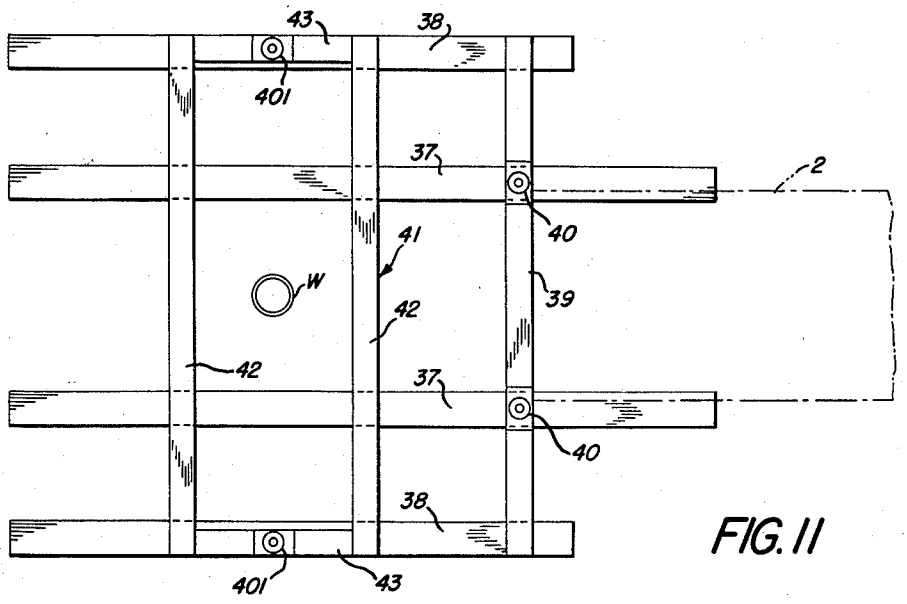


FIG. 11

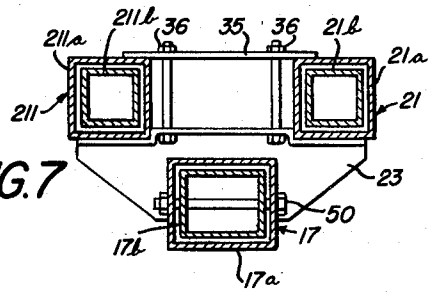


FIG. 7

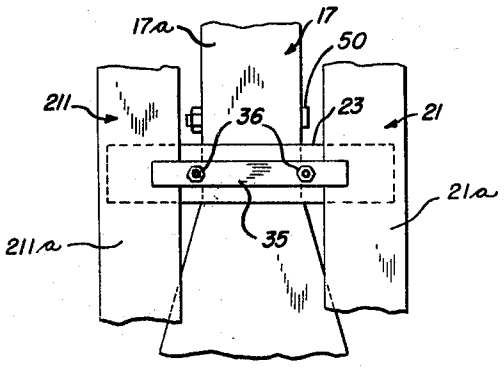


FIG. 8

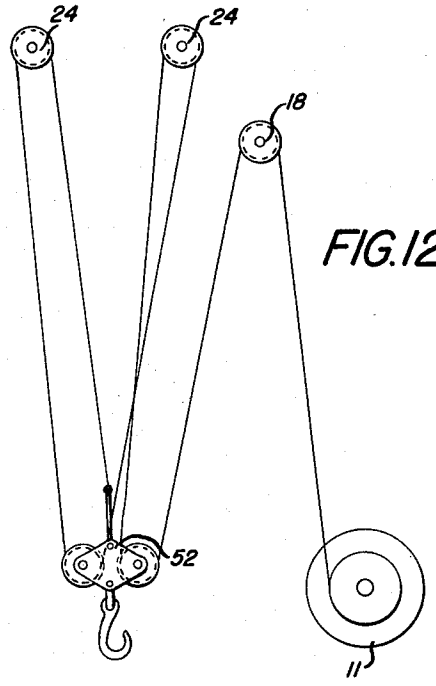


FIG. 12

