July 11, 1933. G. G. AGOSTONI 1,918,077

INTERNAL GRINDING APPARATUS

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Fig. 1.

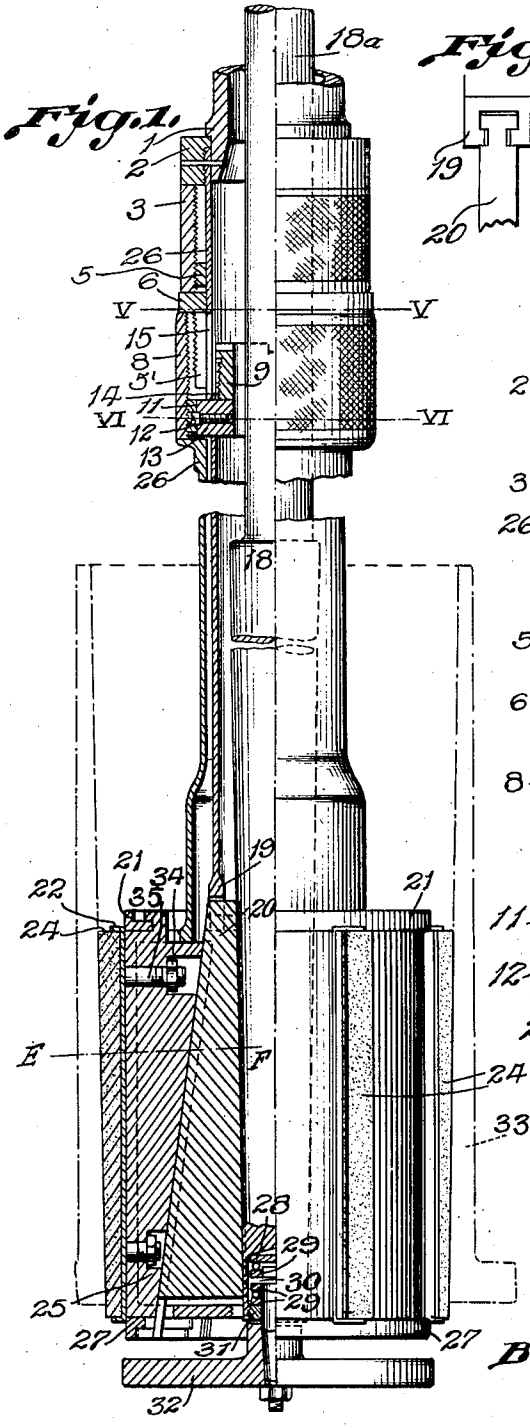

Fig. 3.

Fig. 7.

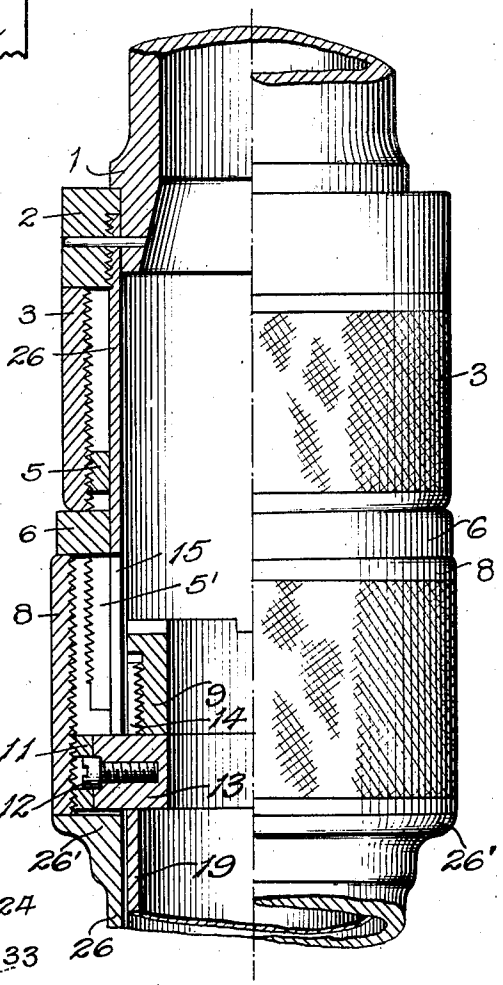

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Fig. 4.

