June 13, 1961 E. H. CLARK, JR 2,988,145

WELL BORE DRILLING AND CEMENTING APPARATUS

Filed Dec. 3, 1956 2 Sheets-Sheet 1

FIG. 2.

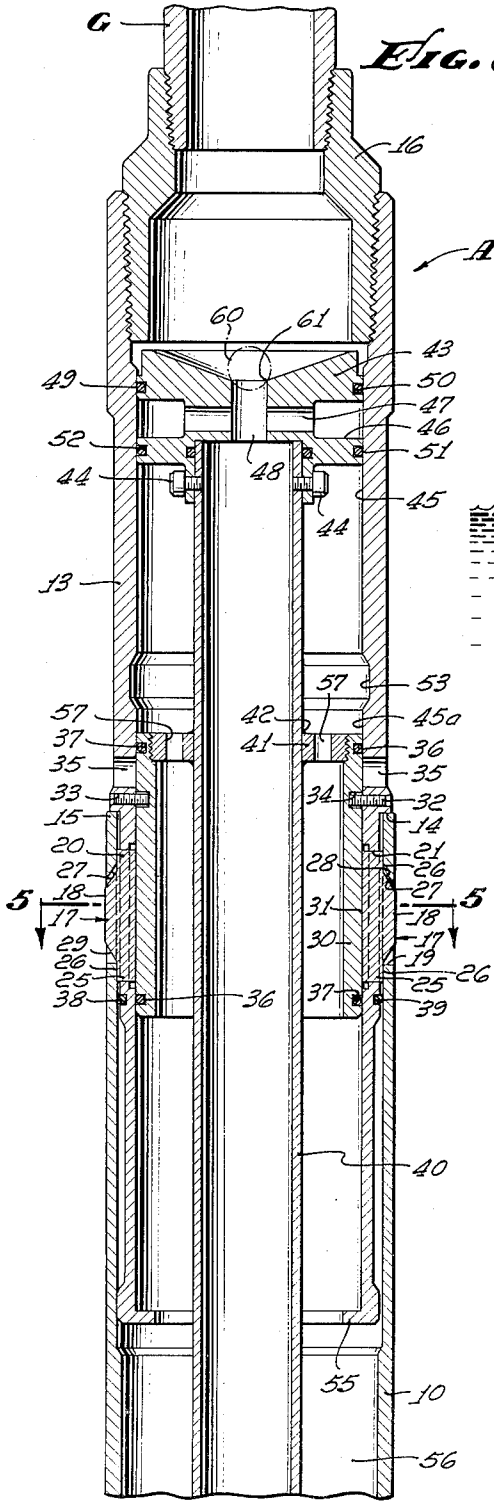
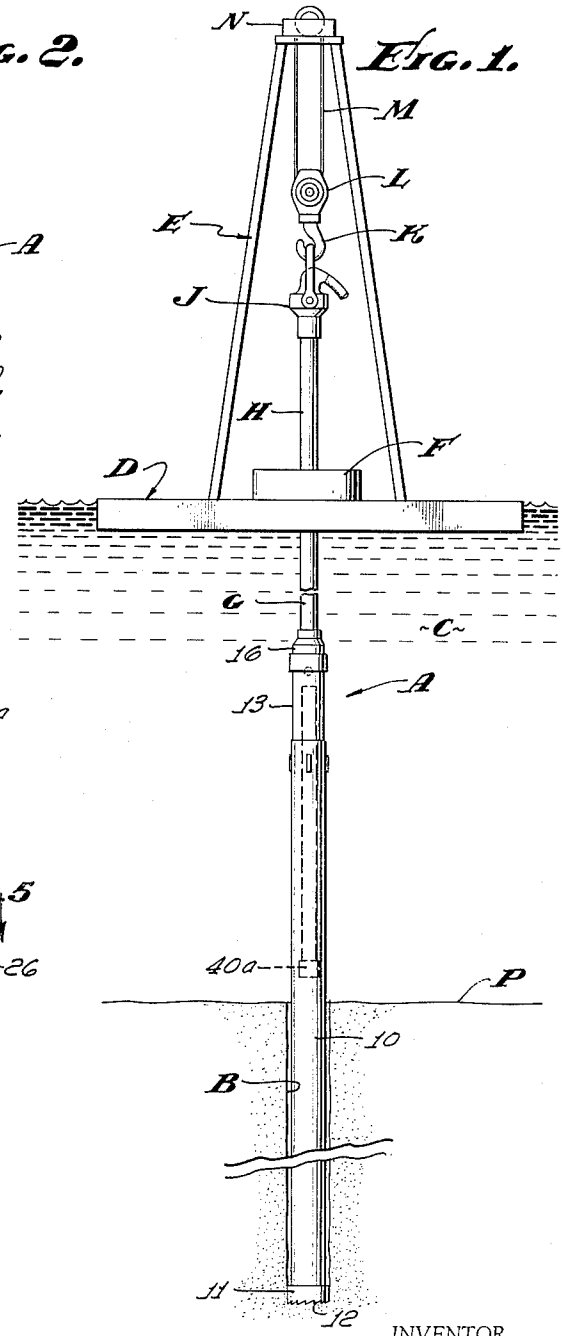


FIG. 1.



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WELL BORE DRILLING AND CEMENTING APPARATUS

Filed Dec. 3, 1956 2 Sheets-Sheet 2

Fig. 3.

