Dec. 20, 1966 P. W. SCHUMACHER, JR 3,292,719

DRILL BIT

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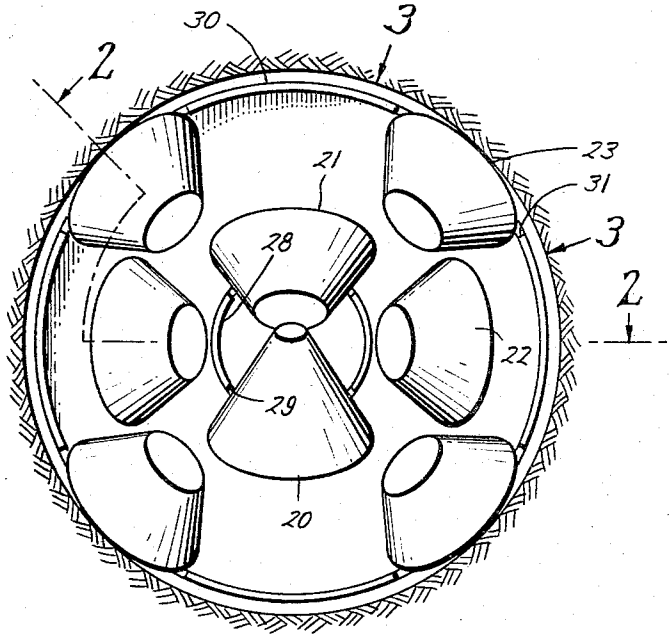
Fig. 1



