May 30, 1939. C. W. FLOSS 2,160,494

HONING MACHINE

Filed March 14, 1938 2 Sheets-Sheet 1

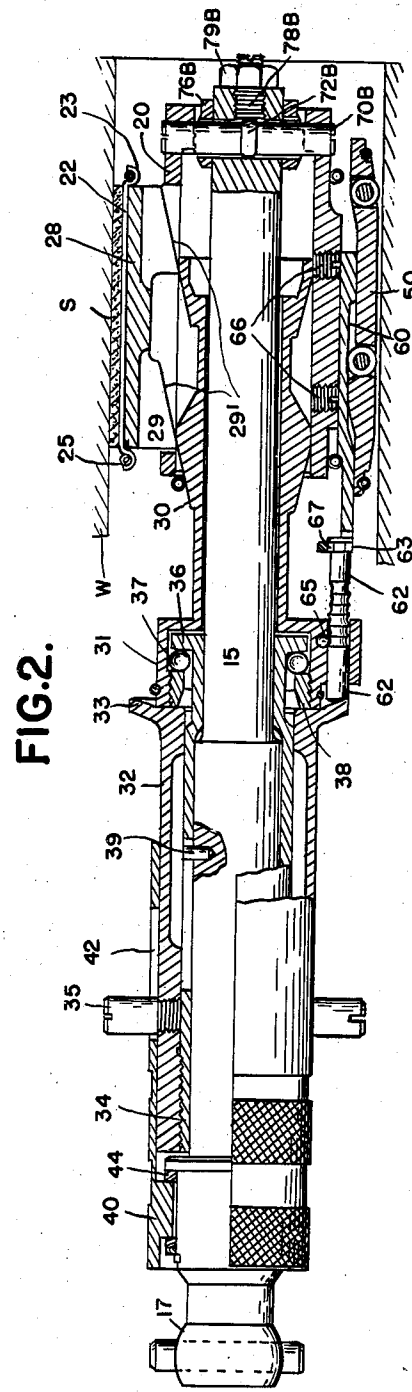


FIG.2.

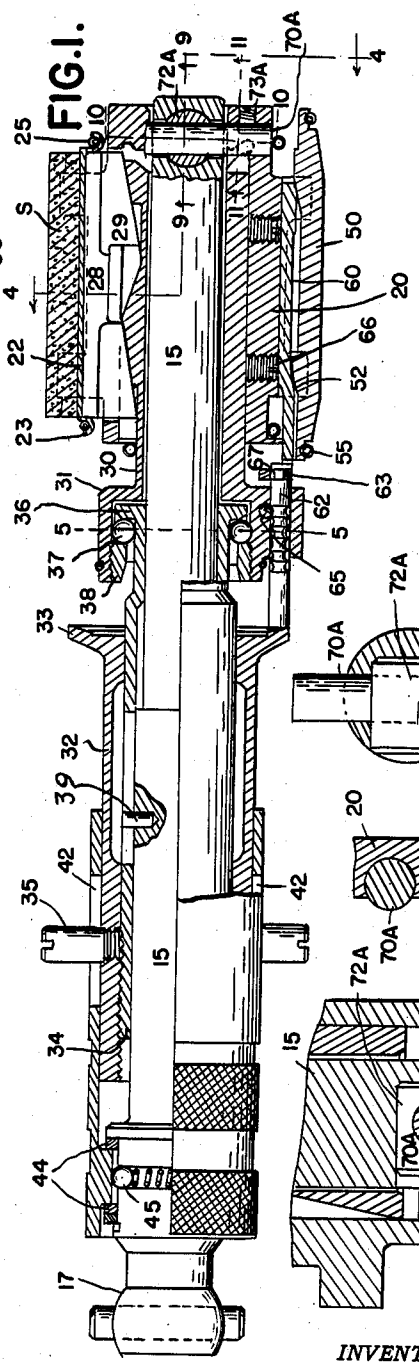


FIG.1.

FIG.10.

FIG.11.