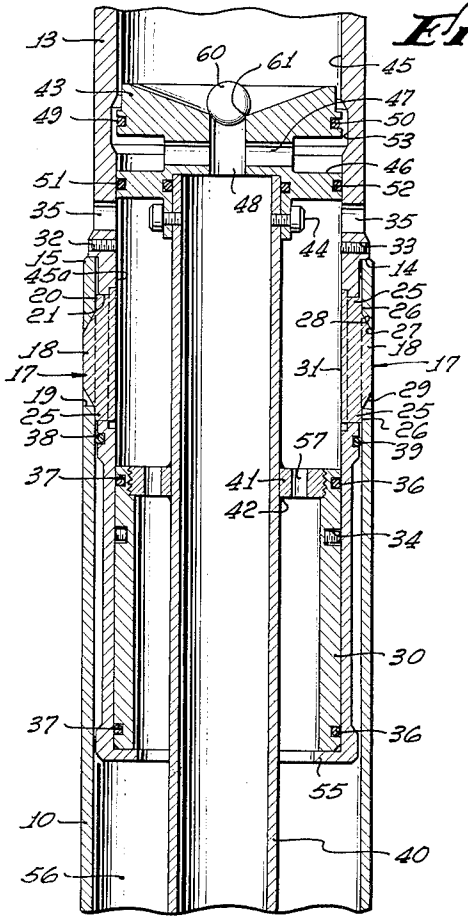


Fig. 4.

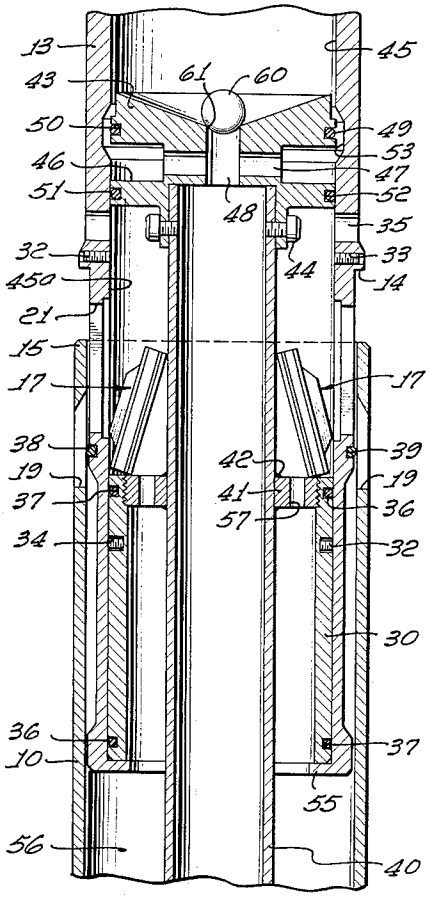
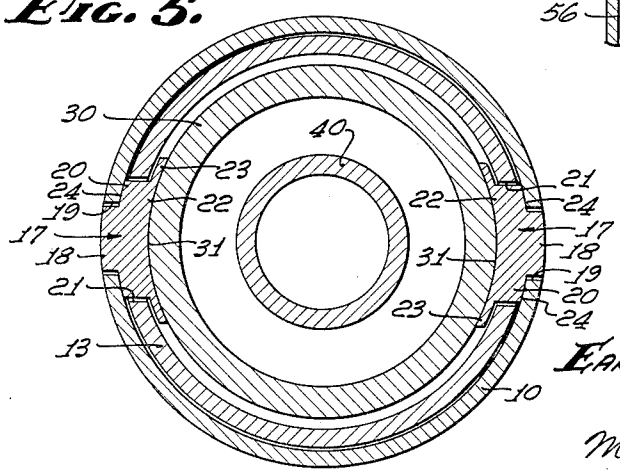


Fig. 5.



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WELL BORE DRILLING AND CEMENTING APPARATUS

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Filed Dec. 3, 1956, Ser. No. 625,990
24 Claims. (Cl. 175—317)

The present invention relates to apparatus particularly useful in the drilling of well bores and in the cementing of well casing, and the like, therein.

Some well bores are drilled from offshore locations into the floor of a body of water, such as the ocean. A comparatively large diameter hole is first drilled to receive the conductor or surface pipe or casing, which may be one or several hundred feet in length, this pipe then being cemented in place. The upper end of the conductor pipe may be slightly above the ocean floor when the pipe is cemented in place. In the performance of subsequent operations in the well bore, equipment must be lowered through the body of water and directed into the upper end of the conductor pipe therebelow, which may be difficult of performance unless the equipment can be properly centered with respect to the conductor pipe.

Accordingly, it is an object of the present invention to provide improved well apparatus that utilizes the conductor pipe as an instrumentality in drilling the hole in which the conductor pipe is to be disposed, and which is also capable of use in cementing the conductor pipe in place.

Another object of the invention is to provide apparatus of the character indicated, in which assurance is had that no cement will be present within the uppermost portion of the conductor pipe, thereby insuring the proper entry of other equipment into the conductor pipe for the performance of other operation, such as the drilling of the hole below the conductor pipe.

A further object of the invention is to provide apparatus capable of rotating the conductor pipe in drilling the upper portion of the well bore, of cementing the conductor pipe in place, and of being readily released from the conductor pipe after the cementing operation has been completed.

An additional object of the invention is to provide apparatus for rotating conductor pipe or casing in the drilling of a well bore, the apparatus being releasable from the pipe or casing whenever desired, without the necessity for turning the apparatus in any direction.

Yet another object of the invention is to provide apparatus for rotating casing in the drilling of a well bore, which is also capable of use in cementing the casing in place, circulating excess cement from the casing, and of being released from the casing. In a more limited sense, the conditioning of the apparatus to circulate excess cement from the casing also results in the release of the apparatus from the casing.

Still a further object of the invention is to provide tubular apparatus for rotating casing in the drilling of a well bore, and embodying a connection with the casing through which the drilling torque is transmitted, such connection being readily released to disconnect the apparatus from the casing.

