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Mott

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[54] **METHOD AND APPARATUS FOR AUTOMATIC MUD DIVERTER VALVE**

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Related U.S. Application Data

[63] Continuation of Ser. No. 73,379, Sept. 17, 1970, abandoned.

[52] **U.S. Cl.** **175/65,** 137/460, 137/614.2, 166/224, 166/315

[51] **Int. Cl.** **E21b 33/00**

[58] **Field of Search** 175/67, 69, 242, 175/317; 137/456, 460, 614.2, 504, 563, 458; 251/31; 166/224, 225, 226, 315

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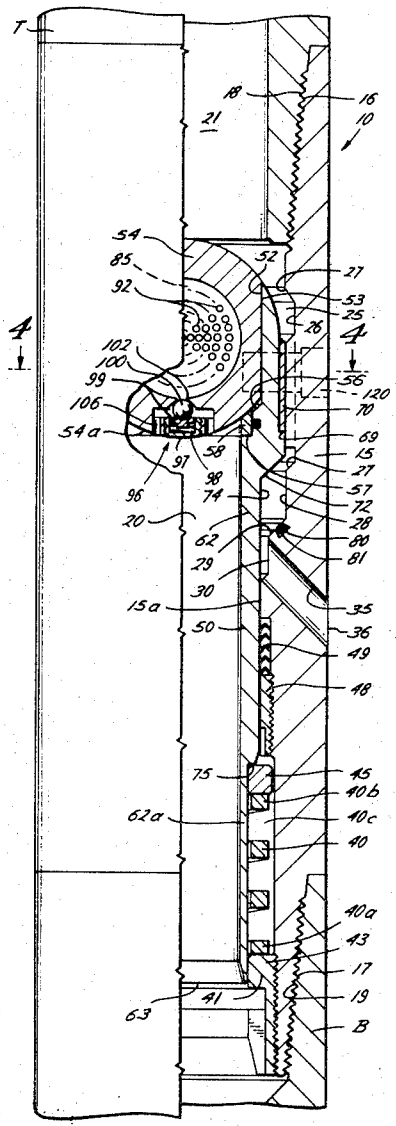
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[57] **ABSTRACT**

A tubular member positioned above a jet nozzle drill bit in a drill string includes a rotatable ball valve which closes to automatically divert drilling fluid and the like in the well bore if the jet nozzles become clogged thus permitting continued circulation of the fluid. The mud diverter valve attempts to prevent clogging of the jet nozzles by maintaining channeled openings in the rotatable ball valve unclogged, but diverts the drilling fluid into the annulus between the drilling string and the well bore if the channelled openings become clogged for continued circulation of the fluid.

