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AIR OR GAS CIRCULATION ROCK BIT ANTI-CONTAMINATION VALVE

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FIG. 1.

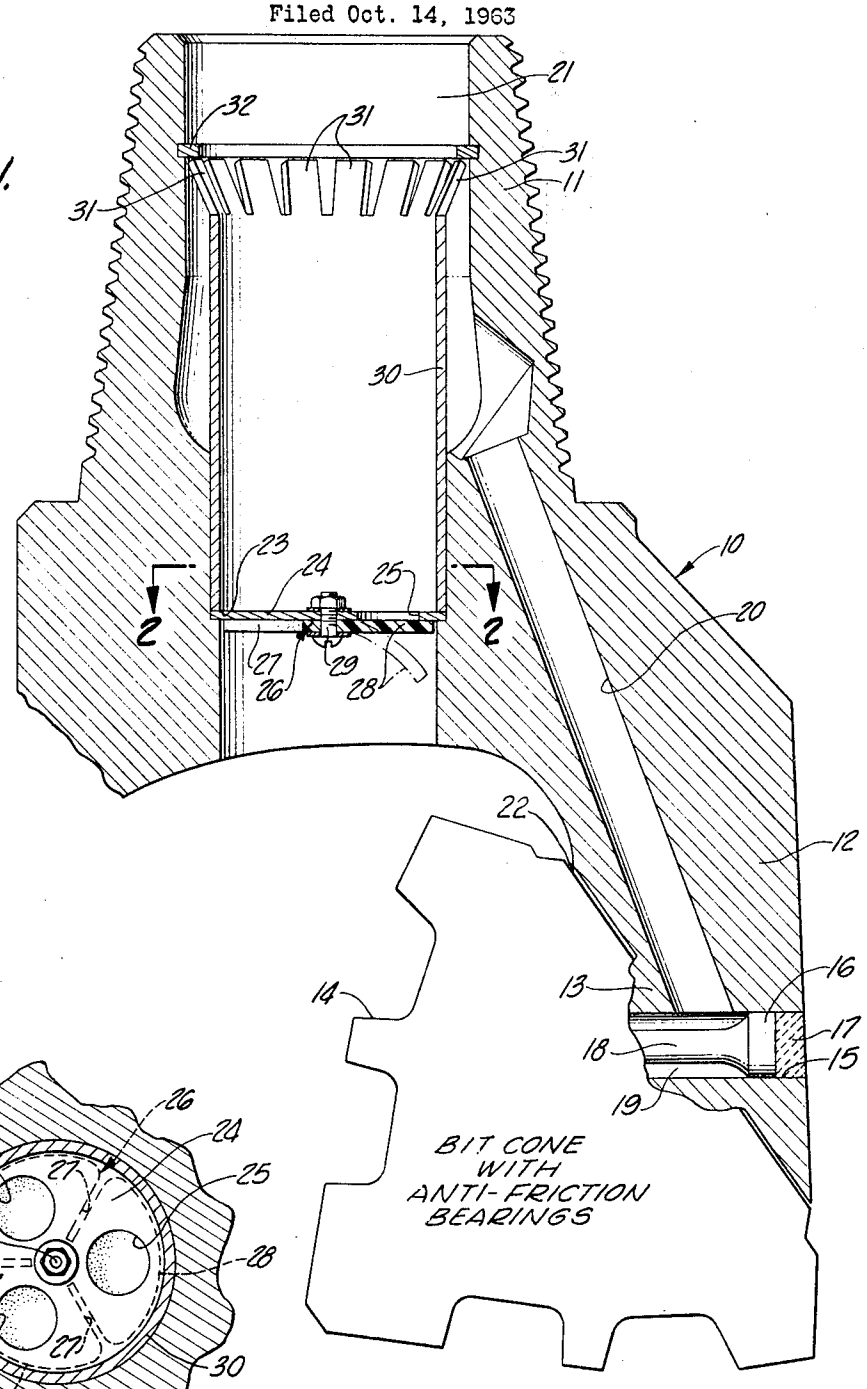

FIG. 2.

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AIR OR GAS CIRCULATION ROCK BIT ANTI-CONTAMINATION VALVE

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This invention relates to improvements in rock bits employed in drilling wells. The conventional rock bit consists of a body attachable to the lower end of a drill string which body has downwardly extending legs on which there are journals that rotatably mount roller cutters. The body usually has a central circulation fluid passage therethrough through which a liquid circulation fluid such as mud is discharged for the purpose of cooling and cleaning the cutters and flushing the cuttings upwardly through the well bore.

