United States Patent [19]

Brown

[11] **3,766,991**

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[54] **ELECTRIC POWER SWIVEL AND SYSTEM FOR USE IN ROTARY WELL DRILLING**

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[21] Appl. No.: **130,597**

[52] **U.S. Cl.** **173/20**, 173/57, 173/164, 175/85

[51] **Int. Cl.** **E21b 19/16**

[58] **Field of Search** 173/57, 164, 20, 173/79; 175/85; 166/77.5, 85

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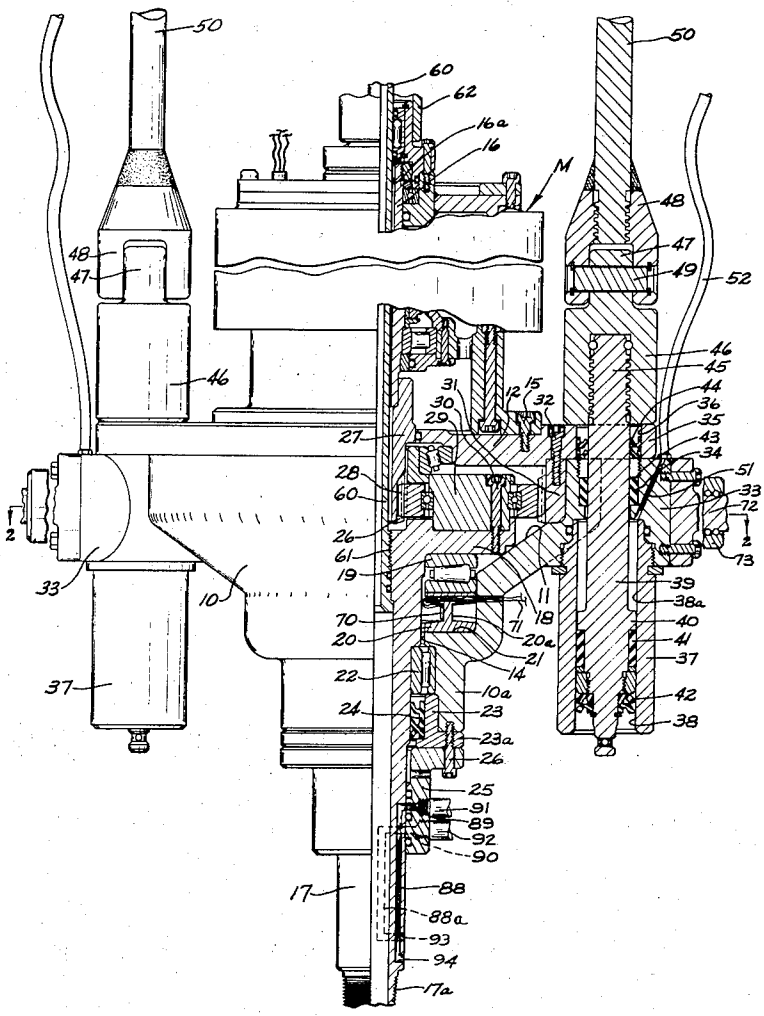
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[57] **ABSTRACT**

An electric power swivel for rotating and handling drill pipe during well drilling, adapted for use with either conventional drill pipe or larger diameter casing strings and having fluid pressure cushioned suspension means to accommodate vertical movements required in making up and breaking out threaded connections between pipe sections.

