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[54] **FORMING ROLL**

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[56] **References Cited**

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3,514,136 5/1970 Kennicott .....287/53 R

2,634,144 4/1953 Friedman.....287/53 R

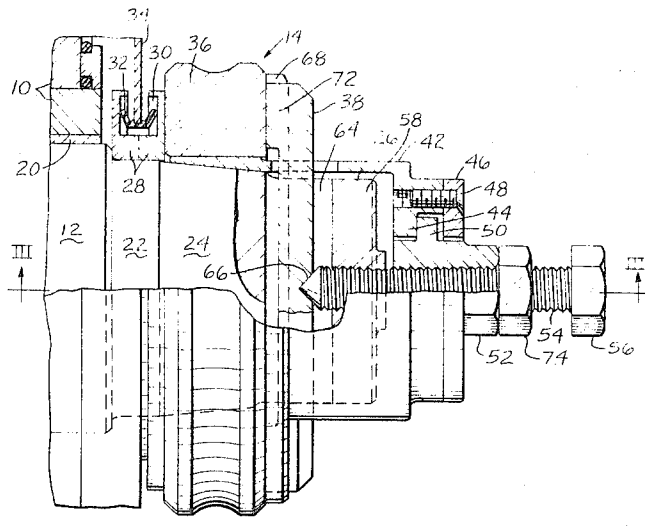
Primary Examiner—Andrew V. Kundrat

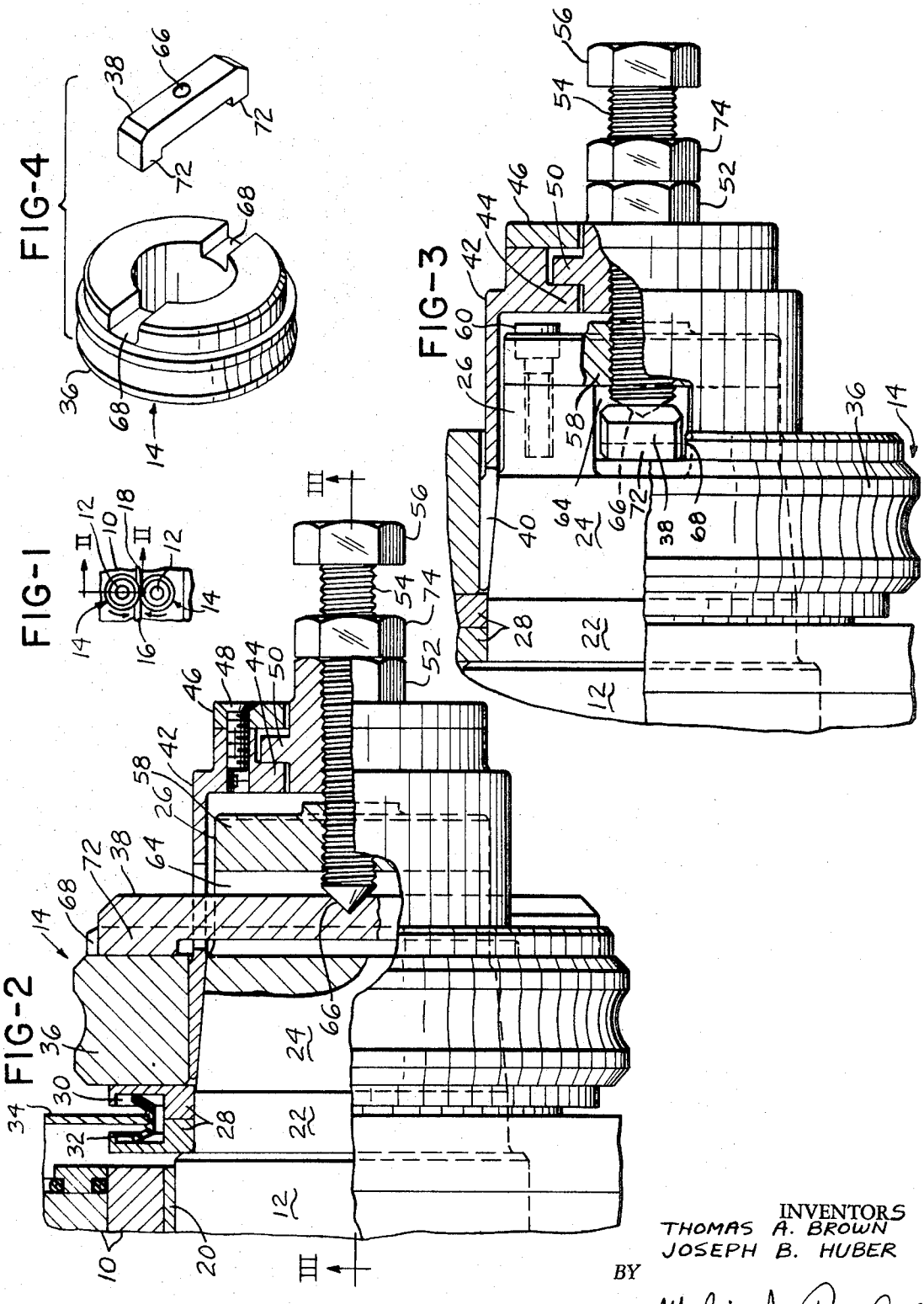
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[57] **ABSTRACT**

