May 13, 1952 E. B. WILLIAMS, JR 2,596,832

CORE BARREL

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Fig. 1.

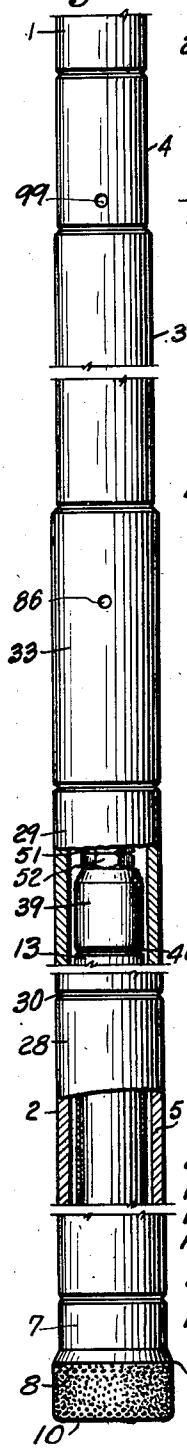



Fig. 2.

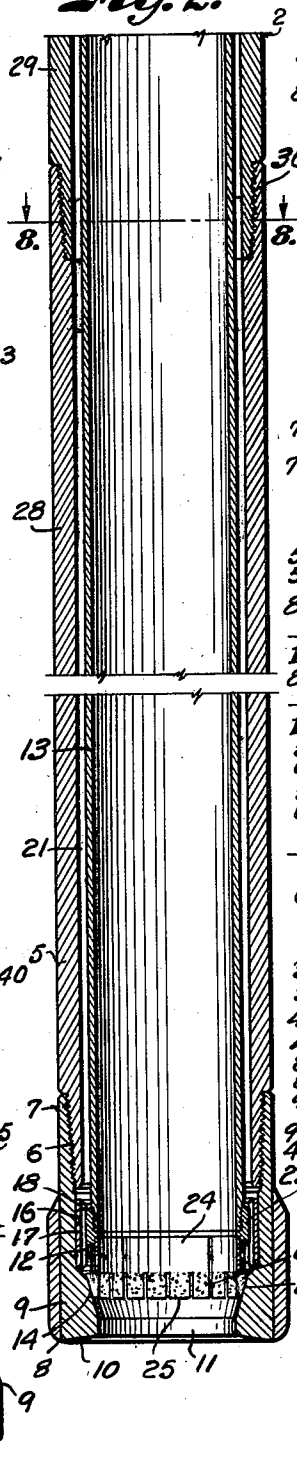



Fig. 3.

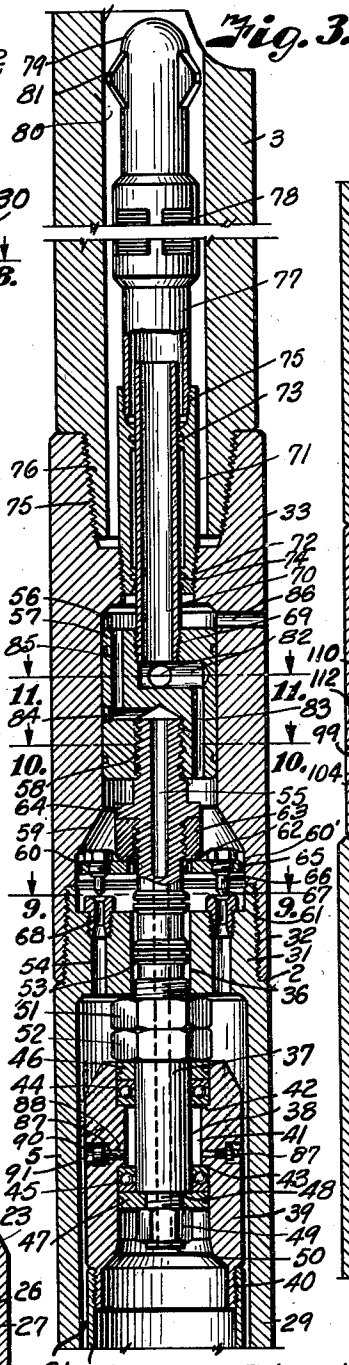
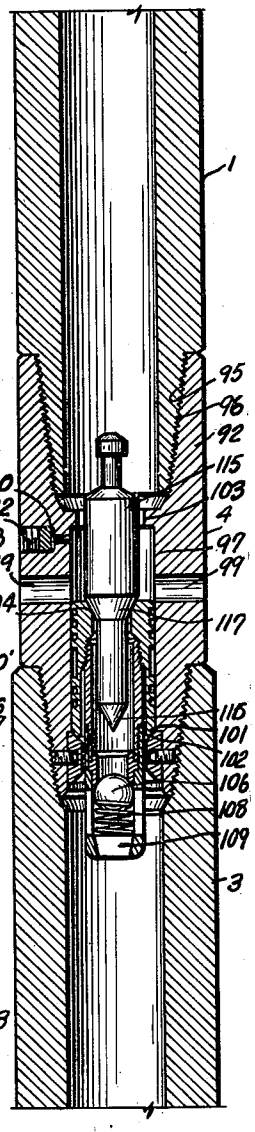



Fig. 4.