For various reasons many wells are now being drilled which, instead of employing a liquid circulation fluid, employ either a compressed gas or compressed air. Such circulation fluids are forced down the drill string and are discharged through the body of the bit and flush the cuttings upwardly in the well bore. In order to cool the anti-friction bearings that rotatably mount the roller cutters on the journals the body is equipped with branch passages that communicate with the circulation fluid passage in the body. These branch passages conduct a portion of the circulation fluid—in this instance, air or gas—to the interiors of the roller cutters. The air or gas is thus forced rapidly through the anti-friction bearings and escapes from the cutters adjacent the inner sides of the legs on which the cutters are rotatably mounted. The continuous flow of the air or gas through the bearings serves to cool them sufficiently to assure continued rotation of the cutters as the drill string and body are rotated and prevents ingress of abrasive cuttings into the bearings.

It is sometimes desirable to introduce a small amount of water into the air or gas at the top of the drill string so that it will be carried down the drill string in the form of water vapor. However whether or not water is introduced into the air or gas before it is pumped down the drill string, water strata are frequently encountered in the course of drilling the well. Consequently for either or both of these reasons moisture may be present in or around the bit while the well is being drilled using gaseous circulation fluids. Because of the presence of moisture, when drilling operations are temporarily halted, such as is occasioned by the addition of another stand of drill pipe to the drill string, a reversal of flow of the gaseous circulation fluid and moisture may take place. This is apt to cause moistened rock dust or cuttings to be carried upwardly into the body of the bit and to settle in and plug the branch passages that conduct circulation fluid to the bearings of the cutters. If one or more of the branch passages become thus plugged, their respective cutters are consequently deprived of circulation fluid when drilling operations are resumed. The bearings in the cutters heat rapidly and may freeze so that the cutter no longer rotates on its journal. This results in a rapid destruction of the cutter requiring that the drill string and bit be removed and the bit replaced.

It is a primary object of the present invention to provide a novel rock bit for drilling with gaseous circulation fluids wherein a one-way valve means is located in the circulation passage through the body of the bit below the points of communication of the branch passages therewith. This one-way valve means permits of the downward flow of the gaseous circulation fluid during normal drilling operations but prevents reverse flow therethrough. Consequently when drilling operations are temporarily suspended and there might be a tendency for reverse flow

to take place, moistened powders or cuttings cannot enter the circulation fluid passage, settle or collect in the branch passages, and plug them.

Another object of the invention is to provide a well drilling bit having the above mentioned characteristics wherein a one-way valve means is readily removable and may be easily substituted for. The one-way valve means has passages therethrough which, in effect, throttle or regulate the amount of gaseous circulation fluid that is discharged by the body of the bit against or between the cutters. As the drilling of the well proceeds there frequently is occasion to vary or change the amount of circulation fluid that is discharged. This variation can be readily accomplished by removing the one-way valve means and substituting another having different sizes of passages therethrough.

With the foregoing and other objects in view, which will be made manifest in the following detailed description and specifically pointed out in the appended claims, reference is had to the accompanying drawings for an illustrative embodiment of the invention, wherein:

FIGURE 1 is a partial view in vertical section through a well drilling bit embodying the present invention.

FIG. 2 is a partial view in horizontal section taken substantially upon the line **2—2** upon FIG. 1 in the direction indicated.

Referring to the accompanying drawing wherein similar reference characters designate similar parts throughout, the bit embodying the present invention consists of a body generally indicated at **10** conventionally having at its top a threaded pin **11** by which it may be attached to the lower end of a drill string. The body has downwardly extending legs **12** only one of which is shown but it may be understood that there are usually three or four of such legs. Each of the legs has an inwardly extending journal **13** that is usually integral therewith and on each journal there is rotatably mounted a roller cutter **14**. Usually anti-friction bearings (not shown) are interposed between the cutter **14** and the journal **13**. These frequently are both roller bearings and ball bearings, the ball bearings being inserted between their races on the interior of the cutter and on the exterior of the journal through an opening **15** that is subsequently closed by a ball plug **16** welded in place such as by a weld **17**. The ball plug **16** has a portion which is of reduced diameter indicated at **18** that provides a clearance space leading around the ball plug to the ball bearing of the anti-friction bearings. This clearance space, indicated at **19**, communicates with a branch passage **20** in each leg **12** and the branch passages **20** in turn communicate at their upper ends with a vertical central circulation passage **21** in the body of the bit. In the course of drilling the gaseous circulation fluid which may be moistened is forced down the drill string and is discharged through the passage **21** against or between the roller cutters **14**. A portion of the circulation fluid is forced through the branch passages **20** and through the clearance space **19** to the interior of the roller cutters **14**, where it passes between the balls or rollers of the anti-friction bearings and finds egress through the clearance space **22**. This portion of the circulation fluid discharging continuously in this manner serves to cool the anti-friction bearings and prevents ingress of abrasive cuttings to the bearings.

