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[21] Appl. No. 724,843
[22] Filed Apr. 29, 1968
[45] Patented July 27, 1971

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[54] **EXPLOSIVE ACTUATED PULLING APPARATUS**
4 Claims, 3 Drawing Figs.

[52] U.S. Cl. 29/255,
81/52.35, 29/260
[51] Int. Cl. B23p 19/04
[50] Field of Search. 29/254,
255, 252, 258, 259, 260, 275, 276; 81/52.3, 52.35

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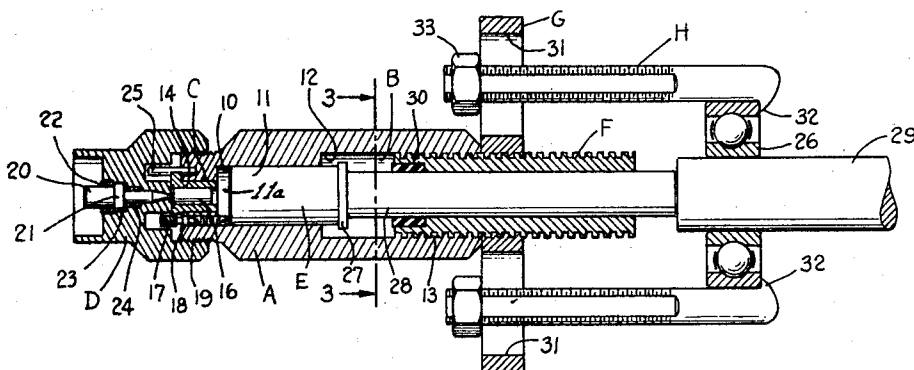
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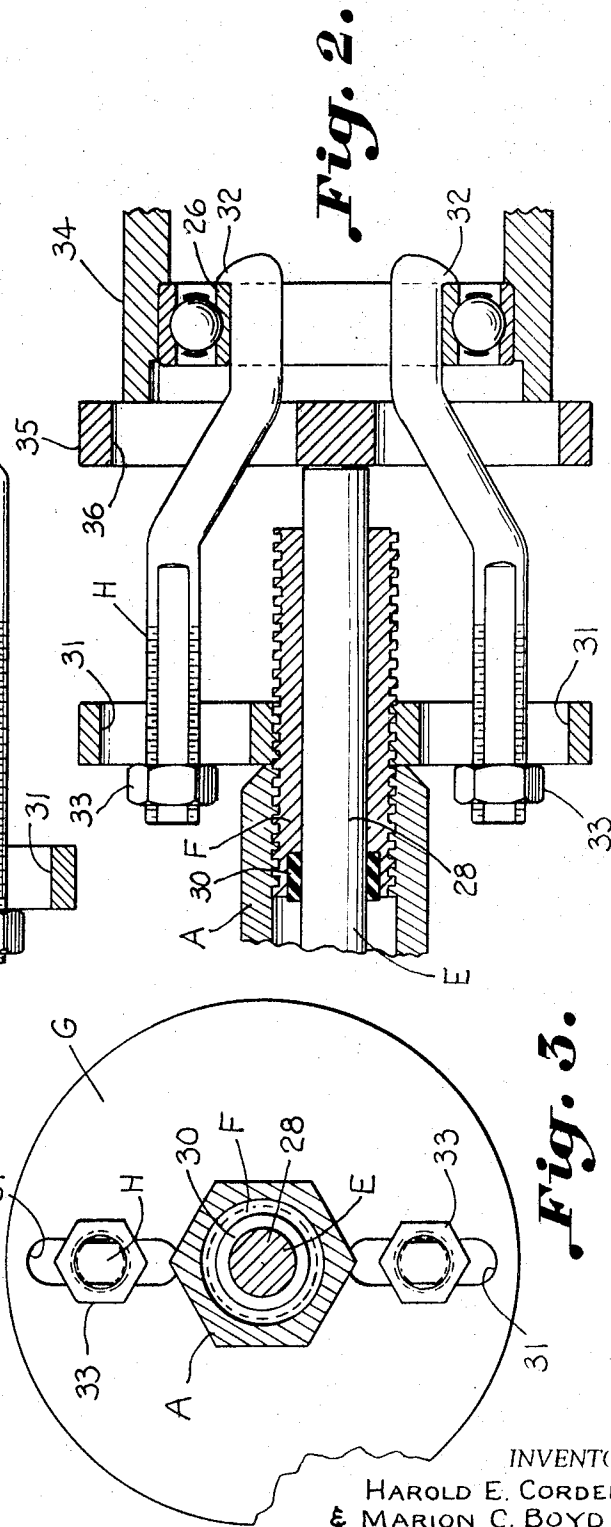
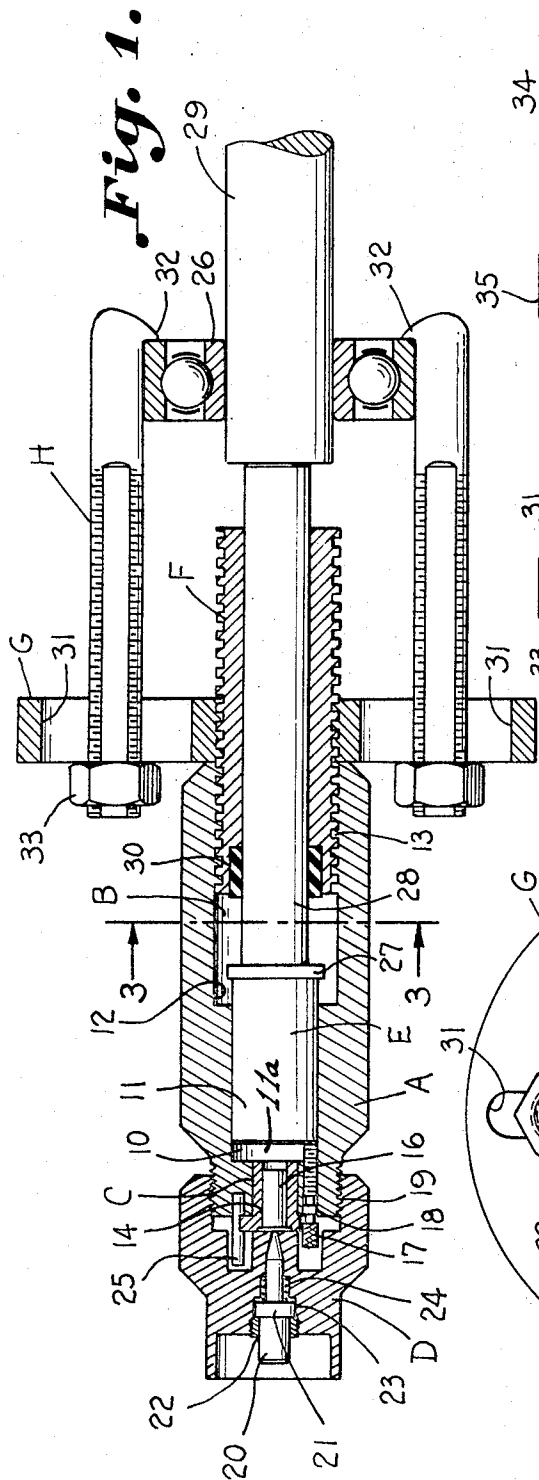
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ABSTRACT: An explosive powered apparatus for pulling bearings and the like, from within or on shafts. The apparatus includes a barrel having a breech adjacent one end in which an explosive is carried. A piston is carried within the barrel for relative movement therewith. A sleeve having threads thereon is threaded within one end of the barrel for restricting the movement of the piston when the explosive is detonated and for regulating the force applied. A retaining member is carried adjacent the free-end of the sleeve, and has arms extending out therefrom for engaging the bearing. When the explosive is detonated the free-end of the piston pushes against the end of the shaft upon which the bearing is carried causing the arms to pull the bearing longitudinally along the shaft, thus freeing it. When the bearing is carried within the shaft a plate is positioned between the end of the piston and the shaft for transferring the force from the piston to the shaft during the pulling operation.