This invention possesses many other advantages, and has other objects which may be made more clearly apparent from a consideration of a form in which it may be embodied. This form is shown in the drawings accompanying and forming part of the present specification. It will now be described in detail, for the purpose of illustrating the general principles of the invention; but it is to be understood that such detailed description is not to

be taken in a limiting sense, since the scope of the invention is best defined by the appended claims.

Referring to the drawings:

FIGURE 1 is a diagrammatic side elevational view of apparatus embodying the invention and associated equipment for drilling a well bore at an offshore location;

FIG. 2 is a longitudinal section through the apparatus, with its parts conditioned for rotating the conductor pipe or casing;

FIG. 3 is a view similar to FIG. 2, disclosing the apparatus conditioned for circulating excess cement slurry from the interior thereof;

FIG. 4 is a view similar to FIG. 2, illustrating the apparatus released from the conductor pipe or well casing, to which it has been originally connected;

FIG. 5 is an enlarged cross-section taken along the line 5—5 on FIG. 2.

The apparatus A is illustrated in FIG. 1 of the drawings as being used in the drilling of a well bore B at an offshore location and through a body of water C, such as the ocean or sea, the drilling operation being conducted from a drilling barge D floating at the surface of the water and being suitably anchored to prevent its lateral movement. A derrick E of any suitable type is mounted on the drilling barge, the barge having a rotary table F and drive mechanism for rotating the drill string G, the upper Kelly portion H of which is slidably splined to the rotary table is a known manner. The entire drill string G is carried in the usual manner by a swivel J suspended from the hook K of the traveling block L connected through the usual lines M to the crown block N at the top of the derrick and thence to a suitable drawworks (not shown) mounted on the barge D.

The drilling of the well bore B commences at the floor P of the ocean. As illustrated, it is desired to use the conductor pipe or casing **10** in the drilling of the bore hole B, such conductor pipe or casing being cemented in place after the well bore has been carried to the desired depth. Thus, the conductor pipe or casing **10** has a drive shoe **11** provided with suitable teeth **12** at its lower end, which is to dig into the bottom of the hole B and effect its disintegration. The upper end of the conductor pipe **10** is releasably connected to a tubular drive member **13** through which the drilling weight is imposed on the conductor pipe or drill casing **10** and the drive shoe **11** attached thereto, and through which the drilling torque is also transmitted. This tubular drive member **13** is piloted within the upper portion of the conductor pipe **10** and has a downwardly facing shoulder **14** engaging the upper end **15** of the conductor pipe **10** to transmit the drilling weight therebetween. The upper end of the drive member **13** is threadedly secured to an adapter or stub **16** that is, in turn, threadedly secured to the lower end of the string of drill pipe or drill casing G, the upper part of which is constituted by the kelly H extending through the rotary table F, and which is connected to the swivel J.

The drilling torque is transmitted from the drill pipe G to the adapter sub **16** and the tubular drive member **13**, and from the latter to the conductor casing **10** through the agency of a plurality of drive or coupling keys **17**. Each key includes an outer portion **18** fitting within a companion slot **19** in the upper part of the conductor pipe **10**, an intermediate portion **20** of greater width than the outer portion fitting within a companion longitudinal slot **21** in the tubular drive member **13**, and an inner portion **22** of greater width than the intermediate portion which is disposed within the tubular drive member **13** to provide oppositely directed flanges or stop surfaces **23** adapted to engage the inner wall of the tubular drive member. The intermediate portion **20** of each key is also provided with longitudinal flanges or stop shoulders **24** engageable with the inner surface or wall of the con-

ductor pipe 10, so as to limit the outward expansion of the outer portion 18 of each key 17 within its companion slot 19 in the conductor pipe.

The intermediate and inner portions 20, 22 of each key have their upper and lower end portions 25 extending beyond the corresponding portions of the outer end 18 of each key, so that the intermediate portion has upper and lower shoulders 26 engaging the inner wall of the conductor pipe 10 when the outer portion 18 of the key is disposed within the companion slot 19 in the conductor pipe. In addition, to facilitate release and removal of each key 17 from its companion slot in the conductor pipe, the upper ends 27, 28 of each slot 19 and outer key portion 18 are inclined in an upward and inward direction. The lower end 29 of the outer key portion may also be inclined in a downward and inward direction, so as to be assured that there will be companion tapered surfaces between the outer key portion 18 and the upper end 27 of the conductor pipe slot in the event the keys 17 were assembled in an inverted position.

The keys 17 are initially retained in coupling relation between the tubular drive member 13 and the conductor casing 10 by a retainer or holding sleeve 30 within the tubular drive member which engages the back surfaces 31 of the keys, to insure a snug and full retention of the latter in their proper assembled relation. The inner faces 31 of the keys are curved or arcuate to conform to the periphery of the holding sleeve 30. This holding sleeve is initially retained in the position just referred to by one or more shear screws or pins 32 threaded laterally through threaded holes 33 in the tubular drive member 13 and received in a peripheral groove 34 in the holding sleeve. While the shear screws or pins 32 are intact, the sleeve 30 is also disposed across a plurality of outlet circulation ports 35 in the tubular drive member above its drilling weight transmitting shoulder 14. Seal rings 36, such as rubber or rubber-like O rings, are disposed in peripheral grooves 37 in the sleeve, engaging the inner wall of the tubular drive member 13 above the ports 35 and below the slots 21, to prevent leakage of fluid between the sleeve 30 and the tubular drive member 13. Fluid leakage between the drive member 13 and casing 10 is prevented by a seal ring 38 located in a groove 39 in the drive member and engaging the casing 10 below the slots 19.

