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POWER-OPERATED PIPE COUPLING

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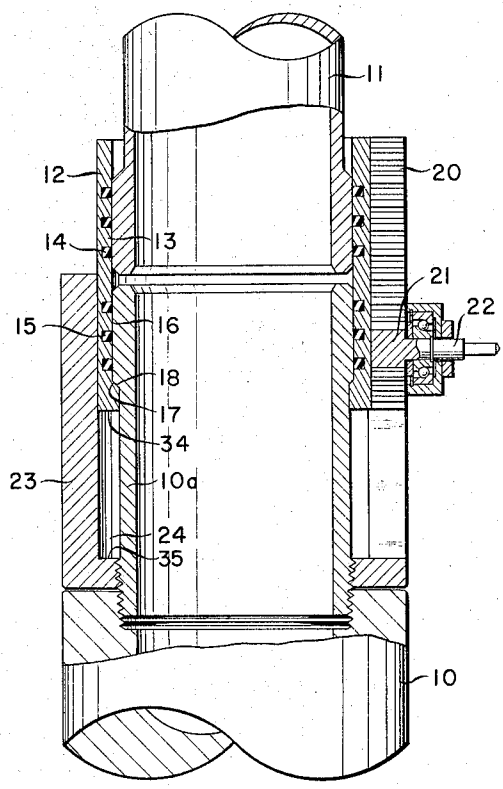

FIG. 1

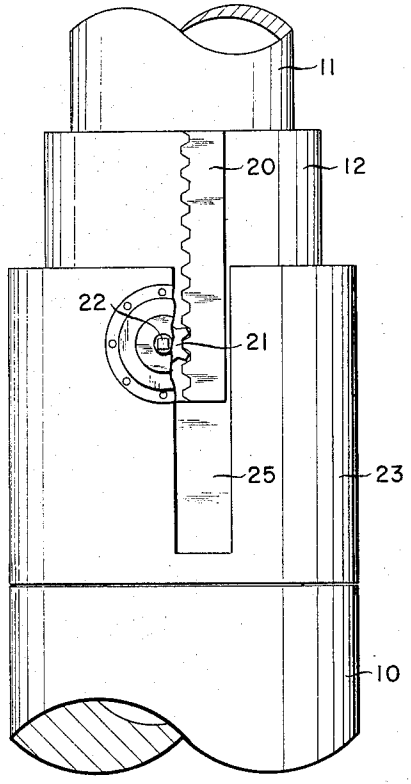

FIG. 2

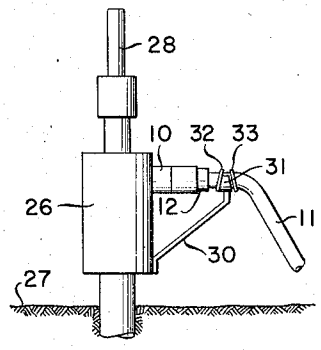

FIG. 3

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POWER-OPERATED PIPE COUPLING

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The present invention relates to pipe couplings and pertains more particularly to a coupling for use in high pressure flow lines, such for example, as those utilized on oil and gas producing wells.

Heretofore, offshore wells have been drilled either from stationary platforms anchored to the ocean floor, movable barges temporarily positioned on the ocean floor, or from movable barges floating on the body of water in which drilling operations are being carried out. Regardless of the manner in which the wells are drilled, most wells were completed in a manner such that the outermost tubular member of the well extends upwardly from the ocean floor to a point above the surface of the water where a wellhead assembly or Christmas tree is mounted thereon for controlling the production of the well.

Wellheads extending above the surface of the water constitute a hazard to the navigation of vessels in the area as well as constituting a structure which is readily attacked by wave action, it being well known that the corrosive action of sea water and air readily attack the normal steel wellheads unless they are protected in a suitable manner by corrosive resistance material. However, when the wellhead and/or casinghead extend above the surface of the water, the flow-controlling component of the wellhead may be readily adjusted by an operator working from a platform adjacent the wellhead structure above the surface of the water. Additionally, any workover or reconditioning operations carried out on the well may be readily accomplished as all of the portions of the wellhead structure which must be disassembled in order to carry out these operations, are above the surface of the water where they may be reached by maintenance crews. Thus, pipe couplings of any suitable design may be employed in the flowline positioned above the surface of the water since they may be readily connected and disconnected by maintenance men employing normal tools used for working on pipe lines on land.

Recently, however, methods and apparatus have been developed for drilling and completing oil and gas wells on the ocean floor in a manner such that after completion of the well, the wellhead assembly, including various components such as flow control valves and pipe couplings, is positioned beneath the surface of the water, preferably on the ocean floor. These facilities are often positioned in water depths greater than the depth at which a diver can safely and readily work. It may therefore be seen that the adjustment of any wellhead component from time to time, or the task of disconnecting or connecting pipe couplings during maintenance or reconditioning work on the well, presents a considerable problem when the wellhead assembly is positioned below the surface of the water.