20 Claims, 5 Drawing Figures



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Fig. 1

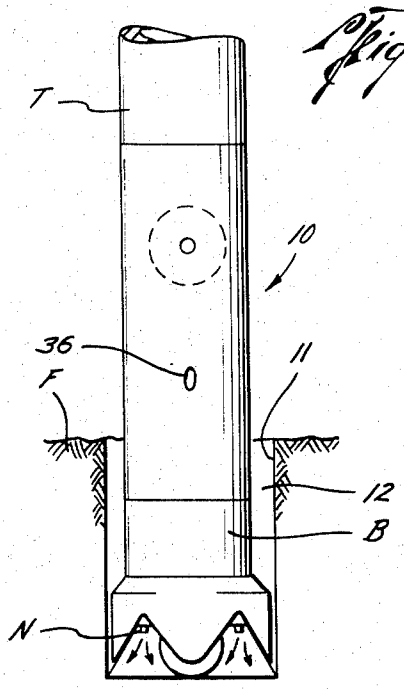


Fig. 4

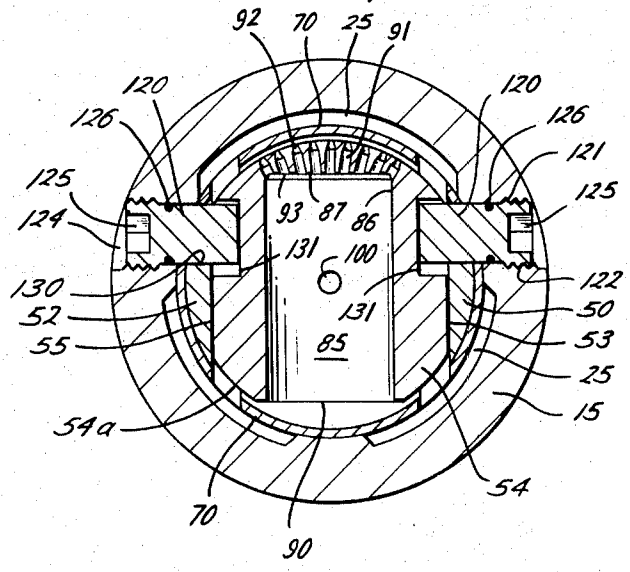
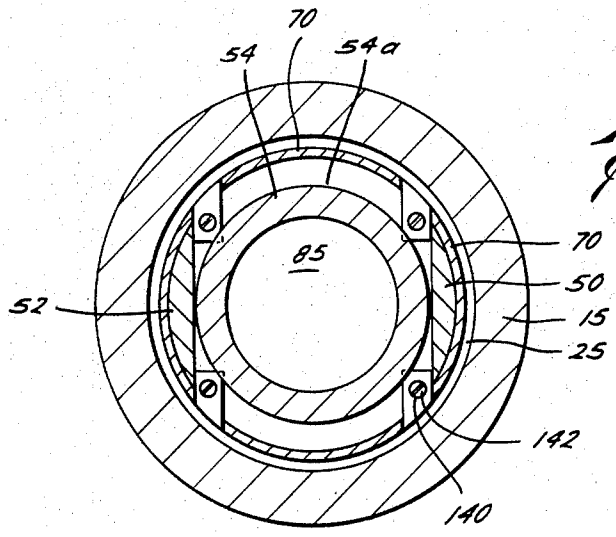


Fig. 5



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Fig. 2

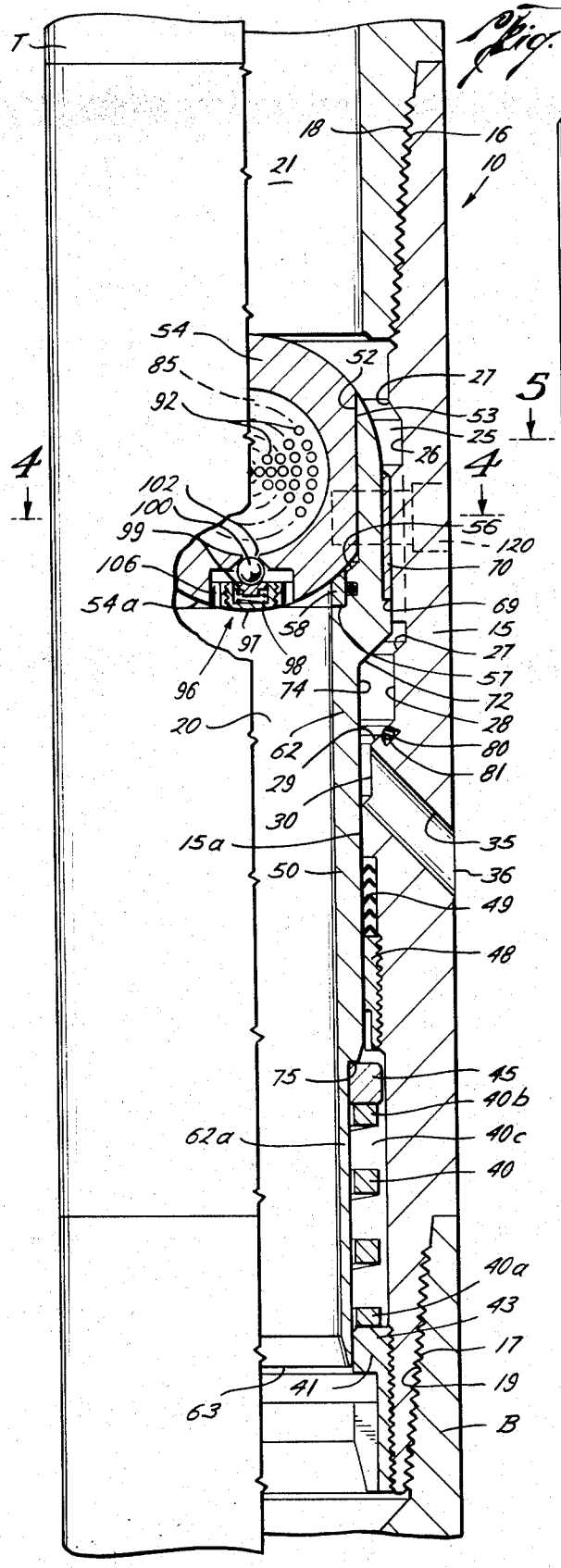
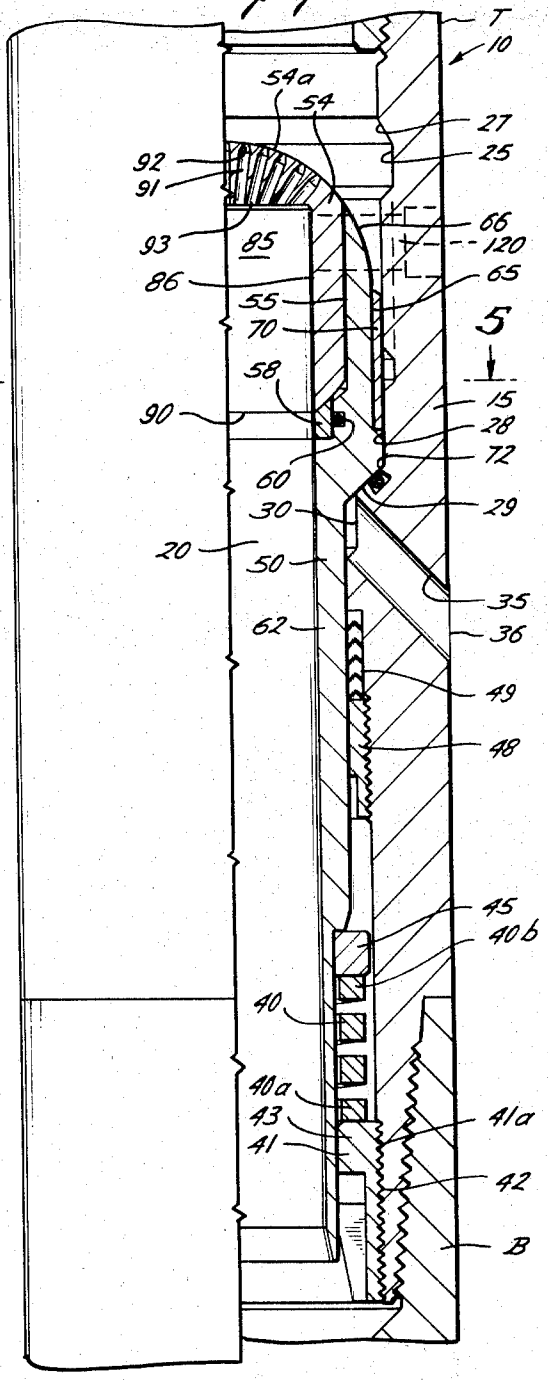