The retaining or holding sleeve 30 is connected to a central tubular member 40 by having its upper portion threadedly secured to a ring 41 encompassing the tubular member, to which the ring is suitably attached, as by use of welding material 42. This tubular member 40 extends upwardly into the tubular drive member 13, and also downwardly into the conductor casing 10 to any desired distance, as, for example, about ten feet. The tubing extends into the conductor pipe or drill casing 10 to a substantial extent, to insure the absence of cement in the upper portion of the conductor pipe after the operation of cementing the casing in the well bore has been completed. The tubing 40 also has the purpose of effecting release of the retaining sleeve 30 whenever the coupling keys 17 are to be released, in order to disconnect the tubular drive member 13 from the conductor pipe 10.

The upper end of the tubing 40 is piloted within a circulation head 43, to which it is suitably secured by one or more cap screws 44, this circulating head making a sliding fit with the cylindrical inner wall 45 of the tubular drive member 13. The circulation head 43 has an intermediate annular groove 46 that communicates with lateral or radial circulation ports 47 opening into a central passage 48 through the head. A seal ring 49, such as a rubber or rubber-like O ring, is disposed in a peripheral groove 50 in the head above the circulation groove 47; whereas, a similar seal ring 51 is disposed in a peripheral groove 52 in the head below the circulation groove 47. These seal rings 49, 51 will prevent leakage of fluid around the head 44 when sealingly engaged with the cylindrical wall 45 of the tubular drive member 13. At the lower end of the cylindrical inner wall 45 is an elongate inner by-pass groove 53 in the tubular drive member, below which is a lower cylindrical inner wall 45*a* of the tubular drive member of the same internal diameter as the cylindrical wall 45 thereabove. The lower seal ring 51 on the head 44, as explained hereinbelow, is adapted to seal against the lower cylindrical wall portion 45*a* below the by-pass groove 53. Such sealing engagement will occur when the shear screws 32 are disrupted, whereupon the circulation head 44, tubing 40, connecting ring 41 and holding sleeve 30 can shift downwardly to a position in which the lower end of the holding sleeve engages an inwardly directed stop flange or shoulder 55 on the tubular drive member 13. When this occurs, the lower seal ring 51 on the head will engage the lower cylindrical wall portion 45*a* of the tubular drive member 13, while the retaining sleeve 30 will be disposed below the drive or coupling keys 17, permitting the latter to shift inwardly of the tubular drive member and conductor pipe 10, to disconnect the tubular drive member from the conductor pipe.

When the holding sleeve 30 is in the lowermost position in engagement with the stop flange 55 on the tubular drive member 13, fluid is permitted to pass upwardly through the annular space 56 between the tubing 40 and the conductor casing 10, through the holding sleeve 30, such fluid continuing to pass through the circulation ports 57 in the coupling ring, and thence outwardly through the circulation ports 35 in the tubular drive member, in the manner described hereinbelow.

The apparatus A is releasably coupled to the upper portion of the drill or conductor casing 10, which has the drive or drilling shoe 11 on its lower end, the parts occupying the positions disclosed in FIG. 2, in which the retaining sleeve 30 is disposed across the outlet ports 35 of the tubular drive member 13 and behind the keys 17, to hold the latter in a position coupling the tubular drive member 13 to the conductor pipe 10. At this time, the circulation head 44 is disposed in its uppermost position and is sealed against the upper cylindrical wall 45 of the tubular drive member. The tubular drill string G is connected to the tubular drive member 13 through the agency of the sub 16, and the drill string is lowered until the drive shoe 11 engages the floor P of the ocean, after which the drill string G is rotated at the proper speed by means of the rotary table F, the torque being transmitted through the tubular drive member 13 and the keys 17 to the drill casing or conductor pipe 10. At the same time, appropriate drilling weight can be imposed on the drive shoe or drill bit 11 at the lower end of the drill casing through engagement of the tubular drive member shoulder 14 with the upper end 15 of the drill casing. Circulating fluid is pumped through the swivel J and down through the drill string G, passing through the sub 16 and the central passage 49 of the circulation head 44, continuing on down through the central tubing 40 and discharging therefrom into the conductor pipe 10. At this time, the fluid cannot pass upwardly around the central tubing 40, since the outlet or circulation ports 35 are closed by the sleeve 30. Consequently, the circulating fluid must pass down through the conductor pipe 10 to its lower end, carrying the cuttings developed by the drive shoe 11 away from the bottom of the well bore and upwardly around the conductor pipe 10 to the ocean floor P.

The drilling action will continue in the manner just described until a sufficient length of bore hole B has been drilled to accommodate the length of conductor pipe 10 releasably secured to the tubular drive member 13. Actually, it is preferred that the hole B be drilled to a depth such that the upper end of the conductor pipe is disposed slightly above the ocean floor, such as, for example, five feet. When the desired length of bore hole has been drilled, the conductor pipe 10 is cemented in place without the necessity for withdrawing the conductor pipe, or any of the apparatus connected thereto, from

the well bore. The required amount of cement slurry to cement the conductor pipe **10** in the well bore B is mixed and pumped down through the drill string G, passing through the adapter sub **16** and the central head passage **49** into the central tubing **40**, such cement slurry discharging into the conductor pipe **10** below the lower end **40***a* of the tubing and proceeding downwardly through the conductor pipe **10**, exhausting from its lower end **11** and then passing upwardly through the annulus around the conductor pipe **10** back to the floor of the ocean P. A sufficient quantity of cement slurry is usually mixed and pumped in place as to not only fill the well bore annulus around the conductor pipe **10**, but also to fill the conductor pipe itself. However, the cement probably will not extend within the conductor pipe substantially above the lower end **40***a* of the central tubing **40**, since the fluid in the conductor pipe above the lower end of the tubing is a dead column and has no place into which it can be displaced. However, even if a substantial quantity of cement slurry does pass upwardly around the tubing **40**, it can be circulated out of the conductor casing **10** above the lower end **40***a* of the tubing through use of the present apparatus.