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PORTABLE WELL DRILLING MACHINE AND TELESCOPING TRIPOD MAST THEREFOR

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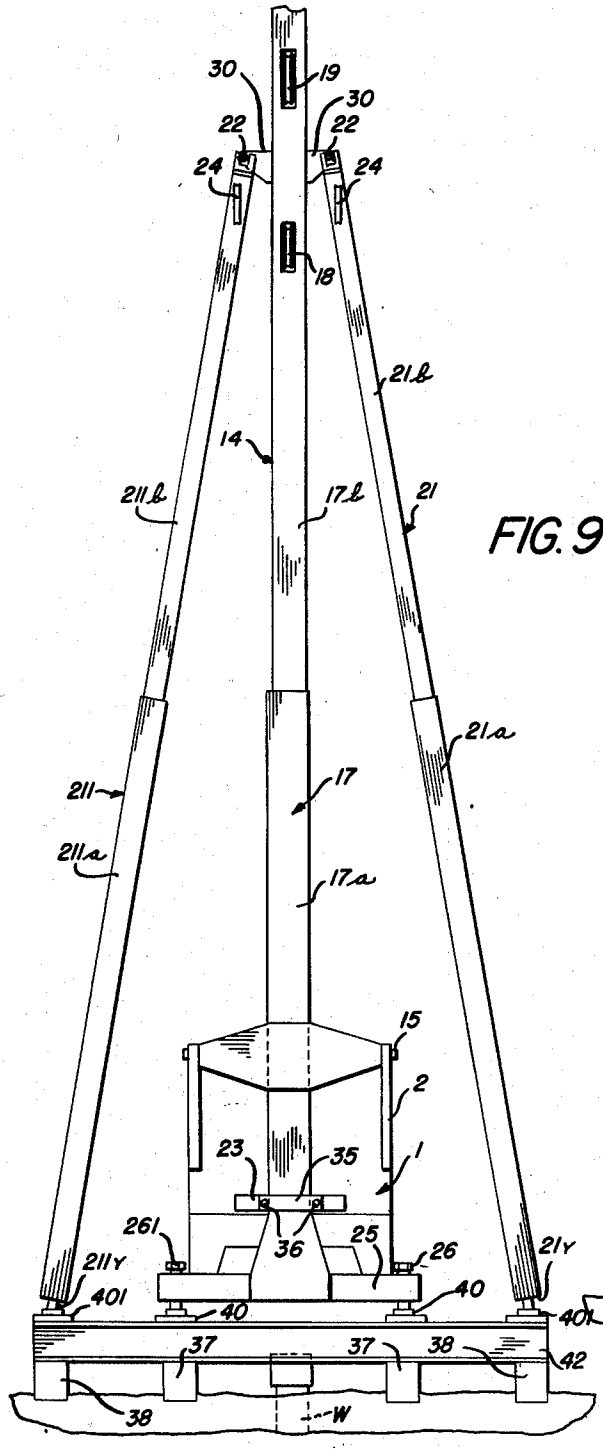