26 Claims, 15 Drawing Figures



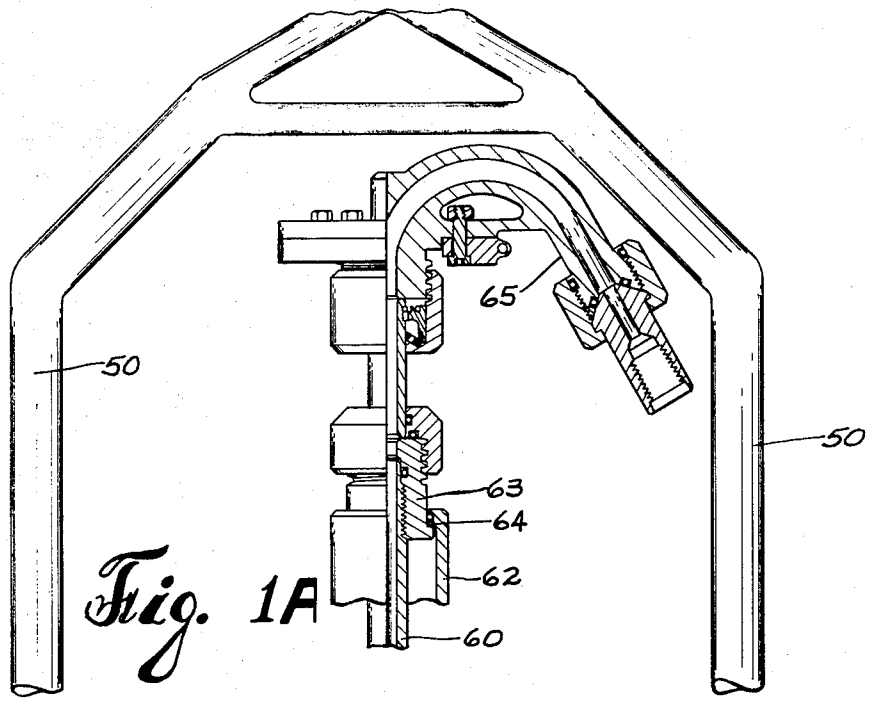


Fig. 1A

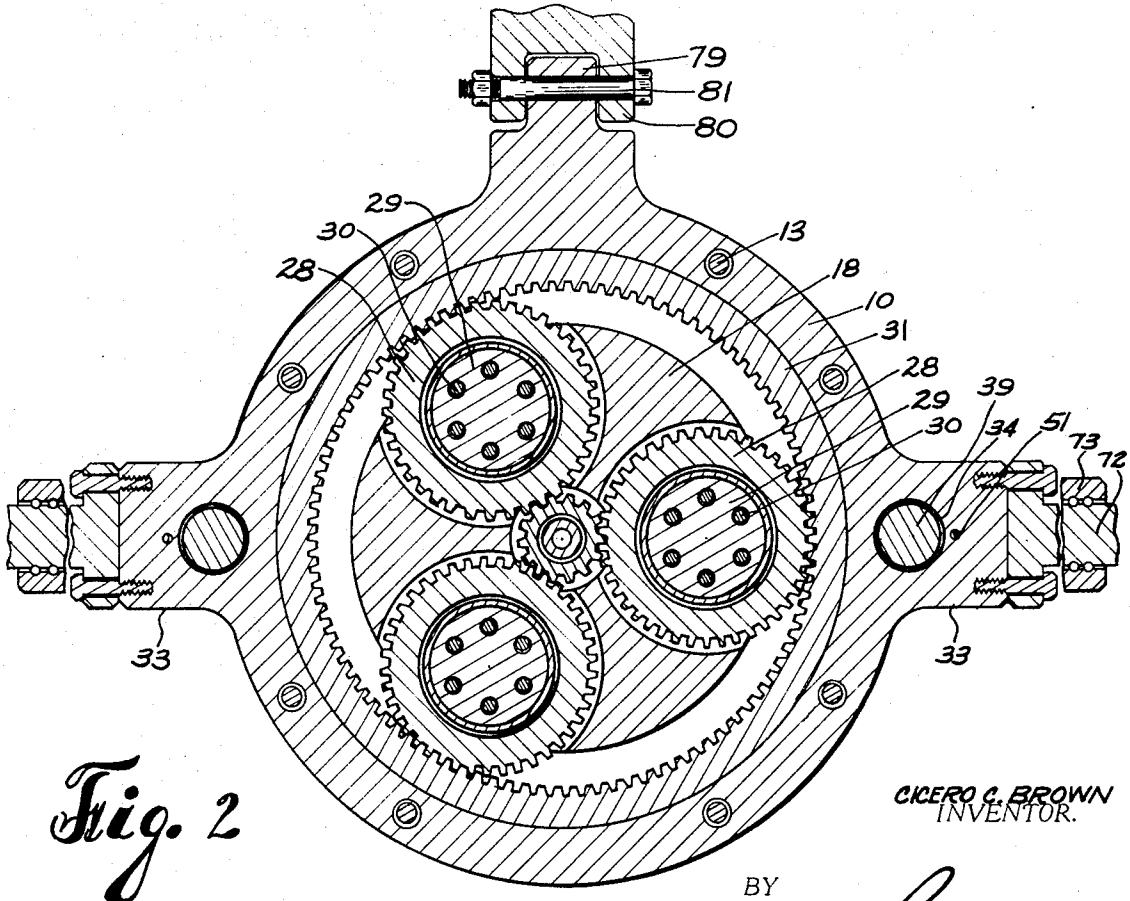


Fig. 2

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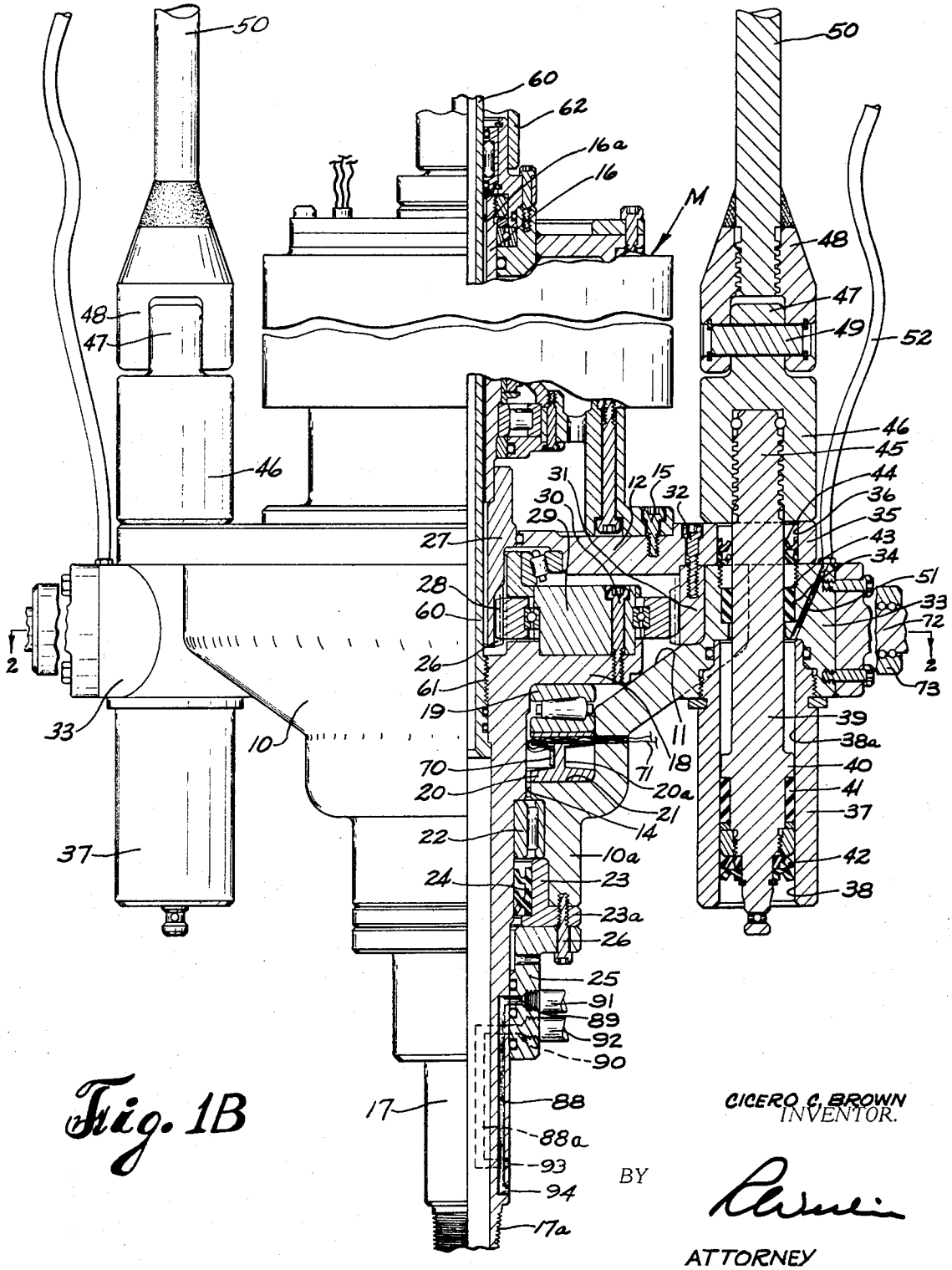