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Fig. 5.

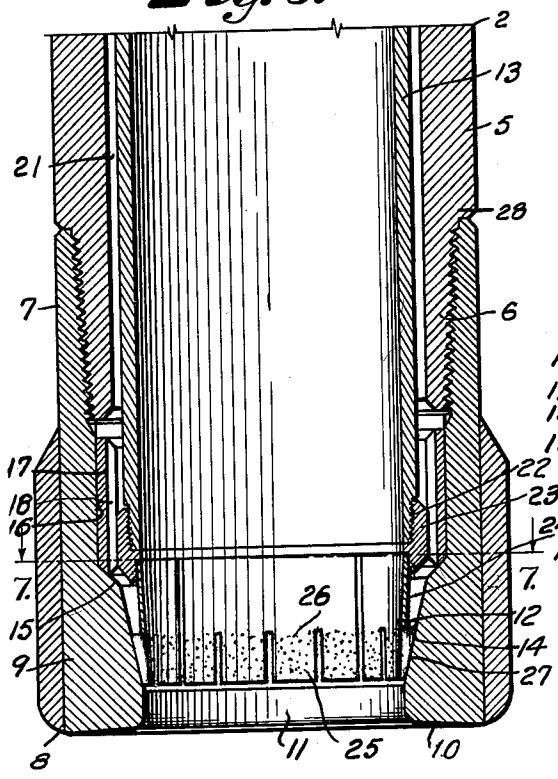



Fig. 6.

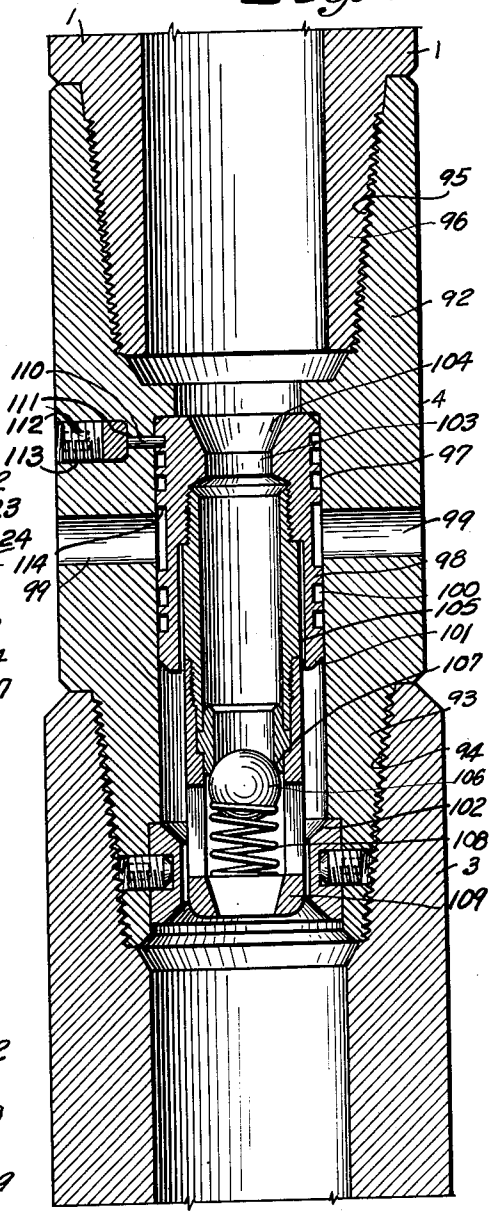
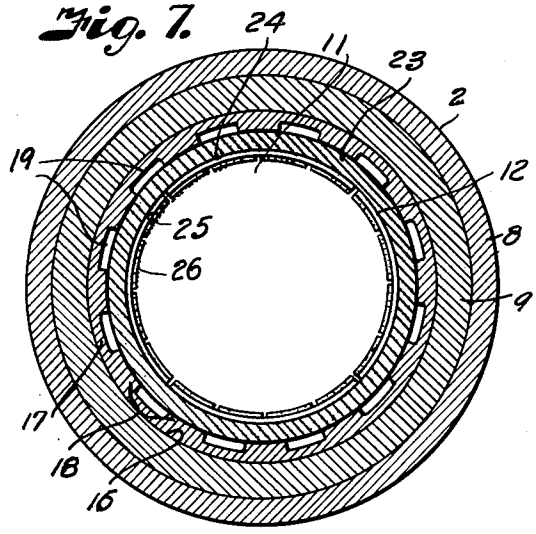



Fig. 7.