FIG. 9

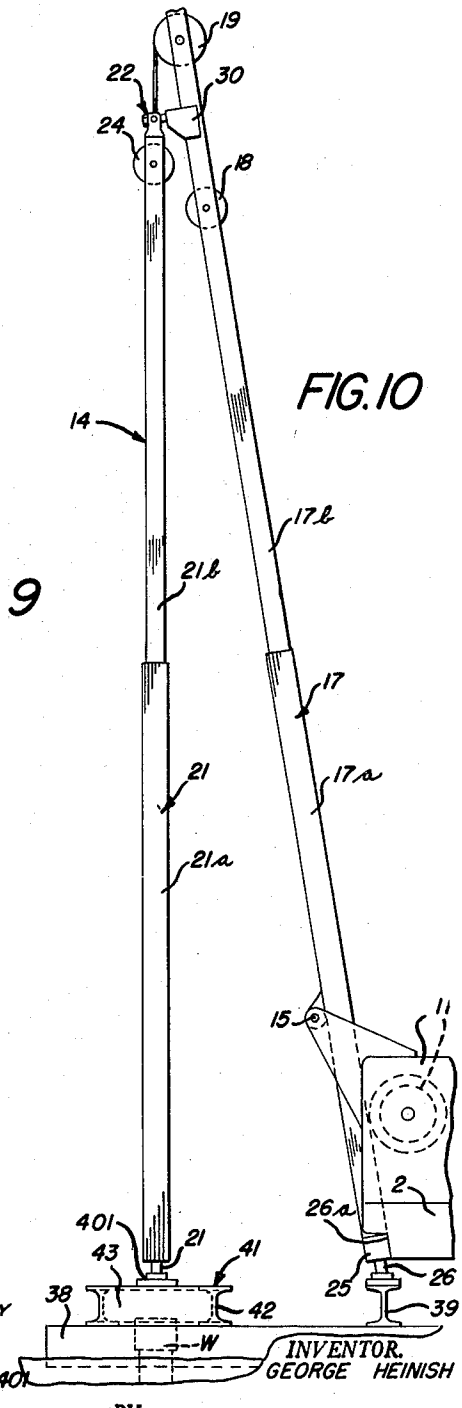


FIG. 10

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PORTABLE WELL DRILLING MACHINE AND TELESCOPING TRIPOD MAST THEREFOR

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FIG. 4

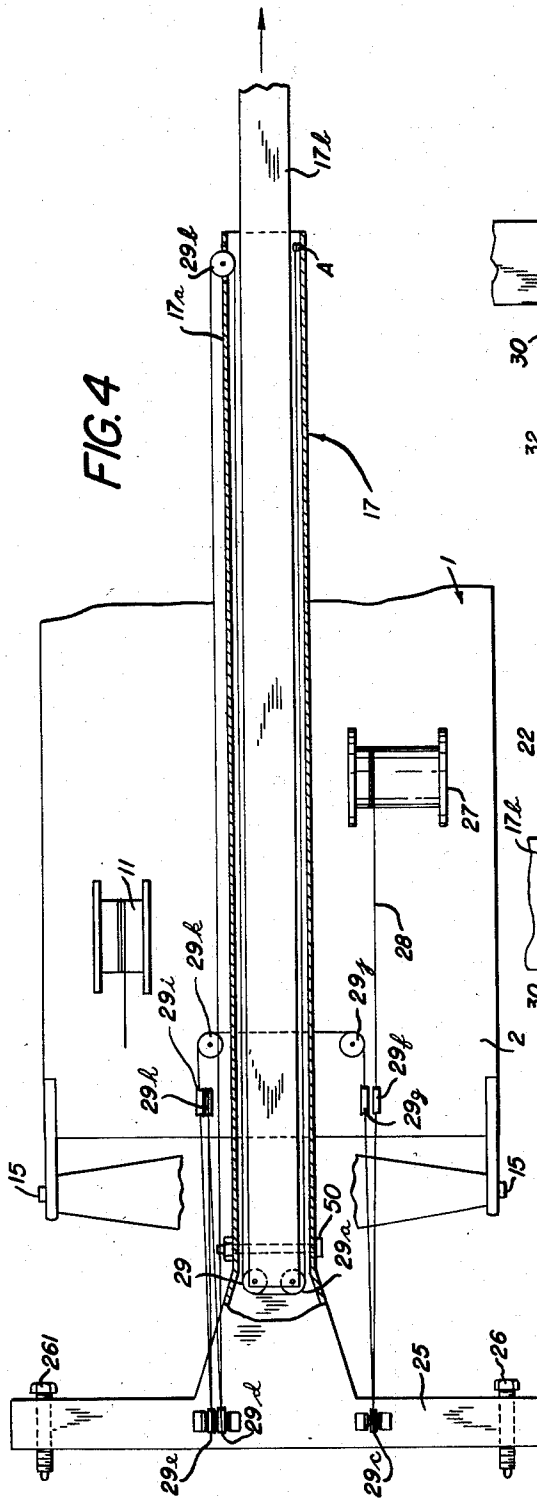


FIG. 6

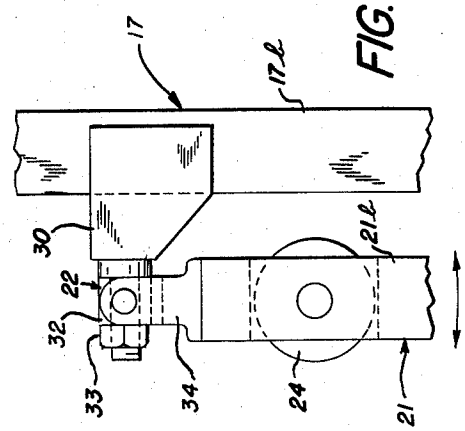
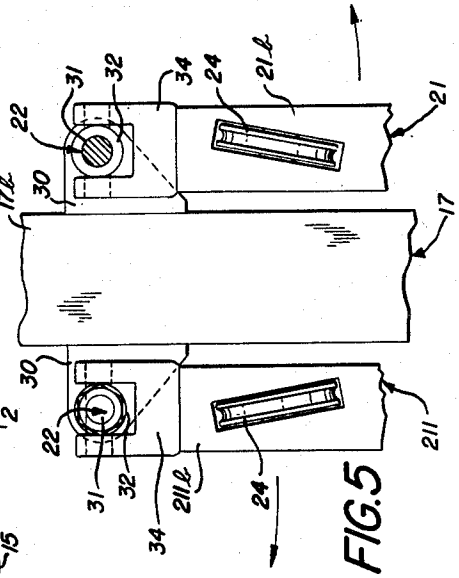


