Aug. 29, 1967 G. S. KNOX 3,338,596

WELL HEAD CONNECTOR

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FIG. 1.

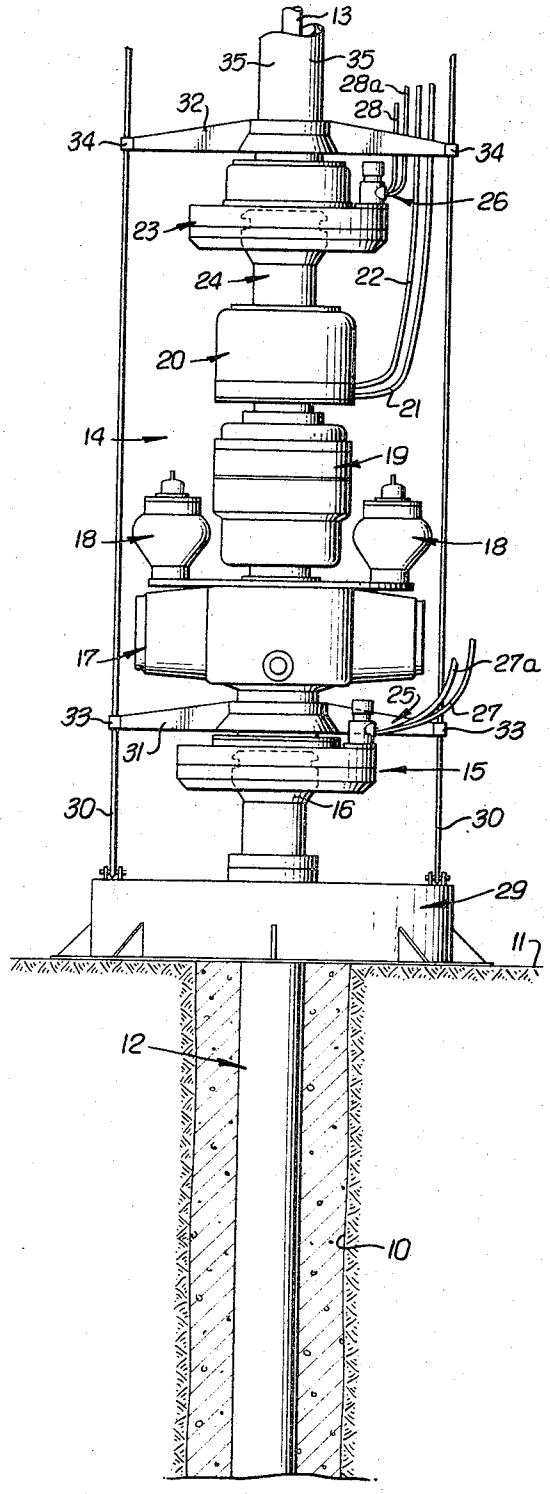


FIG. 4.

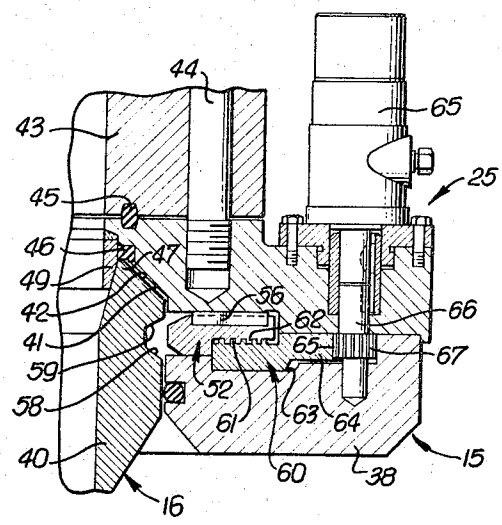
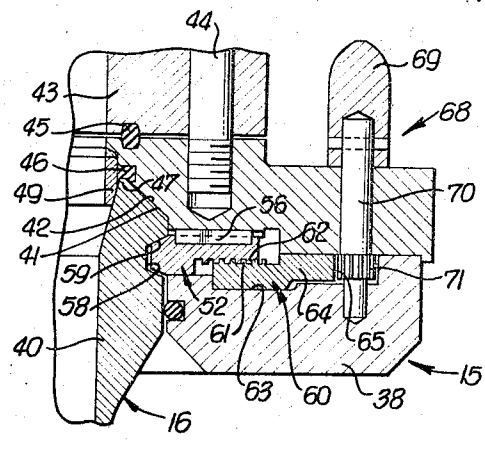


FIG. 5.



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WELL HEAD CONNECTOR

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FIG. 2.