A form roll of hard material, such as cemented tungsten carbide, for example, is mounted on a driving shaft. A bar-like key engages a hole in the shaft and notches in the roll and is engaged by a screw which clamps the key to the roll. A split sleeve is forced between a cylindrical central bore in the roll and a tapered portion on the shaft which the roll surrounds.

8 Claims, 4 Drawing Figures





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FORMING ROLL

The present invention relates to the connection of forming rolls to drive shafts for the rolls and is particularly concerned with the application of the inention to rod mills and the like.

The roll and mounting arrangement therefor according to the present invention represents an improvement over the rolls and mounting arrangements illustrated in U.S. Pat. Nos. 3,514,136 and 3,514,137, which were assigned to the same assignee as the present application.

Rod mills and tube mills are well known and consist of a frame having a plurality of pairs of driven rolls through which the material being treated is passed for forming. The forming of the material is accomplished by forming rolls having contoured grooves therein which progressively shape the member passing therethrough to the desired cross sectional configuration and size. A typical rod mill, for example, might take a round rod of a certain size and reduce it by progressive stages to a round rod of a smaller size. Other cross sectional shapes are also possible.

The work load on such forming rolls is extremely heavy and in order to insure an accurate end result and to eliminate slippage and breakage of the rolls and deflection thereof, it is extremely important that the roll be firmly connected to its driving shaft. The extremely heavy service to which the rolls are subjected requires that they be made of a hard material, such as cemented tungsten carbide. Heretofore, it has been difficult and expensive to attach rolls of tungsten carbide to the supporting shafts therefor and the present invention is particularly directed to an improved mounting arrangement for rolls of this type.

Accordingly, the primary objective of the present invention is the provision of an improved mounting arrangement for connecting forming rolls to the drive shafts in a rod mill or the like.

Another objective of this invention is the provision of a cemented tungsten carbide forming roll for a rod mill and a novel mounting arrangement therefor for fixedly connecting the roll to its supporting and driving shaft.

Other objectives and advantages of the present invention will become more apparent upon reference to the following detailed specification taken in connection with the accompanying drawings in which:

FIG. 1 is a schematic representation of one stand of a rod mill;

FIG. 2 is a fragmentary sectional view indicated by line II—II on FIG. 1 and showing more in detail the connection of a typical forming roll to its supporting and driving shaft;

FIG. 3 is a sectional view indicated by line III—III on FIG. 2; and

FIG. 4 is a perspective view showing the forming roll together with the key which keys the roll to the roll drive shaft.

BRIEF SUMMARY OF THE INVENTION

In the present invention, large, heavy shafts are provided firmly mounted in a supporting frame and arranged in pairs so that rolls mounted on the shafts will be presented to each other to receive a work member such as a rod therebetween.

The rolls are mounted on a tapered portion of the shaft by a split tapered sleeve pressed into the space between the roll and the shaft and the rolls are, furthermore, keyed to the shaft. The rolls have drive notches in one side and a barlike key passes through a hole in the shaft and engages the notches to key the roll to the shaft and to drive the roll.