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EXPLOSIVE ACTUATED PULLING APPARATUS

This invention relates to an explosive-type apparatus provided for pulling bearings, pinions, or other machine elements rigidly mounted by a press or shrink fit on or within a shaft.

Explosive powered pulling apparatus have been used in the past for removing bearings and the like, however, normally such have been restricted to a particular application, either due to the amount of force being supplied in removing the bearings, or due to the physical construction of the apparatus. One particular puller is illustrated in U.S. Pat. No. 2,331,167, granted to Brecht et al. on Oct. 5, 1943. The puller illustrated therein, is particularly designed for removing pinions from railway motor shafts. It appears that such would be satisfactory for such an operation, but would encounter difficulties in removing small bearings and the like from smaller shafts, either due to the problem of controlling the pressure applied or due to difficulty in engaging the bearing.

Accordingly, it is an important object of the invention to provide an improved explosive-type bearing puller which is adapted to pull bearings from shafts.

Another important object of the present invention is to provide an explosive-type bearing puller in which the force exerted in pulling the bearing can be readily regulated.

Another important object of the present invention is to provide an explosive-type bearing puller which can be readily attached to the bearing for removing such therefrom.

Still another important object of the present invention is to provide an explosive-type bearing puller which is adapted to pull bearings carried externally on a shaft, as well as internally within a shaft.

The construction designed to carry out the invention will be hereinafter described, together with other features thereof.

The invention will be more readily understood from a reading of the following specification and by reference to the accompanying drawing forming a part thereof, wherein an example of the invention is shown and wherein:

FIG. 1 is a longitudinal sectional view of a pulling apparatus constructed in accordance with the present invention,

FIG. 2 is a longitudinal sectional view illustrating the apparatus modified to pull internal bearings, and

FIG. 3 is a sectional view taken along line 3-3 of FIG. 1.

The drawing illustrates an explosive powered apparatus for pulling a bearing and the like from a shaft where such is carried in a pressure fit relationship. The explosive powered apparatus includes a barrel A having an elongated cylinder B therein. A breech member C adapted to receive an explosive charge is carried adjacent one end of the barrel. A breech block D and firing mechanism is movably secured over the end of the breech member C. Threads are carried on the inner wall of the cylinder B adjacent the other end of the barrel. An elongated piston having a head adjacent one end is received in a closely fitting relationship within the cylinder B and has a reduced portion adjacent the other end thereof. The piston is positioned in the cylinder with the reduced portion extending out the open end thereof. A sleeve F having threads on its surface is screwed into the open end of the cylinder for regulating the longitudinal movement of the piston. The sleeve F has a bore extending therethrough which is of a larger diameter than the reduced portion on the piston E and a smaller diameter than the head so that the reduced portion of the piston extends therethrough while the movement of the head is limited by the inner end of the sleeve F. A retaining member G is carried adjacent one end of the sleeve. Arms H extend outwardly from the retaining member and engage the bearing which is to be pulled off the shaft. The inner end of the reduced portion of the piston E abuts against the shaft which carries the bearing so that when the explosive charge is placed in the breech member C and fired, the expanding gas forces the piston against the end of the shaft producing relative movement between the barrel A and the piston E causing the bearing to be moved longitudinally relative to the shaft. The force can be regulated by rotating the sleeve F within the cylinder.

The barrel A is constructed of hardened steel capable of withstanding shock and has an elongated cylinder B therein. The elongated cylinder B has a reduced portion 10 provided for receiving a head 11 of the piston E. One end of the reduced portion 10 of the cylinder B terminates into a larger bore 12 which has coarse threads 13 adjacent the end thereof. The breech member C is integral with the other end of the barrel and includes a sleeve 14 having a flange adjacent its outer edge which fits within the end of the barrel and is provided with a breech opening which receives a charge of explosive material conveniently in the form of a blank cartridge 16, as illustrated in FIG. 1. In one particular embodiment the blank cartridge is 32 caliber. The explosive charge carried within the cartridge can be varied so as to regulate the force applied to the piston head for pulling the bearing. Any suitable gas producing propellant, either explosive or nonexplosive may be utilized. A power adjustment screw 17, also, extends through the head of the barrel A, and is provided for regulating the distance between the breech member and the end of the piston head 11. By rotating the power adjustment screw within the threaded hole to a desired marking 18 carried adjacent the outer end thereof, the amount of power created by a given load in the blank 16 can be regulated.