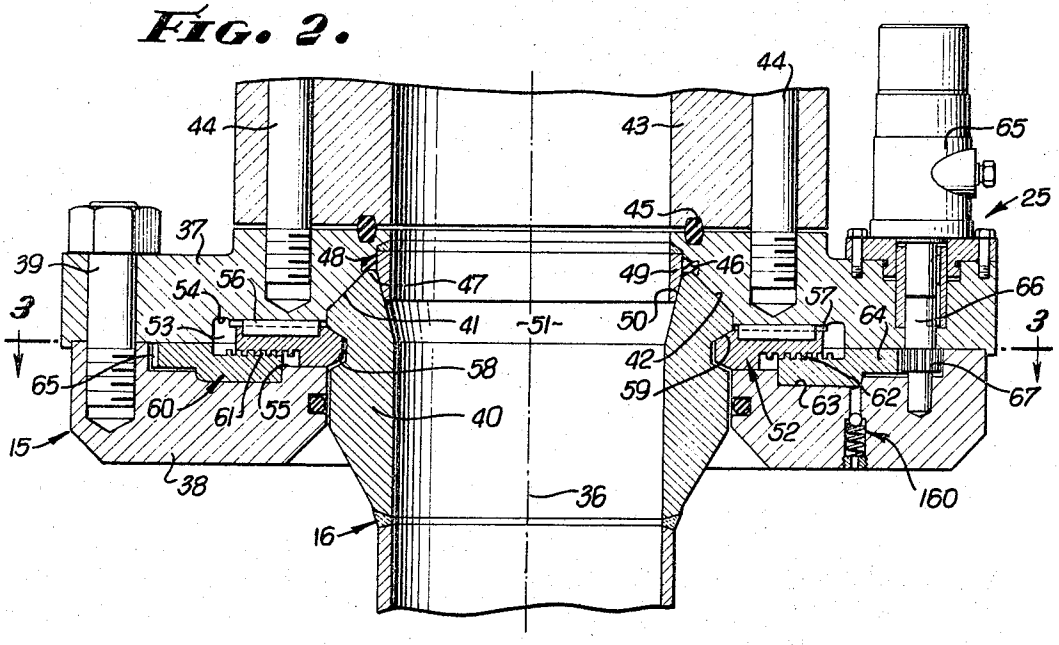
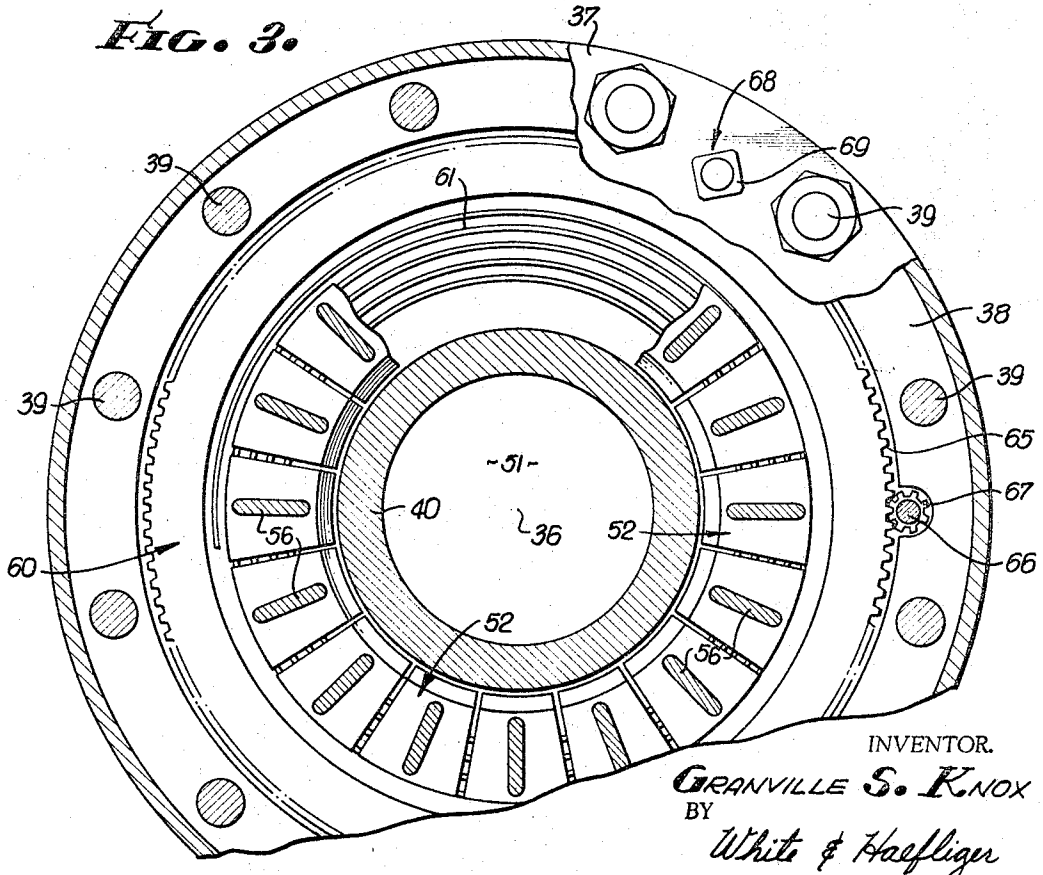


FIG. 3.



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WELL HEAD CONNECTOR

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FIG. 6.

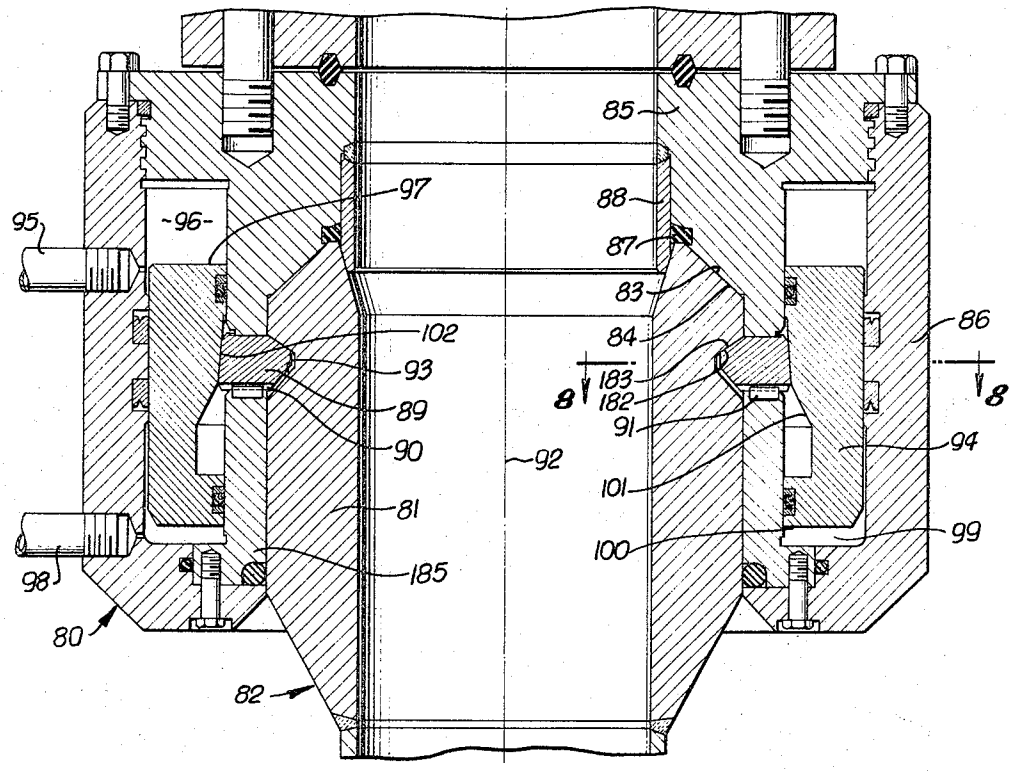


FIG. 7.