Fig. 1B

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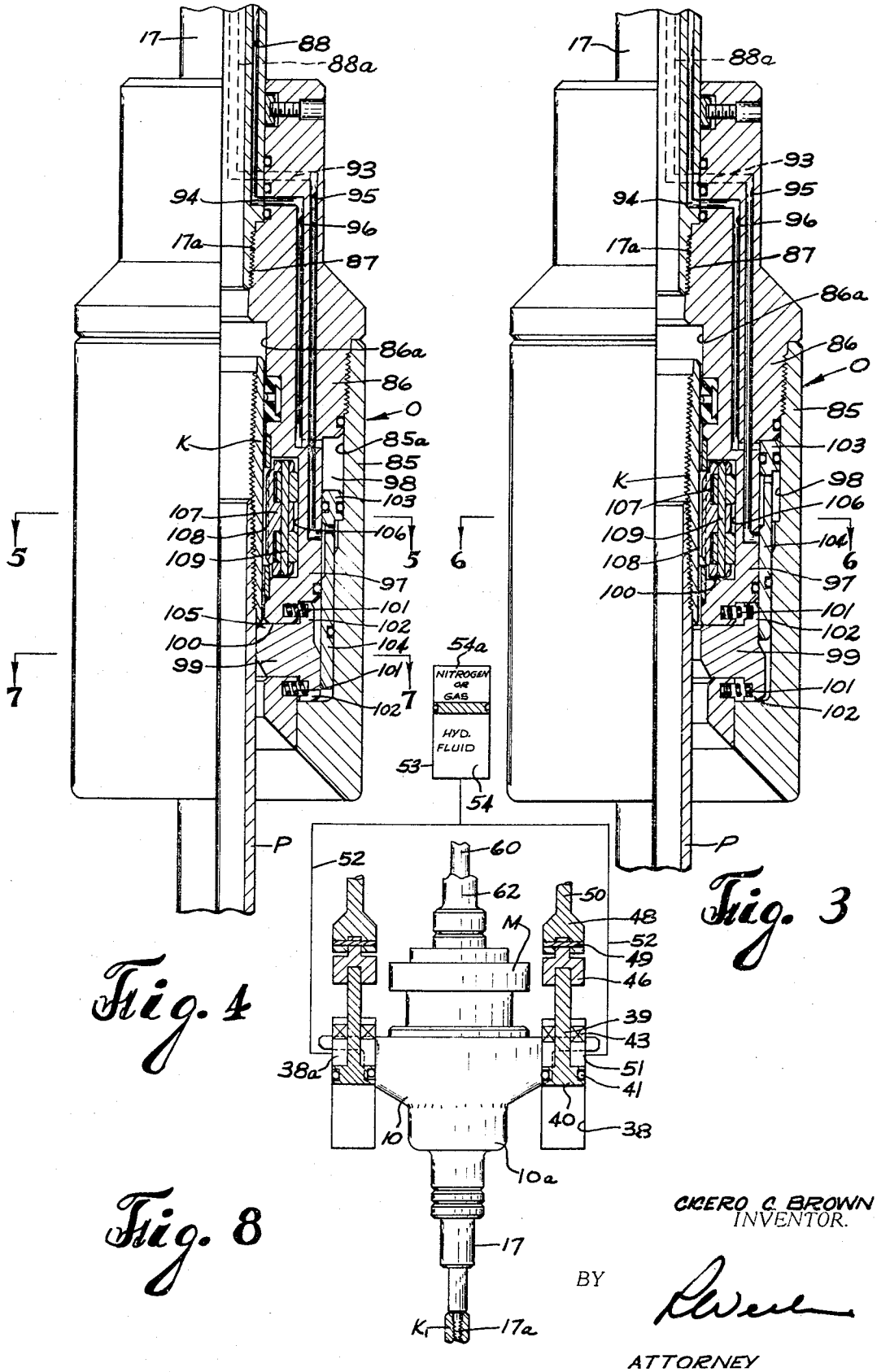


Fig. 4

Fig. 3

Fig. 8

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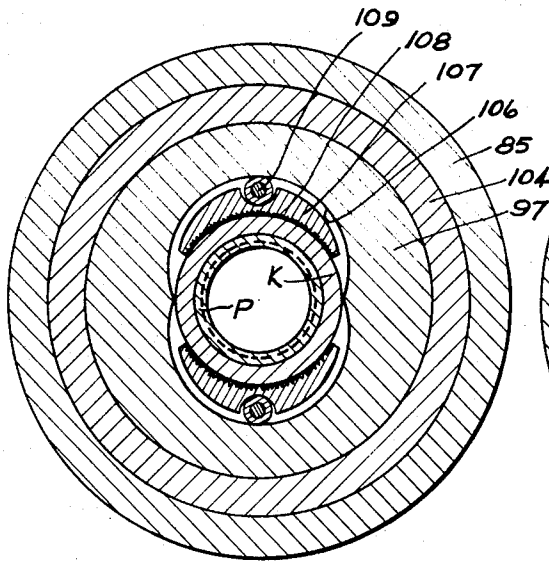