It is therefore a primary object of the present invention to provide a power-operable pipe coupling adapted to connect underwater pipe lines together or to connect an underwater pipe line to an underwater well or other installations below diver depth in a body of water.

A further object of the present invention is to provide a power-operated pipe coupling adapted to connect two ends of a pipe together which are positioned in register one with the other in fixed spaced-apart relationship.

Another object of the present invention is to provide a pipe coupling adapted to be actuated by suitable prime mover means, preferably in the form of a power wrench, that is lowerable through a body of water and engageable with the pipe coupling to actuate said pipe coupling to either connect or disconnect the coupling from an adjacent pipe end.

These and other objects of this invention will be understood from the following description taken with reference to the drawing, wherein:

FIGURE 1 is a longitudinal view, taken partially in cross section, showing the pipe coupling of the present invention in its extended form so as to engage the end of a mating section of pipe;

FIGURE 2 is a side view of a pipe coupling of FIGURE 1, partially cut away to show the interaction of the gear mechanism of the coupling; and,

FIGURE 3 is a diagrammatic view illustrating an underwater wellhead positioned near the ocean floor where the wellhead is connected to an underwater pipe line by means of the power actuated coupling of the present invention.

Referring to FIGURES 1 and 2 of the drawing, a pair of pipe sections **10** and **11** are shown as being positioned in axial register and connected together by means of a power-operated pipe coupling in accordance with the present invention.

The pipe coupling includes a concentrically mounted tubular sleeve **12** carried at one end of pipe section **10** and being slidably mounted thereon for limited axial movement to a position extending beyond the normal end of the pipe section **10**. Thus, in its extended position, as shown, about half of the extendable tubular sleeve **12** is positioned adjacent and in sealing contact with the outer surface of the end of pipe line **11**. Preferably a raised contact or sealing surface **13** is provided on the end of pipe section **11**.

Suitable sealing means, such as O-ring seals **14**, are provided and are carried on the inner surface of the extendable tubular sleeve **12** for sealing against the sealing surface **13** of the pipe section **11**. It is to be readily understood, however, that the seals **14** are to seal the space between the tubular sleeve **12** and the landing surface **13** at the end of pipe section **11** and may just as readily be carried in a recessed manner on the other surface of pipe section **11** in a manner identical with that illustrated with regard to the sleeve **12**. Thus, with the seals **14** being carried by the end of pipe section **11**, new seals could be installed each time the pipe section **11** was replaced.

In a like manner a series of O-ring seals **15** are provided in recessed portions of the inner surface of the tubular sleeve **12** and positioned thereon so as to contact a sealing surface **16** carried near the end of pipe section **10**. Preferably, suitable stop means or movement-limiting means are provided between the slidable tubular sleeve **12** and the end of the pipe section **10** so that the tubular sleeve **12** is not extended sufficiently to fall off the end of the pipe section **10** or to disengage rack **20**, with pinion **21**. One form of movement-limiting means or stop means may be a shoulder **17** formed on the inner surface of the sleeve **12** so as to cooperate with an outwardly extending shoulder **18** carried on the outer surface of a portion of the pipe section **10**. While stop shoulders **17** and **18** prevent the sleeve **12** from being driven sufficiently far so as to become disengaged from the pipe section **10**, it is to be noted that prior to such an occurrence, the rack **20** disengages the pinion **21** even if shoulders **17** and **18** are not present. Once such disengagement had occurred, further driving of sleeve **12** is not possible. Thus, it is seen that an important purpose of shoulders **17** and **18** is to limit the travel of sleeve **12** to a position where the rack **20** and pinion **21** are still engaged, the sleeve **12** has traveled far enough to seal effectively on the surface **13**, and the sleeve **12** is still engaged on pipe end **10***a* and sealed against surface **16**. It is equally important that

precautions be taken to insure that the rack **20** and pinion **21** are not disengaged when the sleeve **12** is driven to the open, or released, position. Numeral designations **34** and **35** in FIGURE 1 illustrate one means which are employed by the tool design to guard against this possibility. When the connector is driven to the released position, the end **34** of sleeve **12** lands on the shoulder **35** of housing cylinder **23**, limiting the travel of sleeve **12**; and, again, preventing disengagement of rack **20** with pinion **21**.