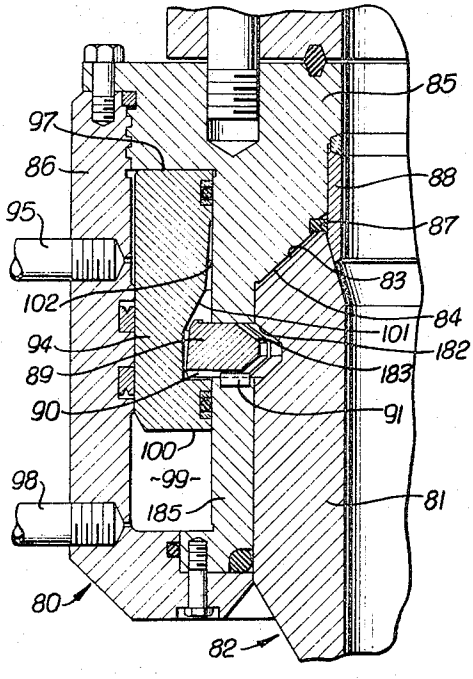
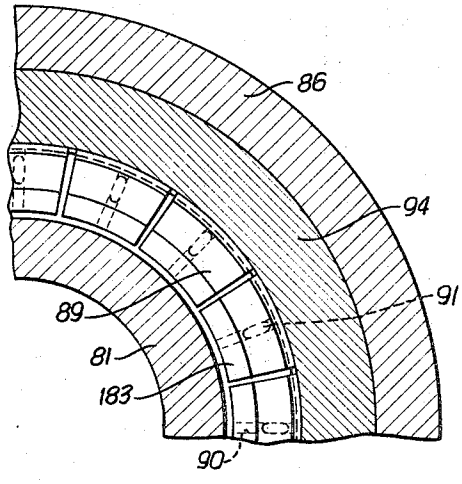


FIG. 8.



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WELL HEAD CONNECTOR

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FIG. 10.

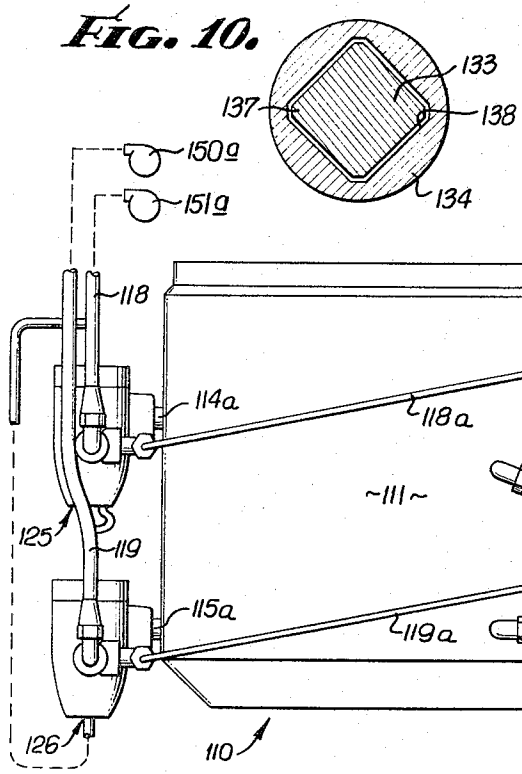


FIG. 9.

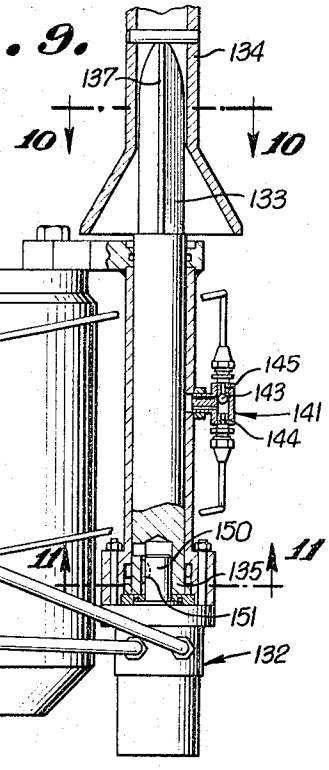


FIG. 12.

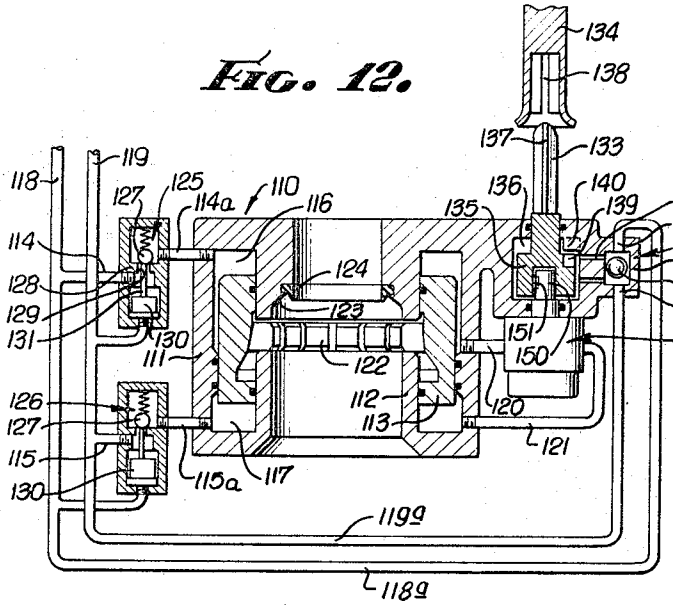
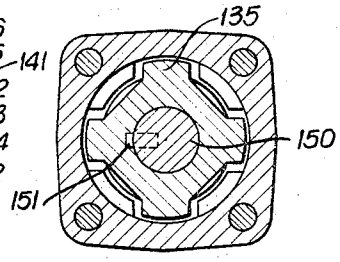


FIG. 11.