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Fig. 8.

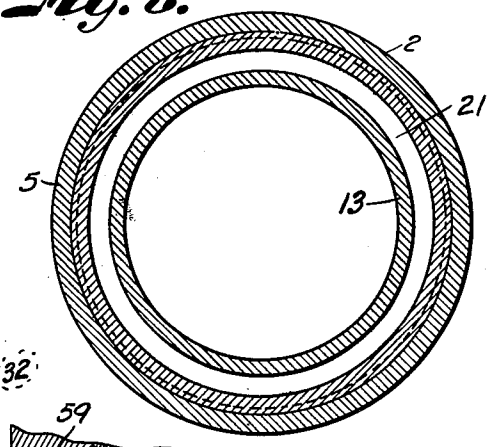
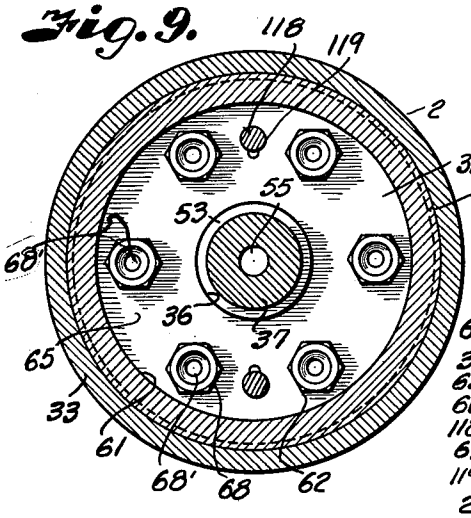



Fig. 9.



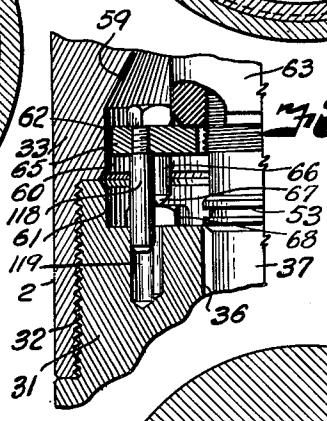




Fig. 12.

Fig. 10.

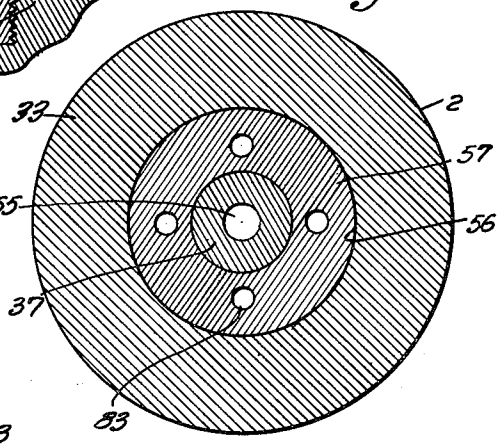
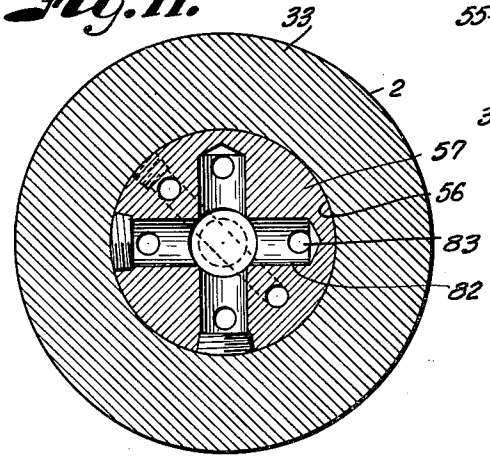



Fig. 11.




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# UNITED STATES PATENT OFFICE

2,596,832

## CORE BARREL

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Application March 7, 1949, Serial No. 79,988

10 Claims. (Cl. 255—72)

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This invention relates to core barrels such as used in core drilling of earth formations to determine the rock structure and has for its principal objects to provide a core barrel in which the core has free passage into the receiving barrel during drilling operations; to provide a core barrel with mechanism that is responsive to pressure of the drilling fluid for supporting the core-receiving barrel and preventing engagement of the core gripping mechanism with the core; to provide a core barrel with core gripping mechanism adapted to function automatically in gripping the core upon dropping of the core receiving barrel when the pump pressure is shut off prior to adding sections of drill pipe or pulling the drilling string from the bore hole; and to provide the core barrel with a simple mechanism for maintaining pressure of the drilling fluid which is required in supporting the core receiving barrel in position to prevent engagement of the core gripping mechanism upon fluctuations in the drilling fluid pressures.

