



## UNITED STATES PATENT OFFICE

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APPARATUS FOR GRINDING LONG  
CYLINDERS

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7 Claims. (Cl. 51—261)

My invention relates to an apparatus designed and worked out particularly for grinding long cylinders, such, for example, as are used in the landing gear of heavy air craft and where speed and accuracy are required.

Among the salient objects of my invention are: to provide an apparatus by means of which a cylinder of any length can be accurately ground or reground for the purpose of providing a true, smooth and perfect fit of the plunger within said cylinder; to provide an apparatus which can be adjusted as to its grinding element relative to the holding and guiding sleeve which enters the cylinder; to provide a device of the character referred to which is simple, practical and highly efficient in accomplishing the desired end; and, in general, to provide a grinding apparatus of the character referred to which can be used in cylinders of any length and can be adjusted for grinding cylinders of different diameters.

In order to further explain my invention, I have illustrated one practical embodiment thereof on the accompanying sheet of drawings, which I will now describe. In the drawing

Figure 1 is a side elevation of a lathe showing my invention in place thereon, with the cylinder to be ground also in place ready to receive the grinding apparatus;

Figure 2 is an enlarged side elevation of my invention, detached and partly in section to show the interior thereof;

Figure 3 is a cross sectional view taken on the line 3—3 of Fig. 2; and

Figure 4 is a cross sectional view taken on line 4—4 of Fig. 2.

Referring now in detail to the drawing, 5 designates as a whole a lathe of any standard type, having the usual chuck 6, traveling carriage 7, and the usual operating mechanism. This mechanism forms no part of my invention proper, but my invention is used in connection with such a lathe.

The invention as here embodied consists of a body sleeve or cylinder 8, having in its outer end a bearing member 9, resting against an annular shoulder 10, formed in said body cylinder 8, and held in place by means of a screw member 11, through which bearing member 9 and screw member 11, an operating shaft 12 is mounted to be driven from a pulley 13, as hereinafter again referred to.

Secured to the other end of said body cylinder 8, is an extension 14, provided along one side with a groove 14', seen in Fig. 4 also, and in its end provided with an oval shaped enlargement

of its bore, as at 15, in which, on the shaft 12, is a ball-bearing element 16, with a retaining disc or plate 17, secured against the end of the extension member 14, said plate having an opening 18 therein large enough to permit of a limited lateral movement of the end of the shaft 12, in a manner to be described.

Mounted over said extension 14, is an outer bearing sleeve 19, the end of which is extended beyond the retaining plate 17, and is provided at one side with an opening 20, through which a grinding element 21, mounted on the shaft 12, can protrude to different distances. It is to be understood that the end of the shaft 12 flexes slightly to permit the grinding element 21 to be moved to and through the opening 20 for different distances for grinding the inside of cylinders of different diameters. This lateral adjustment is accomplished by two adjustment screws 22 and 23, through the end of the extension member 14, as seen in Fig. 4, the inner ends of said screws bearing against the ball-bearing element 16, the opposite side of which element bears against the side of the oval opening or enlargement 15 of the cylindrical extension 14. This adjustment is accomplished by turning one screw out and the other in, the ball-bearing element being thus moved in the oval opening 15 and operating to move the grinding element out or in, through the side opening 20 in the outer or bearing cylinder 19. Thus the ball bearing element 16, on the shaft 12, has a three point bearing at all times and is held in place by the two screws 22 and 23. A pipe 24 is mounted along side of the body cylinder 8, and connects at its inner end with the groove 14', the other end being adapted to be connected with a source of grinding fluid to be discharged onto the grinding element 21, as clearly indicated in Fig. 2. Thus the invention proper is assembled as a unit.

I will now describe how the invention proper is used in connection with a standard lathe. A holding bracket 25 is mounted on the carriage 7 of the lathe, as seen in Fig. 1, and the outer end of the body cylinder 8 is clamped therein, as at 26. A motor 27 is also mounted on said carriage 7, as indicated, with drive pulley 28 and belt 29 to the drive pulley 13 on the shaft 12 of the device. Thus the grinding device is moved forwardly endwise as the carriage 7 is moved on the lathe.

The tube or cylinder, designated 30, to be ground, is secured at its end in the chuck 6, as shown, with a holding bracket 31 on the lathe bed

for holding the outer end of said tube or cylinder rotatably in position to be bored.

It will be understood that the outer bearing sleeve 19 of the grinding device fits snugly in the cylinder and that the grinding element 21 is adjusted to protrude through the opening 23 in the side of said bearing sleeve 19 to engage and grind the inner wall of the tube or cylinder 30 as said tube or cylinder 30 is rotated by the lathe chuck 6.