In this manner, the rolls are firmly held on the shaft against slipping thereon and are also supported against deflection in any direction so that breakage of the rolls is minimized.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to the drawings somewhat more in detail, in FIG. 1 the frame of the rod mill is indicated at 10 and rotatably mounted therein are shafts 12 arranged in opposed pairs and each carrying a forming roll 14. A rod 16 of a larger size passes rightwardly through each stand of the rod mill and emerges therefrom at the right as a rod 18 of smaller size and predetermined cross sectional configuration.

Turning now to FIG. 2 a typical shaft 12 is shown which is journaled in frame 10 as by a bearing 20 and, at the outside of the frame has a first reduced diameter portion 22, a tapered portion 24, and a second reduced diameter portion 26.

The first reduced diameter portion 22 receives a pair of rings 28 which have substantlal annular cross sections thereof in abutting relation and which rings together define a cavity 30 in which is a seal member 32, carried on a member 34 which is sealingly attached to frame 10 of the rod mill.

Abutting the outer ring 28 is a forming roll 36 according to the present invention and abutting the outer side of roll 36 is a drive key 38.

The roll 36 surrounds the tapered portion 24 of shaft 12 and positioned between tee cylindrical central bore of roll 36 and the tapered portion 24 of shaft 12 is the split tapered end region 40 of a sleeve member 42 which extends outwardly a substantial distance beyond key 38. At its outer end sleeve 42 has an inwardly directed flange 44 and a retainer ring 46 is connected to the end of sleeve 42 by screws 48 to define an annular cavity for receiving the radial flange 50 of a nut 52. Nut 52 is threaded on a large bolt 54 having an exposed head 56, which at its inner end, is threaded through a disc member 58 connected to the end of shaft 12 by cap screws 60.

The second reduced diameter end portion 26 of shaft 12 has a transverse slot therein and closely receives the transversely extending bar-like key 38. Key 38 is confined within the slot 64 provided therefor in the end of shaft 12 by disc 58 and, furthermore, has a conical recess 66 engaged by the conical end of screw 54. Key 38 extends through apertures provided therefor in sleeve 42 and engages notches 68 in the outer side of roll 36. In this manner roll 36 is keyed to shaft 12 so as to rotate therewith.

The roll 36 is, thus, fixedly keyed to shaft 12 to rotate therewith while being firmly supported thereon by the split tapered portion 40 of sleeve 42.

The roll 36 is clamped tightly against rings 28 by turning screw 54 so that key 38 is forced against the roll which clamps the roll 36 tightly against rings 28. Thereafter, nut 52 is rotated to press sleeve 42 toward

roll **36** and this will press the tapered region **40** of the sleeve firmly into the space between roll **36** and tapered portion **24** of shaft **12**.

To permit the best bearing between the parts, lugs **72** on the ends of drive key **38** bottom in notches **68** of the roll **36**.

After the foregoing adjustments have been made, lock nut **74** on screw **54** can be tightened up against nut **52**.

From the foregoing, it will be seen that the forming roll is extremely solidly supported on its drive shaft and fixed thereon against rotation so that high work loads can be imposed on the roll without the chance of it slipping on its supporting shaft or becoming loose on the supporting shaft. The roll, furthermore, is also supported so that it has little tendency to break and thus can deliver the maximum useful life.

In connection with the strength of the roll, it will be evident that the solid roll illustrated in this application has considerably greater strength than would be possible if the roll were made in sections as, for example, and outer roll part mounted on an arbor. The gain in strength of such a solid roll over a composite roll is calculated in the manner in which the strength of a beam is calculated. In the case of a composite roll the strength would be the sum of the cubes of the radial thickness of the composite parts whereas in the case of a solid roll the strength is measured by the cube of the total radial thickness of the roll and is, therefore, greater.

In the particular case where the roll is made of tungsten carbide, which is a material having three times the resistance of deflection of steel, it will be evident that the solid carbide roll without a central arbor disposed between it and the shaft has much greater strength than a carbide roll of lesser radial thickness and having a steel sleeve interposed between it and the support shaft.