In accomplishing these and other objects of the invention as hereinafter pointed out, I have provided improved structure, the preferred form of which is illustrated in the accompanying drawing wherein:

Fig. 1 is an elevational view of the lower end of a drilling string equipped with a core barrel and operating mechanism embodying the features of the present invention, parts being broken away and shown in section to show interior construction.

Fig. 2 is an enlarged longitudinal section through the lower portion of the core barrel, particularly illustrating connection of the drill bit and the mounting of the core gripping mechanism.

Fig. 3 is a similar section through the upper portion of the core barrel and the mechanism associated therewith to retain the core gripping mechanism out of contact with the core and to permit automatic engagement of the core gripping mechanism responsive to the presence and absence of pump pressure on the drilling fluid, respectively.

Fig. 4 is a section through the drilling string near the connection of the drill pipe, particularly illustrating release of the piston valve controlling the ports for bleeding the drilling fluid from the drill pipe prior to pulling of the drilling string as when removing the core from the bore hole.

Fig. 5 is an enlarged section through the lower end of the core barrel and drill bit particularly illustrating the core gripping or catching mechanism.

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Fig. 6 is an enlarged section through the bleeder valve showing the valve piston in position for closing the ports through which drilling fluid is released from the drill pipe.

Fig. 7 is a horizontal section through the drill bit and core catcher taken on the line 7—7 of Fig. 5.

Fig. 8 is a horizontal section through the inner and outer core barrels on the line 8—8 of Fig. 2.

Fig. 9 is an enlarged section on the line 9—9 of Fig. 3, particularly illustrating the choke ports.

Fig. 10 is an enlarged horizontal section through the control piston on the line 10—10 of Fig. 3.

Fig. 11 is a similar horizontal section on the line 11—11 of Fig. 3, particularly illustrating the port arrangement.

Fig. 12 is an enlarged fragmentary section showing the guide pins for retaining the choke pins in concentric relation with the choke ports.

Referring more in detail to the drawings:

1 designates the lowermost joint of string of drill pipe to which is connected a core barrel 2 embodying the features of the present invention, the core barrel being connected with the drilling string through a screen housing tube 3 and a bleeder coupling 4.

The core barrel assembly 2 includes an outer barrel 5 having its lower end terminating in an externally threaded tool joint 6 which engages in the internally threaded neck 7 of a core bit 8. The core bit 8 may comprise a cylindrical body 9 having a lower circumferential drilling face 10 encircling an axial core passageway 11 through which the core feeds through core catcher 12 and into the inner or core receiving barrel 13. Above the entrance to the core bit the passageway 11 flares outwardly as at 14 to provide a wedging surface for seating and contracting the core catcher 12 when the core catcher moves into engagement therewith as later described. Above the annular flaring seat 14, the passageway is provided with a shoulder 15 terminating in a cylindrical bore 16 in which is seated a liner 17 having circumferentially spaced vertical ribs 18 forming vertical passageways or watercourses 19 therebetween for the flow of drilling fluid around the core for washing cuttings made by the bit upwardly within the bore hole.

The inner barrel 13 is of smaller diameter than the inner diameter of the outer barrel 5 to provide a vertical longitudinal passageway 21 for downward flow of drilling fluid to the watercourses 19. The inside diameter of the inner

barrel is of such size and character as to permit free feeding of the core therein. The lower end of the inner barrel is externally threaded as at 22 (Fig. 5) to mount the core catcher 12 which includes a collar 23 vertically guided by the ribs 18 to retain concentric alignment of the inner barrel. Fixed to and depending from the collar is a ring of arcuate segments 24 that are formed of thin flexible material and which carry a plurality of gripping fingers 25. The gripping fingers have a substantially hard granular material coating the inner faces thereof as indicated at 26 so as to frictionally engage the core when the fingers are contracted about the core by wedging action of the seat 14 on the tapered exterior faces 27 of the respective fingers as the barrel moves downwardly responsive to shutting off the pump pressure as later described.