FIG. 5



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United States Patent Office 2,847,098 Patented Aug. 12, 1958

2,847,098

PORTABLE WELL DRILLING MACHINE AND TELESCOPING TRIPOD MAST THEREFOR

George Heinish, Akron, Ohio

Application July 14, 1954, Serial No. 443,223

3 Claims. (Cl. 189—11)

This invention relates to portable well drilling machines and telescoping tripod masts therefor, and is especially useful where it is desired to provide a portable well drilling machine capable of handling long strings of tools, pipe and casing.

The savings in drilling and moving costs which can be effected by using portable well drilling machines is widely recognized by well drilling contractors, however, in deeper wells such as are common in the oil and gas industry where long strings of well casing or pipe must be placed in the wells, the mast of the portable well drilling machine is usually inadequate to do the work safely. To comply with highway regulations and to achieve portability the masts of portable well drilling machines are usually made in two sections, the top section generally telescoping within the bottom section and then the entire assembly being lowered to a horizontal position on top of the machine for moving.

When setting up to drill a well the mast is raised to a position substantially vertical leaning slightly forward and then the upper section is extended to provide the necessary working height for the drilling tools and lengths of pipe to be handled. Since the mast in its extended position is relatively weak it is customary to strengthen and support it by the use of braces and guy wires. However, even with bracing and guy wires the capacity of the regular masts are often inadequate and additional shear legs or shear poles are rigged up to carry the main portion of the load. Even in a comparatively shallow well of 3,000 feet the strings of well casing that may have to be set will weigh 25 to 30 tons so that it is readily apparent that this work cannot be handled on a single pole mast extending unsupported 60 feet into the air. The shear poles or shear legs used for handling heavy strings of well casing are set in alignment with the well and directly under the load whereas the drilling machine mast must lean out over the well in order to provide working room around the well. The casing tackle is reeved over sheaves mounted on top of the shear legs with the running line being carried over the machine mast so as to guide the line to the hoisting drum.

Shear poles or legs are commonly transported separately from the machine, rigged up on the ground and raised into position after the machine mast has been raised.

The present invention aims to overcome the foregoing and other difficulties and to provide a combination portable drilling machine and telescoping tripod mast having the characteristics of great load handling ability in drilling operation, ease of setting up and taking down at the drilling location, and portability and compactness.

It is the primary objective of this invention to combine the large load handling capacity of a set of shear legs or shear poles with the fast set up and portability of a telescoping mast in a new and novel manner which I call a "telescoping tripod mast" and which is described in detail and shown in the attached specification and sketches.

Another object is to eliminate the separate laborious handling of the shear legs to save time. The new tripod mast is handled entirely by the machine power.

Another object is to transport the shear legs on top of the machine with the regular mast.

Still another object is to eliminate the machine mast braces which customarily are used to support it as a combination column and cantilever beam.

These and other objects will appear from the following description, reference being had to the accompanying drawings which illustrate one embodiment of the invention.

Of the drawings,

Fig. 1 is a side elevation of a drilling machine embodying the invention, the telescoped mast being shown in the transporting position;

Fig. 2 is a view of the base of the tripod mast packed for transport, taken on line 2—2 of Fig. 1;

Fig. 3 is a detail view of the lower portion of the principal leg of the mast, taken on line 3—3 of Fig. 1, other portions being broken away;

Fig. 4 is a diagrammatic view, partly in section, of the principal leg of the mast, taken substantially on line 4—4 of Fig. 1, and showing the mast-hoisting mechanism of the drilling machine;

Fig. 5 is a detail view of the pivotal connection of the mast legs to each other, taken on line 5—5 of Fig. 1, parts being broken away;

Fig. 6 is a side view of Fig. 5;

Fig. 7 is a sectional view, taken on line 7—7 of Fig. 1 showing the clamping and leg supporting bracket;

Fig. 8 is a detail view of the clamping and leg supporting bracket taken on line 8—8 of Fig. 1;

Fig. 9 is an elevation of the erected tripod mast and its supports looking toward the rear of the drilling machine, i. e., from the left of Fig. 1;

Fig. 10 is a side view of the erected tripod mast, parts being broken away;

Fig. 11 is a plan view of the mast base or foundation;

Fig. 12 is a diagram illustrating a typical five line casing tackle employed in the apparatus of the invention.