FIG.9.

INVENTOR
CARL W. FLOSS
BY Swan, Mayer & Hardesty
ATTORNEYS

May 30, 1939. C. W. FLOSS 2,160,494

HONING MACHINE

Filed March 14, 1938 2 Sheets-Sheet 2

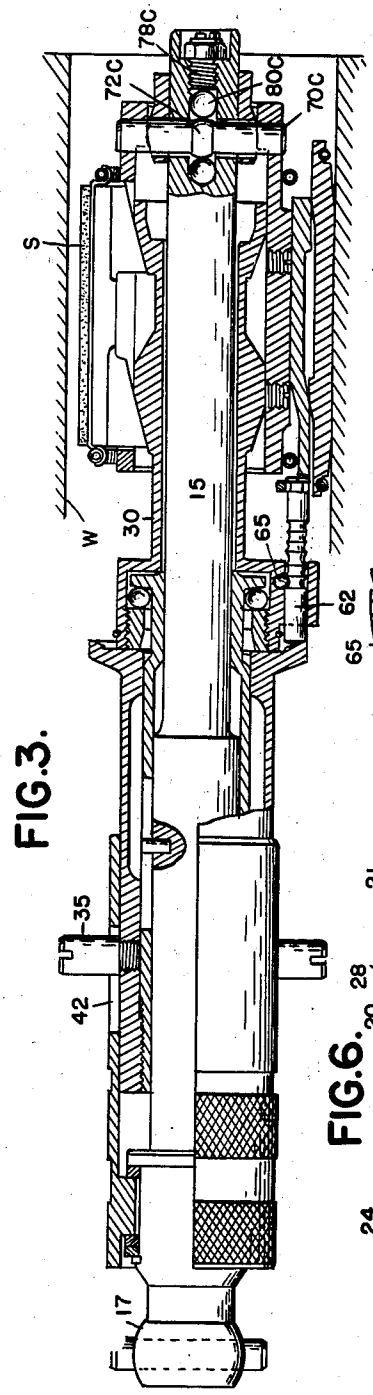


FIG.3.

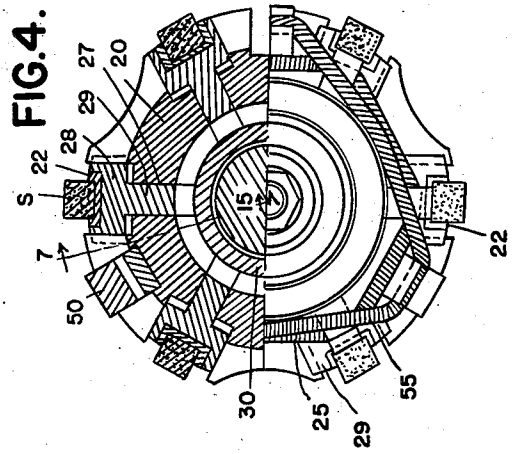


FIG.4.

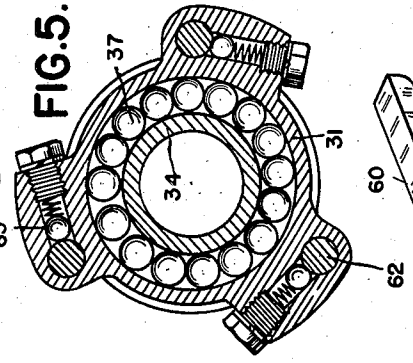


FIG.5.

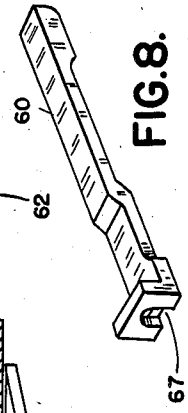


FIG.8.

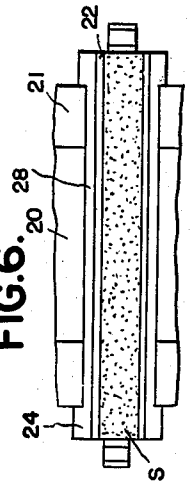


FIG.6.