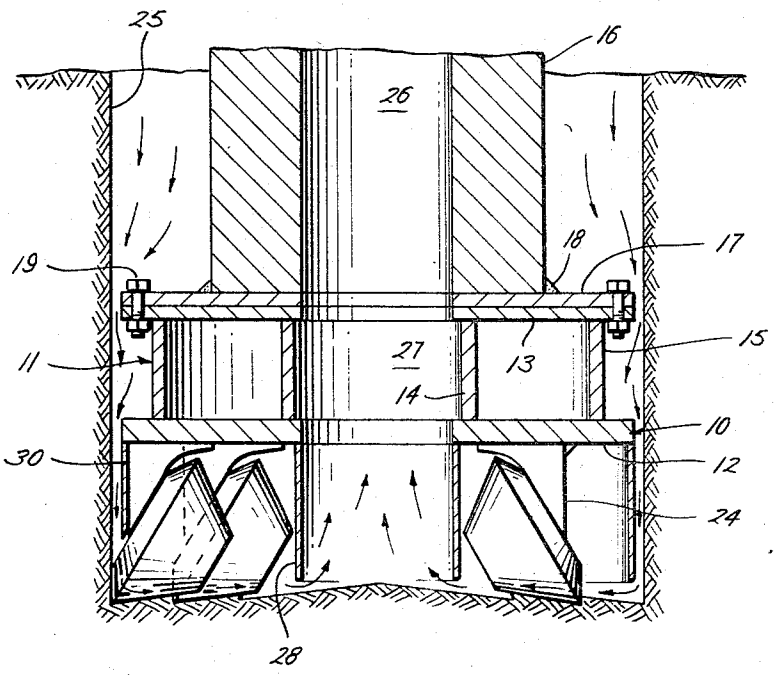


Fig. 2

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Fig. 3

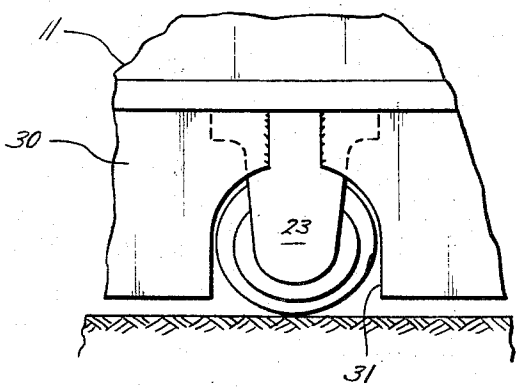


Fig. 4

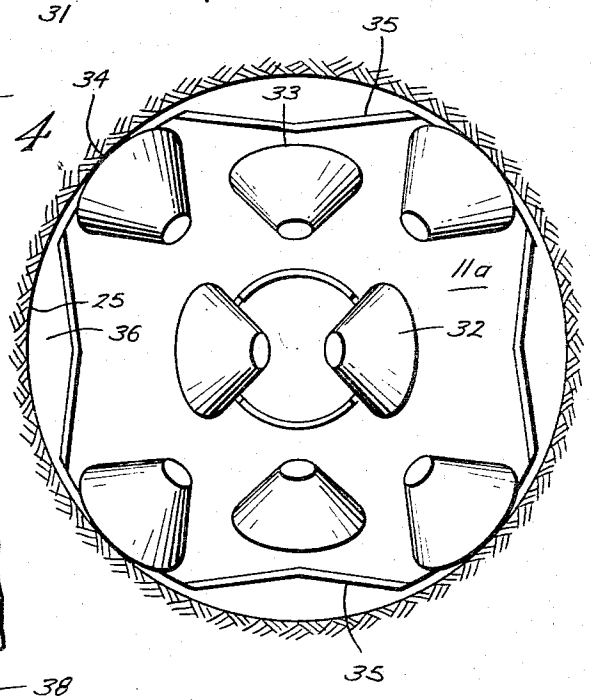
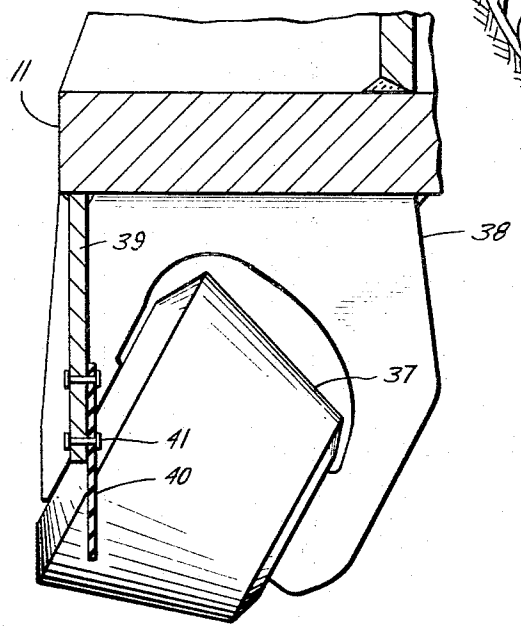


Fig. 5



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United States Patent Office 3,292,719 Patented Dec. 20, 1966

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DRILL BIT

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Filed Jan. 15, 1964, Ser. No. 337,871
5 Claims. (Cl. 175—339)

This invention relates generally to an earth boring drill of the roller cutter type and more particularly to a drill for producing relatively large diameter bore holes.

In the drilling of earth bores for wells, shafts and the like, a bit head, having cutters mounted on the lower portion thereof, is connected to the lower end of a drill stem which is rotated to cause the cutters to roll upon the bottom of the bore hole being produced to cut or crush the formation being encountered. A drilling fluid, which may be a gas or a liquid, is pumped downwardly through the drill stem and bit head and rises in the space between the drill stem and the wall of the hole to the surface of the earth. Reverse flow of the drilling fluid may be employed by pumping the drilling fluid downwardly about the drill stem and thence upwardly through the interior of the drill stem.

One of the most important desired functions of the drilling fluid thus circulating is to remove quickly the cut or crushed particles of the formation from the bottom of the hole and from the roller cutters. This function is not always efficiently performed, especially in the drilling of large diameter holes, because such bits may have widely spaced cutter assemblies and much space between the bit head and the bottom of the hole.

If the cuttings are not quickly removed, they may be recut by the roller cutters, and the formation particles may accumulate around the cutters and between the bit head and the bottom of the hole, whereby the cutters may cease to rotate on their axes and may be worn by skidding upon the hole bottom, thus reducing the useful life of the drill bit. Such formation clogging of the drill bit is commonly known as "balling up." This invention has for one of its general objects the provision of a new and improved roller type drill bit having means arranged to cause the drilling fluid to perform the desired function of quickly removing the formation particles from the bottom of the hole and from the areas about the roller cutters.

Another object is to provide a new and improved drill bit having widely spaced cutters arranged to effectively produce a relatively large diameter bore hole.

Another object is to provide a new and improved drill bit having skirts or means arranged between some of the roller cutters to channel or direct the drilling fluid closely along the hole bottom and about some of the roller cutters.

Other objects will become apparent from the following description and the accompanying drawings, in which:

FIGURE 1 is a bottom plan view of a drill embodying one form of the invention, showing the arrangement of the roller cutters and the skirts extending between some of the cutters.

FIGURE 2 is a sectional view taken along line 2—2 in FIGURE 1.

FIGURE 3 is a fragmentary detail view taken along line 3—3 of FIGURE 1.

FIGURE 4 is a bottom plan view of another embodiment of the invention.

