Nov. 11, 1958 W. M. PETRELL 2,859,939

ROTARY DRIVE BUSHING

Filed March 6, 1957 2 Sheets-Sheet 1

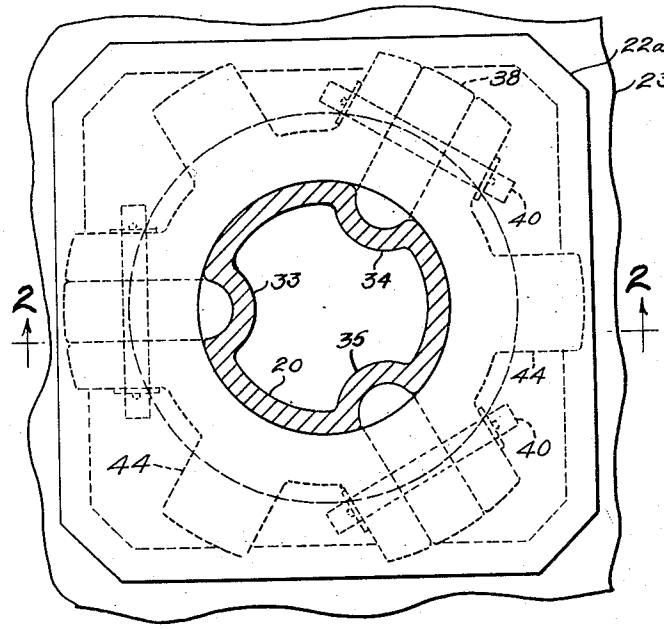


Fig. 1

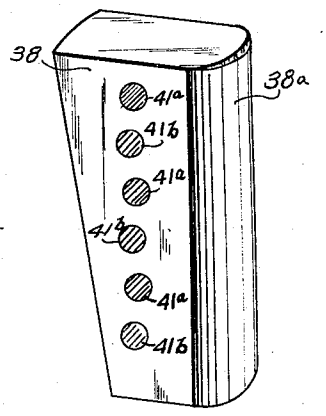


Fig. 5

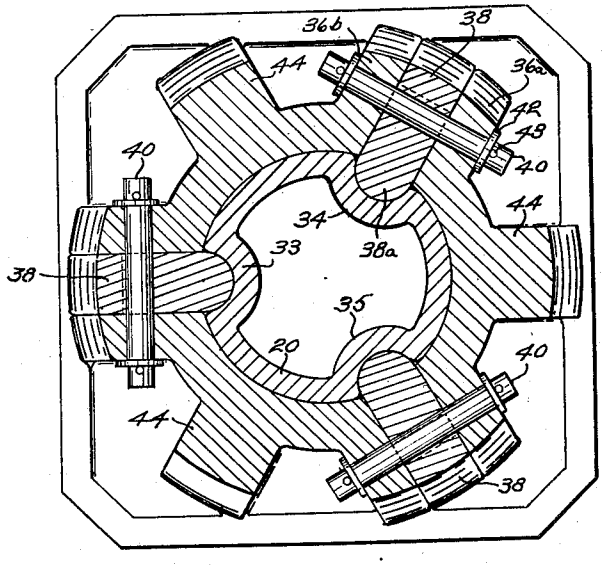


Fig. 3

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ROTARY DRIVE BUSHING

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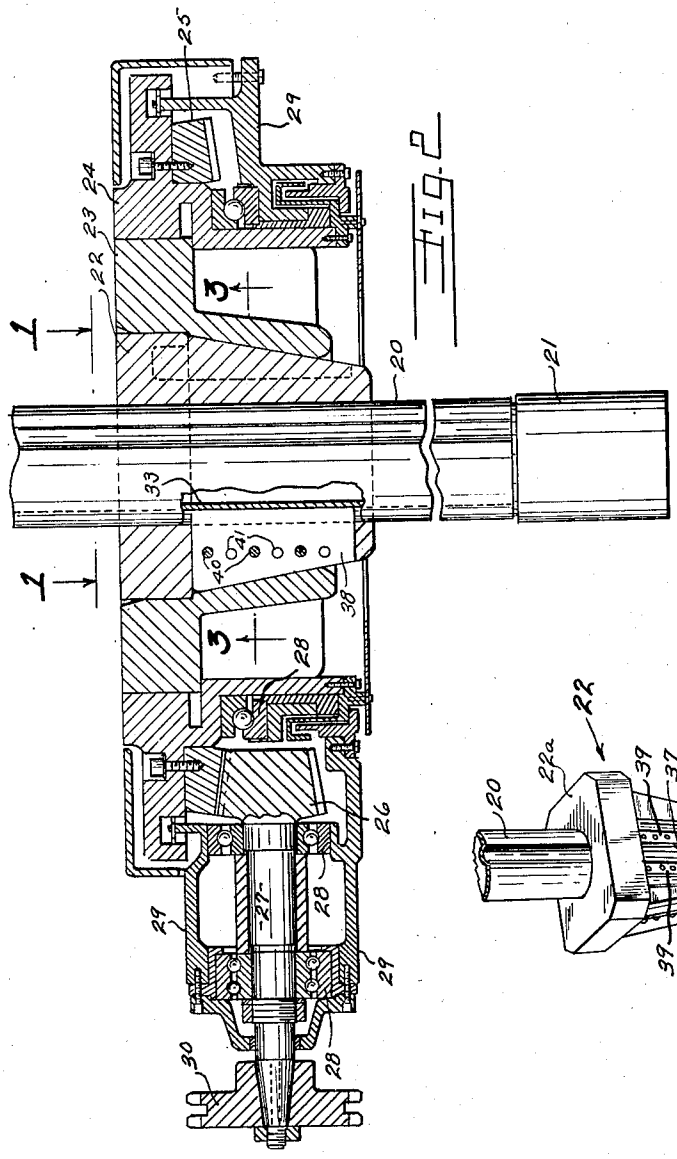


FIG. 2

FIG. 4

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ROTARY DRIVE BUSHING

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5 Claims. (Cl. 255—23)

The invention relates to novel and improved means for rotary drilling or piercing mechanism of the type wherein an elongated member is rotated while simultaneously being advanced axially to effect a boring operation.

The invention is particularly effective in connection with drilling or boring in mining operations where the material being pierced is of exceptional hardness, and I have made use of the invention in one specific exemplification comprising the mining of the ferrous ore taconite. In the surface mining of taconite, for example, one preferred practice involves the drilling or piercing of a hole to a depth of thirty or forty feet, and possibly eighteen inches in diameter, placing an explosive charge in the finished hole, and detonating the charge to fracture the adjoining taconite rock into fragments which can be picked up by mobile power means, and removed to crushers to initiate a series of operations leading to ultimate beneficiation.

In drilling or piercing unusually hard and highly abrasive material of this type, operators have used to good effect an elongated drilling or boring member, conventionally termed a Kelly bar, provided with means for simultaneously rotating it, and advancing it axially. The comminuted products of disintegration are conveyed rearwardly out of the aperture in any suitable way, for example by steam pressure developed at the leading end of the boring tool, and it will be readily apparent that in the course of the operation there is severe abrasive wear of the boring tool and associated guiding and driving equipment.