Fig. 6

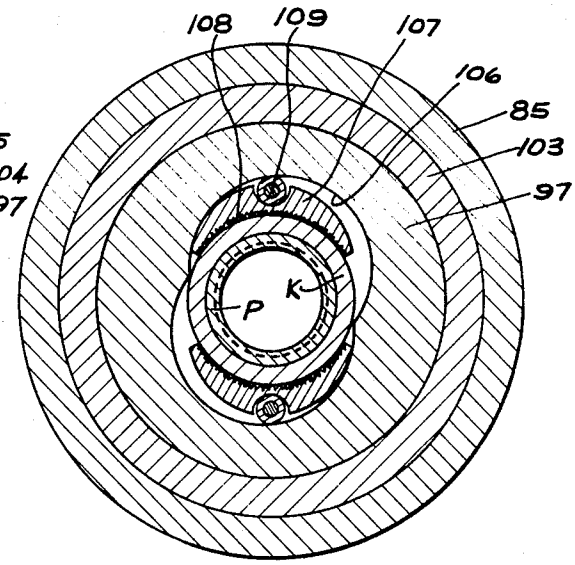


Fig. 5

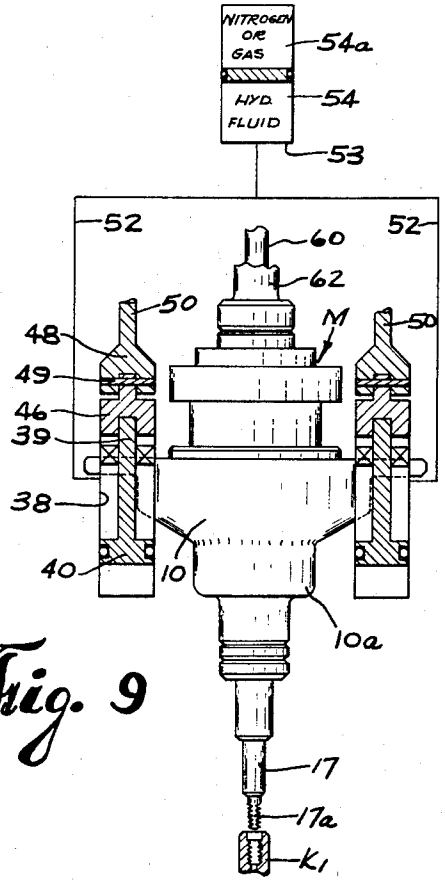


Fig. 9

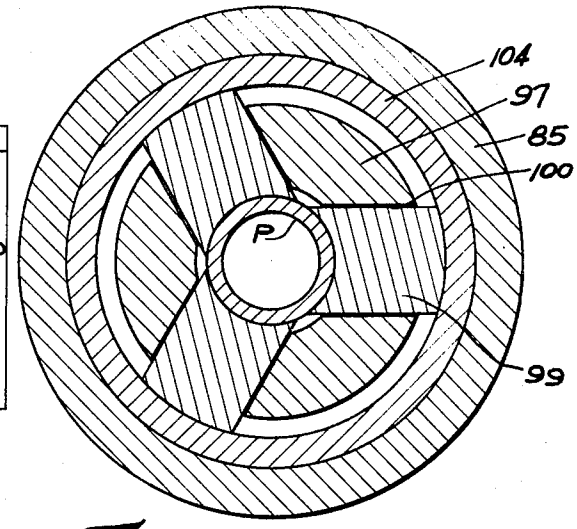


Fig. 7

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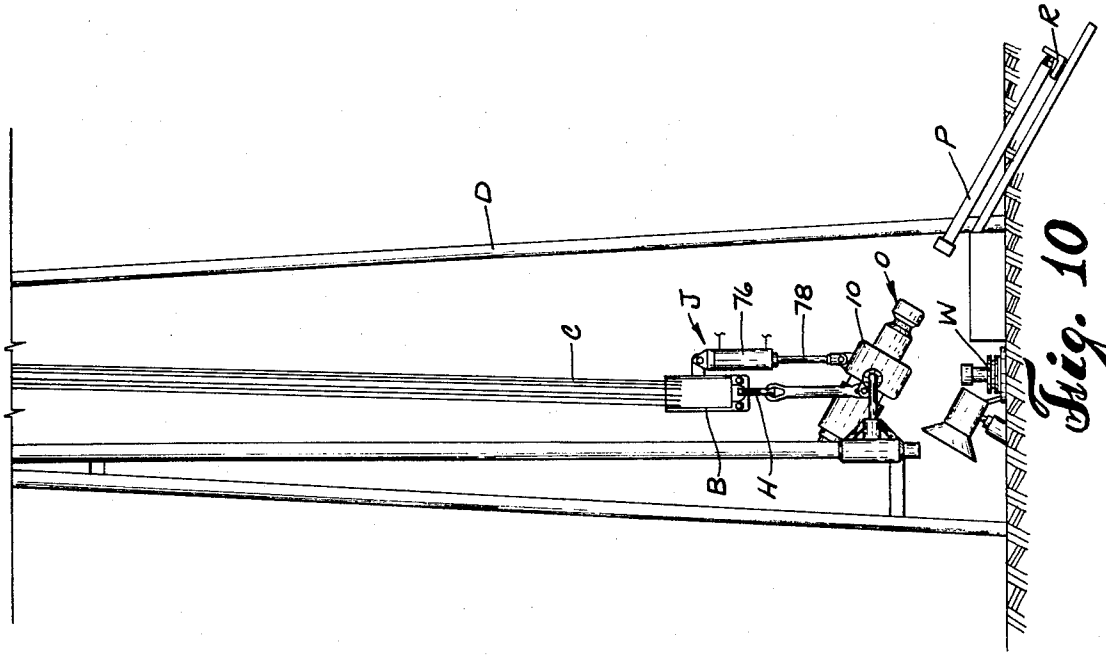