Suitable power-operated actuating means are provided on the end of the pipe section **10** to which the extendable sleeve **12** is attached in order to extend or retract the sleeve **12** from engagement with a cooperating pipe section **11**, as needed. One form of actuating means is provided by a rack **20** which is fixedly secured, as by welding, to the outer surface of the tubular slidable sleeve **12**. Mounted on the pipe section **10** in operative engagement with the rack **20** is a suitable gear means such as a pinion **21** having a drive shaft **22** extending outwardly therefrom for engagement with any suitable form of prime mover means, such for example as a power wrench. Thus, in rotating the shaft **22** and pinion **21**, the rack **20** and the sleeve **12** attached thereto is moved in one direction or the other. While a rack and pinion arrangement has been illustrated, it is to be understood that a worm gear or lead screw or any other suitable type of actuating means may be employed just as readily. While the sleeve **12** may be mounted directly on the outside of the pipe section **10**, it is preferably enclosed in a housing cylinder **23** which surrounds the end **10***a* of the pipe section **10** in a manner so as to be spaced therefrom to form the annular space **24** into which the sleeve **12** may be retracted. As shown in FIGURE 2, the cylindrical housing **23** is provided with a longitudinal slot **25** of a length sufficient to receive the rack **20** therein when the sleeve **12** is in its retracted position.

In using the pipe coupling of the present invention it may be seen that after the two pipe sections **10** and **11** are positioned in axial register one with the other, a wrench is connected to the shaft **22** of the pinion **21** which is then rotated so as to drive the rack **20** and the sleeve **12** to an extended position with the seals **14** on the inner surface of the sleeve **12** forming a fluidtight seal against the sealing surface **13** of the pipe section **11**.

Referring to FIGURE 3 of the drawing, an underwater wellhead **26** is diagrammatically shown as being positioned on the ocean floor **27**, the upper end of the production wellhead **26** being closed by suitable closure means **28**. A bracket **30** may be fixedly secured at its lower end to the wellhead **26** while its outer end is provided with a U-shaped saddle **31** in which an underwater pipe line section **11** may rest. If desired, the sides of the U-shaped saddle **31** may slope upwardly and inwardly thus serving as aligning means for a pair of sloping flanges or guide means fixedly secured to the outer surface of the pipe **11**, as by welding. With the pipe **11** in the saddle **31** in the flanges **32** and **33** on opposite sides of the saddle **31**, it is known that the end of the pipe line **11** is in fixed space relationship and axial alignment with the pipe section **10**, as shown in FIGURE 1. With the two pipe sections **10** and **11** arranged in this manner, suitable means may be employed to operate the gear mechanism of the present pipeline coupling so as to extend the slidable sleeve **12** outwardly to engage the end of the pipeline **11** in a fluidtight manner, as illustrated in FIGURE 1. One suitable form of apparatus for accomplishing this operation is described and illustrated in U.S. Patent 3,099,316 which is directed to an underwater manipulator device having a power wrench thereon for carrying out operations of this type underwater. The manipulator device is provided with suitable means for lowering through the water as well as propulsion means for moving it through the water to a predetermined position on or adjacent a wellhead or other underwater installation.

While a pipe line connector of the present invention has been described hereinabove as being normally fixedly mounted on the wellhead **26** (FIGURE 3), it is to be understood that in many cases it may be preferred to mount the coupling device on the section of flow line **11** which is to be installed and connected to the underwater wellhead **26**. Thus, any time the underwater pipe line **11** has to be replaced, the power actuated coupling carried at the end of the line could be inspected, repaired and new seals installed, if necessary, before being used on a new section of pipe line to be lowered to the ocean floor.

I claim as my invention:

1. A pipe connector carried at one end of a pipe section and adapted to be extended axially to connect to a second pipe section, said pipe connector comprising:

an outer concentrically mounted tubular sleeve sealingly carried outwardly at the end of said pipe section and slidably mounted for limited axial movement to a position extending beyond the normal end of said pipe section, said pipe section end having an axially-extending slot therein,

a first gear carried outwardly on said sliding tubular sleeve, said first gear comprising a rack fixedly secured to and arranged longitudinally of said sleeve and slidable in said pipe section slot to thereby restrain said sleeve to axial movement,

a second gear carried near the end of said pipe section in engagement with said first gear, said second gear including a pinion fixedly mounted on said pipe section and in rotatable engagement with said rack, and

drive shaft means operatively connected to one of said gears and extending outwardly therefrom for engagement with means for actuating said one gear to move said sliding tubular sleeve axially, the outer end of said sleeve being adapted to sealingly mate telescopically with the terminal end of a second pipe.

2. The pipe connector of claim **1** including seal means carried on the surface of said tubular sleeve near the outer end thereof for sealing against a cooperating sealing surface near one end of a second pipe section.

3. The pipe connector of claim **1** including sleeve stop means formed on said pipe section near the end thereof and engageable with a portion of said sleeve for limiting the axial movement of said sleeve.

4. The pipe connector of claim **1** wherein said pipe section is provided with a longitudinal annular recess extending in from one end and being of a size to contain said sleeve therein with a wall portion of said pipe section extending axially on the inside and on the outside of said sleeve.

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