Fig. 3



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METHOD AND APPARATUS FOR AUTOMATIC MUD DIVERTER VALVE

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a continuation of application Ser. No. 73,379, filed Sept. 17, 1970, now abandoned.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to the field of automatic mud diverter valves and more particularly to new and improved method and apparatus mud diverter valves.

2. Description of the Prior Art

In the prior art if the jet nozzles of a jet nozzle drill bit become clogged by chunks of formation, cuttings or mud downhole, the drill string was pulled with drilling fluid in the string. This was known as pulling a "wet" string and subjected workmen to having fluid spilled all over them and the rig floor. Such wet pulling of the string required costly down time as well as being extremely undesirable for the workmen.

Further, once the drilling bit was unclogged, the drilling string was run back into the well bore but had to be filled with fluid from the top of the drilling floor since suspended particles such as cuttings in the well bore might once again clog the nozzles.

Other prior art tools were tools used to "drain" the drill string when the jetting nozzles became clogged, thus eliminating the pulling of a "wet string." However, such draining required a great deal of time and was thus costly in view of the cost per hour of men and drilling rigs.

Also, other devices used screens and the like in the tubing for straining the fluid before it reached the jet nozzles thus desiring to prevent clogging of the nozzle, but such screens did not provide a means for removing the screened particles into the annulus between the well bore and drilling string thus leaving the particles in the drilling string above the screen and eventually causing the string to become clogged. In addition, there was no way to circulate the particles in the drill string out into the annulus between the well bore and drill string with the drain device or screen device.

SUMMARY OF THE INVENTION

Briefly, the present invention relates to a new and improved method and apparatus for an automatic mud diverter valve including a tubular member or sub positioned above a jet nozzle drilling bit in a drill string and having an inner bore communicating with the bore of the drill string, such tubular member having a circulation channel therein for permitting communication between the inner bore of the tubular member and the annulus between the well bore and the tubular member when the circulation channel is open, a movable member mounted in the bore of and with said tubular member, said movable member having channels therein and being adapted to be positioned such that the channels are transverse to the inner bore and adapted to be positioned such that the channels are aligned with the inner bore to permit communication through the inner bore and drilling bit, a piston member for moving said movable member to the transverse and aligned positions, a circulation bypass channel in the tubular member which permits circulation of the drilling lfuid around the movable member and through the circulation channel when the channels of the movable member and nozzles of the jet nozzle drill bit are clogged wherein increased circulation pressure above the movable member moves the piston downwardly to move said movable member to its aligned position such that the channels in the movable member are aligned with the inner bore of the tubular member to thus permit circulation through the tubular member and drilling through the jet nozzle drill bit and wherein such downward movement of the piston member also prevents communication and circulation of the drilling fluid between the circulation bypass channel and the circulation channel in the tubular member.