A breech block D is removably secured over the end of the breech member C by complementary threads 19 and the breech member D is provided with a firing pin 20 mounted for limited movement towards and from the breech member. The firing pin 20 may be mounted within the breech block in any convenient manner, and one convenient way is by providing a collar 21 which surrounds the stem of the firing pin and is positioned within a cup-shaped retaining bushing 22 which is screwed into the opening 23 and faces the barrel. A spring 24 is carried within a reduced bore in abutting relation with the collar 21 on the other side thereof, from the bushing 22 for returning the firing pin to its initial position after such has been depressed as by striking with a hammer or the like. An alignment pin 25 is carried within a bore provided in the end of the barrel for limiting the distance that the breech block D can be screwed on the barrel. Actually, the firing pin is slightly offset from the longitudinal axis so that the reduced end thereof will strike the rim of the blank 16 when such is, in turn, struck.

As previously mentioned, the piston E has an enlarged elongated head 11 which fits snugly within the reduced portion of the cylinder so that when the expanding gas is created upon firing the blank such tends to force the piston to the right relative to the barrel. Since the piston is held stationary, the barrel, in turn, moves to the left pulling the bearing therewith. The piston has an enlarged collar 27 integral with one end of the head which limits the relative movement between the barrel and itself. An elongated reduced portion 28 extends through the barrel and a sleeve F and abuts against the end of the shaft 29 upon which the bearing 26 is carried. The sleeve F has complementary coarse threads thereon, permitting such to be screwed within the barrel A. A rubber bushing 30 is carried within the inner end of the sleeve and extends slightly therebeyond for absorbing the shock created by the piston striking thereagainst during the pulling operation. As can be seen, the distance which the barrel A travels relative to the piston E can be regulated by turning the sleeve within the barrel. Thus, the pulling force can be readily regulated and such provides a much safer unit.

A retaining member G is screwed on the sleeve F for holding the arms H. A retaining member is constructed of steel and is disc shaped with a plurality of radial slots 31 therein for receiving one end of the arms H. While in the preferred embodiment, the retaining member is shown screwed on the sleeve F, it is to be understood that such could be mounted on the barrel A. The arms H have an inwardly turned hook portion 32 adjacent the inner end thereof, which fits over the bearing 26 so that when such is pulled to the left it tends to pull the bearing therewith. The other end of the arms H is threaded and extends through a suitable slot 31 in the retain-

ing disc G. A nut 33 is screwed on the end of the arm, and is drawn up tightly against the retaining disc G so that the hook portion 32 adjacent the other end is exerting a pulling pressure on the bearing 26. It is noted that the threaded end of the arms is flattened along its longitudinal axis so that such does not turn within the slot 31 when the nut 33 is being screwed thereon.

FIG. 2 is a modified form of the invention wherein the arms H are modified so as to pull a bearing 26 carried internally within a shaft 34. In this arrangement an additional steel retaining disc 35 is positioned adjacent the end of the shaft 34 and has elongated slots 36 therein through which the arms H extend. It is noted that the arms taper inwardly adjacent the medial portion thereof so as to extend within the shaft 34 in order for the hooked portions 32 to fit behind the bearing 26. The end of the reduced portion of the shaft fits flush against the center of the disc 35 during the pulling operation. The pulling apparatus is held in position by drawing the nuts 33 tightly against the retaining member G. When the blank 16 is fired such causes the housing or barrel A to move to the left relative to the piston E pulling the bearing 26 therewith.