Again referring, by way of example, to the surface mining of taconite, the boring operation is in reality a spalling operation. The boring tool, or Kelly bar, has a hollow interior for the accommodation of fuel and water passages. The fuel can be a hydrocarbon such as kerosene which, at the burning tip of the Kelly bar, is combined with a combustion supporting agent such as gaseous oxygen. Water is also transmitted through the Kelly bar, and supplied in jet form to the combustion zone. The combustion operation develops an extremely high temperature in a restricted area, usually between four thousand and forty-five hundred degrees Fahrenheit, and the injection of water jets to this zone subjects the taconite rock to rapid and excessive alternations of heat and cold which literally blast the rock to minute fragments. At the same time the steam developed from the water jets blows the comminuted rock particles rearwardly along the Kelly bar and outwardly at the top of the orifice. The Kelly bar advances by gravity as the hole deepens, and is rotated by means of a bushing within which the bar slides. Some of the fragmented abrasive material finds it way inwardly between the Kelly bar and its drive bushing, the fit between said elements being necessarily rather loose, and the relatively movable surfaces wear rapidly so that it is difficult to maintain a good working connection between the Kelly bar and the drive bushing. In the past this working connection has been achieved by means of a simple key which has a mutual interfit in

grooves in the bar and the bushing. This has, of course, the advantage of permitting advance movement of the bar while giving a positive interlock for bar rotation. As heretofore explained, there is rapid wear of the co-operating drive surfaces, with necessary frequent replacement of the drive bushing and the keys.