Fig. 10

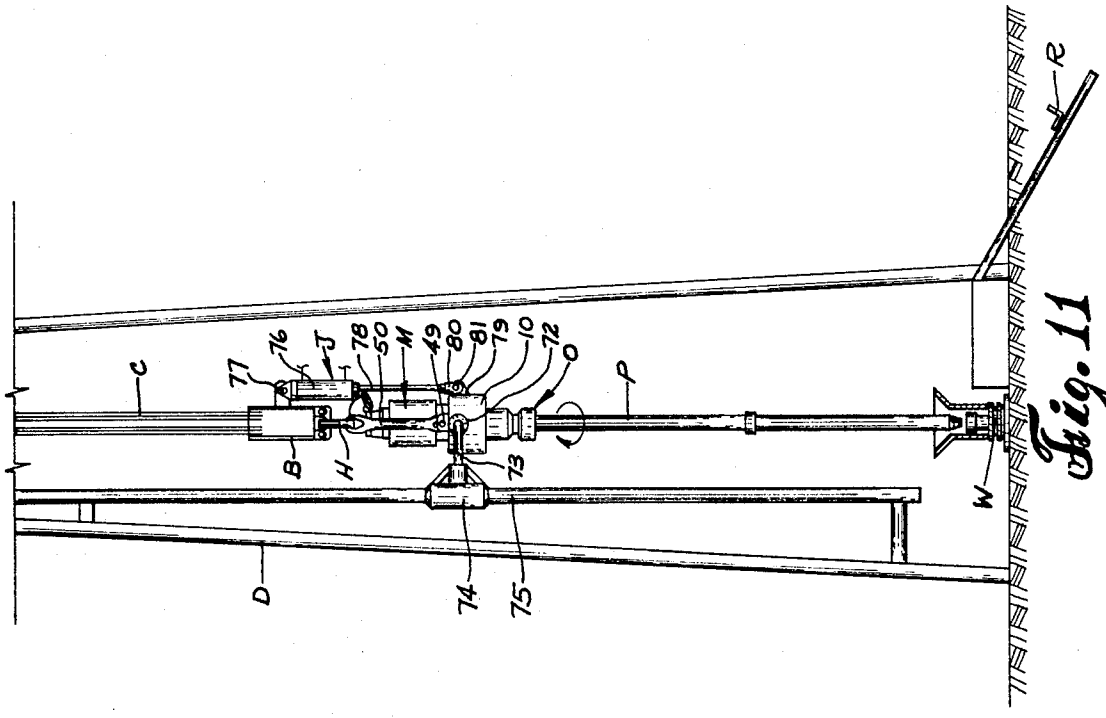


Fig. 11

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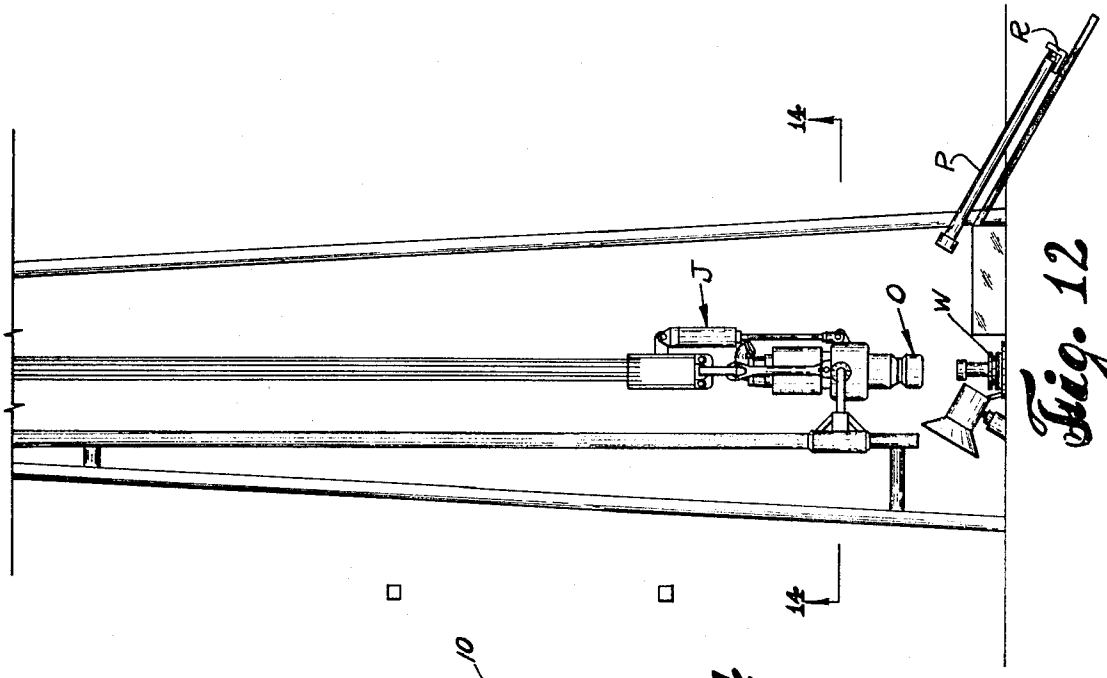


Fig. 12

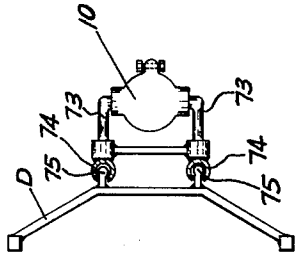


Fig. 14

Fig. 13

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ELECTRIC POWER SWIVEL AND SYSTEM FOR USE IN ROTARY WELL DRILLING

BACKGROUND OF THE INVENTION

Conventional rotary drilling requires the use of a heavy rotary table and its large and heavy drive connections and appurtenances and large drilling engines, all of which are relatively expensive and cumbersome, and have other undesirable features particularly in connection with drilling operations conducted in water bodies.

The present invention is directed to an electric power drive swivel with several appurtenances by which a relatively simple drilling system is provided which obviates most of the objectional features of more conventional systems, which is highly flexible for application to a wide variety of drilling conditions, and which is readily portable and easily assembled and disassembled as may be required.

THE INVENTION

The system in accordance with this invention includes a swivel stem suitably supported for rotation in a casing on which is mounted a reversible electric motor connected to the swivel stem by an efficient gear train. The swivel structure is supported from the travelling block of the drilling rig by a fluid-pressure cushioned suspension and is pivotally mounted in a guide frame slidable longitudinally in the derrick. A fluid pressure actuated tilting jack is arranged between the travelling block and the swivel housing to enable angular tilting of the swivel for alignment with pipe sections to be transferred to and from the drill string during the drilling operation. The system also includes a novel form of connector for connecting the swivel to the drill pipe sections and a strain gauge arrangement for continuously monitoring loads on the swivel and its supporting system.

Other and more specific objects and advantages of this invention will become more readily apparent from the following detailed description when read in conjunction with the accompanying drawing.

In the drawing:

FIGS. 1A and 1B, together, comprise a vertical view, partly in elevation and partly in section of the power swivel in accordance with one embodiment of this invention;

FIG. 2 is a cross-sectional view taken on line 2—2 of FIG. 1A;

FIG. 3 is a vertical partly sectional view of one form of a connector device for drivingly connecting the power swivel to a pipe string, the parts being shown in the unactuated position;

FIG. 4 is a view similar to FIG. 3 showing the parts in the actuated pipe-gripping position;

FIGS. 5 and 7 are cross-sectional views taken on lines 5—5 and 7—7, respectively of FIG. 4;

FIG. 6 is a cross-sectional view taken on line 6—6 of FIG. 3;

FIG. 8 is a view partly in elevation and partly in section showing one position of the power swivel suspension;

FIG. 9 is a view similar to FIG. 8 showing another position of the power swivel suspension;

FIGS. 10, 11, 12 and 13 are generally diagrammatic views showing several positions of the power swivel in the drilling derrick at different stages of operation; and

FIG. 14 is a cross-sectional view taken on line 14—14 of FIG. 12.

Referring to the drawing, the power swivel comprises a hollow casing 10 of inverted generally frusto-conical shape defining an enclosure 11 closed at its upper end by a cap plate 12 removably secured to the upper end of the casing by bolts 13 (FIG. 2) and communicating with an axial bore 14 opening through throat portion 10*a* defining the lower end of the casing. An electric motor, designated generally by the letter M, is vertically mounted centrally on cap plate 12 and removably secured thereto by cap screws 15. Motor M may be of any well known construction having sufficient power and adapted for reversible operation. The details of the motor do not form a part of this invention, except that it is provided with a hollow drive shaft 16, suitably supported for rotation in the vertical position and having an axial bore 16*a*.

A tubular swivel stem 17 extends through bore 14 and carries a horizontally extending annular head 18 at its upper end. The lower end of stem 17 projects from thelower end of casing 10 and is provided with a threaded pin 17*a* for connection to other tools, as will appear subsequently. Head 18 is rotatably supported on roller bearings 19 which are, in turn, seated on the upper flanges of a horizontally disposed H-beam collar 20, which encircles the swivel stem and is seated on an upwardly facing shoulder 21 in casing 10. Roller bearings 22 are mounted between swivel stem 17 and the wall of throat portion 10*a* at a point below shoulder 21 and are held in place by a tubular bushing 23 which also defines a packing space containing seal packing 24 for sealing off between swivel stem 17 and bushing 23. A tubular cap 25 surrounds the portion of the swivel stem extending below the lower end of throat portion 10*a* and is secured to the latter by means of cap screws 26 which extend through the flange 23*a* on bushing 23 and thereby serve to also secure bushing 23, bearings 22 and seal packing 24 in place about the swivel stem.

Swivel stem 17 is rotatably driven by motor shaft 16 through a train of gears which includes an annular pinion 26 mounted on a hub sleeve 27 which is suitably secured coaxially to the lower end of shaft 16; a set of three planetary gears 28 in mesh with pinion 26 and rotatably mounted about enlarged hubs 29 which are secured to head 18 by means of cap screws 30. The planetary gears are in mesh with a sun gear 31 seated against the inner wall of casing 10 near its upper end and secured to cap plate 12 by means of cap screws 32.