To facilitate assembly, the outer barrel 5 comprises a lower section 28 and an upper section 29 connected by a threaded joint 30 as shown in Fig. 2. The upper end of the upper section 29 has a closed head 31 having the outer circumference of reduced diameter and externally threaded as at 32 to mount the coupling joint 33 in which the control piston and choke mechanism is slidably mounted as later described. The head 31 is provided with an axial bore 36 which reciprocably mounts a tubular rod 37 having its lower end 38 journalled within a swivel head 39 that is contained within the upper end of the outer barrel and which is threadedly connected as at 40 with the upper end of the inner barrel 13, the swivel head having an axial bore 41 in which is formed oppositely facing annular shoulders 42 and 43 seating antifriction bearings 44 and 45, the bearings being retained against the shoulders by sealing rings 46 and 47, the lower ring 47 being retained against a shoulder 48 on the lower end of the piston rod by a nut 49 that is threaded onto the reduced threaded extension 50 thereof as clearly shown in Fig. 3. The upper sealing disk is retained by jamb nuts 51 and 52 that are threaded onto the piston rod to cooperate with the lower nut 49 in rotatably anchoring the piston rod 37 from longitudinal movement relatively to the inner core receiving barrel 13. With this arrangement it is obvious that the piston rod 37 may rotate freely within the inner barrel 13 while supporting the inner barrel with the gripping fingers 25 of the core catcher 12 out of wedging engagement with the seat 14. The piston rod 37 has a plurality of liquid seals 53 to seal the axial bore 36 and retard leakage therethrough of the drilling fluid so that the supply of drilling fluid is diverted into the annular passageway 21 through a plurality of ports 54 that are arranged in circular series about the piston rod 37 as shown in Figs. 3 and 9. As above stated, the piston rod 37 is hollow to provide a vertical passageway 55 therethrough for relieving fluid within the inner barrel as the core rises therein during drilling operations. The joint 33 has a coaxial cylindrical bore 56 in the mid portion thereof to form a piston chamber in which is slidably mounted a piston 57 that is connected with the upper end of the piston rod by threading of the terminal end of the rod into an internally threaded socket 58 of the piston (Fig. 3).

The entrance of the piston chamber 56 flares downwardly and outwardly as shown at 59 and joins with a counterbore 60 cooperating with the counterbore 61 in the upper face of the head 31 to house a choke mechanism 62 by which a substantially uniform pressure is maintained on the drilling fluid passing through the ports 54 from above the piston as later described. The choke mechanism includes a collar 63 that is threaded on the piston rod in abutting engagement with an annular shoulder 64. Carried by the collar 63 and projecting outwardly and circumferentially thereof is a flange 65 that is adapted to reciprocate with the piston rod within the counterbore 60 but which provides an annular space 60' therebetween to pass the drilling fluid. Mounted in the flange in axial alignment with each of the ports 54 are choke pins 66 having tapered lower ends 67 reciprocable within the choke orifice members 68 that are removably threaded within the upper ends of the ports 54 as shown in Fig. 3. With this arrangement the flow through the ports 54 is controlled by position of the choke pins relative to the choke orifices 68' in the members 68 so that substantially uniform pumping pressure can be maintained on the drilling fluid in the passageway 21. The piston 57 has an axial threaded bore 69 mounting a nipple 70 (Fig. 3) that reciprocates with the piston through a sleeve 71 that is threaded within an internally threaded bore 72 of the joint member 33, the sleeve carrying sealing rings 73 and 74 for forming liquid seals about the nipple. The upper end of the joint 33 has an internally threaded socket 75 for receiving an externally threaded pin 76 on the screen housing section 3. Fixed to the upper end of the sleeve 71 is a tube 77 carrying a screen section 78 by which the drilling fluid is screened while flowing from the bore of the drill pipe 1 to the nipple 70. The upper end of the tube 77 is closed as at 79 and the tube is centered within the bore 80 of the housing by radially extending wings 81. Formed in the piston in connection with the lower end of the flow tube 70 are a plurality of radial channels 82 that connect with vertical channels 83 so that the drilling fluid is adapted to be passed through the piston and to act on the underside thereof in retaining the piston in its uppermost position to suspend the inner barrel 13 with the gripping fingers 25 of the core catcher in the upper portion of the flaring seat 14. The fluid relief passageway through the piston rod connects with a radial port 84 that leads to a vertical port 85 opening through the top of the piston and which discharges through the piston chamber to the exterior of the joint 33 through a lateral port 86.

In order to maintain pressure within the bore 41 of the swivel head and prevent the possibility of leakage of drilling fluid through the ring seals into the bearings, the swivel head is provided with a pressure fitting 87 by which lubricant is admitted under pressure to fill the space within and between the bearings. To maintain the pressure on the lubricant, a ram 88 is slidably mounted within a lateral bore 89 and which is actuated by a piston 90 that is slidable in a counterbore 91 to project the ram into the lubricant chamber responsive to pressure of the drilling fluid acting on the external side of the piston.

