United States Patent [19]

Anderson

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[54] **RESILIENT DRILL STRING GUIDE AND SEAL**

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[73] Assignee: **Gardner-Denver Company,** Quincy, Ill.

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[52] **U.S. Cl.** ..... **173/164,** 81/57.34, 175/84, 308/4 R

[51] **Int. Cl.** **E21b 19/16**

[58] **Field of Search** ..... 173/164, 16 A; 175/84, 175/220; 166/84, 173, 175, 81; 15/104.04; 81/57.3, 57.16, 57.19, 57.21; 308/4 R, 4 A; 277/236

[56] **References Cited**

UNITED STATES PATENTS

3,148,739	9/1964	Mattingly et al.	175/84 X
3,178,745	4/1965	Kleebauer	15/77
3,680,412	8/1972	Mayer et al.	81/57.34

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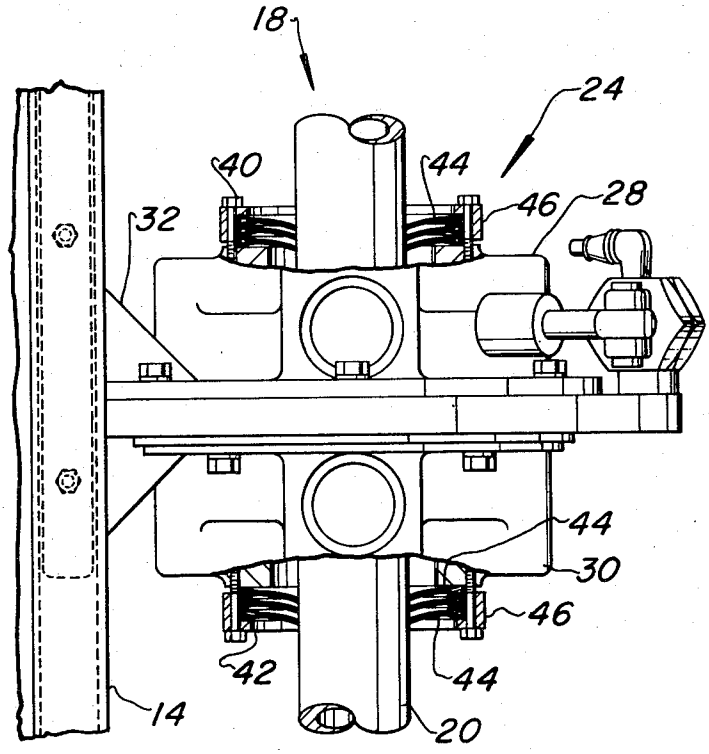
[57] **ABSTRACT**

A guide or centralizer characterized by a plurality of radially inwardly projecting wire bristles formed in a ring brush assembly for engagement with the elongated drill string sections of a rock drilling apparatus. The resilient character of the brushlike guide prevents scoring or galling of the drill string section outer surface under heavy lateral forces tending to deflect the drill string. The brushlike guide also serves as a dust and rock chip seal for a joint breakout mechanism.

