ABSTRACT: A tool for honing, grinding, lapping or otherwise finishing internal cylindrical surfaces comprising an abrading head unit including a hollow mandrel having a plurality of slots in the wall thereof through which abrasive stones are slidable and a shaft rotatable to cause inward and outward adjustment of the stones. The unit is readily removable connected to an actuator unit adapted to rotate the head unit and to adjust the shaft whereby to adjust the stones relative to the mandrel.
METAL FINISHING TOOL

This invention relates to tools for honing, grinding, lapping, cutting or otherwise finishing internal cylindrical surfaces.

In our copending application, Ser. No. 805,478, filed on Mar. 10, 1969, now U.S. Pat. No. 3,561,172, we disclose and claim a tool of the above type comprising a hollow mandrel having a plurality of angularly arranged slots in the wall thereof, through which are slideable abrasive or cutting elements. A shaft rotatably mounted in the mandrel is operably connected to the abrasive elements so that a small rotatory adjustment of the shaft relative to the mandrel causes outward movement of the elements.

Such tool works very satisfactorily. However, the range of movement of the abrading elements is relatively small and therefore the average machine shop or machinist must keep in stock a number of such tools of different sizes in order to finish holes of different diameters. This may involve a considerable investment.

Also, in so-called honing tools of the above type, it is essential to control the diameter of the hole being finished to a high degree of accuracy and therefore it is desirable to provide for a minute and precise adjustment of the abrasive elements. Most prior art honing tools accomplish this by settings which urge the abrasive elements outwardly into engagement with the workpiece surface. The tool is withdrawn when an appropriate amount of material has been removed. This is a relatively slow procedure and is found to be undesirable when refreshing oval or out-of-round holes since the spring-pressed abrasive elements merely enlarge the hole but may not make it truly cylindrical. The tool disclosed in our above-noted application overcomes this defect by providing for positive adjustment of the abrasive elements to different settings. However, the adjusting device, which is manually operable, requires rather precise setting to likewise adjust the abrasive elements.

It therefore becomes a principal object of the present invention to reduce the cost of tools of the above type.

Another object is to provide a tool of the above type having abrasive head unit and an actuating unit capable of being used to drive and adjust any of a large number of abrasive head units.

Another object is to provide a tool of the above type in which a minute and precise adjustment of the abrasive elements is effected by a relatively large and coarse movement of an adjusting member.

The manner in which the above and other objects of the invention are accomplished will be readily understood on reference to the following specification when read in conjunction with the accompanying drawings, wherein:

FIG. 1 is a side view, partly in section, of an abrasive or honing tool embodying a preferred form of the present invention.

FIG. 2 is a transverse sectional view taken along the lines 2--2 of FIG. 1.

FIG. 3 is a transverse sectional view taken substantially along the line 3--3 of FIG. 1, but partly shown as an end view.

FIG. 4 is a side view of part of an abrading head unit.

Referring to the drawings, the tool comprises basically an abrasive head unit, generally indicated at 11, and an actuating unit, generally indicated at 12, the two units being readily separable as will be described later. Thus, the actuating unit can be used interchangeably to drive any of a large number of less expensive abrasive head units.

The unit 11 comprises a cylindrical mandrel 13 having a bore 14 therein and an enlarged head section 15 in which a plurality of slots 16 (FIG. 3) are formed. The slots extend the length of the section 15. Abrasive stones 17, extending the lengths of the slots 16, are slideable in the slots and each is integrally attached to a stone holder 18 having a cylindrically formed end portion 20 fitted in mating slots 21 and 22 formed in a shaft 23 which is rotatably mounted in the bore 14. A reduced bearing portion 24 on the right-hand end of the shaft is rotatably mounted in a reduced bearing section 25 of the mandrel bore.

The mandrel has a flange 26 adjacent its left-hand end arranged to fit against a similar flange 27 formed on an annular or tubular body 28 of the unit 12 and is removably held thereagainst by a knurled coupling member 30 which is screw threaded on flange 27.