When the desired quantity of cement slurry has been pumped into the casing **10**, a valve member or plug **60**, such as a ball, may be dropped through the drill string G or may actually be disposed at the upper end of the charge of cement slurry, this ball coming to rest upon a companion valve seat **61** at the upper end of the head **44** and around the central passage **49**, to preclude further downward flow of fluid through the central passage. Pressure may now be built up in the fluid in the drill string G above the valve **60** and head **44**, such pressure or force being exerted in a downward direction through the circulation head **44** on the central tubing **40**, and being transmitted from the latter through the coupling ring **41** to the holding sleeve **30**, being imposed on the shear screws **32**. When the pressure so imposed exceeds the shear strength of the screws **32**, the latter are disrupted, which then permits the circulation head **44**, tubing **40**, coupling ring **41** and sleeve **30** to shift downwardly to a position limited by engagement of the lower end of the retaining sleeve **30** with the stop flange **55** of the tubular drive member, such as disclosed in FIG. 3. When this occurs, the circulation head **44** is disposed partially across the internal by-pass groove **53** of the tubular drive member **13**, with the lower head seal ring **51** engaging the lower cylindrical wall **45***a* of the tubular drive member and with the upper seal ring **49** disposed opposite the groove **53**. It is to be noted that the outlet ports **35** of the drive member **13** are also now in an open position. Accordingly, circulation fluid can be pumped down through the string of drill pipe G, passing through the adapter or sub **16** into the upper portion of the tubular drive member **13**. Inasmuch as the ball valve element **60** has closed the central head passage **49** against downward flow of fluid therethrough, the circulating fluid will then pass around the exterior of the upper portion of the head **44**, and through the by-pass groove **53** into the head groove **47**, then flowing through the circulation ports **48** of the head into the central passage **49**, continuing on down through the tubing **40** to its lower end **40***a* and then passing upwardly through the annulus **56** between the tubing **40** and the conductor pipe **10** into the tubular drive member **13**, flowing upwardly through the interior of the retaining sleeve **30** and its circulation ports **57** and through the outlet ports **35** in the tubular drive member into the ocean. This circulating fluid will displace any fluids or fluent material in the conductor pipe **10** and the tubular drive member **13** above the lower end **40***a* of the central tubing. Thus, if any cement slurry is present around the central tubing **40**, it will be flushed upwardly out of the conductor pipe **10** and the tubular drive member **13** into the ocean C.

Fluid is circulated down through the drill pipe G for as long as is necessary, to insure the thorough flushing of any cement and other undesired substances from the interior of the conductor pipe **10** and the tubular drive member **13**.

At the time the circulation head **44**, tubing **40** and retaining sleeve **30** are shifted downwardly, to establish circulation through the apparatus in the manner just described, the retaining sleeve **30** is shifted below the keys **17**, and the latter may then drop inwardly into the tubular drive member **13** and come to rest on top of the coupling ring **41**, thereby disconnecting the tubular drive member **13** from the conductor pipe or drill casing **10**. If, for some reason, the keys **17** do not shift inwardly of their own volition, following removal of the holding sleeve **30** from its position of retention behind the keys, the tubular drive member **13** need merely be shifted upwardly after circulation has been established through the apparatus to remove any excess cement slurry from the upper portion of the conductor pipe **10**. The inclined upper surface **28** on each key engages a companion inclined surface **27** at the upper end of the companion conductor pipe slot **19**, which will force the keys **17** inwardly to the released position, such as disclosed in FIG. 4. The drill string G and tubular member **13**, and the remainder of the apparatus contained therewithin, can now be elevated from the conductor pipe **10** and removed back through the drilling barge D, leaving the conductor casing or pipe **10** cemented in place, with its upper end extending the desired distance above the floor P of the ocean.

After the cement is set and hardened around the casing, other equipment can readily be lowered through the drilling barge D, and the entry of such equipment into the conductor pipe will be facilitated, inasmuch as there will be no cement within the upper portion of the conductor pipe (as, for example, within the upper ten feet of the conductor pipe). Thus, a drill bit, or the like, secured to the lower end of a drill string may be lowered into the casing to drill out the cementitious material therewithin, and then continue to drill the well bore below the drive shoe **11**, all in a known manner.

It is, accordingly, apparent that an apparatus A has been provided by means of which the conductor pipe **10**, or corresponding tubular member, can be used to drill a portion of the well bore B, the conductor pipe then being cemented in place without the necessity for removing the apparatus from its operating location, such as in the ocean. The apparatus is released from the conductor pipe after the latter has been cemented in place without the necessity for rotating any part. The apparatus insures the absence of any cementitious or solid materials in the upper portion of the conductor pipe by establishing positive circulation through the upper portion of the conductor pipe. The conditioning of the apparatus for establishing circulation in the manner just described also effects automatic release of the apparatus from the conductor pipe.

The inventor claims:

1. In apparatus of the character described: a first tubular member adapted to be disposed in a well bore; a second tubular member adapted to move said first tubular member in the well bore; and means for releasably coupling said second tubular member to said first tubular member, comprising a key on one of said members fitting within a slot in the other of said members to couple said members together, retaining means shiftable with respect to said one of said members and engaging said key to maintain said key in said slot, and means for shifting said retaining means relative to said one of said members from engaged position with said key to allow withdrawal of said key from said slot and disconnection of said members from each other.

2. In apparatus of the character described: a first tubular member adapted to be disposed in a well bore; a second tubular member adapted to move said first tubular member in the well bore; and means for releasably coupling said second tubular member to said first tubular

member, comprising a key on one of said members fitting within a slot in the other of said members to couple said members together, retaining means engaging said key to maintain said key in said slot, and means responsive to the pressure of fluid in said second tubular member for shifting said retaining means from engaged position with said key to allow withdrawal of said key from said slot and disconnection of said members from each other.