In accordance with the present invention, a shoulder **23** that faces upwardly is formed in the circulation fluid passage **21**. This shoulder serves to support a perforated plate **24** in which a plurality of discharge ports **25** are formed. As illustrated, the number of discharge ports **25** is shown as being three, but their number and their sizes may vary. On the underside of the plate **24** there is secured a section of flexible material **26** which may be of leather, neoprene rubber or the like. This section is

divided by radial slots **27** into lobes **28** all of which are centrally connected to each other around the attaching bolt **29**. The lobes function as flapper valves and serve as one-way check valves which permit of downward flow of circulation fluid through the ports **25** during normal drilling operations. However when drilling is temporarily halted or suspended and there is any occasion for reverse flow, the lobes **28** prevent upward flow through the passage **21**. As this one-way valve means is located below the points of communication of the branch passages **20** with the circulation fluid passage **21**, no dust or cuttings can rise in the circulation passage **21**, settle or collect in the branch passages **20**, and plug these passages such as is apt to occur particularly when the gaseous circulation fluid has been moistened.

The plate **24** and its attached flexible lobes **28** is retained in place against the shoulder **23** by a tubular sleeve **30** that fits snugly within the circulation fluid passage **21** below the points of communication of the branch passages **20** therewith. Adjacent the points of communication of the branch passages **20** with the circulation fluid passage this sleeve is in spaced relation to the walls of the circulation fluid passage **21**. The top of the sleeve **30** is flared and divided into outwardly extending fingers **31** which are engaged by and retained in place such as by a split snap ring **32**.

As drilling operations proceed there may be occasion to alter or vary the size or shape of the ports **25** in the plate **24**. This can be readily accomplished by removal of the snap ring **32**, withdrawing the sleeve **30**, and substituting a different plate **24** having the desired or required size and shape of ports **25**.

From the above described construction it will be appreciated that an improved rock bit has been developed primarily designed for use with gaseous circulation fluids. In such bits a portion of the circulation fluid is conducted to the interior of each roller cutter and discharged through its anti-friction bearings to cool them. Provision is made for preventing reverse flow of circulation fluid and cuttings through the bit which might tend to plug the branch passages whenever drilling operations are temporarily suspended. The one-way valve means used for this purpose is readily removable and replaceable to vary the amount of circulation fluid that is discharged by the body against or between the cutters.

Various changes may be made in the details of the construction without departing from the spirit and scope of the invention as defined by the appended claims.

I claim:

1. A rock bit having a body on which cutters are rotatably mounted, said body having a main circulation passage therethrough for the discharge of circulation fluid,

and having branch passages each with a point of communication with the main circulation passage and leading to the interiors of the cutters, an imperforate tubular sleeve having its lower end snugly fitting the main circulation passage below the points of communication of the branch passages therewith, said sleeve extending above said points of communication, the wall of said main circulation passage adjacent the upper end of said sleeve being spaced outwardly from said sleeve to provide circulation in the main passage exteriorly of the sleeve to said points of communication with said branch passages as well as interiorly of the sleeve, releasable sleeve anchoring means engaging the wall of said passage and said sleeve, and a substitutable downwardly opening one-way valve supported in and upwardly removable from said main circulation passage and held in position beneath and by said sleeve.

2. A rock bit having a body on which cutters are rotatably mounted, said body having a main circulation passage downwardly therethrough for the discharge of circulation fluid and having branch passages, the latter having points of communication with the main circulation passage and leading to the interiors of the cutters, said main passage having a support therein below said points of communication of the branch passages, an apertured orifice plate resting upon said support, a one-way upwardly closing valve element and supporting means therefor adjacent said orifice plate, a sleeve in said main circulation passage having its lower end snugly fitting said main passage and resting upon said orifice plate, said sleeve extending above said points of communication, the wall of said main circulation passage adjacent the upper end of said sleeve being spaced outwardly from said sleeve to provide circulation in the main passage exteriorly of the sleeve to said points of communication with said branch passages as well as interiorly of the sleeve, and releasable means in said main passage engaging the upper end of said retainer sleeve to hold said sleeve and orifice plate in position in said main passage.

3. The structure in claim **2** and said retainer sleeve, from its bottom to a point above said points of communication of said branch passages having a wall portion free of apertures.

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