Referring to the attached drawings, Figure 1, shows a side elevation of a portable well drill ready for moving on the road and carrying a tripod mast on top of the machine. The sketch shows a percussion or cable tool type of machine but the tripod mast of the invention is also applicable to a rotary type of drill or to a universal machine that uses both methods of drilling.

In Figure 1, numeral 1 indicates the drilling machine as a whole, numeral 2 the frame structure of the drill, 3 the trailer axle and wheels, 4 the towing truck or tractor, 5 the power unit, 6 the main transmission shaft, 7 the spudder crankshaft, 8 the spudder, 9 the tool hoisting drum, 10 the bailing reel, 11 the casing reel, 12 the cathead shaft. Power is transmitted to the various shafts and reels by suitable gear or chain drives from the main transmission shaft 6 which in turn is driven from the power unit 5 by means of a belt drive 13 as will be understood by those familiar with the art.

The tripod mast referred to as a whole as 14 is carried on top of the machine. It is supported at the drilling end on a pivot 15 and at the power unit end by the cross member 16 of the frame structure of the machine. The pivot 15 also serves as the turning point around which the mast assembly is raised to drilling position. As can be seen the upper sections of mast are telescoped within the lower so as to shorten the overall length for moving. The mast designated as a whole by numeral 14 consists of three legs arranged as shown in Figures 1 and 2. The primary leg 17, having lower section 17*a* slidably receiving telescoping upper section 17*b*, is attached to the pivot

15 in line with the longitudinal centerline of the machine and, at its upper end, carries the sheaves for reeving the working lines, such as casing line sheave 18 to carry line to casing reel 11, crown sheave 19 to carry drilling line to the spudder 8 and tool hoisting drum 9, sand sheave 20 to carry the sand line to the bailing reel 10.

The other two legs 21 and 211 of the tripod each have a lower section 21*a* and 211*a*, respectively, slidably and telescopically receiving upper section 21*b* and 211*b*. The legs 21 and 211 are carried on top of the main leg 17 and have the upper ends of their respective upper sections 17*b*, 21*b* and 211*b* attached together with suitable pivots 22 while the lower ends of lower sections 17*a*, 21*a* and 211*a* are held in proper spaced relationship by bracket 23. More exact details of joint 22 and bracket 23 will be described with Figs. 5 and 6. At this time I merely wish to show the general construction. Each of the two legs 21 and 211 are arranged to carry one or more additional casing line sheaves 24 for reeving up a multiple part hoisting tackle.

As previously described, all three of the mast legs are made in two sections that telescope one within the other. As shown in Figure 7, these telescoping sections may each consist of four structural steel angle bars having the customary cross lacing or plates. In Fig. 7, by way of example only, the angle bars are shown connected with cross lacing, i. e., angulary secured braces secured to the outside of the lower leg section and to the inside of the upper leg section to allow the corner angles to have free sliding movement with each other. The basic idea is not limited however to the details of the leg construction which could just as well be one pipe say 8" diameter inside of a 10" pipe or each leg could be made of two sizes of structural steel channels with cross lacing. I have shown the legs in Figure 7 with four angles since, in the preferred form, the angles permit greater freedom of design and construction. As shown particularly in Fig. 7, the upper sections of the legs are enough smaller in outside dimension to pass freely inside the lower sections. For purposes of simplification the corner angles and cross lacing construction of the mast legs has been shown only in Fig. 7.

Of course, when the mast is to be raised and the upper sections extended, some means must be provided not only to perform the operation of raising the mast but also to lock the upper sections in extended relationship to the lower sections. My U. S. Patent No. 2,589,080 shows a preferred automatic locking means and power raising means that would function very well with the tripod mast of the present application. It is to be understood however that this tripod mast could be provided with non-automatic locking devices and raised by a hand winch and still obtain some of the primary benefits of the tripod mast although it would be slower to set up.

Figure 3 shows that the lower end of leg 17 is provided with a box type cross sill 25 carrying at its outer ends built-in screw jack assemblies 26 and 261. The lower end of leg 17 is built in this manner so that sill 25 establishes contact with the drilling machine frame 2 at properly formed side joints 26*a* to receive the sill when the mast is raised for drilling. This permits the proper positioning of the mast, i. e., the proper forward lean and the two screw jacks 26 and 261 permit leveling the machine and plumbing the mast transversely.