FIGURE 5 is a detail view showing an alternate type of cutter assembly and another embodiment of the skirting means.

Referring to FIGURES 1, 2 and 3, a drill embodying the invention is shown generally at **10** and includes a bit

head **11**. The bit head **11** comprises a lower plate **12** and an upper plate **13**. An inner cylindrical spacer **14** and an outer cylindrical spacer **15** are disposed between the plates **12** and **13** and are welded or secured thereto in any other suitable manner. A portion of a drill stem is shown at **16**, and a flange **17** is secured to the drill stem **16** by means of a weld **18**. As shown, the flange **17** is connected to the plate **13** by means of bolts **19**. Central cutter assemblies **20** and **21** are welded or otherwise secured to the lower surface of the plate **12** of the bit head **11**. Intermediate cutter assemblies **22** and outer cutter assemblies **23** are also attached to the bit head **11** in a similar manner. Each cutter assembly comprises a downwardly extending leg **24** having a downwardly and inwardly extending shaft (not shown) upon which are mounted the roller cutters. The roller cutters may have conventional cutting teeth or other cutting elements and may be mounted on suitable bearings as is well known in the art.

As may be seen in FIGURE 1, cutter assemblies **20** and **21** are arranged centrally to cut at and proximate the axis of the drill. The outer cutter assemblies **23** are disposed to cut in a path at and near the wall **25** of the bore hole. The cutter assemblies **22** are disposed to cut a path intermediate the central cutters and the outer cutters whereby the entire bottom of the bore hole is drilled.

The drill stem **16** has a passageway **26**, and the bit head **11** has a passageway **27** therethrough in communication with the passageway **26** of the drill stem **16**. A generally cylindrical central skirt **28** is attached to the bit head **11** by means of a weld, and forms a continuation of the drilling fluid passageways **26** and **27**. The skirt **28** extends downwardly in close proximity to the bottom of the hole, and the lower portion of the skirt may be scalloped or cut away as shown at **29** to fit closely around portions of the cutter assemblies **20** and **21**, which cutter assemblies extend radially inwardly of the skirt **28**.

An outer skirt **30** is welded to the bit head **11**, and extends downwardly in close proximity to the bottom, and is arranged to substantially span the space between the outer cutter assemblies **23**. It is cut away at its bottom edge as shown at **31** for each outer cutter assembly **23** so that a portion of the outer cutter may extend radially outwardly thereof.

In operation, the drill stem **16** is rotated causing the bit cutters to roll upon the bottom to cut the formation being encountered. As shown in FIGURE 2, a drilling fluid, such as a liquid or a gas, is circulated downwardly about the drill stem **16** and moves radially inwardly under the outer skirt **30** and around the cutters **23** and around the cutters **20** and **21**, under and upwardly through the skirt **28** and the passageways **27** and **26** to the surface of the earth. Since an effective volume of the fluid thus circulating is constrained to pass close to the bottom of the hole and closely around some of the cutters, the cuttings will be efficiently removed by the circulating fluid from the bottom of the hole and from around such cutters.

If desired, the drilling fluid may be circulated downwardly through the passageway **26** of the drill stem **16** and through the passageway **27** and central skirt **28**, thence radially outwardly under the central skirt **28** and the outer skirt **30** and upwardly in the space between the stem **16** and the wall **25** of the bore hole to obtain a reverse but similar result to that just described as to cutting removal and cleaning of the cutters.

FIGURE 4 shows another embodiment of the drill bit of the invention and is similar in construction and operation to that just described, and comprises a bit head **11*a*** having central cutter assemblies **32**, intermediate cutter assemblies **33** and outer cutter assemblies **34** mounted on the bit head **11*a***. The drill employs the

central skirt **28** to embrace the central cutters **32** in the manner just described. Skirts **35** are attached to and extend downwardly from the bit head **11***a*, and substantially span the space between the outer cutters **34**. The skirts **35** are arranged so that drilling fluid passageways **36** are formed between the outer surfaces of the skirts **35** and the wall **25** of the bore hole.

FIGURE 5 is a fragmentary view showing an alternate construction having a cutter **37** mounted in a yoke-type cutter support **38**. The cutter support **38** may be welded to the bit head **11**. The cutter **37** is supported on a shaft bearing structure (not shown) in the well known manner. An outer skirt **39** is welded to the bit head **11** and extends downwardly thereof. A skirt extension **40** is attached to the lower portion of skirt **39** by means of rivets **41** or the like. The skirt extension **40** may be made of a heavy rubber belting, or the like, and may extend downwardly from the skirt **39** in close proximity to the bottom of the hole.