It is an object of the present invention to provide a new and improved method and apparatus for an automatic mud diverter valve.

Still yet another object of the present invention is to provide a new and improved automatic mud diverter valve wherein circulation of the drilling fluid may still be accomplished even though the jet nozzles of the jet nozzle drill bit are clogged.

Still yet another object of the present invention is to provide a new and improved method and apparatus for an automatic mud diverter valve wherein channel members in a movable member of such valve are continually wiped to remove clogged material therefrom to thus attempt to prevent clogging of the channel members.

Still yet another object of the present invention is to provide a new and improved method and apparatus for an automatic mud diverter valve which eliminates the pulling of a wet string if the jet nozzles of the jet nozzle drill bit become clogged.

Yet another object of the present invention is to provide a new and improved method and apparatus for an automatic mud diverter valve wherein the string above the automatic mud diverter valve may be filled with drilling fluid which enters through the valve as the string is lowered into a well bore rather than filling of the string from the surface of the well site.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of the automatic mud diverter valve of the present invention in use in a well bore with a jet nozzle drilling bit and drilling string;

FIG. **2** is a partial cross-sectional view of the automatic mud diverter valve of the present invention;

FIG. **3** is a view similar to FIG. **2**, illustrating the valve of the present invention in an open position;

FIG. **4** is a view taken along line **4—4** of FIG. **3**, illustrating the relationship of a movable member of the present invention relative to a tubular member of the present invention; and

FIG. **5** is a view taken along line **5—5** of FIG. **3**, illustrating the position of the movable member when such valve is open.

DESCRIPTION OF THE PREFERRED EMBODIMENT

As illustrated in FIG. **1**, the automatic mud diverter valve of the present invention is generally illustrated by the numeral **10** and is connected with a tubular drilling string T and a jet nozzle drill bit B having jet nozzles N as is well-known in the art. As further illustrated in FIG. **1**, the drill string is positioned in a well bore **11** of a subsurface formation F to enable the jet nozzle drill bit B to move deeper into the formation through jetting ac-

tion as is known in the art. The nozzles N permit jetting of fluid under high pressure through the drill string T, the valve **10** and out through the nozzles N for drilling operations as is well-known. The drilling fluids, as is wellknown in the art, circulate around the drill bit and up the annulus **12** between the formation in the drill string T to the well surface (not shown) to float the cuttings and the like to the surface of the well site.

As illustrated in FIGS. **2** and **3**, the automatic mud diverter valve **10** includes a tubular member **15** which is connected through the usual box and pin threaded connections **16** and **17**, respectively, to the pin and box threaded connections **18** and **19**, respectively, of an upper tubular drill string member T and the jet nozzle drill bit B, respectively, as illustrated in FIG. **1**.

The tubular member **15** is provided with an inner bore or channel **20** which communicates with the inner bore or channel **21** of the tubular member T and the inner bore or channel (not numbered) of the drill bit B.

An enlarged circulation bypass channel **25** is milled in the inner wall **15***a* of the tubular member **15**. The enlarged circulation bypass channel **25** is defined by the inner wall **26** of the tubular member T, a pair of shoulder portions **27** at each end of said inner wall **26**, and a smaller diameter inner recessed wall **28** adjacent a lower inclined shoulder **27**. The circulation bypass channel **25** is further defined by the sloped shoulder **29** and a milled recessed cylindrical wall **30** of less diameter than recessed walls **28** and **26**. An **0**-ring seal **80** is positioned in a slotted groove **81** as illustrated in FIGS. **2** and **3** on the sloped shoulder **29** for a purpose to be set forth hereinafter.

A circulation channel **35** is formed through the wall of tubular member **15** for permitting communication from the inner bore **20** of the member **15** immediately adjacent the milled surface **30** through such channel **35** and out an opening **36** into the annulus **12** between the formation **11** and the drill string T.