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3,338,596

WELL HEAD CONNECTOR

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Filed Aug. 30, 1963, Ser. No. 305,640
14 Claims. (Cl. 285—18)

This invention relates generally to improvements in well head connector assemblies, usable for connecting and sealing well head assemblies to projecting well fittings. More particularly, the invention concerns improvements having to do with unusually advantageous interlocking and sealing features of connector assemblies and well fittings, as will appear.

The use of well head connectors, particularly as adapted to off-shore well drilling and producing operations, are described in my United States Letters Patent 2,962,096. In such an underwater environment where the well head equipment such as blowout preventers, safety valves and the like must operate for long periods of time without care or attention, it becomes extremely important to provide a trouble free, positive and enduring sealing relationship between the connector and the projecting well fitting to which the connector is attached. Also, the interlocking of the connector and fitting, particularly as it may affect the sealing relationship therebetween, is of critical importance.

Accordingly, it is a major object of the present invention to provide an improved well head connector assembly wihch satisfies the above requirements, the construction and operation of the assembly being unusually simple, trouble free and otherwise advantageous as will be brought out. Broadly considered, the improved assembly comprises, in combination, a body connectible in telescopic relation with annular extent of an axially projecting well fitting, the body having a stop engageable with the fitting to locate the body thereagainst, with metallic and non-metallic sealing means carried by the body, the non-metallic sealing means having an annular portion to be compressed generally axially by the fitting terminal when the stop is engaged against the fitting thereby to seal off the body and fitting joint, lock means carried for movement into position interlocking the body and fitting and securing stop and fitting interengagement, and means for moving said lock means into said position. More specifically regarding the establishment of sealing, the non-metallic seal preferably has an annular portion to be axially forcibly compressed by the fitting terminal when the stop shoulder is engaged against the fitting, the metallic seal in the form of a radially compressible metal ring is preferably provided to be carried by the body to engage the fitting and confine the non-metallic seal in a channel and against escape from compression by the fitting terminal. In this regard, a metal-to-metal seal is typically provided by interference engagement of the ring and fitting when tapered extents of the stop and fitting are engaged, the construction being such that the metal-to-metal seal and non-metallic seal complement each other. Thus, in the event of a slight leak through some small imperfection in the metal-to-metal sealing surfaces, the leakage would be positively retained by the non-metallic or elastomeric seal for sufficient time to permit the imperfection to become bridged by rust, tar, wax, sediment or other deposits.

In view of the importance of the sealing relationships described above, and which exist when the body, stop and fitting are interengaged, it becomes important and is another major object of the invention to secure stop and fitting interengagement in response to movement of the lock means. This is accomplished in a broad sense by providing a force responsive actuator operable to move the lock means into locking position together with independently operable primary and auxiliary force transmitting means to operate the actuator. As will appear, one of the primary and auxiliary force transmitting means includes a rotary coupling projection carried by the assembly to be engaged by a rotary tool operable under water and exteriorly of the body.

In one form of the invention, the actuator is rotatable about the connector body axis to operate the lock means, each of the primary and auxiliary force transmitting means having rotary drive transmitting connection with the actuator. In another form of the invention, the actuator is movable axially of the body in response to fluid pressure communication thereto, and the force transmitting means includes primary and secondary sources of fluid pressure and conduits for so communicating said fluid pressure. In addition to the latter, pressure blocking means is provided in series with said conduits for blocking escape through the primary conduit of fluid pressure transmitted to the actuator through the auxiliary conduit, and for blocking escape through the auxiliary conduit of fluid pressure transmitted to the actuator by the primary conduit.

It is a still further object of the invention to provide an improved, efficient, and highly reliable underwater well head assembly wherein multiple connector units are characterized as connectible in novel manner with tubular well head fitting stubs that project upwardly at upper and lower locations. For example, the lower unit is carried by the lower stub and transmits thereto the weight of the interconnected upper stub and upper connector unit. Also, each unit comprises a body having a stop engaging the stub to which the body is connected, thereby to locate the body thereagainst in aligning relation and to transmit weight thereto, and an annular non-metallic seal is carried by the unit to be axially compressed by the stub terminal when stop and stub are engaged, whereby the body and stub joint is sealed off. Here again, the sealing and aligning relationships are assured by lock means forcibly interlocking the body and stub with the stop and stub interengaged.

These and other objects and features of the invention, as well as the details of illustrtaive embodiments, will be more fully understood from the following detailed description of the drawings, in which:

FIGURE 1 is an elevation showing an underwater well head assembly incorporating the invention;

FIGURE 2 is an elevation taken in section showing one preferred form of well head connector incorporating the invention, the connector locked to a well head fitting stub;

FIGURE 3 is a section taken on line 3—3 of FIGURE 2;

FIGURE 4 is a fragmentary elevation in section showing the unlocked condition of the FIGURE 2 connector body and the primary force transmitting means associated therewith;

FIGURE 5 is a fragmentary elevation in section showing the locked condition of the FIGURE 2 connector body and the auxiliary force transmitting means associated therewith;

FIGURE 6 is an elevation taken in section showing another preferred form of well head connector incorporating the invention, the connector locked to a well head fitting stub;

FIGURE 7 is a fragmentary elevation in section showing the unlocked condition of the FIGURE 6 connector body;

FIGURE 8 is a section taken on lines 8—8 of FIGURE 6;

FIGURE 9 is a side elevation of a well head connector similar to the well head connector of FIGURE 6 and

showing primary and auxiliary force transmitting means for operating the piston actuator;

FIGURES 10 and 11 are enlarged sections taken on lines 10 and 11 of FIGURE 9; and

FIGURE 12 is a schematic illustration of the primary and auxiliary force transmitting means for operating the lock actuator.