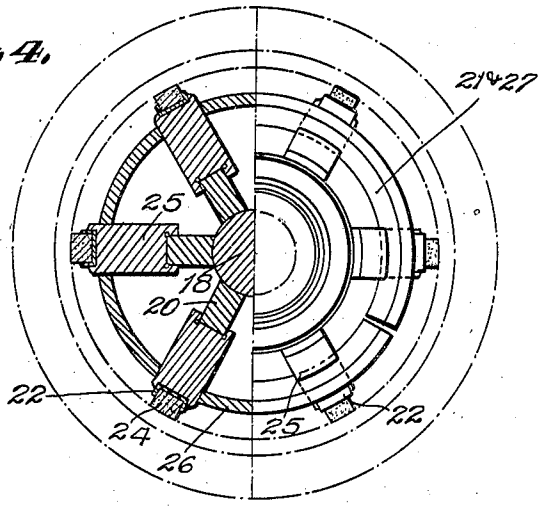
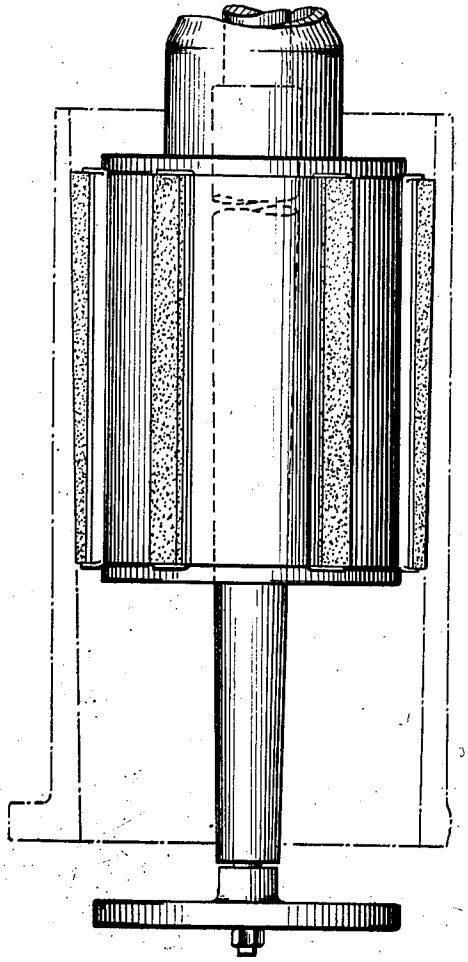


Fig. 2.



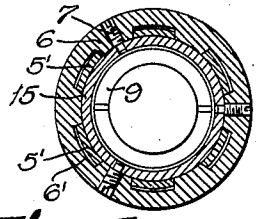
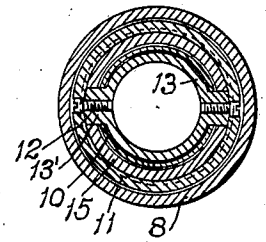


Fig. 5.

Fig. 6.



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UNITED STATES PATENT OFFICE

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INTERNAL GRINDING APPARATUS

Application filed March 6, 1931, Serial No. 520,607, and in Italy March 20, 1930.

The present invention relates to improvements in apparatus for polishing and calibrating or grinding the internal conical surfaces of tubular bodies by means of abrasives, such tubular bodies being represented, for example by guns, cylinders of internal combustion engines, pump and compressor cylinders and, broadly, any other hollow body the internal surface of which requires calibrating or grinding operations.

