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APPARATUS FOR GRINDING

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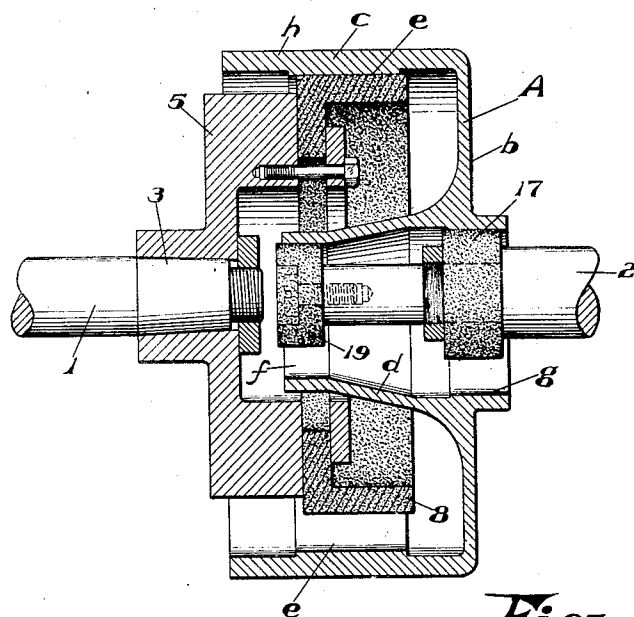


Fig. 2

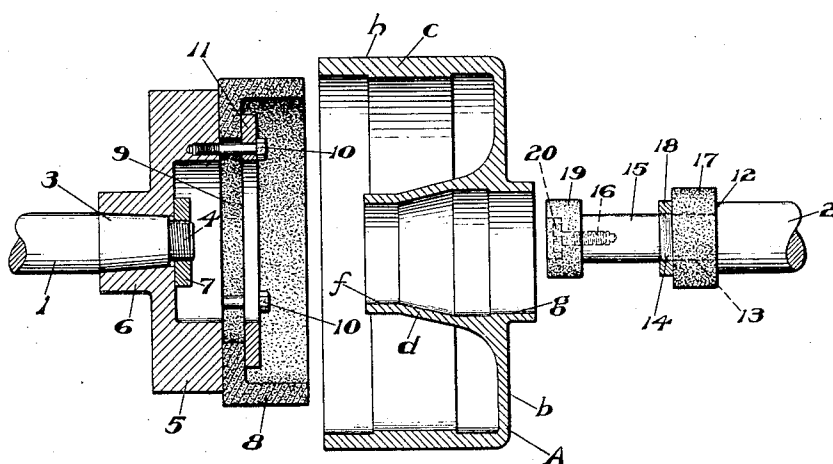


Fig. 1

Inventor

Dwight C. Page

By

Geo. W. Knevelly Jr.

Attorney

UNITED STATES PATENT OFFICE

DWIGHT C. PAGE, OF WORCESTER, MASSACHUSETTS, ASSIGNOR TO THE HEALD MACHINE COMPANY, OF WORCESTER, MASSACHUSETTS, A CORPORATION OF MASSACHUSETTS

APPARATUS FOR GRINDING

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The invention relates to internal grinding, and contemplates the grinding of separate concentric internal surfaces or bores at a single operation by means of different sized wheels. According to the invention two or more grinding wheels operate through the same working range or traverse space, one or more of the smaller grinding wheels operating in the imaginary cylinder defined by the periphery of the larger wheel as it moves through its operative traverse.

This method of grinding is particularly useful in connection with grinding machines operating on the principle of the disclosure in the copending application Serial No. 276,381 of Waldo J. Guild, filed May 9, 1928, in which a plurality of surfaces to be ground may be brought to the desired size simultaneously. The conception of the present invention, that one grinding wheel may operate literally within another, enables the machine, as disclosed in the said copending application, to grind several different surfaces on peculiar shaped workpieces efficiently at a single operation.

As illustrative of a particular mode in which my method of grinding may be carried out, I have illustrated in the accompanying drawings a particular workpiece having an internal large diameter surface to be ground, and a pair of smaller concentrically located surfaces generally inside the first surface. In the said drawings:—

Fig. 1 is a view in horizontal cross section of the said workpiece together with a view in cross section of an annular grinding wheel, and a view in elevation of a pair of cylindrical grinding wheels, said wheels being exterior to the bores in the workpiece.

Fig. 2 is a similar view on a somewhat larger scale of the same parts shown in Fig. 1, the several grinding wheels being shown in grinding engagement with the surfaces to be ground.

Like reference characters refer to like parts throughout the drawings.

An internal grinding machine provides a spindle upon which the grinding wheel is mounted, said spindle being rotated rapidly, with consequent rotation of the grinding

wheel so that it may cut the workpiece. In the co-pending application Serial No. 276,381 referred to, a pair of grinding spindles are provided, such as the spindles 1 and 2 of the present drawings, and these spindles are mounted in opposed relation, their axes being preferably in the same horizontal plane, and desirably, but not necessarily, in the same vertical plane. Means are provided, in the machine of the said copending application, to feed the workpiece or workpieces in a horizontal direction in relation to the spindles, in order that the grinding wheels may enlarge the bore or bores of the workpiece or workpieces. Means are further provided for causing each spindle 1, and 2, to traverse back and forth in an axial direction, and these traversing motions of the spindles are always equal and opposite. Finally, means are provided for causing both spindles to withdraw from the workpiece or workpieces, when the grinding is completed, in an axial direction.