As illustrated in FIGS. **2** and **3**, a spring means or means for urging **40** is positioned adjacent the threaded pin end **17** inside the bore **20** and is retained in such position by a threaded retainer member **41** having threads **41***a* for threaded engagement with the threads **42** in the inner bore and a seating member **43** which abuts the end **40***a* of the spring means **40**. The other end **40***b* of the spring means **40** is mounted with a movable block member **45**.

A threaded retainer ring **48** is threadedly engaged (not numbered) with the inner wall **15** below the circulation channel **35** for retaining a chevron seal **49** in position to prevent leakage of fluid from the circulation channel **35** and a slidable piston means **50** which abuts the seal means **49** and retainer ring **48**, as illustrated in FIGS. **2** and **3**.

As illustrated in FIGS. **2** and **3**, the piston **50** is generally in the form of a sleeve or cylindrical member which extends from an area adjacent the circulation bypass channel **25** to immediately adjacent the member **41**.

The sleeve **50** includes an enlarged diameter mounting or connection portion **52** which abuts a machined cutaway or milled surface **53** of a movable member or rotatable ball **54** adjacent an inner side wall **55** thereof.

An inner milled shoulder **56** is further machined at **57** to receive the seating and sealing member **58** of the ball **54** such that movement of the movable member **54** or rotation of the ball **54** as will be set forth hereinafter enables the outer spherical surface **54***a* of the ball **54** to seat on the seating means **58**. As illustrated in FIGS. **2** and **3**, an **0**-ring seal and groove **60** are provided for preventing leakage between the seating member **58** and the milled area **57**.

An inner decreased diameter portion **62** of the sleeve **50** extends from the milled area **57** to the end **63** of such sleeve **50**. An outer wall **65** of the upper enlarged portion **52** of such sleeve **50** is curved at **66** to complement and match the spherical curved surface **54***a* of the ball **54**. Below such curved surface **66** a shoulder **69** receives one end of a wiper or scraper member **70**.

Below the wiper or scraper **70**, an inner curved sloped shoulder **72** which is shaped to complementary seat on the surface area **29** of the tubular member **15** as will be set forth hereinafter, extends downwardly to the decreased diameter portion **62** of such sleeve **50**. The outer surface wall **74** of the decreased diameter portion **62** extends downwardly and abuts the inner surface wall **15**a of the tubular member **15** and the chevron sealing member **49** and retainer member **48**. A milled flat shoulder member **75** of the lower decreased diameter portion **62** abuts and rides on a portion of the block member **45** as illustrated in FIGS. **2** and **3**. A retaining portion or wall **62***a* of the portion **62** extends downwardly past and immediately adjacent the spring means **40** to retain such spring means in the area **40***c* between the inner wall **15***a* of the member **14** and the retaining portion **62***a*.

The movable member **54** in this embodiment is illustrated as a rotatable ball, but of course may include some other type of rotatable or movable member. Such ball **54** as set forth hereinabove includes an outer milled flat surface area **53** to enable the ball to be positioned immediately adjacent the inner surface **55** of the upper sleeve member portion **52**, and an outer spherical surface **54***a* for seating on the seating and sealing member **58**.

The rotatable ball **54** includes a cavity **85** defined by the sidewalls **86** and an end wall **87**. An opening **90** permits communication of the cavity with the inner bore **20** of the member **15**. As illustrated in FIGS. **2**, **3** and **4**, a plurality of channel members **91** are machined in the ball **54** and extend from a restricted nozzle area **92** immediately adjacent the outer sperical surface **54** to openings **93** which communicate with the cavity **85**. The nozzle openings **92** are designed smaller in cross-sectional area than the cross-sectional area of the nozzles of the jet nozzle drill bit B.

As further illustrated in FIGS. **2** and **3**, a spring loaded valve generally designated at **96** is machined and positioned in the ball **54** and includes a threaded plug member **97** which retains and houses a spring member **98** which continuously urges a member **99** upwardly to force a ball member **100** upwardly to obstruct an opening **102** to prevent communication between the cavity **85** and a channel or passageway **106** which communicates with the bore **20**.

As illustrated in FIGS. **2**, **3** and **4**, a pair of pin members **120** are threadedly engaged at **121** with the inner walls **122** of a machined slot **124** in the tubular member **15**. A milled or cutaway area **125** is provided for loosening or tightening the pins **120**. **0**-ring seals **126** are positioned in **0**-ring grooves (not numbered) in the pins **120** for sealing between the pins **120** and the member **15** to prevent loss of fluid from the bore **20** of such member **15**. The pins **120** extend inwardly through the

inner wall 15a of the member 15 and through holes 130 in the upper portion 52 of the sleeve member 50 for retaining such sleeve member 50 relative to the ball 54.