The invention will first be described in connection with its application to submarine well head fitting stubs, although it will be understood that the use of the invention is not restricted to this particular application. Accordingly, in FIGURE 1 a drill hole 10 sunk beneath the ocean floor 11 contains a string of casing 12 cemented or otherwise affixed in position for further suitable drilling or producing operations. Drill pipe or tubing is shown at 13 above the well head assembly or equipment string generally designated at 14, the pipe extending downwardly through the string and casing.

The well head assembly includes a lower connector unit 15 fastened on to the casing stub 16 projecting upwardly. The lower connector unit carries the equipment generally designated at 17, 18, 19 and 20, and including such items as blowout preventers 17 and 19, hydro-pneumatic accumulators 18, and electrically operated control manifold 20. The latter is supplied with hydraulic pressure as by line 21, a multiple conductor electric cable 22 also running to the control manifold for purposes of controlling hydraulic pressure application to the items 17, 18 and 19. The pressure lines between the manifold and the equipment in the string are not shown in FIGURE 1.

The manifold 20 also controls pressure application to the lower connector unit 15, while an upper connector unit 23 above the manifold 20, attached to a riser or stub fitting 24 is preferably operated from a separate control manifold located at the surface. Attachment of the connector unit 23 to the stub 24 may be in the same manner as attachment of the unit 15 to the stub 16, as will further be described in relation to the different embodiments illustrated. Suffice it to say at this point that the connectors 15 and 23 may be individually operated to attach to or release from their respective stub fittings, connector 15 operating in response to electrical signals transmitted through the cable 21 to the control manifold 20, and connector 23 operating in response to manipulation of a control valve in a manifold located at the surface. Primary force transmitting means associated with the respective connectors are designated at 25 and 26, fluid pressure lines thereto from the control manifolds being indicated at 27, 27*a*, 28 and 28*a*.

To complete the general description of FIGURE 1, the numeral 29 designates the base of a frame for the well head assembly, the frame also including guide lines 30 and transverse members 31 and 32 interconnecting the guide lines at vertically opposite ends of the equipment in the string. The guide lines extend to the surface and the transverse members have slidable connection therewith at 33 and 34 for guiding the parts of assembly 14 downwardly into position as shown. If the connector 23 is released from the stub fitting 24, it may be elevated to the surface as the upper casing 35 is run upwardly. All of the equipment 14 may be pulled to the surface by releasing the connector 15 from the stub 16, and maintaining connection of the connector 23 to the stub fitting 24 while the casing 35 is run upwardly.

Turning now to FIGURES 2–5, the typical connector 15 comprises a body having a vertical axis 36 and upper and lower annular body sections 37 and 38 suitably interconnected as by the fasteners 39. The body is received downwardly over the upper terminal 40 of the stub fitting 16, an annular stop shoulder 41 on the body section 37 facing axially or longitudinally downwardly for engagement with the fitting terminal shoulder 42 to locate the body thereagainst. The stop 41 and the end shoulder 42 are preferably tapered as illustrated to properly axially

align the connector 15 with the stub 16, and provide an extremely rigid seating surface to prevent relative movement between body and stub when these parts are clamped together. Suitable fasteners interconnecting the riser 43 and the body section 37 are shown at 44, and an annular seal is provided at 45 between the elements 43 and 37.

The body 15 carries sealing means such as is shown at 46 and characterized as having an annular portion to be longitudinally forcibly compressed by the fitting terminal 40 when the shoulders 41 and 42 are interengaged, thereby to seal off the body and fitting joint. This sealing means typically comprises an elastomer such as rubber or a suitable plastic such as tetrafluoroethylene. More specifically, the nose portion 47 of the fitting terminal 40 penetrates the seal to compress it in a channel 48 when the shoulders 41 and 42 are properly interengaged. The annular channel is typically constructed to confine the seal against escape from compression by the fitting terminal, and for this purpose the body section 37 carries an inner ring 49 to engage the fitting at the tapered interface 50, whereby the channel 48 containing the seal 46 opens longitudinally to receive penetration of the fitting terminal. Accordingly, the stub terminal 40 and the ring 49 having interference engagement at 50 form a metal-to-metal annular seal through or past which fluid from within the interior 51 must pass before reaching the channel 48 in the first instance. Supplementing this, the internally tenacious, relatively rigid, non-metallic seal 46 compressed by the fitting nose 47 forms a confined annular seal through which any fluid penetrating the metal-to-metal seal must pass to escape the channel 48. Accordingly, a highly reliable dual sealing action is provided in such a way that the seal 46 is not damaged or excessively compressed, and the controlled sealing pressure is evenly annularly distributed around the metal seal 50 and around the non-metallic seal 46 when the shoulders 41 and 42 are interengaged, the latter tapered shoulders providing positive axial alignment and great rigidity so that the great bulk of the loading transferred from the body 15 to the fitting 16 is supported independently of the sealing elements. Relative movement between sealing surfaces, tending to cause deterioration of the seals, is thereby prevented.

It is of importance, as can be seen from the above description, that the shoulders 41 and 42 be brought into and remain in interengagement in order to establish the desired sealing action. For this purpose, the connector assembly includes lock means carried for movement into position interlocking the body 15 and the fitting 16 and securing proper interengagement of the shoulders 41 and 42. The illustrated lock means comprises a series of generally radially movable lugs 52 carried by the connector body and spaced radially outwardly and longitudinally of the ring 49. In particular, the lugs are retained within an annular opening 53 formed by annular recesses 54 and 55 in the upper and lower body sections 37 and 38 respectively. A check valve pressure bleed for space 53 is indicated at 160, and similar bleeds may be provided in the other connectors described herein.