Thus I have provided a very simple, yet a very practical and successful apparatus for accurately and rapidly grinding long tubes or cylinders and the adjustment of the grinding element is accomplished by the slight flexing of the shaft laterally, as will be understood from the showing in Fig. 2, and while I have shown and described in detail one practical embodiment of my invention, I do not limit the invention to the details of construction and arrangement, except as I may be limited by the hereto appended claims.

I claim:

1. In a grinding apparatus of the character referred to, a body, a shaft extending longitudinally through said body and provided at one end with driving means, a bearing in the other end of said body for the other end of said shaft, said bearing being movable laterally to move the end of said shaft laterally in said body, means for moving and holding said bearing in different positions of adjustment laterally, said shaft being held so it can be flexed at its end, and a grinding element on the end of said shaft outside of said bearing and movable laterally with said bearing and the end of said shaft to protrude beyond the periphery of said body.

2. In a grinding apparatus of the character referred to, a long body cylinder supported at one end only with its other end free to telescope into another cylinder, a shaft therein, a bearing means at the supported end of said body cylinder for said shaft, driving means on said shaft, a ball bearing element in the other end of said body cylinder for said shaft, said bearing element being adjustable laterally with said shaft in said body cylinder, said shaft being supported to be flexed therewith, means for adjusting the same, a grinding element on the end of said shaft outside of said bearing element and adjustable laterally therewith to move the periphery of said grinding element to and beyond the periphery of said body cylinder, and means for supplying a fluid to said grinding element.

3. In combination, a body cylinder, a shaft therein, a bearing in one end of said cylinder for said shaft, driving means on the end of said shaft outside of said bearing, a ball bearing element in the other end of said body cylinder for said shaft, a three point support therefor, means for adjusting said ball bearing element and the end of said shaft laterally together in said body cylinder, a bearing cylinder on the end of said body cylinder to fit within a cylinder to be ground, and a grinding element on the free end of said shaft outside of said ball bearing element, said grinding element being adjustable laterally with said ball bearing element and said shaft to move said grinding element beyond the periphery of said bearing cylinder.

4. In a grinding apparatus, a body, a shaft, a ball bearing element in said body for said shaft, said element and shaft being movable laterally in said body, said shaft being flexibly supported, screw means for moving said element and holding it in different lateral positions, said means forming a three point support therefor, two of said supports being adjustable, means for driving said shaft, a bearing cylinder on the end of said body, and a grinding element on the end of said shaft outside of said ball bearing element and movable laterally therewith, said bearing cylinder having a side opening through its wall for said grinding element.

5. An apparatus for grinding cylinders including in combination, a body cylinder, a shaft in said cylinder, a bearing in the end of said cylinder for said shaft, drive means on the outer end of said shaft, a ball-bearing element adjustably seated in the opposite end of said body cylinder and movable laterally in said seat with the end of said shaft, screw means for adjusting and holding said ball-bearing element and shaft in adjusted positions, a bearing cylinder over the end of said body cylinder, said bearing cylinder having an opening through the side of its end, a grinding element on the outer end of said shaft and movable laterally therewith to protrude through said opening in said bearing cylinder, and means for supplying a suitable grinding fluid to said grinding element.

6. In a grinding apparatus, in combination, a long body cylinder, a long shaft therein, driving means on the end of said shaft outside of said body cylinder, a bearing element in the opposite end of said body cylinder for said shaft, said bearing element being movable laterally with the end of said shaft in said body, said shaft being flexibly held whereby one end can be moved laterally, screw means for adjusting and holding said bearing element in different positions laterally, a grinding element on said shaft outside of said bearing element, means for holding said body cylinder at one end, said means being movable longitudinally to move said grinding apparatus endwise into a tube or cylinder to be ground, and means for holding and rotating a tube or cylinder to be ground, substantially as shown and described.

7. In combination with a lathe, lathe chuck and carriage, a cylinder held and rotated by said chuck, of means for grinding said cylinder and comprising a cylinder body held by one end on said lathe carriage with its free end projecting into said cylinder, a bearing sleeve on the end of said body to fit slidably within said cylinder and having an opening through its side, a shaft in said body, a grinding element on the end of said shaft within said bearing sleeve and positioned to protrude through said opening, a bearing element for said shaft in said cylinder body, screw means for moving said bearing element and said shaft and grinding element laterally, a motor on said lathe carriage and driving connections from said motor to said shaft, for driving said shaft and grinding element.

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