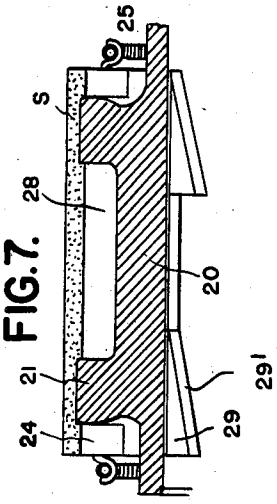


FIG.7.

INVENTOR

CARL W. FLOSS

BY Swan, Mye & Hartzell

ATTORNEYS

Patented May 30, 1939 2,160,494

UNITED STATES PATENT OFFICE

2,160,494

HONING MECHANISM

Carl W. Floss, Detroit, Mich.

Application March 14, 1938, Serial No. 195,780

15 Claims. (Cl. 51—184.3)

This invention relates to finishing devices for the internal surfaces of cylinder bores and the like, and particularly to an improved unitary honing head, rotatable and reciprocable with relation to the work and carrying a plurality of stones expansible and contractible radially to operative and inoperative positions.

An important object of the invention is to provide improved universal-joint-type connecting means whereby the honing head is attached to its driving shaft, which connecting means is extremely compact in its longitudinal dimension, readily replaceable in event of damage or undue wear, and incorporates large bearing surfaces rendering it extremely rugged.

It is also an object to provide such a joint which is capable of adjustment to compensate for wear.

Still another object is to provide an improved honing head of the character indicated, having guide means expansible concurrently with contraction of the honing elements, and vice-versa, to engage the work and guide the head into and from the same and prevent scratching of the work by the hones.

Still another object is to provide extremely simple, positive and readily adjustable means for mounting the head and for radially actuating the hones and the guiding means.

Other objects and advantages will be apparent from the following description, wherein reference is made to the accompanying drawings illustrating preferred embodiments of my invention and wherein similar reference numerals designate similar parts throughout the several views.

In the drawings:

Figure 1 is a longitudinal view, partly in side elevation and partly in substantially diametrical section, of a honing head incorporating the principles of this invention, showing the radially expansible and contractible guide and honing elements in an intermediate position as respects their radial movement.

Figure 2 is a similar view showing a construction somewhat modified with respect to its universal driving joint portion which serves to connect the head to the shank, and in certain guide element details, but otherwise similar, showing the honing elements expanded into contact with the work and in a worn down condition, the guide elements being retracted out of engagement with the work.

Figure 3 is another view of like character, showing a construction which is also essentially similar but somewhat further modified insofar as the construction of the universal driving joint is concerned, showing the honing elements retracted and the guide elements expanded to contact the work.

Figure 4 is a composite view partly in section and partly in end elevation, taken as indicated by the line 4—4 of Figure 1 and looking in the direction of the arrows.

Figure 5 is a cross sectional view taken substantially on the line 5—5 of Figure 1 and looking in the direction of the arrows.

Figure 6 is a fragmentary plan view of one of the honing stones and adjacent portions of its mounting means.

Figure 7 is a fragmentary radial section taken as indicated by the line 7—7 of Figure 4 and looking in the direction of the arrows.

Figure 8 is a perspective view of one of the sliding cam members which serves to actuate and to back the guide slippers.

Figure 9 is a detailed section taken at right angles to Figure 1, and as indicated by the line and arrows 9—9 thereof.

Figure 10 is a detailed cross section taken substantially on the line 10—10 of Figure 1, and looking in the direction of the arrows.

Figure 11 is a sectional detail taken substantially on the line 11—11 of Figure 1, and looking in the direction of the arrows.