Keys 56 carried by the lug upper portions extend radially and are guided within ways 57 formed by the body upper section 37, the ways extending radially, whereby the lugs or latches 52 are movable toward and away from the axis 36. Such movement brings the lugs into and out of the annular groove 58 sunk in the periphery of the fitting terminal 40. The groove 58 is tapered at 59 to receive lateral thrust exerted by the lugs and to transmit a portion or component of said thrust acting to anchor the body on the fitting with the shoulders 41 and 42 urged into tight interengagement, as seen in FIGURE 2. FIGURE 4 shows the lugs 52 fully retracted laterally from the groove 58 freeing the connector unit 15 from the fitting 16 and with shoulders 41 and 42 slightly separated.

The connector assembly also includes means for moving the lugs between the positions shown in FIGURES 2

and 4, one such means as seen in these figures including an annulus **60** carried by the connector body and having a lock urging shoulder spiraling about the axis **36**, the shoulder typically being carried by the spiral thread **61**. The latter interfits the spiral thread **62** on each of the locking lugs or latches, whereby as the annulus is rotated about the axis **36** the latches are moved inwardly or outwardly depending upon the direction of annulus rotation. As seen in FIGURES 2 and 4, the annulus **60** is received within an annular recess **63** sunk in the lower section **38** of the connector body for guided rotation. A portion **64** of the annulus carries peripheral gear teeth **65** circularly spaced about the axis **36** for receiving drive transmitted by what has previously been referred to as primary and auxiliary force transmitting means.

As shown in FIGURE 2, the primary force transmitting means **25** includes a hydraulic motor **65** carried by the upper body section **37** and driving a shaft **66** carrying a gear **67** in engagement with the peripheral gear teeth **65** of the actuator annulus **60**. Accordingly, the reversible motor **65** may be operated to rotate the annulus in either direction about the axis **36** to lock or unlock the connector **15** to the fitting stub **16**.

The auxiliary force transmitting means to operate the annulus **60** is generally shown at **68** in FIGURES 3 and 5 to include a rotary coupling projection **69** carried by the assembly to be engaged by a rotary tool operable underwater and exteriorly of the connector body. Further reference to the type of tool which may be used will be made at a later point in the description. Suffice it to say at this time, that the auxiliary force transmitting means in this instance is mechanical in nature, and that rotary drive may be transmitted from the projection **69** to the rotary shaft **70** and to an auxiliary gear **71** which engages the teeth **65** on the actuator annulus, thereby to rotate the latter. The auxiliary means **68** is free to idle when the primary force transmitting means **25** is operated, but in the event of malfunction of the latter, the means **69** may be operated independently to unlock or lock the connector with respect to the fitting **16**.

Referring now to FIGURES 6–8, a modified connector is illustrated at **80** as connectible with the terminal **81** of the stub fitting **82**. As before, the terminal **81** comprises an enlarged head with a tapering terminal shoulder **83** sized to engage a stop shoulder **84** on the connector body. The latter includes interconnected inner and outer annular sections **85** and **86**, the inner section carrying a non-metallic annular seal **87**, a metallic ring seal **88**, the stop shoulder **84**, and a circular series of locking lugs **89**. The functioning and general construction of the elements **83–88** is substantially the same as previously described in connection with the corresponding elements of FIGURE 2.

In this form of the invention, the locking lugs or latches **89** have radially extending slots or ways **90** receiving the radial keys or guides **91** carried by the body inner section **185** as shown. Accordingly, the lugs are guided for movement toward and away from the axis **92** of the body and fitting, and into and out of the annular groove **93** sunk in the periphery of the terminal **81**. The groove is tapered at **182** to match the taper **183** of the lugs **89**, in order to transmit a component of laterally exerted thrust such as will pull or maintain the shoulders **83** and **84** in correct and positive interengagement during the connection process.

FIGURE 6 shows a lock moving means in the form of a force responsive annular actuator **94** located generally in the space or chamber between the inner body sections **85** and **185** and outer body section **86** so as to be movable longitudinally therein. Such movement is effected in the down direction by communication of pressure through line **95** to the pressure space **96** above the upper pressure face **97** of the actuator, any fluid below the actuator exiting through the pressure line **98**. Conversely, upward movement of the actuator occurs when pressure is communicated through line **98** to the space **99** below the actuator pressure face **100**, line **95** then exhausting any fluid from the upper space **96**. During the down stroke of the actuator, the lock camming and blocking surfaces **101** and **102** are brought sequentially into engagement with the outer surfaces of the locking latches or lugs **89**, thereby to cam them into the position shown in FIGURE 6, and hold them in said position against dislodgment therefrom. FIGURE 7 shows the actuator **94** in the up position prior to urging of the latches **89** into interlocking relation with the fitting **82**. It is also clear that after the actuator **94** has been returned back up to the position shown in FIGURE 7, from the position shown in FIGURE 6, the connector **80** may be lifted off the fitting terminal **81** since the latches **89** will become displaced outwardly to the position shown in FIGURE 7 as their surfaces or tapers **183** bear against the recess taper **182**.

Referring now to FIGURES 10–12, the description of the connector, as it may actually be constructed in FIGURE 9 and as it is schematically shown in FIGURE 12, will proceed with the same numerals applied to the corresponding elements in these figures. The connector is generally designated at **110**, and includes outer and inner members or shells **111** and **112** suitably interconnected. An annular actuator is shown at **113** to have the same general configuration and operation as the actuator **94** in FIGURES 6–8. Thus, primary force transmission to the actuator is accomplished by pressure fluid transmission through the primary conduits **114** and **115**, the former conduit communicating with the space **116** above the actuator to urge it downwardly by pressure application thereto, and latter conduit **115** communicating with the space **117** below the actuator to urge it upwardly in response to pressure exertion thereagainst. Fluid pressure lines **118** and **119** transmit pressure from a source to the respective conduits **114** and **115** as shown. Sources of fluid pressure such as pumps appear at **150***a* and **151***a*.