As shown in Figure 2, the other two legs 21 and 211 simply end in suitable bases 21*x* and 211*x* which are approximately the size of the leg cross sections. Each of the leg bases 21*x* and 211*x* are also provided with a built-in screw jack assembly 21*y* and 211*y*. These screw jack assemblies engage sockets 40 or plates on the foundation sills which will be described later in connection with setting up the tripod mast in its operating position.

As stated before the tripod mast of the invention, in its preferred construction, is to be provided with suitable means for raising the mast to the operating position utilizing the power unit of the drilling machine. This can be accomplished in a variety of ways including mechanical, hydraulic or electrical methods. For simplicity I describe a simple mechanical method. Referring to Figure 1 again, a small winch drum 27 can be located at any convenient position on the well drill and power driven from the power unit 5 through any shaft of the machine that is suitable. In this case it is shown chain driven from the jackshaft of the main hoisting drum 9. It is to be understood that the winch drum 27 has its power controlled through a friction clutch drive (not shown) for hoisting and a friction brake (not shown) for lowering. A mast hoisting cable 28 is then reeved from the winch drum 27 to the drilling end of the machine and thence through the main leg 17 of the mast. The method of reeving the cable is shown diagrammatically in Figure 4. A number of small sheaves 29, 29*a*, 29*b*, etc., are used to guide the hoisting cable. Two of the sheaves 29 and 29*a* are at the lower end of the upper section 17*b* of mast leg 17, one 29*b* is at the upper end of the lower section 17*a* of mast leg 17 on one side, three 29*c*, 29*d* and 29*e* are mounted in the mast base sill 25, four 29*f*, 29*g*, 29*h*, and 29*i* are mounted at the bottom of the drilling machine frame and two 29*j* and 29*k* are mounted also at the drilling end of the frame at right angles to sheaves 29*f*, 29*g*, 29*h* and 29*i*. The hoisting cable 28 is anchored at the upper end of the lower section 17*a* at point "A," thence it passes in turn to 29*a*, 29, 29*b*, 29*d*, 29*h*, 29*e*, 29*i*, 29*k*, 29*j*, 29*g*, 29*c* and 29*b*, and thence to winch drum 27 where the cable end is anchored. The arrangement is such that the cable passes back and forth from the points outlined in the space between the inner and outer sections 17*a* and 17*b* of mast leg 17. From the three sheaves 29*c*, 29*d* and 29*e* in the mast base sill 25 the cable is thus reeved to form a 5 part tackle with the sheaves 29*f*, 29*g*, 29*h* and 29*i* on the drilling machine frame 2, the two sheaves 29*k* and 29*j* being positioned so as to carry the cable transversely from one side to alignment on the other side.

This mast hoisting arrangement is used to raise the tripod mast in two steps using the drilling machine power. The first step is to elevate the three telescoped legs 17, 21 and 211 as a unit from the horizontal transporting position to a substantially vertical position. The second step is to extend the three telescoped legs to their full height.

The first step requires that the two mast sections 17*a* and 17*b* of main leg 17 be locked together, for example by pin means 50, in their telescoped position. This prevents shortening the reaches of the hoisting cable within the mast between point "A" and sheaves 29 and 29*a*, while at the same time the five reaches of cable between sheaves 29*c*, 29*d*, 29*e* on the mast sill 25 and the sheaves 29*f*, 29*g*, 29*h* and 29*i* on the frame 2 are shortened merely by taking in cable on the winch drum 27. This causes the entire mast assembly to tilt from a horizontal to a vertical position around pivot 15. Pivot 15 is so positioned in relation to the center of mass of the telescoped mast that the mast top just overbalances towards the well W moving sill 25 of mast leg 17 into firm but not banging engagement with side points 26*a* of the frame 2.

The second step is accomplished simply by unlocking, i. e., withdrawing the pin means 50 holding together the two sections 17*a* and 17*b* of the mast leg 17 so that the upper section can slidably move within the lower when continued taking in of the cable with winch drum 27 will shorten the reaches of cable within the mast between point "A" and sheaves 29 and 29*a* and thereby extend the mast.