Referring now to the drawings, reference character 15 designates a drive shank, which is adapted to be rotated and reciprocated by suitable operating mechanism (not shown), such as a honing machine of conventional or any desired construction, although I preferably use a machine arranged and controlled in the manner disclosed in my copending application, Serial No. 190,665, filed February 15, 1938. To such driving mechanism the shank is connected by coupling means, of which only a portion, designated 17, is shown. The present invention concerns itself with the honing head proper, which is considered to be intended for honing the internal surface of a cylindrical bore, such as that of an engine or pump cylinder. It will be appreciated that one such honing head may be used alone, or that they may be used in multiple to hone several cylinders at once.

The work is diagrammatically indicated at W in Figures 2 and 3. In Figure 2 the honing stones S are shown expanded to engage the work, and in Figure 3 retracted from engagement therewith. A plurality of stones (six in the constructions shown) are carried in longitudinal, parallel and outwardly facing relation by a hone body 20.

The hone body is drivable by the shank but limitedly universally movable relatively thereto. Each stone is cemented or otherwise suitably held in a sheet metal clip 22. Each clip projects at both ends and is hooked as at 23 to accommodate the elastic band type contracting springs 25 which encircle the assembly, one at each end, to draw inwardly all of the stones at once.

Each sheet metal clip 22 is fitted in a stone holder 28. These are carried by inwardly projecting portions 29 mounted for radial sliding movement in slots 27 in the hone body 20 (see Fig. 4), and provided at their inner extremities with inclined cam surfaces 29' engaging operatively inclined cam surfaces carried by a sleeve cam 30 slidably formed of three interfitted sections and slidable but non-rockable on the shaft. The inclination of the cam portions 29'—30 is such that pulling the sleeve cam inwardly or away from the head expands the stones into engagement with the work, while when the sleeve is moved outwardly of the shaft the stones are contracted by the springs 25.

Power is applied to the sleeve assembly comprising sleeve sections 32, 34 to move the sleeve cam in this manner, through the pins 35, actuable by the control apparatus (unshown). At its outer end sleeve 32 carries a radially projecting flange 33 having an outer surface developed spherically about the desired rocking center of the cam sleeve and honing head. The inner sleeve 34, slidably fitted upon the shaft 15, is threadedly interfitted with the sleeve 32, so that ordinarily these two sleeves move as a unit. The inner sleeve projects toward the head farther than does sleeve 32, having at its end a radially projecting flange 36, the inner surface of which is also developed spherically about the rocking center. Flange 36 is enclosed by the belled inner extremity 31 of the cam sleeve, and ball bearings 37 within the housing thus formed are rollable upon the spherical surface of the flange to permit such universal movement of the cam sleeve, while transmitting the longitudinal thrust. A ring 38 threaded into the housing section 31 of the cam sleeve traps the balls therein and is adjustable to compensate for wear. Rotation between sleeve 34 and shaft 15 is prevented by a pin and slot connection, the pin being designated 39. To change the initial longitudinal positioning of the cam sleeve 30, it is only necessary to rotate the sleeve 32 which then, because of its threaded engagement with sleeve 34 tends to move the latter longitudinally of the shaft, changing the position of sleeve 34 with relation to the actuating pins 35, whose travel is fixed. This will be seen to adjust the effective longitudinal position of sleeve 34, and so of the thrust flange 36 and cam sleeve 30. Rotation of sleeve 32 is normally prevented by an outer sleeve 40 having longitudinal slots 42 slidably overengaging pins 35. Sleeve 40 is rotatable upon shaft 15 but held against longitudinal movement with respect thereto, as by abutment rings 44, and yieldably held in any position to which it may be turned, by means of a serrated internal surface (undesignated), against which bears a spring pressed detent ball 45.