Casing 10 is formed with a pair of laterally extending ears 33,33 spaced 180° apart and having vertically extending bores 34,34 therethrough. Cap plate 12 has similar ears 35,35 overlying ears 33, 33 and provided with bores 36,36 registering with bores 34, 34. Tubular sleeve 37,37 having axial through-bores 38,38 are screwed into the lower ends of bores 34,34. Each of the bores 38 defines a pressure cylinder 38*a* adpated to receive a piston 39 formed with a lower head 40 fitted with seal rings 41 and 42 for slidable sealing engagement with the wall of bore 38. Piston 39 extends upwardly through bores 34 and 36 which are provided with respective packings 43 and 44 sealing with the piston to close the upper ends of the cylinders. The upper end portions of pistons 39 which project above cap plate 12 are provided with externally threaded pins 45 which are screwed into hanger caps 46. The latter have upwardly extending lugs 47 which are received in clev-

ises **48** and pivotally secured thereto by means of transversely extending pivot pins **49.** The clevises are secured to the opposite ends of a bail **50** (FIG. 1A) by means of which the entire device is swung from the hook H or like connection of a travelling block B employed in conventional rotary drilling (FIGS. **10–14**) and suspended from drilling cables C in a conventional drilling derrick D.

Each of the cylinders **38***a* is in communication with a port **51** which is connected to a conduit **52** which leads to a closed reservoir **53** (FIGS. **8** and **9**) wherein a charge of hydraulic fluid **54** is continuously pressurized by a body of an inert pneumatic fluid **54***a* such as nitrogen gas.

A tubular mandrel **60** extends upwardly through the bore of swivel stem **17,** being threadedly connected to the stem at a point opposite head **18** by a threaded connection **71.** The mandrel extends upwardly through the bore of hub sleeve **27** and bore **16***a* of motor shaft **16** and thence through a swivel housing **62.** A swivel bushing **63** (FIG. 1A) is threadedly secured to the upper end of mandrel **60** and is provided with a suitable rotary connection **64** to the upper end of swivel housing **62.** The upper end of bushing **63** is connected to the goose-neck fittings **65** of conventional design adapted for conducting drilling mud or other fluid to the drilling string through the bore of mandrel **60.**

For continuously measuring the load on the swivel, a plurality (only one shown) of a generally conventional type of strain gauge **70** are mounted on the inner face of web **20***a* of H-beam **20,** the leads **71** of the gauges being brought outside casing **10** to a suitable electrical instrument panel (not shown) at the drillers station, where the forces to which the strain gauges are subject may be suitably measured and indicated and recorded.

The outer ends of ears **33** are fitted with trunions **72** journalled in the ends of guide arms **73** (FIGS. 1B, **2,** and **11**) which connect guide sleeves **74** disposed for sliding movement on vertically disposed guide bars **75** suitably mounted in drilling derrick D in which the power swivel is suspended.

The trunions thus provide a pivoting connection between the power swivel and the guide sleeves so as to permit the power swivel to be tilted at an angle to the vertical when required in operations to be described subsequently (FIGS. **10** and **12**).

In order to effect tilting of the power swivel when desired, a fluid pressure actuated tilting jack, designated generally by the letter J, (FIGS. **10** to **13**) is connected between travelling block B and casing **10** of the power swivel. Such a tilting jack is disclosed in my copending application, Ser. No. 125,740, filed Mar. 18, 1971. Jack J comprises a cylinder **76** hingedly connected at **77** to the side of travelling block B and enclosing a piston **78** having its free end hingedly connected to casing **10.**

A connection for the end of piston **78** to casing **10** is shown in FIGS. **2** and **10** to **14,** and comprises a hinge lug **79** projecting radially outwardly from casing **10** at the mid point between ears **33,33.** Lug **79** is adapted to be received in a clevis **80** carried by the outer end of piston **78** and is hingedly secured thereto by a transverse hinge pin **81.**

FIGS. **3** to **7,** inclusive, illustrate an overshot form of a connector device, designated generally by the letter O, for drivingly connecting swivel stem **17** to the upper end of a string of drill pipe P or a section thereof fitted with a collar K. This embodiment comprises a tubular housing **85** having a bore **85***a* and threadedly connected to a threaded pin formed on a head **86** having an axial bore **86***a*, the upper end of which is provided with a threaded socket **87** adapted to receive pin **17***a* of the swivel stem. The latter is provided with longitudinal passages **88** and **88a** in its wall communicating at their upper ends with spaced ports **89** and **90** respectively in cap **25** which are connected respectively to conduits **91** and **92** for circulation of pressure fluid between a suitable source (not shown) and the connector device. At a point above pin **17***a* passages **88a** and communicate respectively with spaced ports **93** and **94** which communicate, respectively, with conduits **95** and **96** extending through head **86** and a reduced diameter extension **97** thereof into communication with spaced points in a cylinder **98** defined between the wall of bore **85***a* and extension **97.**

A set of angularly spaced lugs **99** are mounted for limited radial movement through correspondingly shaped radial slots **100** in the lower end of extension **97.** Lugs **99** are resiliently biased outwardly by means of springs **101** arranged between extensions **102** on the upper and lower ends of the lugs and opposed portions of the lower end of extension **97.** A sleeve piston **103** is slidably mounted in cylinder **98** and is secured to the upper end of a skirt **104** which extends downwardly between the wall of bore **85a** and the exterior of extension **97,** the skirt being movable downwardly behind lugs **99** to urge the latter inwardly against the opposition of springs **101.** The arrangement is such that when pressure fluid is introduced through conduit **96** above piston **103** forcing the latter downwardly, skirt **104** will force lugs **99** inwardly against pipe P and define shoulders **105** (FIGS. **4** and **7**) beneath the lower end of collar K and thereby prevent the connector device from being pulled off the end of the pipe, thus performing the functions of more conventional elevators.

A pair of arcuate recesses **106** are provided in opposite portions of the inner wall of extension **97.** A pair of arcuate cam shoes **107** having toothed inner faces **108** are rockably mounted on shafts **109** vertically disposed in recesses **106.** The shapes of the cams and recesses are made so that an initial rotational movement of the connector in either direction will rock the cams into tight gripping engagement with collar K and thereby transmit corresponding rotary movement from the power swivel through the connector device to the pipe.

Where the drill string is the relatively small diameter conventional drill pipe, or has flush diameter boxes, pin **17a** on the swivel stem may be screwed directly into the usual threaded box K_1 of the pipe (FIGS. **8** and **9**). Still another suitable form of connector device which is adapted to be insertible in the bore of the drill string and non-threadedly connected thereto is disclosed in my U. S. Pat. No. 3,552,507 and U. S. application, Ser. No. 52,517, filed July 6, 1970. An additional form of connector device for use in combination with a power swivel is illustrated in my copending U. S. application, Ser. No. 70,425, filed Sept. 8, 1970.

OPERATION

In operation, the power swivel will be hung from the travelling block, as best seen in FIGS. **10** to **14,** and connected to guide bars **75.** Where the pipe sections P to be employed in the well are being introduced into

the derrick from a supply located outside the derrick and presented by a conveyor R or the like, as shown in FIG. **10**, at an angle to the vertical, jack J will be actuated to tilt the power swivel at an angle appropriate to align connector O with the pipe section which will then be pushed into the bore of the connector by any suitable manual or mechanical means, not shown. The end of the pipe section will be secured in the connector by actuation of lugs **99** by means of pressure fluid supplied through passages **88** and **96** to cylinder **98** to move piston **103** and skirt **104** downwardly to the position shown in FIG. **4**.

