Dec. 22, 1970 G. R. HELD 3,548,548

HONING TOOL AND POWER DRIVE THEREFOR

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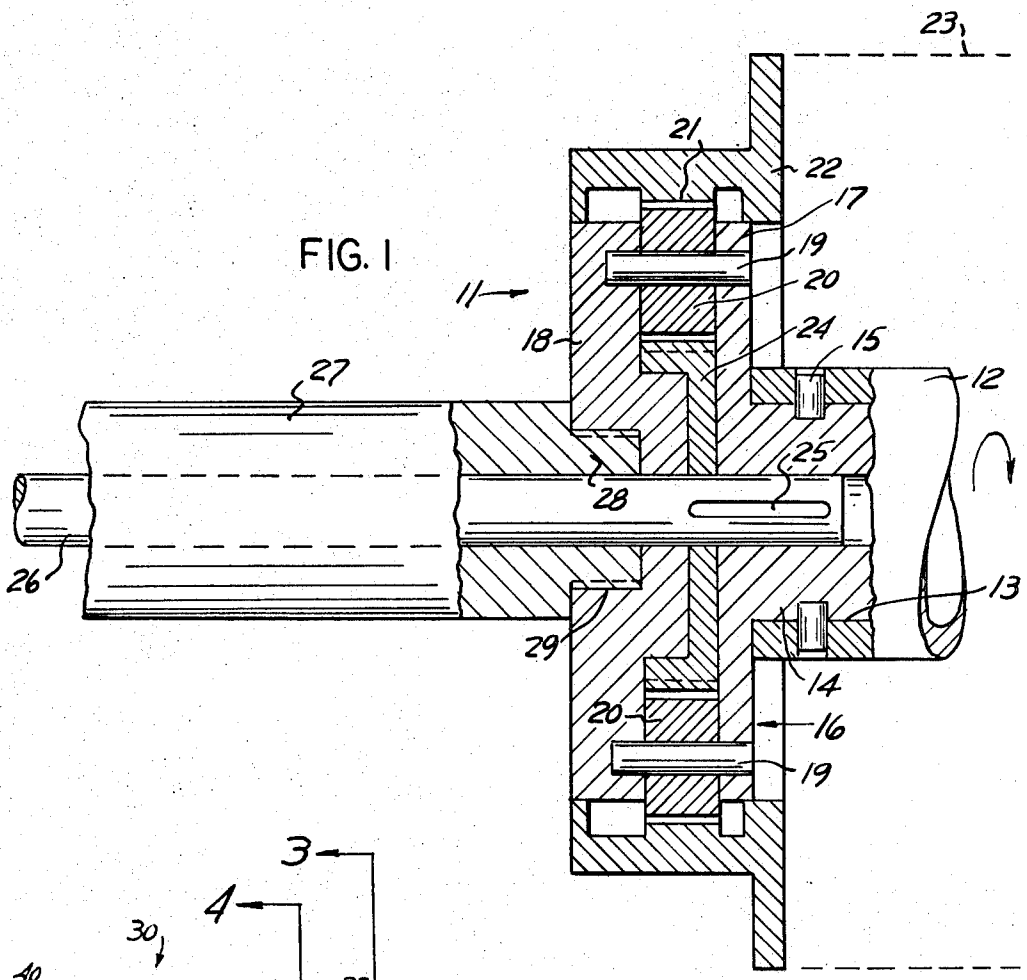
FIG. 1