Also radially slidable in the hone body are a plurality of guide slippers 50, arranged longitudinally in parallel relation to the honing stones. The projecting ends of the guide slippers may be engaged by similar endless belt-type retracting springs 55. The inner surface of the guide slippers are inclined as at 52, and beneath each and longitudinally slidable in the honing head is an actuating cam 60, reciprocable by the same sleeve assembly which serves to actuate the cam 30. Cams 60, however, have their cam surfaces arranged to retract the guide slippers when the honing stones are expanded, and vice versa. The slippers serve to center the honing head with respect to the bore when the stones are retracted, during longitudinal feeding of the head into and retraction thereof from the bore. A driving connection between cam sleeve 30 and slipper actuating cams 60 is provided by pins 62, one coupled to each of the cams 60 and extending inwardly through the enlarged bell-shaped section 31 of cam sleeve 30. The pins are slidable in the section 31 but normally held against such movement with relation thereto by spring-pressed detent balls 65 engaging cooperatively serrated external surface portions of the pin. The driving connection thus provided between the cam sleeve which actuates the honing stones radially, and the slipper actuating cams 60, serves to move the slippers in the above described manner, concurrently with but in a reverse direction to the honing stones. The limit of retraction position of each guide slipper is adjustably fixed by abutment screws 66 upon which its sliding cam 60 rides, the screws being threaded in the hone body. It will be seen that by backing the screws out of the body, the cams and slippers may be moved radially outwardly thereof, and vice versa. To allow for movement between the pins 62 and cams 60 during such adjustment, the connection between these elements is one which permits radial sliding motion without unwanted longitudinal motion. At its inner extremity the cam element is turned inwardly perpendicularly to the body of the cam, and a radially disposed slot 67 therein (Fig. 8) slidably engages a notch 63 in the extremity of pin 62.

When the stones S are of their full or maximum intended thickness, the cam portions 29' of the stone holders ride upon the lower ends of the cooperating sloping cam portions of cam sleeve 30, in the manner indicated in Figure 1, the adjusting sleeve 40 being then so turned that the normal path of the cam sleeve is farther out upon the shank. Pin 62 at such time, together with its attached cam 60, also is so retracted inwardly that its cam surfaces and those of the guide slippers 50 engage only at their lower portions. As the stones wear, adjusting sleeve 40 is so turned as to move the cam sleeve 30 inwardly of the shaft and lift the stone holders radially outwardly toward the higher portions of the frusto-conical sections of the cam sleeve. The flange 33, however, prevents such movement of pins 62, which abut thereagainst, the effect being to accomplish reverse outward adjustment of the cams 60, whereby proportionately greater outer thrust of the guide slippers is also effected, to maintain their relative adjustment with respect to the stones.

To move the stones longitudinally through the bore, effort is always applied near the leading end of the stone, to draw rather than push them over the work. Referring to Figures 6 and 7, the stone holders will be seen to be provided at each end with laterally extending ears 24, while the hone body portions 21 between which the stone holders are radially slidably fitted are so curved at their ends which abut the ears 24 to allow each stone holder to rock or adjust itself about a transverse axis, thus maintaining the stone throughout its length in proper alignment with

the work and their engagement pressure uniform. Although the rotary drive is transmitted through the inwardly projected rib section 29, the longitudinal drive is not. In whichever direction the stone may be moved longitudinally, it is driven from a point near its leading end by engagement of the ears 24 with the driving lugs 21 at that end of the hone body. The effect is thus always to draw rather than push the stones along the work, preventing any unwanted chattering, jamming or cocking and insuring smooth longitudinal actuation of the stones at all times.

The rotary drive is transmitted from the shank to the hone body by a universal joint connection located at the outer end of the shank and head. In the three longitudinal views, Figures 1, 2 and 3, three modified forms of universal joint are shown, although since the other portions of these views are similar, like reference characters have been applied to each except as to the portions showing such universal joints. To these portions, also, like reference numerals have been applied, save that in Figure 1 the universal joint portions are denominated by reference characters distinguished by the addition of the letter "A" to each, while in Figures 2 and 3 the letters "B" and "C", respectively, distinguish the reference characters which are used to designate corresponding parts.