An object of the present invention is to provide a novel and improved drive connection between a drive bushing and a driven boring member, which connection includes means for wear compensation so as to reduce the operating expense and the necessity for parts replacement.

Other objects and advantages will be apparent from a study of the following description of one exemplification of the invention in conjunction with the accompanying drawings, in which:

Fig. 1 is a view, partially in top plan and partially in horizontal section, showing my improved drive bushing in place on a Kelly bar, the view being taken from the position of the line 1—1 of Fig. 2.

Fig. 2 is a view mainly in vertical section but showing the Kelly bar in side elevation, the sectioned parts being mostly the driving and positioning elements, the view being taken at approximately the position of the line 2—2 of Fig. 1.

Fig. 3 is a horizontal sectional view taken on the line 3—3 of Fig. 2.

Fig. 4 is a perspective view of the drive bushing in place on the Kelly bar, but with the locking keys and retaining means not shown.

Fig. 5 is a perspective view of one of the locking keys.

Referring first to Fig. 2 there is shown a boring or piercing tool **20** which may be of any customary type, but which herein is usually referred to as that particular variety termed a Kelly bar. None of its internal detail is here shown, since not necessary for an understanding of the present invention. Within the removable tip portion **21** are the means for supplying fuel and water for the boring operation, said means likewise being not shown.

The Kelly bar is axially movable (downwardly in Fig. 2) responsive in the present instance to gravity only, and is axially rotatable responsive to rotation of its drive bushing **22** which nests in and is rotated by an adapter or master bushing **23**. Adapter **23** is driven by a rotatable turntable **24** which has affixed thereto a bevel ring gear **25** in mesh with a drive pinion **26** on drive shaft **27**. The drive shaft and turntable are supported in frictionless bearings **28** in housing **29**, the housing being carried by a mobile unit or truck (not shown) so that the assembly can be moved from place to place. The drive shaft is provided with a pulley **30** which can be driven by a chain, belt, or gearing from any convenient power source, possibly a power take off from the mobile unit's internal combustion engine. Conventional packing and other assembly parts are shown, but not described, since not forming an essential part of the present invention.

The drive bushing **22** could nest directly in turntable **24**, by making obvious changes in dimension in one or both of these two elements, but it is convenient to use the present system wherein the element **23** can be used as an interchangeable adapter so as to accommodate various sizes or shapes of drive bushing.

The Kelly bar **20** in the present instance is an elongated hollow cylinder having three depressed portions or flutings **33**, **34** and **35** which present outwardly concave seats for key members soon to be described. The drive bushing **22** is a roughly conical block with a central aperture to receive the Kelly bar in sliding fashion. It is provided with three pairs of parallel flanges, one set only being described, and indicated at **36***a* and **36***b*. They extend between top and bottom face portions **22***a* and **22***b*. Between each pair of flanges the bushing wall has a closed

end slot 37 (Fig. 4) which slidingly receives a key block 38 having an inner semi-cylindrical face 38*a* which seats in the fluting in the Kelly bar, as best seen in Fig. 3, so as to establish a driving connection between the bushing and the bar.

The flanges 36*a* and 36*b* are each provided with a row of apertures 39 as seen in Fig. 4, which are aligned to receive locking cross pins 40 which also pass through apertures in the key block 38 and retain it in place.

Referring to Figs. 2 and 5, it will be see that the apertures in the key block 38 are arranged in two aligned rows. One row, containing the apertures 41*a*, lies in a plane parallel to the face 38*a*, and closer thereto than the other row 41*b* which lies in another parallel plane. The planes of the aperture centers are spaced apart approximately one-sixteenth of an inch, although this dimension can be varied. The connecting pins are intended to pass through one set of apertures only, that is to say, through either the apertures 41*a* or the apertures 41*b*, there being in the present instance only three pins in each set of key blocks. From a consideration of the structure shown, it will be apparent that the key blocks can be held in an inward or an outward position, depending on the choice of the apertures 41*a* or 41*b* when inserting the pins.

In practice, during a first time period after installation, the pins will be in the inner apertures 41*a* so as to dispose the seating faces 38*a* in their outer positions. During continued use the abrasive material driving upwardly along the Kelly bar subjects both the bar flutings and the key block faces to wear, and eventually when the mutual interfit of the drive bushing and Kelly bar becomes loose, the locking pins may be withdrawn and inserted in the outer apertures 41*b* which moves the key blocks inwardly to take up the wear. The pins 40 may be retained in any suitable way such as by a washer 42 backed up by a cotter pin 43.