The carbide material from which the rolls are made is extremely expensive and is, furthermore, difficult to machine. In the rolls shown in U.S. Pat. Nos. 3,514,136 and 3,514,137, the roll illustrated is provided with lugs projecting therefrom to be received in notches in a drive ring.

In forming rolls according to the prior art patents referred to, the carbide roll is formed to the maximum axial thickness and is machined while in the green state to remove the material from between the lugs. It is not practical to attempt to mold the lugs on the body of the roll but these can only be satisfactorily provided by machining away the carbide material while in the green state from between the lugs.

It might be mentioned that carbide material in the green state is what is arrived at by first pressing the carbide powders and binder material to the desired configuration and then subjecting the resulting work member to a presintering step which makes the material solid enough to be handled and machined although still in a very fragile condition. The machine member is then finally sintered and, in the process, shrinks to its final size, and then may be ground on certain areas to provide smooth surfaces.

The roll according to the present invention has the particular advantage that the notches for receiving the bar-like drive key can be machined out of the roll rather than machining the roll away to leave projecting drive lugs. The amount of material to be removed from the roll when it is made according to the present invention is thus substantially less and less material is required for making the roll and the roll is, therefore, more inexpensive because of the reduced machining time and the reduced amount of material that is employed for making the roll.

Furthermore, the drive ring illustrated in the above mentioned patents is also eliminated, thereby reducing the cost of the entire assembly. It has been found that, due to the tapered sleeve between the shaft and the roll, the roll is firmly supported, even in the absence of a drive ring engaging the outer face thereof, and does not deflect and break even when the ring is absent.

Modifications can be made in the present invention falling within the scope of the appended claims.

What is claimed is:

1. In a mill, such as a rod mill haVing a frame, a shaft rotatable in the frame with one end projecting from the frame and a roll mounted on the projecting end of said shaft; said projecting end of said shaft having a portion in the axial plane of said roll which tapers inwardly in the axially outward direction and a shoulder between the tapered portion and the frame, said roll having a cylindrical central bore larger in diameter than the largest diameter of said tapered portion of said shaft, said roll on the side facing said frame abutting said shoulder, a sleeve element having an axially split region tapered on the inside and cylindrical on the outside, said region of said sleeve being disposed in the bore in said roll and about the tapered portion on said shaft, a pair of diametrically opposed radial notches in the side of the roll facing away from said frame, each said notch extending radially completely through the respective end portion of the said roll, a diametral recess in the outer end of said shaft, a bar-like key extending through said recess with axial clearance from the side of said recess nearest said frame and having each end terminate in a protruding lug portion seated in said notches, each said lug portion engaging substantially the entire radial and circumferential surface at the axially inner end of the respective notch, first means carried by said shaft and operable for forcing said key in the axial direction of said shaft toward said roll to clamp the roll against said shoulder, and second means also carried by said shaft and operable for forcing said sleeve axially on said shaft to wedge the said region thereof between said roll and said tapered portion of said shaft, said roll comprising a solid body of hard cemented carbide material.

2. A roll according to claim **13** in which said carbide material comprises tungsten carbide.

3. An arrangement according to claim **1** in which the said recess in the shaft is in the outer end thereof, a retainer disc secured to the end of the shaft and confining the bar-like key in the recess in the end of shaft, and said means for forcing the key toward the roll comprising a screw threaded through said retainer disc and engaging said key in about the middle thereof.

4. An arrangement according to claim **3** in which said means for forcing said sleeve element axially on said shaft comprises a nut threaded on said screw and rotatably engaging said sleeve.

5. An arrangement according to claim 4 in which said nut has a peripheral flange, said sleeve element having a recess in the outer end for receiving said flange, and a retaining ring secured to the outer end of said flange and loosely confining the flange on the nut in said recess.

6. An arrangement according to claim 5 in which said screw has a lock nut threaded thereon for locking said nut with the flange to the screw.

7. An arrangement according to claim 1 in which the portion of said sleeve element in said roll is radially thin and the roll from the outer surface of said sleeve element outwardly comprises a solid uninterrupted mass of metal.

8. An arrangement according to claim 7 in which said roll is formed of cemented tungsten carbide.

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