In Figure 1 a transverse drive pin 70A is shown extending diametrically through shank 15 near its end, and projecting therefrom into the hone body, to which it may be connected as by the set screws 73A. Pin 70A is rockable in a longitudinal central plane with respect to the shank 15, the opening in the latter being elongated in this plane to permit such rocking movement. Pin 70A is also rotatable in the shank and in a cylindrical drive element 72A which extends into the shank at right angles thereto and embraces the central portion of the pin. Portion 72A will be seen to control rocking movement of the pin 70A, while as best shown in Figure 9, lateral movement of the body longitudinally of the pin is prevented by an inwardly projecting portion 76A carried by the hone body, and having a double taper for clearance, so shaped as to allow the desired rocking movement of the hone body with relation to the shank.

In the somewhat modified universal joint construction shown in Figure 2, the drive pin 70B is limitedly universally rockable in the shank 15, but provided with a partly spherical central enlargement 72B which is of substantially the same diameter as the aperture in the shank through which the pin projects, such aperture thus forming a bearing for the spherical section 72B, while allowing rocking of the drive pin and so of the hone body which is attached thereto. A portion of such bearing is also formed by an adjustable screw 78B provided with a jam nut 79B and threaded into the end of the shank, to allow taking up any clearance which may develop between the shank and the spherical section 72B. A portion 76B arranged upon the shank and provided with a partly spherical surface concentric with the section 72B and the rocking center serves to prevent lateral movement of the body on the shaft, substantially filling the space between such portions.

In the further modification shown in Figure 3, the construction of which will be seen to be similar to that last described, the bore in which the take up screw 78C is threaded, will be seen to be extended through the shaft and beyond the drive pins 70C to house balls 80C which act as the bearing surfaces engageable with the partly spherical section 72C, the position of the balls being adjustably fixed by the screw 78C.

To reduce wear of the guide slippers I preferably provide these with a hard surface having suitable bearing characteristics. Chromium plating is very satisfactory for this purpose, as it is not only so hard that abrasive particles cannot embed themselves in it, but has very advantageous bearing qualities.

What I claim is:

1. In combination with a shaft adapted to be rotated and reciprocated by a machine tool, a working head carried by the shaft, a set of working elements extensible and retractible radially with respect to the head, a set of guide elements also extensible and retractible with respect to the head, means for concurrently moving one of said sets of elements inwardly and the other set outwardly, comprising a common cam member engageable with all of the elements of one of said sets, and a plurality of oppositely acting cam members engaging the elements of the other of said sets, and common actuating means for all of said cam members.

2. Honing means adapted for use in combination with a machine tool having a rotatable and reciprocable shaft, including a working head adapted for attachment to such a shaft, a set of working elements extensible and retractible radially with respect to the head, a set of guide elements also extensible and retractible with respect to the head, means for concurrently moving one of said sets of elements inwardly and the other outwardly, comprising a common actuating portion for all of the elements of one of said sets, and a plurality of oppositely acting actuating elements interconnected with said common actuating portion and operatively engaging the elements of the other of said sets.

3. In combination with a rotatable and reciprocable shaft, a working head carried by the shaft, a plurality of working elements extensible and retractible radially with respect to the head, a plurality of guide elements also extensible and retractible relatively to said head, and common actuating means for simultaneously moving said working elements and guide elements in opposite directions, comprising oppositely working cam portions connected thereto, and remotely controllable operating means for said cam portions.

4. In combination with a rotatable and reciprocable shaft, a working head carried by the shaft, a plurality of working elements extensible and retractible radially with respect to the head, a plurality of guide elements also extensible and retractible with respect to the head, and common actuating means for said working elements and guide elements including an actuating member connected to both such elements and movable longitudinally of the shaft, and oppositely acting driving means connecting said actuating member to said working elements and to said guide elements to concurrently move the working elements inwardly and the guide elements outwardly, and vice versa.

5. A honing device for use in combination with a machine for rotating and reciprocating the same, including a head, a working element extensible and retractible laterally with respect to the head, operating means for so moving the working element to extend and retract the same, laterally extensible and retractible guide means

also carried by said head, additional operating means for said guide means interconnected with said first mentioned operating means to move said guide means inwardly when the working element is moved outwardly, and vice versa.