4 Claims, 6 Drawing Figures



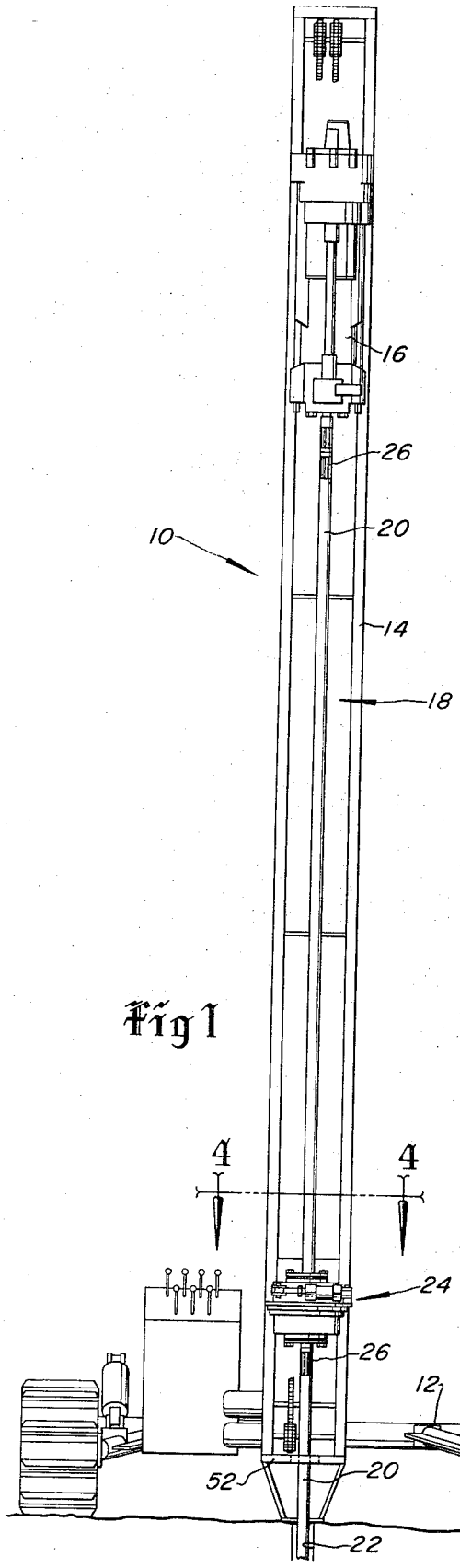


Fig 1

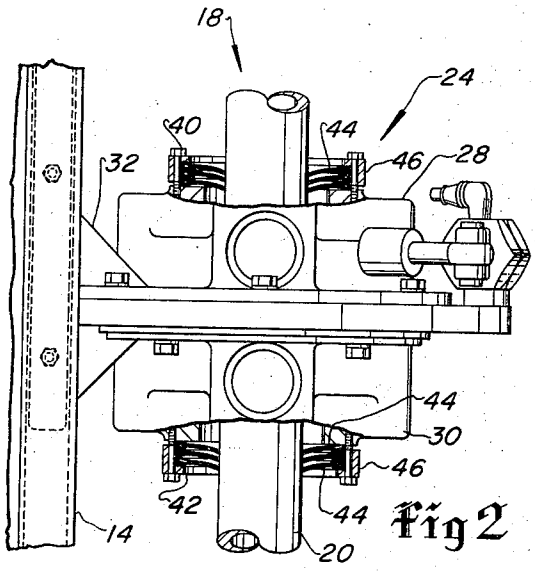


Fig 2

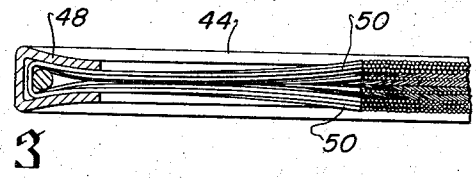


Fig 3

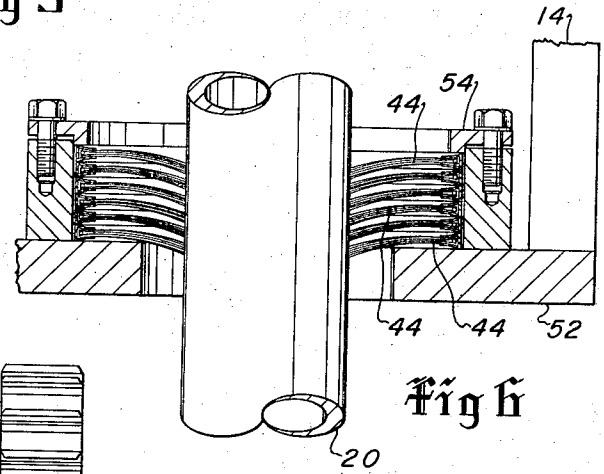


Fig 6

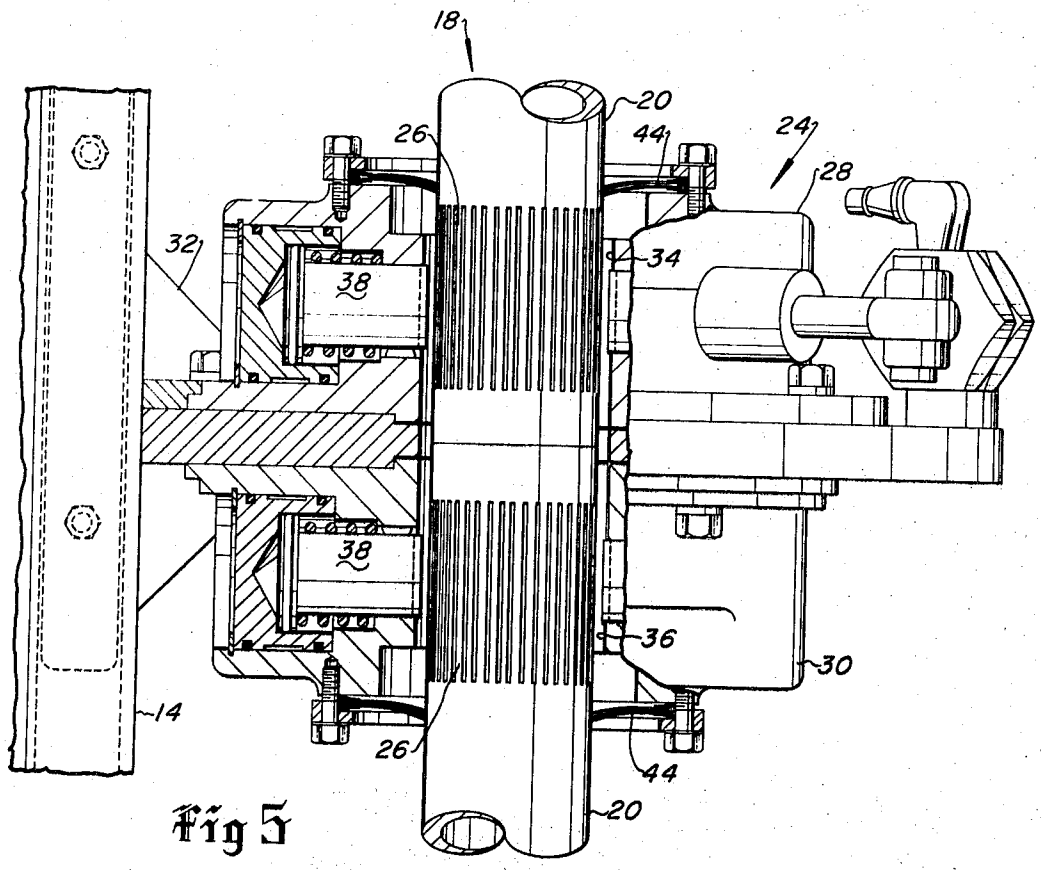


Fig 5

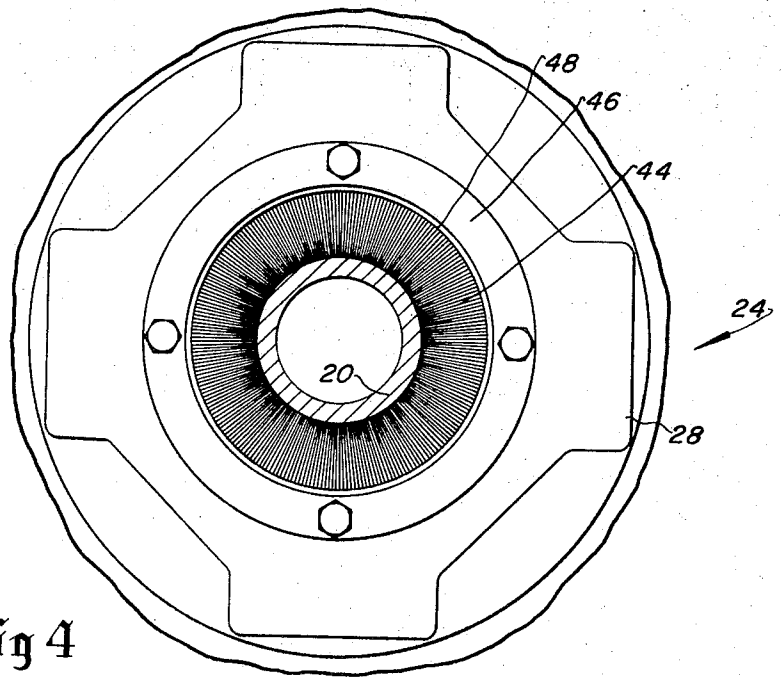


Fig 4

RESILIENT DRILL STRING GUIDE AND SEAL

BACKGROUND OF THE INVENTION

In rotary and percussion rock drilling the longitudinal feeding force exerted on the elongated drill rod sections making up the drill string together with other forces exerted thereon often tends to produce lateral bending or deflection of the drill string. Such lateral bending is usually limited by guide bushings or centralizers which journal the drill string to maintain proper direction of drilling and to prevent buckling of the elongated drill rod sections. Under conditions of heavy lateral deflection forces the outer surfaces of the drill rod sections are often scored and galled from contact with the guide or centralizer bushings. Such scoring creates trapped tensile stresses in the surface of the drill rods to the extent that cracks are formed which grow progressively larger and with continued use of the drill rods eventually cause an early and complete fracture thereof. Moreover, the need for dust seals or rock chip deflectors for breakout mechanisms and other ancillary devices on drilling apparatus cannot be satisfactorily met by close fitting bushings of solid material because the scoring problem arises. Prior attempts to use nonmetallic seals which are engaged by the rotating and axially moving drill rod have been unsuccessful because the seal itself is quickly destroyed from frictional wear and heating.

SUMMARY OF THE INVENTION