Thereupon, the power swivel will be elevated until the pipe section hangs in vertical position over well head W (FIG. **11**) in position to be stabbed into the upper end of the pipe string supported in the well. Thereupon, rotation of the swivel will actuate cam shoes **107** to grip pipe section P and rotate the same to make it up into the box on the upper end of the drill string in the well. After the connection is thus made, continued rotation of the drill string by the power swivel will drill off the added section of drill pipe. Thereafter with the well string including the added pipe section held in slips in the well head, lugs **99** will be retracted by directing flow of pressure fluid through conduits **88***a* and **95** to raise piston **103** and skirt **104**. Subsequently, raising of the power swivel will pull connector O off the upper end of the pipe and enable repetition of operation of adding pipe sections to the well string and drilling them off as required. When drilling off a section of added pipe, drilling fluid will be introduced through goose neck **65**, mandrel **60** and swivel stem **17** to the bore of the drill pipe string and circulated in the usual manner down the pipe string through the drill bit passages (not shown) and thence upward to the surface outside the drill pipe string.

When necessary to withdraw the drill string, the pipe sections are broken out successively by reverse rotation of the power swivel, while the remainder of the string is held conventionally in slips supported in well head W. Each section is removed from the derrick after release from connector O (FIG. **13**), the latter being tilted by means of jack J to an appropriate angle for laying the pipe section onto the transfer conveyor R, one suitable form of which is disclosed in my aforesaid U. S. application, Ser. No. 125,740, filed Mar. 18, 1971. FIG. **12** shows the power swivel returned to the vertical position after releasing the discharged pipe section as shown in FIG. **13**, and is thus in position to be lowered to again engage the upper end of the pipe string for removing the next pipe section.

In making-up and breaking-out the pipe sections, the hangers formed by cylinders **38***a* and pistons **39** perform useful functions as shock absorbers and in enabling smooth handling of the pipe. When a section of pipe P is picked up by the power swivel, the pressure maintained in cylinders **38***a* by the pressurized fluid in reservoir **53** will be sufficient to hold pistons **39** in their lowered position (FIGS. **1B** and **9**). When the threaded pin on the lower end of the pipe section is stabbed into the box on the upper end of the pipe string and the added pipe section is rotated to make up the threads, the entire swivel will be pulled down as the threads are made up and this downward pull will be resiliently opposed by the pneumatically pressurized fluid in reservoir **53** and cylinders **39** which act as shock absorbers to protect against thread damage as the pipe section is made up.

When breaking-out operations are being conducted, the load of the entire pipe string must be taken on the power swivel when the well head slips are released to enable the entire pipe string to be lifted to an appropriate height before the slips are again re-set. As this load is taken, the power swivel will be pulled down relative to bail **50** and pistons **39** secured thereto, the pistons moving up in cylinders **38***a* as the pressurizing fluid in reservoir **53** is compressed (FIG. **8**), usually for the full length of the piston stroke. When the slips in the well head are re-set and the power swivel operated to unscrew the pipe section being removed, the upward movement of the power swivel occasioned by the unscrewing of the threads will be compensated for by relative downward movements of pistons **39** under the cushioning pressure of the pressurizing fluid in reservoir **53** which thereby assures smooth release of the threads without sudden upward jumping of the power swivel when the last thread is released. When this occurs pistons **39** will be returned to the positions shown in FIGS. **1B** and **9**.

Strain gauges **70** likewise perform useful functions in operation of the described assemblage. H-beam collar **20** functions as a compression member between head **18** and casing shoulder **21** and thereby is subject to the varying loads carried by the swivel stem during various stages of operation of the power swivel in handling pipe and during drilling. By mounting the strain gauges **70** on web **20***a* of the H-beam, they will continuously sense and be directly responsive to the varying loads imposed on the swivel stem. Thus, the gauges may be continuously employed with suitable known instrumentation to continuously deliver information to the driller with respect to the total loads on the hoist equipment, the weight-on-bit and other information of like nature which is useful to the driller in the drilling and pipe handling operations.

It will be understood that various changes and modifications may be made in the details of the above-described embodiments within the scope of the appended claims but without departing from the spirit of their invention.

What I claim and desire to secure by Letters Patent is:

1. A power swivel for use in rotary well drilling, comprising:

a. a housing;

b. a tubular swivel stem rotatably mounted in the housing;

c. a reversible electric power motor mounted on the housing and having a tubular drive shaft coaxial with said swivel stem;

d. transmission means in the housing operably connecting said drive shaft to said swivel stem;

e. releasable connector means associated with said swivel stem for drivingly connecting said stem to a pipe section; and

f. fluid pressure-loaded hanger means on said housing for resiliently supporting the swivel from the hoist system of a drilling derrick.

2. A power swivel according to claim **1** including pressure-responsive means mounted in said housing in axial compression between said swivel stem and a relatively fixed supporting element in said housing for directly sensing the compression forces therebetween.

3. A power swivel according to claim 1 wherein said connector means includes:
a. a tubular housing adapted to coaxially receive the upper end of said pipe section;
b. a set of angularly spaced pipe-gripping shoes mounted in the housing for rocking movement into and out of gripping engagement with said pipe end in response to angular movement of the housing relative to the pipe section;
c. a plurality of angularly spaced abutment members mounted in said housing beneath said shoes for radial movement to and from supporting position beneath an external shoulder on the pipe section; and
d. fluid pressure-responsive means in said housing for actuating said abutment members.

4. In a power swivel according to claim 3, conduit means housed in said swivel stem for communicating pressure fluid to said fluid pressure-responsive means.

5. A power swivel according to claim 1 wherein said hanger means comprises:
a. a pair of vertically disposed cylinders mounted at diametrically spaced points in said housing;
b. pistons reciprocable in said cylinders;
c. a bail member connected to the upper ends of said pistons and supported from said hoist system; and
d. a pneumatic pressure fluid reservoir in continuous communication with said cylinders.

6. An assembly for manipulating tubular members comprising:
a. support means;
b. rotary drive means carried by said support means;
c. stem means rotatably powered by said rotary drive means for rotating said tubular members;
d. rotary drive shaft means coaxial with said steam means and extending longitudinally through motor means included in said drive means, said motor means including a reversible electric motor means;
e. first gear means connected with said drive shaft means for rotation therewith;
f. second gear means for meshing engagement with said first gear means and movable by rotation of said first gear means; and
g. drive linkage means operatively connected between said stem means and said second gear means for imparting rotary motion from said second gear means to said stem means, said second gear means including at least three planatary gear means rotatable about gear axes fixed relative to said drive linkage means and said planatary gear means operatively meshing with a surrounding third gear means whereby rotation of said first gear means acts through said planatary gear means against said surrounding third gear means to rotate said drive linkage means.