3. In apparatus of the character described: an outer tubular member adapted to be disposed in a well bore; an inner tubular member piloted within said outer member and adapted to move said outer member in the well bore; and means for releasably coupling said inner member to said outer member, comprising a key on said inner member extending within a slot in said outer member to couple said members together, retaining means in and shiftable relative to said inner member engaging said key to hold it outwardly in said slot, and means for shifting said retaining means relative to said inner member from engaged position with said key to allow inward movement of said key from said slot to disconnect said members from each other.

4. In apparatus of the character described: an outer tubular member adapted to be disposed in a well bore; an inner tubular member piloted within said outer member and adapted to move said outer member in the well bore; and means for releasably coupling said inner member to said outer member, comprising a key on said inner member extending within a slot in said outer member to couple said members together, retaining means in said inner member engaging said key to hold it outwardly in said slot, and means responsive to the pressure of fluid in said inner tubular member for shifting said retaining means from engaged position with said key to allow inward movement of said key from said slot to disconnect said members from each other.

5. In apparatus of the character described: casing adapted to be disposed in a well bore and having cutting means thereon for drilling such well bore; a tubular member; said casing and tubular member being disposed one within the other; means for coupling said member to said casing, whereby said tubular member can rotate said casing; means engaging said coupling means for retaining said coupling means in coupling position; and means for shifting said retaining means from engagement with said coupling means to permit said coupling means to shift from its coupling position and disconnect said member from said casing, whereby said tubular member can be elevated from said casing.

6. In apparatus of the character described: casing adapted to be disposed in a well bore and having cutting means thereon for drilling such well bore; a tubular member piloted within said casing; means for releasably coupling said tubular member to said casing, comprising a key on said member extending within a slot in said casing to couple said tubular member and casing together, retaining means in said member engaging said key to hold it outwardly in said slot, and means responsive to the pressure of fluid in said tubular member for shifting said retaining means from engaged position with said key to allow inward movement of said key from said slot to disconnect said tubular member from said casing.

7. In apparatus of the character described: a first tubular member adapted to be disposed in a well bore; a second tubular member adapted to move said first tubular member in the well bore; means for releasably coupling said second tubular member to said first tubular member, comprising a key on one of said members fitting within a slot in the other of said members to couple said members together, retaining means shiftable with respect to said one of said members and engaging said key to maintain said key in said slot, and means for shifting said retaining means relative to said one of said members from engaged position with said key to allow withdrawal of said key from said slot and disconnection of said members from each other; and tubular means in said second tubular members extending downward substantially within said first tubular member to conduct fluid into said first tubular member.

8. In apparatus of the character described: a first tubular member adapted to be disposed in a well bore; a second tubular member adapted to move said first tubular member in the well bore; and means for releasably coupling said second tubular member to said first tubular member, comprising a key on one of said members fitting within a slot in the other of said members to couple said members together, retaining means engaging said key to maintain said key in said slot, and means responsive to the pressure of fluid in said second tubular means for shifting said retaining means from engaged position with said key to allow withdrawal of said key from said slot and disconnection of said members from each other; said shifting means including tubing extending downwardly substantially within said first tubular member to conduct fluid into said first tubular member.

9. In apparatus of the character described: an outer tubular member adapted to be disposed in a well bore; an inner tubular member piloted within said outer member and adapted to move said outer member in the well bore; and means for releasably coupling said inner member to said outer member, comprising a key on said inner member extending within a slot in said outer member to couple said members together, retaining means in said inner member engaging said key to hold it outwardly in said slot, and means responsive to the pressure of fluid in said inner tubular member for shifting said retaining means from engaged position with said key to allow inward movement of said key from said slot to disconnect said members from each other; said shifting means including tubing extending downwardly substantially within said outer tubular member to conduct fluid into said outer tubular member.

10. In apparatus of the character described: a casing member adapted to be disposed in a well bore; a tubular member; tubing in said tubular member extending downwardly substantially within said casing member to conduct fluid into said casing member; said tubular member having a port through which fluid from said tubing can flow after passing into said casing member; means for releasably coupling said tubular member to said casing member, comprising a key on one of said members fitting within a slot in the other of said members to couple said members together, retaining means engaging said key to maintain said key in said slot, said retaining means being disposed across said port to close the same, and means for shifting said retaining means to open said port and from engaged position with said key to allow withdrawal of said key from said slot and disconnection of said tubular member from said casing member.

11. In apparatus of the character described: a casing member adapted to be disposed in a well bore; a tubular member; tubing in said tubular member extending downwardly substantially within said casing member to conduct fluid into said casing member; said tubular member having a port through which fluid from said tubing can flow after passing into said casing member; means for releasably coupling said tubular member to said casing member, comprising a key on one of said members fitting within a slot in the other of said members to couple said members together, retaining means engaging said key to maintain said key in said slot, said retaining means being disposed across said port to close the same, and means responsive to the pressure of fluid in said tubular member for shifting said retaining means to a position opening said port and from engaged position with said key to allow withdrawal of said key from said slot and disconnection of said tubular member from said casing member.

12. In apparatus of the character described: a casing member adapted to be disposed in a well bore; a tubular member piloted within said casing member; tubing in said tubular member extending downwardly substantially within said casing member to conduct fluid into said casing member; said tubular member having a port through which fluid from said tubing can flow after passing into said casing member; means for releasably coupling said tubular member to said casing member, comprising a key on said tubular member extending within a slot in said casing member to couple said members together, retaining means in said tubular member secured to said tubing and engaging said key to hold it outwardly in said slot, said retaining means being disposed across said port to close the same, and means secured to said tubing and responsive to the pressure of fluid in said tubular member for shifting said tubing and retaining means downwardly in said tubular member to a position wherein said retaining means opens said port and is disengaged from said key to allow inward movement of said key from said slot and disconnection of said tubular member from said casing member.