The present invention provides an improved drill string guide or centralizer for substantially preventing large lateral deflections of a drill string without tending to score, scratch, or otherwise damage the outer surface of the drill rods themselves.

The present invention also provides an improved seal or dust and rock chip deflector for use on joint breakout mechanisms or other ancillary devices on drilling apparatus which is not subject to scoring the surface of a drill rod and which also is operative in a dust laden, nonlubricated environment without tendency to early failure from wear or overheating.

In accordance with the present invention a brushlike arrangement of radial inwardly projecting bristles for engaging the outer surface of tubular drill rods and the like provides for bearing forces exerted on the drill rods themselves to be distributed over a relatively large area of the drill rod surface in a nondamaging manner which provides for greater useful life of the drill rods as well as the guide and seal means itself.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a front elevation of a mobile percussion rock drilling apparatus;

FIG. **2** is a side elevation of a drill string section joint breakout mechanism of the apparatus of FIG. **1** which includes the resilient brushlike drill string guide and seal means of the present invention;

FIG. **3** is a partial section view of one of the brushlike guide and seal members of the present invention;

FIG. **4** is a view taken from line **4—4** of FIG. **1**;

FIG. **5** is a side view of an alternate embodiment of the present invention; and,

FIG. **6** is a partial front elevation of the drilling apparatus of FIG. **1** illustrating a second alternate embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawings and in particular FIG. **1**, a mobile rock drill apparatus is illustrated and generally designated by the numeral **10.** The apparatus **10** includes a crawler type undercarriage **12** upon which is mounted an elongated support or mast **14** for supporting a drill motor **16.** The drill motor **16** may be of the fluid operated rotary-percussion type which is operable to rotate and impact a drill string **18** made up of a plurality of elongated tubular drill string sections or rods **20** coupled end to end for transmitting rotation and percussive energy to a rock penetrating bit portion, not shown, so as to form a drill hole **22.** The drill motor **16** is mounted for reciprocable movement along the mast **14** and is adapted to exert a longitudinal feed force on the drill string **18** in a manner well known.

The rock drill apparatus **10** includes a joint breakout mechanism **24** mounted on the mast **14** and suitably adapted for engaging longitudinal splines **26** on the adjacent ends of two joined drill rods **20** for breaking out or loosening the threaded connection therebetween. The breakout mechanism **24** includes housing portions **28** and **30** (FIGS. **2** and **5**) supported on a member **32** which is retained for longitudinal movement along the mast **14.** The housing portions **28** and **30** are provided with longitudinal bores **34** and **36** through which the drill string projects. The breakout mechanism **24** includes suitable jaw means **38** movable in the bores **34** and **36** for engagement with the splined portion **26** on the drill rods **20** for breaking out a threaded connection therebetween. A more detailed description of the breakout mechanism **24** and its operation is disclosed in U.S. Pat. No. 3,680,412 to J. R. Mayer, et al.