When pulling the drilling string, it is desirable to bleed the drilling fluid from the drill pipe and this is accomplished by providing the bleeder 4. The bleeder 4 comprises a drill pipe joint 92 having a pin end 93 threaded into the internally threaded socket 94 provided in the upper end of the screen housing section 3. The upper end of the coupling 92 has an internally threaded socket 95 for receiving the pin end 96 of the

lower joint of drill pipe 1. Formed in the coupling member 92 is a coaxial piston chamber 97 slidably mounting a piston valve 98 which is adapted to cover and uncover lateral ports 99 opening through the sides of the coupling member as best shown in Fig. 4. The piston 98 is provided with suitable sealing rings 100 to prevent leakage of drilling fluid therearound and the lower end is tapered as indicated at 101 to engage a ring-shaped seat 102 that is fixed in the lower end of the pin 93. The valve piston 98 has an axial port 103 terminating at the upper end of the piston in a conical seat 104. Threadedly mounted in the piston 98 is a tubular nipple 105 that depends therefrom and which carries a downwardly opening check valve 106, the check valve being normally retained against a seat 107 in the nipple by a spring 108 which is seated in the cage 109 for the valve. The piston-like valve is retained in an upper position within the piston cylinder to normally cover the ports 99 by means of a shear pin 110 that is inserted through an opening 111 and which is retained by a plug 112 threaded into a counterbore 113 of the opening. The pin when in position engages in an annular groove 114 of the piston and supports the piston in covering relation with the lateral ports 99 so that drilling fluid passing downwardly through the drill pipe is conducted through the piston and check valve 106 and strainer section 78 to the core barrel.

When it is desired to bleed the drilling fluid from the drill pipe, the shear pin 110 is broken by means of a sinker bar 115 that is dropped through the drill pipe from the top of the drilling string, the sinker bar being provided with a pointed terminal 116 which is adapted to readily pass through the port 103 of the piston and guide a tapered shoulder 117 on the sinker bar into contact with the seat 104 with sufficient force to effect shearing of the pin 110 and cause downward movement of the piston 98 so as to uncover the bleed ports 99. The drilling fluid may then bleed through the ports 99 into the bore hole as the drill pipe is pulled therefrom.

In order to prevent turning of the choke pin carrier collar 65, the collar is provided with depending pins 118 that are slidable in guide bores 119 in the head 31 (Fig. 12).

In using the core barrel, the sections 2, 33, 3 and 4 are connected together as shown in Fig. 1 and are lowered into the bore hole for connection with the first joint of drill pipe 1. The core drill is progressively lowered into the bore hole upon connection of additional joints of drill pipe as in conventional practice until the core bit reaches the bottom of the bore hole. Since there is no pump pressure upon running the drilling string into the bore hole, the inner barrel 13, swivel head 39, choke mechanism 62, piston 57, and nipple 70 are in their lowermost position with the gripping fingers 25 of the core catcher wedging in the flaring seat 14.

Upon starting drilling operation, drilling fluid is supplied under pump pressure through the drill pipe so as to effect circulation for bringing cuttings made by the bit to the top of the ground. The drilling fluid flows through the screen 58, pipe 77, nipple 70, piston ports 82 and 83 into the lower end of the piston chamber 56. Since the choke pins 66 are practically closing the ports of the choke members 68 and the pressure above the piston is equal to the lesser pressure of the upflow around the drill pipe, the higher pressure acts under the piston 57 to raise the piston in its cylinder and lift the inner core receiving barrel 13 through the connecting rod 37 and swivel head connection 39. As long as pump pressure is admitted into the drill pipe, the inner core receiving barrel will remain in its uppermost position. This is obvious because should the inner barrel tend to drop under a reduction in pump pressure, the flow would be restricted through the orifice members which acts to increase the pressure below the piston sufficiently to lift and retain the piston in position to unseat the fingers of the core catcher from the tapered seat 14. In this position the core resulting from rotation of the drill bit is free to feed upwardly within the core receiving barrel 13 without wedging or breaking of segments through dragging of the catcher on the core.

When the drill pipe is rotated, the outer barrel 2 rotates with the drill bit 8, however, the inner barrel may remain stationary since the swivel head thereof is free to rotate on the antifriction bearings 44 and 45. Therefore, the inner barrel will not rotate while the core is feeding thereinto incidental to progress made by the drill bit.

When it is necessary to shut down drilling operations as when pulling the drilling string, the pump pressure is shut off from the drill pipe whereupon pressure equalizes above and below the piston 57 to allow settling of the core receiving barrel so that the wedge faces 27 cooperate with the flaring seat 14 to effect movement of the gripping faces of the core catcher into gripping contact with the lower end of the core then in the barrel. The core may then be broken off by lifting and slightly rotating the drilling string, after which the drilling string is withdrawn from the well carrying the core therewith.

In pulling the drilling string, it may be desirable to bleed the drilling fluid into the bore hole. This is effected by dropping the sinker bar through the drill pipe so as to shear off the pin 110 retaining the piston 98 in position to close the ports 99. The piston 98 will then shift downwardly since the pressure is equalized on the respective ends thereof and uncover the ports 99. The liquid above the piston is then drained through the ports 99. When the bit is in drilling operation the drilling fluid passes through the choke members around the swivel head and through the passageway 21 to the drill bit so as to wash the cuttings upwardly around the outside of the core barrel. Pressure of the drilling fluid acts on the piston 90 so as to maintain pressure on the lubricant in the swivel head and thereby prevent the drilling fluid from entering the bearings 44 and 45. The liquid displaced from the inner core barrel by feed of the core therein is displaced through the hollow connecting rod 37 and through the ports 84 and 85 of the piston to be discharged through the lateral port 86.