Auxiliary force transmission to the actuator **113** occurs through the auxiliary conduits **120** and **121**, the former communicating with the space **116** and the latter with the space **117**. As the actuator moves downward longitudinally, the locks or latches **122** will be displaced inwardly in the same manner as described in connection with FIGURES 6 and 7. Such functioning will take place after the connector is received in telescopic interconnecting relation with a stub fitting terminal of the same type as described and shown at **81** and **82** of FIGURES 6 and 7. In this connection, the stop shoulder **123** and non-metallic seal **124** illustrated in FIGURE 12 correspond to the stop **84** and seal **87** in FIGURES 6 and 7.

It will also be seen from FIGURES 9 and 12 that pressure blocking means is provided in series communication with the primary and auxiliary conduits for blocking escape through the primary conduits of fluid pressure transmitted to the actuator by the auxiliary conduits, and for blocking escape through the auxiliary conduits of fluid pressure transmitted to the actuator by the primary conduits. Thus, in the embodiment illustrated, the pressure blocking means includes a pilot operated ball check valve unit **125** in series with the primary conduit sections **114** and **114***a*, and a pilot operated ball check valve unit **126** in series communication with the primary conduits **115** and **115***a*. Referring to the check valve unit **125**, as pressure fluid starts to exhaust through the primary conduit **114***a*, the ball **127** seats on the flange **128** to block escape through the port **129** and to the supply conduit **114**, assuming no pressure transmission from conduit **119** to the underside of the piston **130** such as would lift the stem **131** to prevent seating of the ball. In similar manner, the ball check valve unit **126** functions to block escape of pressure through conduit section **115***a*, assuming the absence of sufficient pressure transmission through conduit **118** as would act against corresponding piston **130** to un-

seat the ball of said unit **126**. Such conditions would prevail where the lines **118** and **119** might be ruptured for any reason.

Accordingly, the auxiliary force transmitting means would then operate the actuator to connect or disconnect from the stub fitting. Such auxiliary force transmission in either direction through the auxiliary conduits **120** and **121** is effected by a rotary pump **132** driven in forward or reverse rotary directions by the turning of the rotary coupling projection **133**, a tool **134** being usable for this purpose. The pump **132** may be of the positive displacement type in series with the conduits **120** and **121**. Drive from the projection **133** to the pump is accomplished through a rotary coupling element **135** to which the projection **133** may be made integral, as shown, and to pump impeller shaft **150** keyed at **151** to the element **135**. When the element **135** is in a down position within the chamber **136** in the connector body, as shown, the pump **132** is adapted to be rotated by turning of the projection **133**, the latter having splines **137** engageable with the tool grooves **138** for torque transmitting purposes. On the other hand, when the coupling element **135** is in an up position with a notch **139** therein receiving a clutch tongue **140** carried by the connector body, drive from the projection **133** to the pump **132**, and rotation of the pump impeller, are blocked. Under these conditions, escape of pressure fluid through the auxiliary conduits **120** and **121** is blocked. This blocking configuration is existent under normal conditions when primary pressure is transmitted through either of the conduits **118** and **119** to drive the actuator **113** in either direction. Such primary pressure passing, for example, through conduits **114** and **114***a* acts to drive the actuator **113** downward. Accordingly, fluid in space **117** exhausts through conduit sections **115***a* and **115** since the ball **127** of unit **126** is then unseated by upward travel of piston **130** to the underside of which pressure is applied from conduit **118**, as shown.

In order to ensure clutching of the pump **132** against rotation as just described and during normal operation, the coupling element **135** is made responsive to application of pressure exerted through the primary conduiting **118** and **119** to effect movement of the element into up or clutching position. For this purpose, a pilot valve unit **141** is provided to communicate between the primary conduit extensions **118***a* and **119***a* and the rotary coupling element **135** to pass fluid pressure to said element from one of the primary conduits while blocking leakage thereto via the other primary conduit, and vice versa. For example, the pilot valve chamber **142** typically contains a pilot valve in the form of a pressure responsive ball **143** freely movable to block the chamber inlet **144** when fluid pressure is transmitted from conduit **119**, through the chamber inlet **145** and to the underside of the coupling element **135**. Conversely, the pilot ball is movable to block the inlet **145** when pressure is communicated from conduit **118** through the inlet **144** and outlet **146** to the underside of the coupling element **135**. Accordingly, the control of the actuator is accomplished by independently operable main and standby controls which function independently and in a simple and foolproof manner, to accomplish the desired connection and disconnection to a stub fitting.

I claim:

1. The combination of an improved well head connector assembly and a well fitting, comprising:

an upwardly projecting hollow well fitting having an axis and an internal wall surface parallel to said axis, an upper annular nose on said fitting, said nose being defined by two relatively angulated annular surfaces meeting at an apex, the first of said angulated surfaces being downwardly and inwardly directed forming a continuation of and intersecting said inner wall surface at a relatively steep obtuse angle, the second angulated surface being upwardly and inwardly directed and intersecting an imaginary upward extension of said inner wall surface at a relatively small acute angle and forming a stop shoulder, said apex being radially outward of said inner wall surface and above the intersection of said first angulated surface with said inner wall surface,

a well head connector assembly having a body receivable downwardly in axial telescopic relation with said fitting, said body including

a metallic ring attached to said body in a cantilever fashion to project downwardly therefrom, said ring having a radially outer annular sealing surface tapering downwardly complementary to said first angulated surface for forcible engagement therewith along a first frusto-conical interengagement locus,

an annular channel formed in said body radially outwardly from and adjacent to the locus of attachment of said metallic ring, and a relatively rigid elastomeric seal received in said annular channel and exposed downwardly for upward compression of the seal by said nose,

an annular stop shoulder formed in said body radially outwardly from and adjacent to said annular channel, said stop shoulder of the body being tapered downwardly and outwardly complementary to said second angulated surface to receive and engage the relatively acute taper of said fitting stop shoulder, the mass of said nose portion between said angulated surfaces being considerably greater than that of said ring, so as said fitting is received into said body along a second frusto-conical interengagement locus said stop shoulder limits axial penetration of said nose into the seal and the relatively large mass thereof limits radial forces supplied inwardly to said metallic ring by said sealing surface of said fitting, and

lock mean carried by said body and operable for lateral movement into a position interlocking the body and fitting by engaging the fitting and exerting a force which urges said body downwardly.