During normal drilling operations the breakout mechanism **24** is positioned near the lower end of the mast **14** as shown in FIG. **1** where it is in readiness for breaking out a threaded connection between two joined drill rods as the drill string is withdrawn from the hole. In this position of the breakout mechanism **24** it may also serve as a guide or centralizer to prevent lateral excursion of the drill string during drilling operations. It has been determined that the use of metallic bushings or sleeves in the mechanism **24** for guiding the drill string has resulted in severe scoring and metal removal from the outer surface of the elongated drill rods due to the sometimes high lateral forces exerted on the drill string while it is being rotated and axially oscillated during drilling operations. Attempts to prevent damage to the drill rods by the use of nonmetallic sleeves have also been largely unsuccessful due to the rapid degradation of the sleeves from frictional heating and wear.

The aforementioned problems have been substantially eliminated with the present invention. Referring to FIG. **2,** the housing portions **28** and **30** are respectively provided with resilient drill string guide and dust seal means generally designated by numerals **40** and **42.** The guide and seal means **40** and **42** are characterized by a plurality of circular brushlike devices **44** comprising radially inwardly projecting wire bristles which are in relative sliding engagement with the outer surface of the tubular drill rods **20** for guiding the drill string **18** and for substantially preventing the entry of dust and rock chips into the bores **34** and **36** of the breakout housing portions **28** and **30.** Each housing

portion has a quantity of three brushlike devices **44** retained thereon in alignment with the longitudinal axis of the bores **34** and **36** by suitable retainer plates **46** removably fastened to the housing portions. Each device **44** is characterized by a bristle support ring **48** (FIG. 3) which supports the radially inward projecting wire bristles **50.**

For a drilling apparatus capable of drilling with four inch outside diameter tubular drill rods, it has been determined that a total of six brushlike devices **44** arranged in pairs of three, as shown in FIG. **2,** can provide for guiding of the drill string without scoring or damaging the exterior surface of the drill rods **20.** A preferred form of the devices **44** uses from four thousand to five thousand bristles per device with the bristles made of austenitic grade stainless steel wire of 0.018 inch diameter. It is contemplated that wire in the range of approximately 0.015 inch to 0.060 inch in diameter may be used whereas with the use of heavier and stiffer wire the total number of brushlike devices and/or the number of bristles per device may be reduced. An interference fit of approximately one-half inch between the bore diameter of the devices **44** and the drill string section outside diameter is suitable for 4 inch diameter drill rods. A reduced number of brushlike devices **44** may be used as shown in FIG. **5** if it is only desired to primarily use the devices as a dust and rock chip deflector or sealing means to prevent clogging of the bores of the breakout mechanism.

As shown in FIG. **6,** the brushlike devices **44** may also be mounted directly on the mast **14** near the lower end thereof. In the embodiment of FIG. **6** a tubular housing **50** is mounted on a plate **52** attached to the lower end of the mast **14.** A suitable number of brushlike devices **44** are disposed in the housing **50** and retained therein by a cap **54** to serve primarily as a resilient drill string guide which substantially prevents lateral deflection of the drill string **18** without scoring the outer surface of the drill rods or causing severe frictional heating thereof. Moreover, all of the embodiments disclosed herein provide continuous cleaning of the surface of the drill rods and the spline portions thereon thanks to the constant engagement of the wire bristle ends with the drill string as the drill rods pass through the devices **44.**

What is claimed is:

1. In a rock drill apparatus:
an elongated support;
a drill motor mounted on said support for reversible movement therealong;
a drill string connected to said drill motor and comprising one or more elongated tubular drill rods joined end to end; and,
means mounted with respect to said support to be in surrounding engagement with said drill string, said means comprising a plurality of wirelike bristles projecting substantially radially inward with respect to the longitudinal axis of said drill string in such a way that the inward ends of said bristles are in relative sliding engagement with the outer surface of said drill rods for guiding said drill string to substantially prevent lateral deflection of said drill string.

2. The invention set forth in claim **1** wherein:
said means comprises a substantially circular brushlike device including a supporting member for supporting the radial outward extremeties of said bristles.

3. The invention set forth in claim **1** wherein:
said bristles are made of steel wire of a diameter in the range of 0.015 inches to 0.060 inches.

4. The invention set forth in claim **2** wherein:
said rock drill apparatus includes a joint breakout mechanism mounted on said elongated support, said breakout mechanism including a housing having a bore through which said drill string projects and said breakout mechanism includes at least one of said brushlike devices mounted on said housing for guiding said drill string and for substantially deflecting drill cuttings from entry into said bore.

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