From the foregoing it is obvious that the core has free passage to the receiving barrel during drilling and the core catcher catches or grips the core only when the pump pressure is shut off at the upper end of the drilling string. The core catcher, being free of the core during drilling operations does not tend to interfere with entrance of the core or wedging of the core responsive to particles breaking off and wedging on the core catcher since the fingers of the core catcher are in adequately spaced relation with the core during normal drilling operations. It is also obvious that any fluctuations in pump pressure is compensated for by the choking of the drilling fluid on entering the working barrel whereby substan-

tially uniform pressure is maintained on the lifting piston, however, if the pump pressure is shut down the drop in pressure under the piston will immediately effect equalization of pressures on the respective sides thereof to permit dropping of the assembly so as to automatically grip the core and assure complete removal thereof along with the core barrel. It is also obvious that while the core is free during drilling, the core catcher may be engaged with the core at any time by shutting off the drilling fluid. The action of the core catcher is, therefore, under complete control of the driller and permits taking of substantially continuous core samples without loss of sections intermediate the cores that are removed.

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

1. A core barrel including outer and inner barrels with the inner barrel being movable coaxially within the outer barrel, a contractable core catcher carried by the inner barrel, means carried by the outer barrel to effect contraction of the core catcher upon downward movement of the inner barrel within the outer barrel, means connected with the outer barrel for supplying a drilling fluid under pump pressure, pressure actuatable means connecting the inner barrel with the outer barrel and responsive to pump pressure of the drilling fluid for supporting the inner barrel from said downward movement, and choke means carried within the outer barrel and movable with the inner barrel to maintain substantially uniform pump pressure of the drilling fluid on said pressure actuatable means.

2. A core barrel including an outer barrel, a core bit fixed to the outer barrel and having an axial opening for passing a core therethrough, an inner barrel, means supporting the inner barrel in concentric relation with the outer barrel and for axial movement relative to the outer barrel, a core catcher carried by the inner barrel and having means for gripping said core upon axial movement of the inner barrel in one direction, means for supplying drilling fluid under pressure, pressure means responsive to said drilling fluid for axially shifting the inner barrel within the outer barrel in the opposite direction to effect release of the core catcher, and means responsive to fluctuations in said pressure of the drilling fluid to maintain pressure of the drilling fluid substantially uniform on said pressure means.

3. A core barrel including outer and inner barrels with the inner barrel being movable axially within the outer barrel, a cylinder member carried by the outer barrel and having a piston chamber therein, a piston slidable in the piston chamber, a rod connecting the piston with the inner barrel, means for supplying a drilling fluid to the piston chamber under pressure to move said piston in the cylinder and lift the inner barrel, said cylinder having a vent port at the end of the piston opposite to said high pressure for equalizing pressures on said piston upon shutting down the drilling fluid pressure, means for venting the inner barrel through said vent port, a contractable core catcher on the inner barrel, and core catcher contracting means on the outer barrel and adapted to be engaged by the contractable core catcher upon shutting down the pressure on the drilling fluid.

4. A core barrel including outer and inner barrels with the inner barrel being movable axially within the outer barrel, a cylinder member carried by the outer barrel and having a piston chamber therein, a piston slidable in the piston chamber, a rod connecting the piston with the inner barrel, means for supplying a drilling fluid to the piston chamber under pressure to move said piston in the cylinder and lift the inner barrel, a contractable core catcher on the inner barrel, a core catcher contracting means on the outer barrel and adapted to be engaged by the contractable core catcher upon shutting down the pressure on the drilling fluid, an orifice member carried by the outer cylinder for passing flow of drilling fluid, and a choke pin carried by the piston rod and movable into the orifice member upon fluctuations in the pump pressure to maintain substantially uniform pump pressure acting on said piston.

5. A core barrel including outer and inner barrels with the inner barrel being movable axially within the outer barrel, a cylinder member carried by the outer barrel and having a piston chamber therein, a swivel head on the upper end of the inner barrel, a piston slidable in the piston chamber, a rod connected with the piston and rotatably connected with the swivel head, means for supplying a drilling fluid under pressure through said piston to move said piston in the cylinder and lift the inner barrel, a contractable core catcher on the inner barrel, a core catcher contracting means on the outer barrel and adapted to be engaged by the contractable core catcher upon shutting down the pressure on the drilling fluid, a choke orifice member carried by the outer cylinder for passing flow of drilling fluid, and a choke pin carried by the piston rod and movable into the choke orifice member upon fluctuations in the pump pressure to maintain substantially uniform pump pressure acting on said piston.