Having thus explained the various motions imparted to the spindles 1, and 2, in the machine of the aforesaid copending application, which is the machine best adapted for the carrying out of the present invention, I will explain the best practical embodiment of the latter now known to me. The spindle 1 is provided with a reduced or tapered portion 3, and a screw threaded portion 4. A cup shaped member 5 provides a hub portion 6 having an internal bore that fits the portion 3. By means of a nut 7 fitting on the screw threaded portion 4, the cup shaped member is held firmly on the spindle.

A cup shaped grinding wheel 8, having a large hole 9 in its bottom wall is suitably fastened to the cup shaped member 5, as by means of bolts 10, 10 and a metal ring 11. Thus the grinding wheel is held to the spindle and must rotate therewith, while a considerable open space is left inside the wheel and cup shaped member. It will be readily understood that any other method of fastening a hollow grinding wheel to a spindle, providing a large unimpeded space inside the wheel, may be employed in place of the method just described.

The spindle 2 provides a shoulder 12, leaving a reduced portion 13, a part of which is screw threaded, as at 14. The latter merges into a portion of small diameter, 15, which terminates at the front end of the spindle. The said front end is drilled and tapped as at 16.

A cylindrical grinding wheel 17 is held in place against the shoulder 12 by means of a nut 18, while a second cylindrical grinding wheel 19 is mounted on the spindle 2, being held in place by a screw 20. As in the case of the description of the mounting of the grinding wheel 8, it should be understood that any other convenient method of mounting the wheels 17 and 19 upon the spindle 2 may be employed.

The workpiece A to be ground has a radial flange *b* joining tubular portions *c* and *d*, the latter being inside the former. The portion *c* provides an internal cylindrical surface *e* to be ground, while the portion *d* provides internal cylindrical surfaces *f* and *g* to be ground. It will be seen that the greater part of the surface *f* lies within the imaginary cylinder defined by the surface *e*.

The grinding wheels 8, 13 and 19 are shown about to enter the workpiece A in Fig. 1. Fig. 2 illustrates the wheels in grinding position, the wheel 8 grinding the surface *e*, the wheel 17 grinding the surface *g*, and the wheel 19 grinding the surface *f*. The several wheels rotate, as already described, and are also given a limited traverse in opposite directions. The reason why the spindles are moved in opposite directions in the machine of the copending application, is that they must leave the workpiece together (Fig. 1 may be considered to show them leaving as well as entering), which they could not do unless they moved always oppositely, if the grinding is to cease at the same moment for all surfaces. The reason the grinding must cease at the same moment, or rather an equal number of traverses after a known intermediate traverse, is not germane to the present invention, but will be found fully described in the aforesaid copending application.

The workpiece A is held on a fixed axis and rotated, the chuck holding it by its external surface *h*. This also will be found described in the copending application referred to.

The invention described in the aforesaid copending application has made possible the grinding of a plurality of internal surfaces automatically and simultaneously, without any loss of accuracy in bringing these surfaces to size within extremely close limits. Were an ordinary grinding wheel placed on the spindle 1, to grind the surface *e*, the wheel would interfere with the tubular portion *d* if it were large, while if a small wheel were employed it would wear down very

quickly. For a given amount of stock to be removed, a small wheel wears more rapidly than a large one, and hence it is undesirable to use a small wheel on a surface of large diameter, having a proportionally large area. Therefore, according to the present invention, one wheel is caused to grind inside the other, and space is provided beyond the bottom wall of the large wheel to provide for the necessary traverse of the small wheel on the front of the spindle 2. This solves the problem in a practical and efficient manner, and even permits a third grinding operation to be simultaneously performed, as disclosed by the drawings. As this result is wholly new, I wish to claim the method and means for performing it broadly.

Although the invention has been described in connection with a specific machine invented by another, it will be apparent that it is in nowise limited to use with such. For example, the oppositely disposed spindles 1 and 2 could be caused to leave the workpiece at different times instead of simultaneously, and the present invention has utility in any case where it is advantageous to cause two concentric surfaces to be ground simultaneously.

I claim:

1. In a grinding machine, the combination with a pair of grinding spindles facing in opposite directions, of a cup shaped internal grinding wheel on one spindle, and a small internal grinding wheel on the other spindle adapted to fit inside the said cup shaped wheel.

2. In a grinding machine, the combination with a pair of grinding spindles facing in opposite directions, of a cup shaped internal grinding wheel on one spindle, a small internal grinding wheel on the other spindle adapted to fit inside the said cup shaped wheel, and a supporting structure for said cup shaped wheel leaving a space beyond the bottom wall of the cup shaped wheel, said bottom wall being broken away, whereby to allow room for the small wheel to traverse when said wheels move oppositely.

3. In apparatus as claimed in claim 1, the combination with the parts therein specified, of a second small internal grinding wheel on the same spindle as the first small wheel.

4. In apparatus as claimed in claim 2, the combination with the parts therein specified, of a second small internal grinding wheel on the same spindle as the first small wheel.

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