The main object of my invention is to provide an apparatus of the character indicated by which it is possible to carry out the grinding of said internal surfaces in an easy and faultless manner by using two sets of trapezoidal plates radially arranged about an axial spindle. One edge of the set of plates, lying nearer to the spindle, bears longitudinally on the spindle surface, while against the opposite inclined edge of each of the said plates bears the oppositely inclined edge of a corresponding plate of the second plate-set lying away from the axial spindle; the outer end of these latter plates carries the abrasive material. The plate edges bearing against the axial spindle are constantly parallel to the abrasive-carrying edges of the other set of plates. Means are also provided for shifting, as a whole and in either longitudinal direction, the plates that bear on the axial spindle, the object of this shifting being to vary the distance of the abrasives from the lateral surface of the axial spindle and thus adjust the pressure exerted by the abrasives on the surface to be ground.

The portion of the axial spindle against which the inner set of plates normally bear is preferably of conical form, while the inner set of plates may have longitudinal grooves formed upon the edges of said plates adapted to engage with corresponding slots or the like which may be provided on the spindle or shaft.

The plates of the outer set, viz. the abrasive-carrying plates, are carried by a drum and their ends are subject to the action of resilient members, the duty of which is to hold the inclined edges of these plates in engagement with the oppositely inclined edges of the plates of the inner set.

In the following, the term "inner wedges" will be used to designate the inner-set plates, and the term "outer wedges" to designate the outer-set or abrasive-carrying plates.

Further advantages and characteristic features of the invention will become apparent in the progress of the following description.

The invention is illustrated by the accompanying drawings in one of its embodiments which serve only as an example.

Fig. 1 shows, half in elevation and half in longitudinal center section, the aggregate of an apparatus made according to the invention, intended for grinding conical surfaces.

Fig. 2 is a similar view of the bottom, right hand portion of Fig. 1 and shows the grinding member for conical grinding, in a different position, within the cylinder to be ground.

Fig. 3 is a detail figure on a larger scale showing the sliding connection between the upper end of the inner wedges and the member (tube) which causes their movements in longitudinal direction in order to bring about adjustment or radial displacement of the abrasive-carrying outer wedges.

Fig. 4 shows, half as seen from above and half in section through E—F in Fig. 1, the grinding tool shown in Fig. 1.

Fig. 5 is a cross section through V—V in Fig. 1.

Fig. 6 is a cross section through VI—VI in Fig. 1.

Fig. 7 is an enlarged view of the upper adjusting member shown in Fig. 1.

Referring to the drawings, 18 is a spindle, one end of which (in the drawings, the bottom end) is connected to a plate or disc 32 through the intermediary of roller or ball thrust bearings 28—29, so that it can revolve about its axis, the disc being fixed coaxially to the hollow body 33 indicated by dash-dotted lines, said hollow body 33 being fixed to the bench. The spindle portion intended to lie within the hollow body 33 has the form of a truncated cone, the inclination or taper of which is parallel to the inclination or conicity of the internal surface of the body 33 which is to be ground.

A plurality of radial plates 20 are ar-

ranged to bear with one edge against the conical surface of the spindle 18. The other opposite edge of each plate is inclined away from actual parallelism with the first edge so that the plate presents the form of a wedge having a smaller base located at the top. This smaller base is provided with horizontal undercut grooves so that the base appears T-shaped and engages a block having substantially the form of a block letter C which has been turned clockwise one quarter turn for engagement with a corresponding projection of a sleeve 19 secured to a member intended to impart a longitudinal motion in either direction to the various inner wedges 20 for the purpose that will be explained below.

On each inclined or external edge of the radial inner wedges 20 bear the similarly inclined edges of an outer set of radial plates 25. These latter edges, as shown on Figs. 1 and 4, are fitted with two longitudinal flanges, between which the corresponding external edges of the inner wedges 20 are guided. On the external edge of each radial plate or outer wedge 25, plates 22 are fixed by means of bolts 35 and nuts 34 and on these plates the abrasive bodies 24 are mounted. The radial outer wedges project past radial openings formed in the thickness of the bottom flange of tube 26. The extensions of the top and bottom ends of the outer wedges are subjected to the action of resilient rings 21 and 27, the object of which is to maintain the contact of the inclined edges of the outer wedges 25 with the inclined edges of the inner wedges 20 as well as the adherence of the inner edges of the wedges 20 to the axial spindle.

The external surfaces of the abrasive bodies 24 are arranged to remain constantly parallel to the conical surface of the spindle 18 and also to the inner surface of the hollow body 33 which is to be ground.