6. In an apparatus of the character described, an outer barrel, a core drill bit fixed to the lower end of the outer barrel and having a core catcher engaging seat, a coupling member connected with the upper end of the core barrel and having a piston chamber, a piston in said chamber, a connecting rod depending from the piston into the outer barrel, a swivel head rotatably mounted on the depending end of the connecting rod, an inner barrel carried by the swivel head, a core catcher on the lower end of the inner barrel and having gripping means adapted to engage said seat upon downward movement of the piston in said cylinder, a nipple connected with the piston and having sliding movement in the coupling member, said piston having ports connecting the nipple with the opposite end of the piston chamber on the rod end of the piston means for conducting drilling fluid under pump pressure to said nipple to act on the rod connected end of the piston, a collar fixed to the connecting rod and having a plurality of choke pins, and orifice members carried by the outer barrel in cooperation with the choke for passing drilling fluid from below the piston to the drill bit in volume depending upon the position of the choke pins in said orifice members.

7. In an apparatus of the character described, an outer barrel, a core drill bit fixed to the lower end of the outer barrel and having a core catcher engaging seat, a coupling member connected with the upper end of the core barrel and having a piston chamber, a piston in said chamber, a connecting rod depending from the piston into the outer barrel, a swivel head rotatably mounted on the depending end of the connecting rod, an inner barrel carried by the swivel head, a core

catcher on the lower end of the inner barrel and having gripping means adapted to engage said seat upon downward movement of the piston in said cylinder, a nipple connected with the piston and having sliding movement in the coupling member, said piston having ports connecting the nipple with the opposite end of the piston chamber on the rod end of the piston means for conducting drilling fluid under pump pressure to said nipple to act on the rod connected end of the piston, a collar fixed to the connecting rod and having a plurality of choke pins, orifice members carried by the outer barrel in cooperation with the choke for passing drilling fluid from below the piston to the drill bit in volume depending upon the position of the choke pins in said orifice members, and means for discharging drilling fluid from the inner barrel.

8. In an apparatus of the character described, an outer barrel, a core drill bit fixed to the lower end of the outer barrel and having a core catcher engaging seat, a coupling member connected with the upper end of the core barrel and having a piston chamber, a piston in said chamber, a hollow connecting rod depending from the piston into the outer barrel, a swivel head rotatably mounted on the depending end of the connecting rod, an inner barrel carried by the swivel head, a core catcher on the lower end of the inner barrel and having gripping means adapted to engage said seat upon downward movement of the piston in said cylinder, a nipple connected with the piston and having sliding movement in the coupling member, said piston having ports connecting the nipple with the opposite end of the piston chamber on the rod end of the piston means for conducting drilling fluid under pump pressure to said nipple to act on the rod connected end of the piston, a collar fixed to the connecting rod and having a plurality of choke pins, orifice members carried by the outer barrel in cooperation with the choke for passing drilling fluid from below the piston to the drill bit in volume depending upon the position of the choke pins in said orifice members, said piston having a port connecting the hollow rod with the piston chamber at the nipple connected end of the piston, and said piston chamber having a discharge port through a side of the coupling member.

9. An apparatus of the character described including a drill pipe for supplying a drilling fluid under a pump pressure, an outer barrel, a core bit connected with the outer barrel, a core receiving barrel having axial movement within the outer barrel for receiving therein a core made by said bit, a core catcher connected with the core receiving barrel and having an operating engagement with a part carried by the outer barrel upon axial movement of the core receiving barrel within the outer barrel, means connecting the drill pipe with the outer barrel including means responsive to pressure of the drilling fluid and having operative connection with the core receiving barrel for controlling engagement and disengagement of the catcher with a core, and choke means connected with said actuating means to maintain substantially uniform pressure of the drilling fluid on said pressure responsive means when the drilling fluid is under pump pressure.

10. An apparatus of the character described including a drill pipe for supplying a drilling fluid under a pump pressure, an outer barrel, a core bit connected with the outer barrel, a core receiving barrel having axial movement within the outer barrel for receiving therein a core made by said bit, a core catcher connected with the core receiving barrel and having an operating engagement with a part carried by the outer barrel upon axial movement of the core receiving barrel within the outer barrel, means connecting the drill pipe with the outer barrel including means responsive to pressure of the drilling fluid and having operative connection with the core receiving barrel for preventing engagement of the catcher with a core, and means in said connecting means responsive to any pressure fluctuations in the drilling fluid pressure for maintaining a constantly uniform pressure of the drilling fluid on said fluid pressure responsive means as long as drilling fluid is being supplied through the drill pipe under pump pressure.

EDWARD B. WILLIAMS, JR.

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