7. An assembly as defined in claim 6 further including:
a. orienting means for positioning the axis of said stem means at different axial alignments; and
b. communicating fluid flow passage means extending longitudinally through said stem means and said drive shaft means.

8. An assembly as defined in claim 6 further including:
a. connector means carried by said stem means for engagement and release of said tubular members; and
b. load sensing and indicating means for sensing and indicating the load supported by said assembly.

9. An assembly as defined in claim 6 further including:
a. vertical drive means for moving said rotary drive means vertically through said support means; and
b. automatic, resilient shock absorbing means independent of said vertical drive means for accommodating relative vertical movement between said stem means and said support means.

10. An assembly for manipulating tubular members comprising:
a. rotary drive means;
b. tubular stem means rotatively powered by said rotary drive means for rotating said tubular members,
c. connector means carried by said stem means and remotely operable for non-threaded engagement with said tubular members for rotation of said members in any direction;
d. remotely operable means included in said connector means for nonrotative release from said tubular members; and
e. sealing means included with said connector means for forming a sealed engagement between said tubular stem means and said tubular members.

11. An assembly as defined in claim 10 further including vertical drive means for moving said stem means to different vertical positions.

12. An assembly as defined in claim 11 further including orienting means for varying the angle of inclination of said stem means.

13. An assembly as defined in claim 11 further including:
a. support means for supporting said rotary drive means; and
b. automatic shock absorbing means independent of said vertical drive means for accommodating relative vertical movement between said stem means and said support means.

14. An assembly as defined in claim 10 wherein:
a. said rotary drive means includes a reversible electric motor;
b. a drive shaft extends longitudinally through said motor; and
c. a fluid flow passage means extends longitudinally through said drive shaft.

15. An assembly for manipulating tubular members comprising:
a. support means;
b. rotary drive means carried in said support means, said rotary drive means including a reversible electric motor;
c. drive shaft means extending longitudinally through said motor and including a fluid flow passage means extending longitudinally through said drive shaft;
d. stem means rotatably powered by said rotary drive means for rotating said tubular members;
e. connector means carried by said stem means for engagement or release of said tubular members;
f. vertical drive means for moving said rotary drive means vertically through said support means; and
g. automatic, resilient shock absorbing means independent of said vertical drive means for accommodating relative vertical movement between said stem means and said support means, said shock ab-

sorbing means including a pressurized gas acting against an incompressible fluid.

16. An assembly as defined in claim **15** further including load sensing and indicating means for sensing and indicating the load supported by said assembly.

17. A system for handling threaded tubular well members adapted to be joined together to form a tubular string of such members comprising:

a. support means;
b. rotary drive means carried by said support means;
c. stem means rotatably powered by said rotary drive means for rotating said tubular well members and for rotating a string of said members;
d. connector means carried by said stem means and remotely operable for non-threaded engagement with said tubular members and string for rotation of said members and string in any direction;
e. release means included in said connector means and remotely operable for non-rotative release from said tubular members and string;
f. vertical drive means for moving said rotary drive means vertically through said support means;
g. orienting means for changing the inclination of said stem means;
h. remotely operable holding means for preventing rotation of said string while said stem means and a connected tubular member are rotated for removing or adding said connected member to said string; and
i. gearing means included in said rotary drive means for providing sufficient force in said rotary drive means for independently making and breaking fully tightened joints between tubular members.

18. An assembly as defined in claim **17** wherein said rotary drive means includes a reversible electric motor means.

19. An assembly as defined in claim **18** wherein:

a. drive shaft means extend longitudinally through said electric motor means; and
b. fluid flow passage means extend longitudinally through said drive shaft means in fluid communication with said stem means.

20. In a rotary drilling system including a derrick and a vertically movable travelling block suspended in the derrick:

a. an electric powered rotary drive unit pivotally supported from the travelling block and movable vertically therewith;
b. reversibly rotatable hollow swivel means carried by said drive unit for connection to a well pipe;
c. fluid pressure-operated jack means pivotally connecting said drive unit to said travelling block operable to effect angular movement of the drive unit relative to the vertical;
d. a drive connector carried by the swivel means adapted for non-threaded engagement with the upper end of the said well pipe for transmitting torque thereto;
e. a tubular housing included in said connector to coaxially receive the upper end of said pipe string; and
f. a set of pipe-gripping shoes rockably mounted in said housing for angular movement into and out of gripping engagement with the upper end of said well pipe in accordance with the direction of angular movement of said housing relative to said pipe string.

21. A rotary drilling system according to claim **20** including means mounted in said housing for releasably securing said housing against axial release from said well pipe.

22. A rotary drilling system according to claim **21** wherein said last-mentioned means comprises:

a. a plurality of angularly spaced abutment members mounted in said housing beneath said shoes for radial movement to and from supporting positions beneath an external shoulder on the well pipe; and
b. means in the housing for effecting said radial movements.

23. A rotary drilling system according to claim **22** wherein said last-mentioned means comprises:

a. resilient means normally biasing said abutment members outwardly away from said supporting position; and
b. fluid pressure-actuated means in the housing operable to move said abutment members inwardly to said supporting position in opposition to said resilient means.

24. A rotary drilling system according to claim **23** wherein said fluid pressure-actuated means comprises:

a. piston means axially movable to and from positions thrustingly engaging said abutment members; and
b. pressure fluid-supply conduits extending through said swivel means into communication with said piston means.

25. An assembly for manipulating tubular members comprising:

a. support means;
b. rotary drive means carried by said support means;
c. stem means rotatively powered by said rotary drive means for rotating said tubular members;
d. rotary drive shaft means coaxial with said stem means and extending longitudinally through motor means included in said drive means;
e. first gear means connected with said drive shaft means for rotation therewith;
f. second gear means for meshing engagement with said first gear means and movable by rotation of said first gear means;
g. drive linkage means operatively connected between said stem means and said second gear means for imparting rotary motion from said second gear means to said stem means;
h. connector means carried by said stem means and remotely operable for non-threaded engagement and release of said tubular members; and
i. sealing means included with said connector means for forming a sealed engagement between said stem means and said tubular members.

26. An assembly for manipulating tubular members comprising:

a. rotary drive means;
b. tubular stem means rotatively powered by said rotary drive means for rotating said tubular members;
c. drive shaft means extending longitudinally through an electric motor means included in said drive means;
d. a fluid flow passage means extending longitudinally through said drive shaft means in fluid communication with said tubular stem means;
e. connector means carried by said stem means for engagement or release of said tubular member, said connector means including remotely operable means for nonthreaded engagement in release of

said tubular member and further including sealing means for forming a sealing engagement between said tubular stem means and said tubular members;

f. vertical drive means for moving said rotary drive means vertically through said support means; and

g. orienting means for varying the angle of inclination of said stem means.

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