It is obvious that some means must be provided to solidly connect the respective mast upper sections 17*b*, 21*b* and 211*b* to the respective mast lower sections 17*a*, 21*a* and 211*a* when the mast is in extended operating

position as otherwise the size of the load that could be imposed on the mast would be limited to the strength of the hoisting cable **28**, also as just outlined it is necessary to lock the mast sections **17***a* and **17***b* together in telescoped position for transporting and for the first step of elevating the mast. A simple effective manner of doing this is to provide bolted joints between the sections with the bolts taking the shear load. However, the use of bolted joints necessitates having a man climb the mast leg and is not easy or fast. A much better method is to use an automatic positioning lock, as mentioned earlier, on the main leg **17** and either bolted or shear pin joints on the other two legs **21** and **211**. See my Patent No. 2,589,080 for details of the type of automatic lock.

It is not necessary to provide any special means for extending or telescoping the two legs **21** and **211** since this is accomplished by attaching the upper sections **21***a* and **211***a* of these two legs to the main leg at pivot joints **22** and clamping the lower sections **21***b* and **211***b* fast at bracket **23**. The only essential feature of the three legs for proper telescoping or extesion is that they shall be properly held and spaced parallel to each other.

Figure 5 shows a larger scale sketch of the construction of pivot joints **22**. The upper end of the upper section **17***b* of the main leg **17** is provided with two brackets **30** spaced transversely thereof. These brackets **30** are made with two extending pivot shafts **31** which receive the joint trunnion members **32**. The trunnion members are retained by nuts **33**. Each trunnion member is attached by its trunnions to the trunnion bearing brackets **34** built integral with the upper ends of upper sections **21***b* and **211***b* of legs **21** and **211**. This double pivot joint on the upper ends of the legs **21** and **211** permit these legs to be freely moved from positions parallel to the main leg **17** to any angular positions desired as indicated by the arrows.

In Figure 7 is shown the bracket **23** which is used to position and support the lower sections **21***a* and **211***a* of the legs **21** and **211** parallel to the lower section **17***a* of leg **17** and to which the legs are held fast, as for example by means of clamp plate **35** and bolts **36**. When rigging up the machine to drill a well, it is customary to provide a suitable foundation and working platform at the well site. Dependent upon the work to be done this foundation is more or less elaborate and in the case of deeper, more expensive drilling projects may even be a permanent concrete and steel foundation. The foundation plan in Figure 11 is typical of the kind necessary for the average work within the capacity of portable well drills. A description of laying the foundation follows: Two 10" or 12" square timbers **37** about 16'–0 long are leveled and graded in at the well site. These timbers are placed 6'–0 and 10'–0 from the well to the respective ends of the timbers with the longer ends extending back under the frame **2** of the drilling machine. The timbers **37** are also spaced transversely from the well so as to provide working clearance and bring them under the machine frame **2** for proper support of the frame. Two more timbers **38** of the same size but about 12'–0 long are spaced parallel to timbers **37** with their outer ends in line, after setting of the mast support sills, as hereinafter described, these four timbers become the foundation for a planked over platform 12'–0 square for the drillers to work on. Timbers **37** and **38** are sometimes called mud sills.

After the frame **2** of the drilling machine has been set in place in the position indicated in Figure 11 relative to the working platform the following procedure outlines setting up the tripod mast.

(1) The mast is elevated from the horizontal position to the vertical position as previously described.

(2) The main mast leg sill **39** is placed on the timbers **37** and **38** under the mast base sill **25** with the jack pad sockets **40** in line with the jacks **26—261**, the mast sill **25** is bolted or otherwise attached to the machine frame at the side points **26***a*.

(3) The jacks **26—261** are now used to level the the frame **2** of the drilling machine and plumb the mast transversely; longitudinally it is of course positioned by the pivot **15** and frame points **26***a* to lean forward so as to bring the top of the mast when extended in line with the well W as shown in elevation Figure 10.

(4) The main mast leg sections **17***a* and **17***b* are unlocked and the legs extended as previously described.

(5) The upper sections **17***b*, **21***b*, and **211***b* of the three legs are next either automatically locked or otherwise connected to the lower sections **17***a*, **21***a* and **211***a* as previously described.

(6) The base sill **41** for the legs **21** and **211** is placed upon the timbers or mud sills **37** and **38** in the manner shown in Figure 11. This base sill **41** is a steel structure made up of two longitudinal members **42** spaced apart to provide working clearance around the well and tied together at their ends by end members **43**. The end members **43** are provided with two more jack pad sockets **401** to receive the ends of jacks **21***y* and **211***y* of the legs **21** and **211**.