The three flanges 44, not heretofore mentioned may serve as strengthening ribs and may also function in an interfitting relationship between the drive bushing 22 and the adapter or master bushing 23.

As will now be apparent, the invention comprises an apparatus which is structurally simple and mechanically sturdy, and which provides facilities for positive compensation for wear, including the provision of key blocks adjustably positioned inwardly and outwardly in the bushing and engaging the boring tool in slots thereof. Securement of each block at two or more points in the drive bushing, and engagement of each block with the tool over an extended zone of contact, assures an accurate positioning and a positive rotary drive, while still permitting free endwise movement of the tool. The spacing of two sets of apertures in the key block, at respectively different distances from the contacting edge thereof, adapts the block for use in two dimensionally adjusted positions, so that cooperating structural parts have a considerably longer working life. Cylindrical keys which were previously used in alignment semi-cylindrical grooves in bushing and tool wore out rapidly so that frequent replacement was necessary.

What I claim is:

1. Apparatus for earth boring comprising, in combination, a drive bushing, means for rotating said bushing, an elongated boring tool vertically slidable within said bushing, a key groove extending longitudinally in the surface of said tool, a slot in said bushing alignable with said groove, a pair of flanges carried by said bushing, one flange extending along each edge of said slot, each said flange having a row of apertures, each aperture in axial alignment with one on the other flange, a key block slidably insertible between said flanges with an inner edge thereof extending through said slot into said groove, and means for holding said block in either a radially inner or outer position between said flanges comprising two spaced sets of apertures in said block, one set nearer to said edge than the other set, either set being alignable with apertures in both flanges, and cross connecting locking pins insertable through thus aligned apertures in flanges and block.

2. Apparatus for earth boring comprising, in combination, a drive bushing, means for rotating said bushing, an elongated boring tool vertically slidable within said bushing, a key groove extending longitudinally in the surface of said tool, a slot in said bushing alignable with said groove, a pair of flanges carried by said bushing, one flange extending along each edge of said slot, each said flange having a row of apertures, each aperture in axial alignment with one on the other flange, a key block having a flat body portion slidably insertible between said flanges with an inner edge thereof extending through said slot into said grooves, and means for holding said block in either a radially inner or outer position between said flanges comprising two spaced sets of apertures in said block, one set nearer to said edge than the other set, either set being alignable with apertures in both flanges, and cross connecting locking pins insertable through thus aligned apertures in flanges and block.

3. Apparatus for earth boring comprising, in combination, a drive bushing, means for rotating said bushing, an elongated boring tool vertically slidable within said bushing, a key groove of curved contour in cross section extending longitudinally in the surface of said tool, a slot in said bushing alignable with said groove, a pair of flanges carried by said bushing, one flange extending along each edge of said slot, each said flange having a row of apertures, each aperture in axial alignment with one on the other flange, a key block slidably insertable between said flanges with an inner edge thereof extending through said slot into said groove, said inner edge having a curved contour fitting that of the groove, and means for holding said block in either a radially inner or outer position between said flanges comprising two spaced sets of apertures in said block, one set nearer to said edge than the other set, either set being alignable with apertures in both flanges, and cross connecting locking pins insertable through thus aligned apertures in flanges and block.

4. Apparatus for earth boring comprising, in combination, a drive bushing, means for rotating said bushing, an elongated boring tool vertically slidable within said bushing, a key groove extending longitudinally in the surface of said tool, a slot in said bushing alignable with said groove, a pair of parallel flanges carried by said bushing, one flange extending along each edge of said slot, each said flange having a row of apertures, each aperture in axial alignment with one on the other flange, a key block having a flat body portion slidably insertible between said flanges with an inner edge thereof extending through said slot into said groove, and means for holding said block in either a radially inner or outer position between said flanges comprising two spaced sets of apertures in the body portion of said block, one set nearer to said edge than the other set, either set being alignable with apertures in both flanges, and cross connecting locking pins insertable through thus aligned apertures in flanges and block.

5. Apparatus as defined in claim 4 wherein said bushing has three slots spaced one hundred twenty degrees apart, each slot having a key block therein, and each key block being retainably adjustable inwardly and outwardly in its respective slot.

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