13. In apparatus of the character described: a casing member adapted to be disposed in a well bore and having cutting means thereon for drilling such well bore; a tubular member; a tubing in said tubular member extending downwardly substantially within said casing member to conduct fluid into said casing member; said tubular member having a port through which fluid from said tubing can flow after passing into said casing member; releasable means coupling said tubular member to said casing member, whereby said tubular member can rotate said casing member; means extending across said port closing the same and engaging said coupling means for retaining said coupling means in coupling position; and means for shifting said retaining means to a position opening said port and from engagement with said coupling means to release said coupling means and disconnect said tubular member from said casing member.

14. In apparatus of the character described: a casing member adapted to be disposed in a well bore and having cutting means thereon for drilling such well bore; a tubular member; a tubing in said tubular member extending downwardly substantially within said casing member to conduct fluid into said casing member; said tubular member having a port through which fluid from said tubing can flow after passing into said casing member; releasable means coupling said tubular member to said casing member, whereby said tubular member can rotate said casing member; means secured to said tubing and engaging said coupling means for retaining said coupling means in coupling position, said retaining means extending across said port closing the same; and means secured to said tubing and responsive to the pressure of fluid within said tubular member for shifting said tubing and retaining means downwardly of said tubular member to a position opening said port and from engagement with said coupling means to release said coupling means and disconnect said tubular member from said casing member.

15. In apparatus of the character described: a casing member adapted to be disposed in a well bore and having a slot in its upper portion; a tubular member piloted within the upper portion of said casing member; a key removably mounted on said tubular member and extending into said slot to couple said members together and enable the turning effort of said tubular member to be transmitted to said casing member; a sleeve in said tubular member disposed initially behind said key to retain said key within said slot; tubing within said tubular member connected to said sleeve and extending downwardly into said casing member to conduct fluid into said casing member; and means secured to said tubing and responsive to fluid pressure in said tubular member for shifting said tubing and sleeve downwardly of said tubular member to disengage said sleeve from said key and permit its inward movement from said slot to uncouple said tubular member from said casing member.

16. In apparatus of the character described: a casing member adapted to be disposed in a well bore and having a slot in its upper portion; a tubular member piloted within the upper portion of said casing member; a key removably mounted on said tubular member and extending into said slot to couple said members together and enable the turning effort of said tubular member to be transmitted to said casing member; a sleeve in said tubular member disposed initially behind said key to retain said key within said slot; tubing within said tubular member connected to said sleeve and extending downwardly into said casing member to conduct fluid into said casing member; and means secured to said tubing and responsive to fluid pressure in said tubular member for shifting said tubing and sleeve downwardly of said tubular member to disengage said sleeve from said key and permit its inward movement from said slot to uncouple said tubular member from said casing member; the upper end portion of said key and the portion of said casing member defining the upper end of said slot having companion inclined surfaces tapering in an upward and inward direction.

17. In apparatus of the character described: a casing member adapted to be disposed in a well bore; a tubular member piloted within said casing member and having a downwardly facing shoulder engageable with the upper end of said casing member; said tubular member having a side port above said shoulder; a key carried by and movable laterally of said tubular member and extending into a slot in said casing member to couple said tubular member and casing member together for rotation; a sleeve in said tubular member extending across said port to close the same and also across said key to prevent inward movement of said key from said slot; frangible means initially securing said sleeve to said tubular member; tubing in said tubular member secured to said sleeve; a head secured to the upper portion of said tubing and slidable along an inner wall of said sleeve, said head having a central passage therethrough communicating with said tubing; means adapted to move into engagement with said head to close the passage therethrough and enable fluid pressure to be built up in the fluid above said head to exert a downward force on said tubing and sleeve to disrupt said frangible means and shift said head, tubing and sleeve downwardly of said tubular member to a position in which said sleeve has opened said port and is disposed below said key to permit said key to move inwardly from said casing member slot; stop means on said tubular member engageable with said sleeve to limit the extent of its downward movement; and by-pass means around said circulation head when said sleeve engages said stop means to permit circulating fluid to pass around said head for continued passage down through said tubing for upward passage around said tubing and through said open port.

18. A releasing head structure for submarine conductor casing, comprising: a conductor casing having a drilling foot at its lower end; a drill pipe; a sleeve secured to said drill pipe and telescopically fitting said conductor casing, said conductor casing and sleeve having radially aligned key slots; key elements fitted in said key slots and interconnecting said conductor casing and sleeve; means tending to displace said key elements radially inwardly when unsupported at their radially inner sides thereby to free said drill pipe and sleeve from said conductor casing; means within said sleeve and initially engaging the radially inner sides of said key elements to retain said key elements in said key slots, said means being axially movable to release said key elements thereby to free said drill pipe and sleeve from said conductor casing; and seal means disposed below said slots between said casing and sleeve and between said sleeve and key element retaining means.

19. A releasing head structure for submarine conductor casing, comprising: a conductor casing having a drilling

foot at its lower end; a drill pipe; a main sleeve secured to said drill pipe and telescopically fitting said conductor casing, said conductor casing and sleeve having radially aligned key slots; key elements fitted in said key slots and interconnecting said conductor casing and main sleeve; means tending to displace said key elements radially inwardly when unsupported at their radially inner sides thereby to free said drill pipe and main sleeve from said conductor casing; an inner sleeve initially positioned to back said key elements and retain said key elements in said key slots, said inner sleeve being axially slidable to clear said key elements; seal means between said conductor casing, main sleeve, and inner sleeve below said slots; shear elements for securing said inner sleeve in its initial position; and pressure actuated means for moving said inner sleeve to shear said shear elements and release said key elements.