The pins 120 extend through the holes 130 into enlarged milled eccentrically positioned slots 131 in the rotatable ball 54 (FIG. 4). As illustrated in FIG. 4, the diameter of the slots 131 is slightly larger than the diameter of the pins 120 such that rotation of the ball 54 about the eccentrically positioned pins 120 will cause the ball 54 to move upwardly or downwardly relative to the pins 120 and tubular member 15 as will be set forth hereinafter.

In the operation of the invention, the tubular member 15 is connected in the drill string T immediately above the jet nozzle drill bit B as set forth hereinafter. As is well-known in the art, the drill string is then lowered ino the well bore. At this point, the ball valve 54 is positioned as illustrated in FIG. 2 in a closed position such that the plurality of channel members 91 are not aligned with the bore 20 of the member 15 which thus prevents communication of fluid through the ball valve 54. However, in such position the circulation bypass channel 25 permits fluid to circulate around the ball valve 54 and fluid from the well bore is also permitted to enter through the circulation channel 35 to fill the drill string T above and below the ball valve 54. The ball valve 54 is continually forced upwardly along with the piston or sleeve 50 by the action of the spring means 40 which provides an upward thrust on the member 45 which in turn provides an upward thrust on the shoulder 75 of the sleeve 50 to force the ball valve to the position illustrated in FIG. 2.

When the drill string T is filled with drilling fluid, the operator of the rig may then wish to circulate the drilling fluid in the drill string T such that large cuttings or other particles and the like are removed from the inner bore 21 of the drill string T and inner bore 20 of the member 15 before jet nozzle drilling operations begin. This is done by increasing the pressure only a certain amount but less than the amount needed to move the spring means 40 downwardly. As this cleaning operation occurs, the fluid is circulated downwardly through the bore 20 and through the circulation bypass channel 25 out through the circulation channel 35 into the annulus of the well bore to remove large cuttings and the like. As constructed and illustrated in FIG. 2, the cross-sectional area of the circulation bypass channel 25 is greater than the cross-sectional area of the circulation channel 35. With this arrangement, the pressure drop is less through the area of the circulation bypass channel 25 than at the circulation channel 35 and thus in the annulus between the drilling string T and the well bore which therefore enables the fluid to flow into the channel 35 and into the annulus 12.

With the ball 54 closed in FIG. 2, the pressure above and below the ball 54 is equalized; however, when it is desired to begin drilling operations, the circulation and pumping pressure at the well site surface is substantially increased into the area of many thousands of pounds per square inch. This downward pressure thrust is sufficient to overcome the upward thrust of the spring means 40 to compress the spring 40 as illustrated in FIG. 3. As the ball 54 is rotated and moved downwardly by the downward movement of the piston 50 due to the eccentric position of the pins 120 relative to the ball 54, the ball 54 rotates about such pins 120 to the position as illustrated in FIG. 3 such that the channels 91 are sligned with the bore 21 of the drill string T and the bore 20 of the tubular member 15.

As the sleeve 50 moves downwardly, the scraper or wiper member 70 which is mounted with the sleeve 50 by the tab and screw members 140 and 142, respectively, (FIG. 5), contacts the surface wall 28 of the circulation bypass channel 25 and the sloped shoulder 72 moves downwardly to seat on the shoulder 29 of the member 15 with the 0-ring seal 80 providing a seal between the sleeve 50 and member 15. Such seating and sealing action thus prevents communication through the circulation bypass channel 25 and circulation channel 35 and also prevents communication of the circulation bypass channel 25 with the circulation channel 35.

With the ball 54 in the open position as illustrated in FIG. 3, the drilling fluid is then circulated through the nozzles 92, channels 91 and the cavity 85 of the ball member 54 downwardly into the bore 20 and out through the nozzles N of the drill bit B. Any particles which are larger in diameter than the nozzle openings 92 will not pass through such openings and will thus clog the openings to thus prevent clogging of the nozzles N of the drill bit B. As the nozzles 92 become clogged, the circulation pressure thus increases and is indicated by suitable means at the rig site surface and drilling operations are thereafter terminated.

The circulation pressure is then lowered and released until the spring means 40 is sufficient to rotate the ball 54 back to the position illustrated in FIG. 2. As such rotation occurs the sleeve 50 is moved upwardly by the spring means 40 and the ball member 54 rotates about the eccentrically mounted pins 120. As such rotation occurs, some of the nozzles 92 rotate by the scraper and wiper member 70 to wipe off such nozzles and remove clogged particles therefrom thus enabling some of the channels 91 to remain unclogged for further drilling.