From the above, it obviously appears that, when a simultaneous rotation about their axes is imparted to the spindle 18 and tubes 26 and 19, the grinding operation on the inner surface of the hollow body 33 is provided for.

For this operation, however, it is also necessary to gradually move the inner wedges 20 upwardly and thereby to gradually move the outer wedges 25 radially which carry the abrasive bodies 24. Such a gradual movement is obtained by imparting a rotation in the proper direction to a knurled ring 8 provided between the upper flanges 26′ upon tube 26 and a ring 6 fixed near the upper extremity of the tube. Ring or collar 8 is provided with internal screw-thread for engagement with the external screw-thread of a further ring 11, while screws 12 make this ring 11 fast with the radial projections 13′ of a collar 13. The projections 13′ project radially outward through, are also adapted to slide in, longitudinal slots 15 formed in the upper extension of the tube 26. A threaded ring 9 engaged by the internal thread of the top end of tube 19 fixes the said collar 13 to the tube 19 by forcing the projections 13′ of collar 13 against the bottom of longitudinal slots 14 formed in the said upper end of tube 19.

The tube 26 is solid with the ring 6, and it is apparent that when the ring 8 is revolved, the ring moves longitudinally in either direction ring 13 and tube 19 according to the direction in which the ring 8 is revolved.

Since the tube 19 is connected to the inner wedges 20, these wedges will be obliged to move upwardly or downwardly upon rotation of ring 8 and movement of tube 19, and will thus cause the abrasive bodies 24 to be forced outward against or moved inward away from the inner surface of the hollow body 33, this effect being due to the inclination of the contacting edges of the two sets of wedges 20 and 25.

An inner ferrule 1 and an external ring 2 are rendered fast with the top end of the tube 26.

Between the rings 2 and 6, a loose sleeve 3 is interposed; the outer surface of the sleeve is roughened or knurled for manipulation, and its inner surface is screw-threaded.

In the inner surface of the ring 6, notches 6′ are formed into which enter the longitudinal projections 5′ of a ring 5 adapted to slide relatively to the tube 26; the outer surface of this ring is threaded and engages the screw-thread of the sleeve 3.

As the parts 5′ of ring 5 pass through slots in ring 6, turning of the adjustment tube or ring 3 between rings 2 and 6 will cause ring 5 to be so adjusted that the relative displacement of shell 13 for radially positioning the grinding flanges is limited in its upward direction whereby the desired dimension of the work-piece is insured.

It is therefore apparent that, when the sleeve 3 is revolved, the ring 5 and its projections 5′ are displaced and thus alter the distance between the lower ends of these projections 5′ and the collar 13 or the radial projections of this collar; thereby also the displacement of the parts actuated by the rotation of the sleeve 8 is varied, according to the inside dimensions of the hollow body 33 to be ground.

Obviously the portion of axial spindle 18 against which bear the inner edges of the radial wedges 20, and against which they are adapted to slide, instead of a conical form, may have some other shape which will serve the same purpose as the conical form. Furthermore, the spindle, no matter whether in the form of a truncated cone or some

other form, may be provided with longitudinal grooves or other such structure serving as guiding and sliding seats for the edges of the inner wedges, or it may be provided with guiding spigots for engagement with longitudinal slots formed in the edges of said wedges 20.

It is plain that when the spindle 18 is fixed by its top end 18*a*, the plate 32, pin 30 and bearings 28—29—31 may be omitted.

It is manifest that the spindle may be of substantially uniform diameter instead of being tapered or conical, depending on whether the interior of the body which it is desired to grind is cylindrical or conical.