2. The invention as defined in claim **1**, in which said lock means comprises a series of generally radially movable lugs spaced radially outwardly and longitudinally of said ring.

3. The invention as defined in claim **2**, in which said body has a vertical axis and includes interconnected upper and lower annular sections, the upper section carrying said seal, ring and body stop shoulder, and the lower section carrying portions of said locking lugs.

4. The invention as defined in claim **2**, in which said body has an axis and includes interconnected inner and outer annular sections, the inner section carrying said seal, ring, body stop shoulder and locking lugs, said lock moving means comprising a force responsive actuator located generally between said inner and outer sections and being movable axially.

5. The invention as defined in claim **1**, including said fitting which is tubular and has an enlarged head with peripheral grooving tapered to receive lateral thrust exerted by said lock means and to transmit a component of said thrust acting to anchor said body on the fitting with said stop shoulders urged into interengagement.

6. In a well head assembly, a body connectible in telescopic relation with annular extent of an axially projecting well head fitting, the body having a stop engageable with the fitting to locate the body thereagainst, sealing means carried by the body and having an annular portion to engage the fitting and seal off the body and fitting joint when the fitting engages said stop, lock means carried for movement into position interlocking the body and fitting and securing stop and fitting interengagement, means including a force responsive actuator operable to move said lock means into said position, and independently operable primary and auxiliary force transmitting means to operate the actuator, one of said primary and auxiliary force

transmitting means including a rotary coupling projection carried by the assembly to be engaged by a rotary tool operable under water and exteriorly of said body, said body extending longitudinally axially and carrying said actuator for rotation about said axis to operate said lock means, each of said primary and auxiliary force transmitting means having rotary drive transmitting connection with the actuator.

7. The invention as defined in claim 6, in which said actuator comprises an annulus having a lock urging shoulder spiraling about said axis and a series of rotary teeth extending about said axis for receiving drive transmitted by each of said primary and auxiliary force transmitting means.

8. In a well head assembly, a body connectible in telescopic relation with annular extent of an axially projecting well head fitting, the body having a stop engageable with the fitting to locate the body thereagainst, sealing means carried by the body and having an annular portion to engage the fitting and seal off the body and fitting joint when the fitting engages said stop, lock means carried for movement into position interlocking the body and fitting and securing stop and fitting interengagement, means including a force responsive actuator operable to move said lock means into said position, and independently operable primary and auxiliary force transmitting means to operate the actuator, one of said primary and auxiliary force transmitting means including a rotary coupling projection carried by the assembly to be engaged by a rotary tool operable under water and exteriorly of said body, said primary and auxiliary force transmitting means respectively including primary and auxiliary conduits for conducting fluid pressure operable to displace the actuator axially relative to said body, thereby to move said lock means, and pressure blocking means in series communication with said conduits for blocking escape through the primary conduit of fluid pressure transmitted to the actuator by said auxiliary means, and for blocking escape through the auxiliary conduit of fluid pressure transmitted to the actuator by said primary means.

9. The invention as defined in claim 8, in which said pressure blocking means includes check valves in series communication with primary conduits for passing fluid pressure therethrough to reciprocate the actuator.

10. The invention as defined in claim 9, in which said pressure blocking means includes a positive displacement type pump in series communication with auxiliary conduits for passing fluid therethrough to reciprocate the actuator.

11. The invention as defined in claim 8, in which said auxiliary force transmitting means includes a rotary coupling element communicable with said primary conduiting and responsive to application of pressure exerted therethrough to effect movement of said element into position for engagement with a member blocking rotation of said element, whereby said auxiliary force transmitting means is deactivated while said primary force transmitting means operates to conduct fluid pressure to the actuator, said projection having driving connection with said element.

12. The invention as defined in claim 11, including a pilot valve communicating between said primary conduits and said rotary coupling element to pass fluid pressure to said element from one primary conduit while blocking leakage thereof via the other primary conduit, and to pass fluid pressure to said element from said other primary conduit while blocking leakage thereof via said one primary conduit.

13. The invention as defined in claim 12, including a pilot valve chamber containing said pilot valve and a control chamber containing said element, said pilot valve chamber having an outlet communicating with said control chamber and first and second inlets respectively to admit fluid pressure from said primary conduits for communication through said outlet to said control chamber and element therein.

14. The invention as defined in claim 13, in which said pilot valve comprises a pressure responsive ball freely movable to block the first inlet in response to fluid pressure admission through the second inlet, and to block the second inlet in response to fluid pressure admission through the first inlet.

References Cited

UNITED STATES PATENTS

2,330,864	10/1943	Bruno	285—331
2,535,599	12/1950	Preston.	
2,568,232	9/1951	Hamer	285—332.2
2,956,818	10/1960	Dickerson.	
3,147,992	9/1964	Haeber.	
3,216,747	11/1965	Green	285—334.4
3,222,088	12/1965	Haeber	285—18
3,222,089	12/1965	Otteman	285—18
3,228,715	1/1966	Neilon	285—313

FOREIGN PATENTS

1,310,713	10/1962	France.
794,551	5/1958	Great Britain.

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