When the ball 54 is being rotated to the position illustrated in FIG. 2, the ball 54 at some rotational point in time will rotate to a position such that the opening 90 is covered or closed by the seal or seating member 58, but yet such ball 54 will not have rotated to its fully closed position as illustrated in FIG. 2. It is estimated that the arcuate travel by the ball 54 from a point when the opening 90 is first covered by inner surface area 55 of the sleeve member 50 until such ball member has fully rotated to its fully closed position as illustrated in FIG. 2, may be 20 degrees. With the ball 54 in a position where it is not fully seated, there may still exist a pressure differential between the inner bore 21 of the drilling string T and the inner bore 20 of the tubular member 15 below the ball. To insure that the pressure remains equal on each side of the ball to permit the ball 54 to rotate to its fully closed position, the ball and spring member designated at 96 has been provided to enable the pressure above the ball 100 to force the spring means 98 downwardly thus permitting communication through the passageways 106 between the inner bore 21, cavity 85, the opening 102 and the inner bore 20 of the tubular member 15 such that the pressure on each side of the ball 54 is equalized to permit the ball to rotate to its closed position. When the pressure is equalized on each side of the ball and spring valve 96, the spring means 98 forces the ball 100 upwardly to once again block the opening 102.

When the scraper or wiper member 70 has wiped off the surface area of some of the nozzles 92, circulation

may then be initiated to once again clean out and remove the particles wiped off the nozzles **92** by circulating the particles through the circulation bypass channel **25**, circulation channel **35**, into the annulus **12** (FIG. 1) between the formation **11** and the drill string T.

While the invention generally designated at **10** has been designed to prevent clogging of the nozzles N of the jet nozzle drilling bit B, it should be understood that on some occasions such clogging cannot be prevented. However, if clogging of the nozzles N of the jet nozzle drilling bit does occur, circulation around the ball valve **54** through the circulation bypass channel **25** and circulation channel **35** is permitted with the ball **54** closed (FIG. 2) to circulate other particles and cuttings out of the drilling string without lowering or rotation of the ball **54** since pressure on each side of the ball **54** is equalized due to the open bypass channel **25** and the clogged nozzles N. If it is necessary to pull the drilling string T, fluid will escape out into the annulus **11** through the circulation channel **35** which thus eliminates the pulling of a wet string.

The foregoing disclosure and description of the invention are illustrative and explanatory thereof, and various changes in the size, shape, and materias as well as in the details of the illustrated construction may be made without departing from the spirit of the invention.

I claim:

1. An apparatus positioned in a drilling string above a jet nozzle drill bit in a well bore comprising:

a. a tubular member having an inner bore, said tubular member mounted at one end above the drill bit and at the other end to the drilling string for enabling drilling fluid to be circulated from the drill string through said tubular member and out through the drill bit;

b. said tubular member having a circulation channel positioned therein for permitting communication between the annulus in the well bore and said inner bore of said tubular member when said channel is open;

c. a movable member positioned in said inner bore above said circulation channel and mounted with said tubular member, said member having channels therethrough and adapted to be positioned in a transverse position wherein said channels are not aligned with said inner bore and an aligned position with said inner bore wherein said channels are aligned with said inner bore of said tubular member;

d. piston means positioned in said inner bore and mounted between said movable member and said tubular member, said piston means moving said movable member from said transverse to aligned positions as desired; and

e. said tubular member having a circulation bypass channel therein for allowing circulation of drilling fluid around said movable member and through said circulation channel into the annulus when said channels in said movable member are not aligned with said inner bore and wherein an increase in circulation pressure above said movable member moves said piston member and thus prevents communication between said circulation bypass channel and said circulation channel and moves said movable member to align said channels in said movable member with said inner bore thus permitting circulation through said bore and out said jet nozzle drill bit.

2. The structure as set forth in claim **1**, wherein the area of said circulation bypass channel is greater than the area of said circulation channel to provide greater pressure in said circulation bypass channel, which thus enables fluid to move through the circulation bypass channel and out the circulation channel into the annulus between the well bore and the drilling string when said channels in said movable member are not aligned with said inner bore of said tubular member.

3. The structure as set forth in claim **1**, wherein fluid is permitted to enter the drilling string through said circulation channel and said circulation bypass channel in said tubular member to fill the drill string.

4. The structure as set forth in claim **1**, including a means for continuously urging said piston means upwardly and wherein an increase in circulation pressure above said piston member overcomes said means for uging, to move said piston means downwardly to prevent communication between said circulation channel and said circulation bypass channel, and to move said movable member such that said channels in said movable member are aligned with the inner bore of said tubular member.