It will be apparent from the foregoing that the invention will be found to be particularly useful in drill bits which drill bore holes 36 inches in diameter or larger, because relatively few cutters may be employed to drill the entire bore, and because of the provision of the skirts which provide a drilling fluid circulation arrangement which will efficiently remove cuttings from the hole bottom and from the drill bit cutters.

This invention is not limited to the embodiments shown. Various changes within the scope of the following claims will occur to those skilled in the art.

What is claimed is:

1. In an earth boring roller drill, a head adapted to be connected to the lower end of a hollow drill stem, said head having a central drilling fluid passageway therethrough in communication with the drill stem and the lower portion of said head, a plurality of central roller cutter assemblies secured to the lower portion of said head, and arranged to drill the formation at and proximate the axis of the drill, a plurality of outer roller cutter assemblies secured to the lower portion of said head, and arranged to drill an annular path at and near the wall of the bore hole, intermediate roller cutter assemblies secured to the lower portion of said head and arranged to cut annular paths on the formation between said central and outer cutter assemblies whereby the entire bottom of the hole is drilled, a central skirt means attached to said head, and extending downwardly in close proximity to the bottom of the hole and forming a continuation of said central passageway to conduct drilling fluid toward or from the bottom of the hole, the said skirt being arranged to substantially span the space between the said central cutter assemblies, outer skirt means extending downwardly from said head in close proximity to the bottom of the hole and disposed to substantially span the space between said outer cutter assemblies whereby circulating drilling fluid is constrained to move radially near the bottom of the bore hole, under said skirts, and around some of the cutters to clean the same.

2. In an earth boring roller drill, a head adapted to be connected to the lower end of a hollow drill stem, said head having a central drilling fluid passageway therethrough in communication with the drill stem and the lower portion of said head, a plurality of central roller cutter assemblies secured to the lower portion of said head, and arranged to drill the formation at and proximate the axis of the drill, a plurality of outer roller cutter assemblies secured to the lower portion of said head, and arranged to drill an annular path at and near the wall of the bore hole, a central skirt means attached to said head, and extending downwardly in close proximity to the bottom of the hole and forming a continuation of said central passageway to conduct drilling fluid toward or from the bottom of the hole, the said skirt being arranged to substantially span the space between the said central cutter assemblies, outer skirt means extending downwardly from said head in close proximity to the bottom of the hole and disposed to substantially span the space between said outer cutter assemblies whereby circulating drilling fluid is constrained to move radially near the bottom of the bore hole, under said skirts, and around some of the cutters to clean the same.

3. In an earth boring roller drill, a head adapted to be connected to the lower end of a hollow drill stem, said head having a drilling fluid passageway therethrough in communication with the drill stem and the lower portion of said head, a plurality of central roller cutter assemblies secured to the lower portion of said head, and arranged to drill the formation at and proximate the axis of the drill, a plurality of outer roller cutter assemblies secured to the lower portion of said head, and arranged to drill an annular path at and near the wall of the bore hole, intermediate roller cutter assemblies secured to the lower portion of said head and arranged to cut annular paths on the formation between said central and outer cutter assemblies whereby the entire bottom of the hole is drilled, a central skirt means attached to said head, and extending downwardly in close proximity to the bottom of the hole and forming a continuation of said passageway to conduct drilling fluid toward or from the bottom of the hole, the said skirt being arranged to substantially span the space between the said central cutter assemblies, whereby circulating drilling fluid is constrained to move radially near the bottom of the bore hole, under said skirt, and around the cutters to clean the same.

4. In an earth boring roller drill, a head adapted to be connected to the lower end of a drill stem, said head having a drilling fluid passageway therethrough, a plurality of roller cutters mounted on the lower portion of said head, and arranged to drill the entire bottom of a bore hole, skirt means secured to and extending downwardly from said head including a flexible skirt extension in close proximity to the bottom of the hole, said skirt means substantially spanning the space between certain of the cutters, whereby drilling fluid may be circulated through said passageway and under said skirt means

5. In an earth boring rotary drill, a head, a plurality of roller cutters mounted on said head, a skirt on said head extending downwardly in close proximity to the bottom of a bore hole, and disposed between certain of said cutters, the said skirt comprising a pliable material.

References Cited by the Examiner

UNITED STATES PATENTS

839,837	1/1907	Guttzeit	175—355
1,582,332	4/1926	Brutus	175—339
3,100,544	8/1963	Overly	175—333

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