20. A releasing head structure for submarine conductor casing, comprising: a conductor casing having a drilling foot at its lower end; a drill pipe; a main sleeve secured to said drill pipe telescopically fitting said conductor casing, said conductor casing and sleeve having radially aligned key slots; key elements fitted in said key slots and interconnecting said conductor casing and main sleeve; means tending to displace said key elements radially inwardly when unsupported at their radially inner sides thereby to free said drill pipe and main sleeve from said conductor casing; an inner sleeve initially positioned to back said key elements and retain said key elements in said key slots, said inner sleeve being axially slidable to clear said key elements; seal means between said conductor casing, main sleeve, and inner sleeve below said slots; shear elements for securing said inner sleeve in its initial position; a flow tube within said main sleeve extending into said conductor casing and joined to said inner sleeve; a piston head on said flow tube having an axial port communicating with said flow tube; and valve means insertable from the upper end of said drill pipe for closing said port, whereby fluid pressure may be applied to said piston to force said piston, flow tube, and inner sleeve downwardly to shear said shear elements and release said key elements, thereby to free said drill pipe and main sleeve from said conductor casing.

21. A releasing head structure for submarine conductor casing, comprising: a conductor casing having a drilling foot at its lower end; a drill pipe; a main sleeve secured to said drill pipe and telescopically fitting said conductor casing, said conductor casing and sleeve having radially aligned key slots; key elements fitted in said key slots and interconnecting said conductor casing and main sleeve; means tending to displace said key elements radially inwardly when unsupported at their radially inner sides thereby to free said drill pipe and main sleeve from said conductor casing; an inner sleeve initially positioned to back said key elements and retain said key elements in said key slots, said inner sleeve being axially slidable to clear said key elements; shear elements for securing said inner sleeve in its initial position; a flow tube within said main sleeve extending into said conductor casing and joined to said inner sleeve; a piston head on said flow tube having an axial port communicating with said flow tube; valve means insertable from the upper end of said drill pipe for closing said port, whereby fluid pressure may be applied to said piston to force said piston, flow tube, and inner sleeve downwardly to shear said shear elements and release said key elements, thereby to free said drill and main sleeve from said conductor casing; means operable on axial displacement of said piston to define a by-pass around said valve means to permit flow of washing fluid down said flow tube; and ports in said conductor casing adapted to be uncovered on displacement of said main sleeve to permit upward flow of said washing fluid between said flow tube and conductor casing, and discharge through said ports.

22. A releasing head structure for submarine conductor casing, comprising: a main sleeve adapted to telescope into the upper end of a length of conductor casing, said upper end having key slots in its side walls, and said main sleeve having mating key slots; key elements fitting said key slots to interlock said main sleeve and conductor casing; means for moving said key elements radially inwardly to disconnect said main sleeve from said casing; an inner sleeve initially positioned to retain said key elements in their locking position and axially movable to free said key elements, said key elements being arranged to fall radially inwardly on being freed; releasable means for securing said inner sleeve in its initial position; means for moving said inner sleeve axially to a position below said slots thereby to effect disconnection of said main sleeve from said conductor casing; and means at the upper end of said inner sleeve to collect said key elements.

23. A releasing head structure for submarine conductor casing, comprising: a main sleeve adapted to telescope into the upper end of a length of conductor casing, said upper end having key slots in its side walls, and said main sleeve having mating key slots; key elements fitting said key slots to interlock said main sleeve and conductor casing; means for moving said key elements radially inwardly to disconnect said main sleeve from said casing; an inner sleeve initially positioned to retain said key elements in their locking position and axially movable to free said key elements, said key elements being arranged to fall radially inwardly on being freed; releasable means for securing said inner sleeve in its initial position; means for moving said inner sleeve axially to a position below said slots thereby to effect disconnection of said main sleeve from said conductor casing; a drill pipe connected with said main sleeve for rotating said conductor casing and supplying drilling fluid thereto; a piston in said main sleeve and connected to said inner sleeve, said piston having a normally open port therethrough; and means for closing said port whereby a pressure differential may be established across said port to force said piston and inner sleeve axially to release said key elements, thereby to disconnect said main sleeve from said conductor casing; means at the upper end of said inner sleeve to collect said key elements.

24. A releasing head structure for submarine conductor casing, comprising: a main sleeve adapted to telescope into the upper end of a length of conductor casing, said upper end having key slots in its side walls, and said main sleeve having mating key slots; key elements fitting said key slots to interlock said main sleeve and conductor casing; means for moving said key elements radially inwardly to disconnect said main sleeve from said casing; an inner sleeve initially positioned to retain said key elements in their locking position and axially movable to free said key elements; seal means disposed below said slots between said casing and sleeve and between said sleeve and key element retaining means; means for moving said inner sleeve axially thereby to effect disconnection of said main sleeve from said conductor casing; a drill pipe connected with said main sleeve for rotating said conductor casing and supplying drilling fluid thereto; a piston in said main sleeve and connected to said inner sleeve, said piston having a normally open port therethrough; means for closing said port whereby a pressure differential may be established across said port to force said piston and inner sleeve axially to release said key elements, thereby to disconnect said main sleeve from said conductor casing; a flow tube depending from said piston; and means operable on axial displacement of said piston to establish a flow path around said piston, downwardly through said flow tube, upwardly between said flow tube and conductor casing, and out of the upper portion of said conductor casing.

References Cited in the file of this patent

UNITED STATES PATENTS

1,816,991	Van Amburgh et al.	Aug. 4, 1931
2,436,525	O'Donnell	Feb. 24, 1948