6. A honing head construction comprising a hone body rotatable and longitudinally movable with respect to a predetermined axis, elongated stone holders mounted in said body, normally lying substantially parallel to said axis and adapted to be rotated and reciprocated thereby in contact with work desired to be honed, driving portions connecting said hone body and stone holders for transmitting longitudinal drive from the former to the latter, at least two longitudinally spaced driving portions being operatively engageable with each stone holder, one near each end of and adapted to bear outwardly against each of said stone holders, whereby the greater portion of said stone holders are drawn over the work during operative longitudinal movement, in trailing relation to the driving portion, by which they are actuated.

7. Drive means for a honing head or the like, comprising a shaft, a hone body carried thereby and limitedly universally movable relatively thereto, and means connecting said shaft and body including a rockable connecting element extending transversely through at least a portion of the shaft, said connecting element having a partly spherical section concentric with the center of such universal movement, and adjustable bearing means carried by the shaft and engaging said partly spherical section.

8. Drive means for a honing head or the like, comprising a shaft, a hone body carried thereby and limitedly universally movable relatively thereto, and means connecting said shaft and body including a rockable connecting element extending transversely through at least a portion of the shaft and smaller than the opening through which it extends to allow limited universal rocking movement thereof with relation to the shaft, said connecting element having an enlarged partly spherical section concentric with the center of such universal movement and substantially conforming in size to said opening in the shaft, and adjustable bearing means carried by the shaft and engaging said partly spherical section.

9. Drive means for a honing head or the like as set forth in claim 8 in which said connecting element extends transversely through and near one end of the shaft, and said adjustable bearing means comprises a member adjustably fitted into said shaft from the end thereof and disposed generally perpendicularly to said connecting element.

10. Drive means as set forth in claim 8 in which said connecting element extends transversely through and near one end of the shaft, said enlarged spherical section being substantially centered upon the axis of the shaft, said adjustable bearing means comprising a pair of elements housed in an axial bore in the shaft intersecting said opening through which the connecting element extends, one of said elements being disposed upon either side of said sperical section for engagement therewith, and means for urging said bearing elements into engagement with said spherical section.

11. Drive means for a honing head or the like, comprising a shaft, a hone body carried thereby and limitedly universally movable relatively thereto, and means connecting said shaft and body to allow such movement and transmit rotating drive from one to the other, comprising a connecting element extending through the shaft near one end of the latter and having end portions adapted to be secured to the hone body, said connecting element being rockable in one plane which extends through and parallel to the axis of the shaft, means defining such rocking axis and preventing bodily movement of the connecting element along the axis of the shaft, comprising a bearing element extending through at least a portion of the shaft in a direction perpendicular to said plane and rotatable about its own transverse axis, said connecting element being carried by said bearing element.

12. Means as set forth in claim 11 in which said connecting element is snugly fitted but slidable and rotatable in said bearing element.

13. Means as set forth in claim 11 in which said connecting element and bearing element are substantially cylindrical and disposed perpendicularly to each other and the axis of the shaft, the bearing element being rockable with respect to the shaft only about its own axis, and the connecting element being rockable about said same axis, and means connecting the hone body to said connecting element and allowing in addition rocking movement of the hone body about the axis of the connecting element.

14. Drive means for a honing head or the like, comprising a shaft, a hone body carried thereby and limitedly universally movable relatively thereto, and means connecting said shaft and body to allow such movement and transmit rotating drive from one to the other, comprising a connecting element extending through the shaft near one end of the latter and having end portions adapted to be secured to the hone body, said connecting element being rockable in one plane which extends through and parallel to the axis of the shaft, means defining such rocking axis and preventing bodily movement of the connecting element along the axis of the shaft, comprising a bearing element extending through a portion only of the shaft in a direction perpendicular to said plane and rotatable about its own transverse axis, said connecting element being carried by said bearing element.

15. Means as set forth in claim 5 in which said first mentioned operating means and additional operating means are interconnected by a regulable connecting element whereby the initial positioning of the working element and the guide means with respect to each other may be changed.

CARL W. FLOSS.