An annular locating flange 32 is formed on the left-hand end of the mandrel and is fitted within a counterbore 31 in the body 28 to locate the mandrel concentrically of the actuating unit. A flange 29 is formed on the shaft and also loosely fits in the counterbore 31 to prevent endwise movement of the shaft when the parts are assembled as shown in FIG. 1.

The actuating unit 12 comprises an inner drive sleeve 33 slidable along the bore of body 28 and rotatably mounted therein. The sleeve has a square opening therein which is splined over a square end portion 34 of the shaft 23.

The sleeve 33 has a pair of diametrically opposed follower pins 35 attached thereto and movable along substantially helical cam slots 36 formed in the wall of the body 28. Such pins also extend into close-fitting holes formed in an outer sleeve 37 rotatably mounted on the outer periphery of the body 28 and slidable therealong.

The sleeve 37 is screw threaded at 39 to a knurled adjusting nut 38 which is rotatably supported by the sleeve and prevented from movement longitudinally relative to the body 28. For this purpose, an annular disc 40 is attached to the end of the body 28 by a shank 41 which has a head 42 screw threaded into the body 28 to clamp the disc 40 therebetween. The outer periphery of the disc 40 is rotatably received in a counterbore 43 formed in the nut 38 and is retained therein by a suitable snapring 44, permitting rotation of the nut relative to the disc.

The shank 41 is adapted to be mounted in a suitable chuck (not shown) of a drill press, lathe or other rotatable driving device for rotating the tool.

In order to expand or contract the stones 17 within an opening or hole in a workpiece, the nut 38 is rotated in an appropriate direction causing the sleeve 37 to move endwise whereupon the cam slots 36 cause the pins 35 and inner sleeve 33 to rotate to similarly rotate the shaft 23 and thus expand or contract the stones 17. Due to the relatively small helix angles of the screw threads 29 and the large helix angle of the guide slots 36, a relatively large rotational movement of the nut 38 results in a relatively small movement of the stones 17 so that a very minute and accurate adjustment of the latter may be made.

For the purpose of calibrating the extent of the adjustment of the stones, scale indicia 45 are formed around the nut 38 and are read against an index mark 46 formed on the body member 28.

During operation, the tool is rotated in the direction of the arrow A and the threads 39 are preferably so formed that during such rotation the nut 38 may be merely grasped and held against rotation to cause the stones 17 to expand into engagement with the wall surface of a hole in a workpiece being finished.

In order to replace a unit 11 with one having a head section 15 of different diameter, the coupling element 30 is unscrewed and the mandrel and shaft 33 withdrawn endwise and the new unit 11 installed in its place.

We claim:

1. In an abrasive tool having a hollow mandrel, said mandrel having a plurality of spaced slots extending through the wall thereof, a shaft rotatable in said mandrel, a workpiece-engaging members slideable in said slots for movement inwardly and outwardly relative to said mandrel, and means operable by said shaft upon rotation thereof relative to said mandrel for moving said members outwardly;

2. an actuator member having an annular portion, said actuator member being adapted to be rotated about an axis concentric with said annular portion.
means for removably attaching said mandrel to said actuator member, said actuator member having a camming slot in the wall of said annular portion thereof, a drive member rotatably and slidably mounted in the bore of said annular portion and removably splined to said shaft whereby to transmit rotation to said shaft, a follower on said drive member movable along said camming slot, and a sleeve rotatably and slidably mounted on the outer periphery of said annular portion, said sleeve being operatively connected to said follower whereby movement of said sleeve along said annular portion will transmit rotation to said shaft.

2. An actuator according to claim 1 comprising a nut member screw threadably attached to said sleeve,

and means enabling rotation of said nut member and preventing movement thereof along said actuator member whereby rotation of said nut member relative to said actuator member is effective to cause movement of said sleeve along said annular portion.

3. An actuator according to claim 2 comprising indicia on said nut member for indicating the extent of movement of said workpiece-engaging members.

4. An actuator according to claim 1 wherein said drive member comprises a drive sleeve having a noncylindrical bearing opening slidably engaging a mating noncylindrical portion of said shaft whereby to form a driving connection between said drive sleeve and said shaft.