The apparatus constructed in accordance with the present invention provides a relatively safe and simple device for pulling the bearings carried externally and internally on a shaft. The amount of pressure which is to be utilized in pulling the bearing can be readily regulated by rotating the sleeve F and by adjusting the power adjustment screw 18. Since the end of the head 11 of the piston E is chamfered as illustrated and identified by reference character 11a and the threads 13 in the cylinder are coarse, such permits the gas generated by firing the blank 16 to gradually leak off after the bearing 26 has been pulled. The coarse threads 13 on the sleeve and in the cylinder provide a fluid permeable fitting. Such is also true when an excessive charge is used creating an excessive pressure.

While a preferred embodiment of the invention has been described using specific terms, such description is for illustrative purposes only, and it is to be understood that changes and variations may be made without departing from the spirit or scope of the following claims.

We claim:

1. An apparatus for pulling a bearing and the like from a shaft where such is carried in a pressure fit relationship comprising: a barrel having an elongated cylinder therein; a breech member adapted to receive an explosive charge carried adjacent one end of said barrel, a breech block and firing mechanism removably secured over the end of the breech member; threads carried on the inner wall of said cylinder adjacent the other end of said barrel; an elongated piston, said piston having a head adjacent one end received in a closely fitting relationship within said cylinder and a reduced portion adjacent the other end; said piston being positioned in said cylinder with said reduced portion extending out the open end thereof; a sleeve having threads on its surface screwed into the open end of said cylinder for regulating the longitudinal movement of said piston, said sleeve having a bore extending therethrough from an inner end to an outer end; said bore being of a larger diameter than said reduced portion on said

piston and a smaller diameter than said head so that said reduced portion of said piston extends therethrough while the movement of said head is limited by the inner end of said sleeve; a retaining member carried in fixed relation to said barrel; arms extending out from said retaining member for engaging the bearing to be pulled; whereby said inner end of said reduced portion of said piston is placed flush against the end of the shaft which carries said bearing to be pulled so that when an explosive charge is placed in said breech and fired the expanding gas forces said piston against the end of said shaft producing relative movement between said barrel and said shaft, and said force can be regulated by rotating said sleeve within said cylinder.

2. The apparatus as set forth in claim 1, wherein said sleeve can be rotated so as to vary the pulling force applied to said bearing and said sleeve having a shock absorbing member adjacent the inner end thereof for cushioning the shock imparted by said piston during the pulling operation.

3. An apparatus for pulling a bearing and the like from a shaft where such is carried in a pressure fit relationship comprising: a barrel having an elongated cylinder therein; a breech member adapted to receive an explosive charge carried adjacent one end of said barrel, a breech block and firing mechanism removably secured over the end of the breech member; threads carried on the inner wall of said cylinder adjacent the other end of said barrel; an elongated piston, said piston having a head adjacent one end received in a closely fitting relationship within said cylinder and a reduced portion adjacent the other end; said piston being positioned in said cylinder with said reduced portion extending out the open end thereof; a sleeve having threads on its surface screwed into the open end of said cylinder for regulating the longitudinal movement of said piston, said sleeve having a bore extending therethrough from an inner end to an outer end; said bore being of a larger diameter than said reduced portion on said piston and a smaller diameter than said head so that said reduced portion of said piston extends therethrough while the movement of said head is limited by the inner end of said sleeve; a retaining member carried in fixed relation to said barrel; arms extending out from said retaining member for engaging said bearing; a plate positioned adjacent an inner end of said piston, said plate having openings therein through which said arms extend when engaging said bearing so that when an internal bearing is being pulled said plate abuts against the end of said shaft and said arms extend into said shaft for engaging said bearing, whereby when an explosive charge is placed in said breech and fired the expanding gas forces said piston against the end of said shaft producing relative movement between said barrel and said shaft, and said force can be regulated by rotating said sleeve within said cylinder.

4. The apparatus as set forth in claim 1, wherein the end of the enlarged portion of said piston is chamfered, said threads in said cylinder and on said sleeve being coarse providing a fluid permeable fitting so as to permit passage of said expanding gas after said bearing has been pulled in order to permit gradual leaking off of the pressure after said bearing has been pulled.