Variations may be resorted to and parts used without others.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:

1. Apparatus for grinding the interior surfaces of tubular bodies and the like, including the combination, with a rotatable spindle adapted to be arranged and maintained in line with the axis of the bore of the body to be ground, of a plurality of radial wedge plates having their inner edges arranged parallel with the surface of said bore and disposed in contact with said spindle while having their outer edges inclined with respect to said spindle, a plurality of corresponding outer wedge plates having inner inclined edges in contact with the outer inclined edges of said first wedge plates, abrasive bodies disposed upon the outer edges of said outer wedge plates and in turn having their outer edges parallel with the surface of said spindle and the inner surface of said bore, resilient means for retaining said outer wedge plates in contact with said inner wedge plates, means for adjusting said inner and outer wedge plates longitudinally with respect to each other, whereby to radially project and withdraw said abrasive bodies, and a tubular member associated with said spindle to rotate therewith having slots providing for the projection of said outer wedge plates and abrasive bodies therethrough.

2. Apparatus for grinding the interior surfaces of hollow bodies according to claim 1 wherein the spindle is tapered to provide for grinding a tapered bore.

3. Apparatus for grinding the interior surfaces of hollow bodies according to claim 1 wherein the spindle is tapered to provide for grinding a tapered bore, and wherein the means for longitudinally adjusting the wedge plates consist of a movable adjusting member connected to one end of each of the outer wedge plates adapted to impart simultaneously to all said outer plates a longitudinal as well as a radial movement.

4. Apparatus for grinding the interior surfaces of hollow bodies according to claim 1 wherein the spindle is tapered to provide for grinding a tapered bore, and wherein the means for longitudinally adjusting the wedge plates consist of a movable adjusting member connected to one end of each of the inner wedge plates, whereby to simultaneously impart to the same a longitudinal movement at will along said spindle.

5. Apparatus for grinding the interior surfaces of hollow bodies according to claim 1 wherein the means to longitudinally adjust the wedge plates comprise a movable adjusting member is disposed about said spindle and connected to all of the inner wedge plates whereby to simultaneously impart to the same a longitudinal movement along the spindle, an outer adjusting member connected to all of the outer wedge plates adapted to be moved longitudinally at will with respect to said spindle, independently of said first adjusting member and to simultaneously impart both a longitudinal movement and a radial movement to said outer wedge plates, and means for moving either adjusting member at will and thereby moving the corresponding wedge plates connected thereto.

6. Apparatus for grinding the interior surfaces of tubular bodies and the like, including the combination, with a spindle supported in line with the axis of the bore of the body to be ground, of a plurality of radial wedge plates having their inner edges arranged parallel with the surface of said bore and disposed in contact with said spindle while having their outer edges inclined with respect to said spindle, a plurality of corresponding outer wedge plates having inner inclined edges in contact with the outer inclined edges of said first wedge plates, abrasive bodies disposed upon the outer edges of said outer wedge plates and in turn having their outer edges generally parallel with the surface of said spindle and the inner surface of said bore, means for retaining said outer wedge plates in contact with said inner wedge plates, means for adjusting said inner and outer wedge plates longitudinally with respect to each other, whereby to radially project and withdraw said abrasive bodies, and means disposed about said spindle adapted to rotate about the axis of said spindle and cause rotation of all said wedge pieces as an assembly about said spindle.

7. Apparatus for grinding the interior surfaces of tubular bodies and the like, including the combination, with a rotatable spindle adapted to be arranged and maintained in line with the axis of the bore of the body to be ground, of a plurality of radial wedge plates having their inner edges arranged parallel with the surface of said bore and disposed in contact with said spindle while having their outer edges inclined with re-

spect to said spindle, a plurality of corresponding outer wedge plates having inner inclined edges in contact with the outer inclined edges of said first wedge plates, abrasive bodies disposed upon the outer edges of said outer wedge plates and in turn having their outer edges generally parallel with the surface of said spindle and the inner surface of said bore, means for retaining said outer wedge plates in contact with said inner wedge plates, means for adjusting said inner and outer wedge plates longitudinally with respect to each other, whereby to radially project and withdraw said abrasive bodies, a tubular member associated with said spindle to rotate therewith and with said wedge plates and adapted to cause rotation of said plates as an assembly, a stationary stud supporting the projecting end of said spindle and a roller thrust bearing in said end of the spindle engaging said stud in order to avoid friction and maintain an accurate position of the spindle.

Signed at Milan (Italy), this 9th day of February 1931.

GIUSEPPE GIOVANNI AGOSTONI.