(7) The two legs **21** and **211** are freed at their lower ends from leg **17** by removing clamp plate **35** (Figures 7 and 8) and this will permit the two legs **21** and **211** to swing out into alignment with the well by pivoting on the trunnions **32**, see Figures 5 and 6. In the longitudinal plane the legs will hang plumb of their weight.

(8) The legs **21** and **211** are next swung transversely so as to bring their lower ends into line with the base and sills **43** where the leg jacks **21***y* and **211***y* are fitted into their sockets **401**. Transverse swinging of the legs **21** and **211** is permitted by the trunnion **32** pivoting on shafts **31**.

(9) Equalizing the four jack adjustments completes the work of setting up the tripod mast ready for stringing up lines to proceed with the drilling work.

Figures 9 and 10 show the tripod mast in the raised operating position.

Figure 12 shows a five line casing tackle reeved up on the tripod mast and machine casing reel as sketched. It is apparent that the two legs **21** and **211** in this set up act as shear poles or shear legs and carry approximately two-thirds of the load suspended on the hook of traveling block **52**. Also it is apparent that the shear legs can carry a greater part of the load if two more sheaves **24** are mounted at the upper ends of the legs and a quadruple traveling block used instead of a double. Again it would be obvious to further strengthen the tripod mast for heavier work by the use of guy wires and/or braces between the three leg members.

When tearing down after completing the well the reverse procedure is followed in laying the mast back onto the machine. One operating advantage of the tripod mast is that the two shear legs are readily removed from the main leg by taking off nuts **33** Fig. 6. The remaining leg then can be used in the usual manner for light work.

While one complete embodiment of the invention has been disclosed herein, it will be appreciated that modification of this particular embodiment of the invention may be resorted to without departing from the scope of the invention as defined in the appended claims.

What I claim is:

1. A portable unitary well drilling machine including a wheeled vehicle frame, a telescoping tripod mast including a main leg and two secondary legs, each leg having an upper section and a lower section telescoping together, the upper ends of the upper sections of all legs being pivotally secured together with a universal joint, means secured to the main leg of the mast releasably securing together the lower sections of all legs, means pivotally securing the mast to the frame near the well end thereof with the bottom end of the mast extending out over the well, said main leg of the mast having a

transverse sill at its lower end, the ends of the sill engaging with opposite sides of the frame when the mast is raised to brace the frame from the mast, a plurality of sheaves journalled on the sill, a plurality of sheaves journalled on the frame, a sheave journalled at the lower end of the upper section of the main leg of the mast, a sheave journalled near the upper end of the lower section of the main leg of the mast, a power winch on the frame, a cable having one end secured to the winch, the cable extending in several reaches between the sheaves on the frame and the sheaves on the sill, then extending around the sheave near the upper end of the lower section of the main leg, then around the sheave at the lower end of the upper section of the main leg, and with the end of the cable attaching to the lower section of the main leg near the upper end, means for releasably locking the sections of the main leg in telescoped position, jack screws on opposite ends of the sill to position the mast and frame transversely, jack screws on the lower ends of the secondary legs to position the mast fore and aft, and at least one sheave near the upper end of the upper section of each mast leg to receive the cable for loading the mast.

2. A portable well drilling machine including a frame, a telescoping tripod mast including a main leg and two secondary legs, each leg having an upper section and a lower section telescoping together, the upper ends of the upper sections of all legs being pivotally secured together, means releasably securing together the lower sections of all legs, means pivotally securing the lower section of the main leg to the frame, the main leg and two secondary legs riding in substantially horizontal travelling position on the frame, a transverse sill secured to the lower end of the lower section of the main leg, cable means

secured only to the main leg for simultaneously swinging the main leg and two secondary legs about the pivotal securing means on the frame and into substantially vertical position, said cable means subsequently expanding the upper sections simultaneously outwardly with respect to the lower section of each leg, jack screws on the opposite ends of the sill to position the mast and frame transversely, jack screws on the lower ends of the secondary legs to position the mast fore and aft.

3. A portable well drilling machine including a frame, a telescoping tripod mast including a main leg and two secondary legs, each leg having an upper section and a lower section telescoping together, the upper ends of the upper sections of all legs being pivotally secured together, means releasably securing together the lower sections of all legs, means pivotally securing the lower section of the main leg to the frame, the main leg and two secondary legs riding in substantially horizontal travelling position on the frame, means secured only to the main leg for simultaneously swinging the main leg and two secondary legs about the pivotal securing means on the frame and into substantially vertical position, said last-named means expanding the upper sections outwardly with respect to the lower section of each leg.

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