5. The structure as set forth in claim **4**, wherein said movable member includes a rotatable ball having a plurality of channels extending therethrough in one direction.

6. The structure as set forth in claim **5**, wherein said channels in said rotatable ball are smaller than the openings in said jet nozzles to thus prevent cuttings or other particles in the drilling fluid from passing through said channels and clogging the jet nozzles.

7. The structure as set forth in claim **5**, including a pair of pins mounted with said tubular member, said piston means and said rotatable ball, said rotatable ball rotating about said pins as said piston means is moved downwardly by increased circulation pressure or upwardly by said means for urging as the circulation pressure decreases.

8. The structure as set forth in claim **7**, wherein fluid is initially permitted to enter into the drill string through the circulation channel and circulation bypass channel as said rotatable ball and piston means are urged upwardly by said means for urging and wherein increased circulation pressure moves said piston means downwardly and thus overcome said means for urging to rotate said ball valve such that said channels are aligned with said inner bore of said tubular member to permit drilling through the jet nozzles.

9. The structure as set forth in claim **8** wherein until the circulation pressure is increased sufficiently to overcome said means for urging, the drilling fluid is circulated in the drill string through said circulation bypass channel and out said circulation channel into the annulus to remove unwanted particles and cuttings in the drilling fluid.

10. The structure as set forth in claim **9**, wherein clogging of said channels in said rotatable ball or said jetting nozzles in the drill bit, is indicated by an increase in pressure at the surface of the well bore wherein the pressure is reduced to permit the means for urging to move said piston means upwardly to rotate said ball such that said channesl are not aligned with said inner bore and wherein circulation of the drilling fluid occurs through said circulation bypass channel

around said rotatable ball and out through said circulation channel into the annulus.

11. The structure as set forth in claim **1**, including a wiper member for wiping at least some of the exposed openings of said channels to remove clogged particles therefrom as said movable member is moved to a position where said channels are not aligned with said inner bore.

12. The structure as set forth in claim **10**, including a wiper member mounted adjacent said circulation bypass channel and positioned such that rotation of said rotatable ball to the position where said channels in said ball are not aligned with said inner bore wipes the exposed surface area of at least some of said channels to thus scrape and wipe off clogged particles positioned in the top of said channels.

13. The structure as set forth in claim **12**, including a spring loaded ball valve mounted with said rotatable ball, said ball having a channel opening therein blocked by said spring loaded ball, said spring loaded ball being positioned in said rotatable ball to insure that said rotatable ball and piston will be moved upwardly and seated by said means for urging to thus maintain said circulation bypass channel open by permitting drilling fluid to flow from above said rotatable ball and through said spring loaded ball into the lower portion of the tubular member when there is a pressure differential between said inner bore of the tubular member above said rotatable ball and below said rotatable ball which thus equalizes the pressure in said inner bore above and below said rotatable ball to fully seat said rotatable ball.

14. A method of circulating drilling fluid in a drill string and well bore, comprising the steps of:

a. positioning a tubular member in a drill string at a location above a nozzled drill bit;

b. communicating between the inner bore of the tubular member and the annulus between the formation and the drill string through a circulation channel formed in the tubular member;

c. positioning a member having channels therethrough in the bore of the tubular member to prevent communication through the bore to the drill bit;

d. moving the member in response to controlled pressure of the drilling fluid to position the channels to permit circulation of drilling fluid through the drill bit; and

e. preventing communication through the circulation channel when the channels through the member are positioned to permit circulation of drilling fluid through the drill bit.

15. The steps as set forth in claim **14**, including the steps of:

moving the member to prevent communication of drilling fluid to the drill bit by controlling the pressure of the drilling fluid; and

communicating between the inner bore and the annulus through the circulation channel when the member moves to prevent communication to the drill bit.

16. The steps as set forth in claim **14**, wherein:

the steps of moving the member includes rotating the member to position the channels therethrough.

17. The steps as set forth in claim **16**, wherein:

the step of rotating the member further includes the step of moving the member longitudinally.

18. The steps as set forth in claim **14**, including the steps of:

forming the channels through the member to have a nozzle area adjacent a surface of the member; and

wiping the surface of the member adjacent to the nozzle area to remove clogged particles.

19. The steps as set forth in claim **18**, including the step of:

removing particles wiped off the surface of the member adjacent the nozzles from the bore to the annulus through the circulation channel.

20. The steps as set forth in claim **18**, wherein:

the step of forming the channels through the member includes the step of restricting the nozzle area adjacent the surface to have a nozzle area adjacent the surface smaller in cross-sectional area than the cross-sectional area of the nozzle of the drill bit.

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