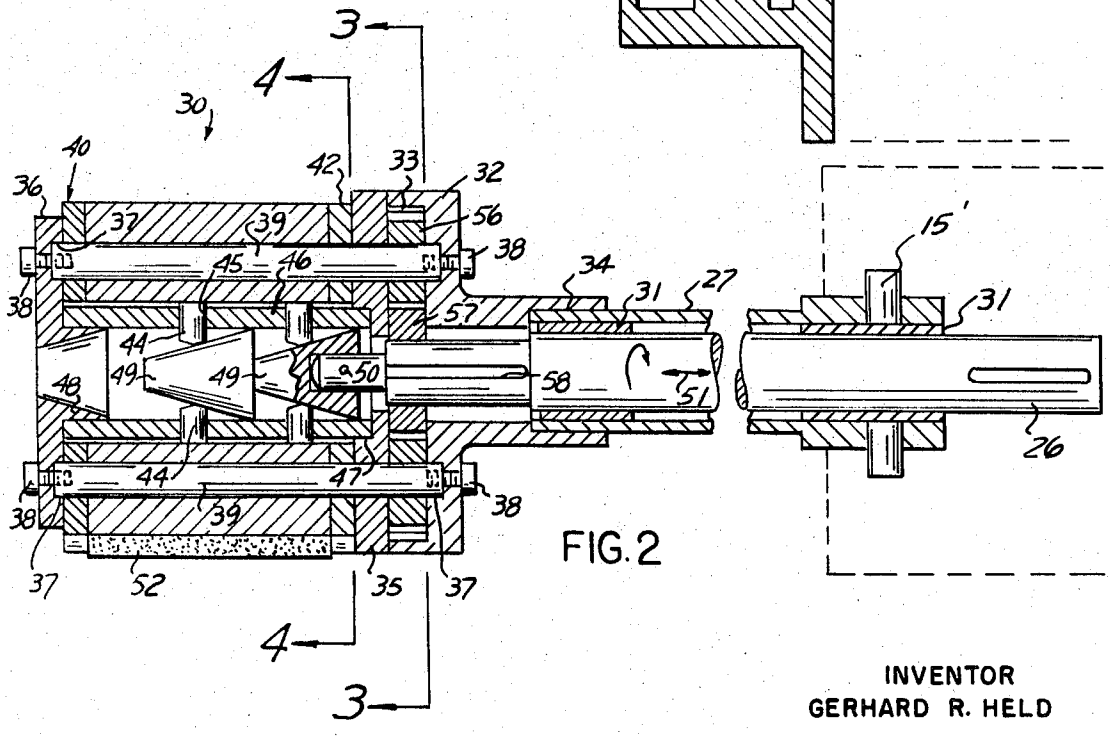


FIG. 2

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FIG. 3

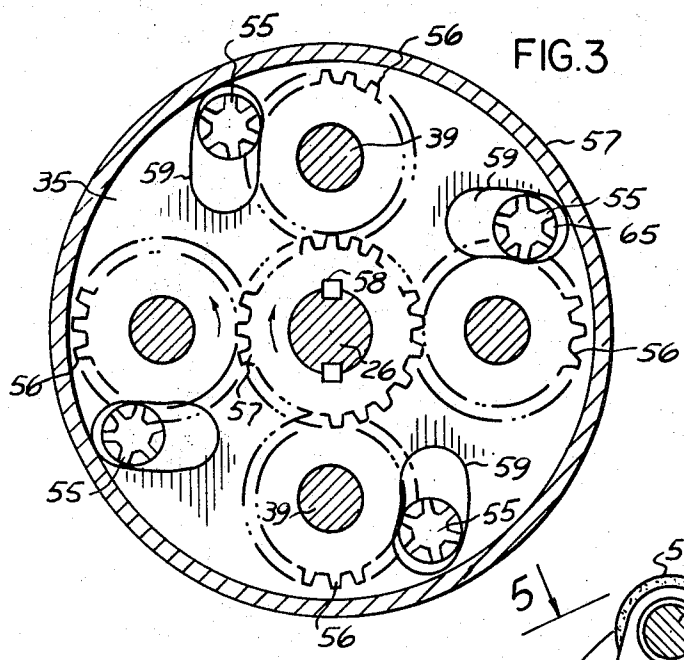


FIG. 4

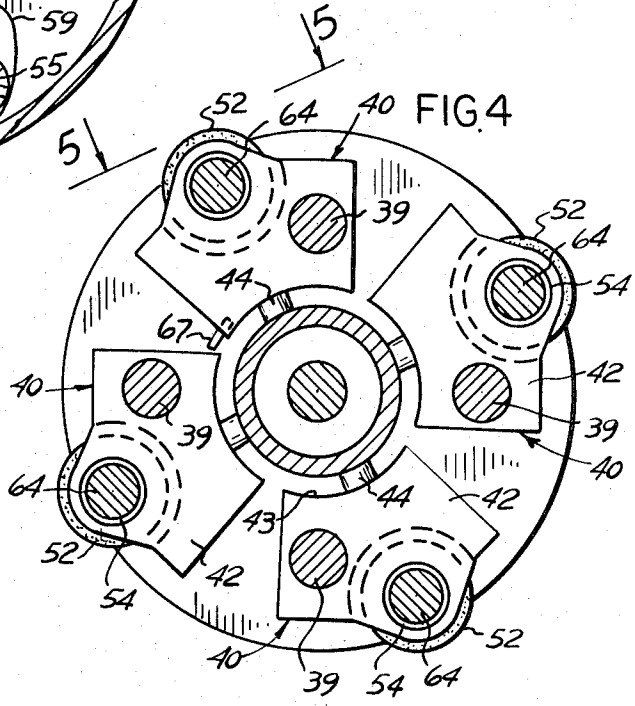


FIG. 5

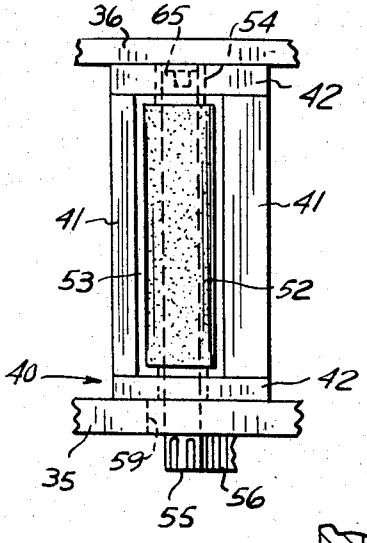
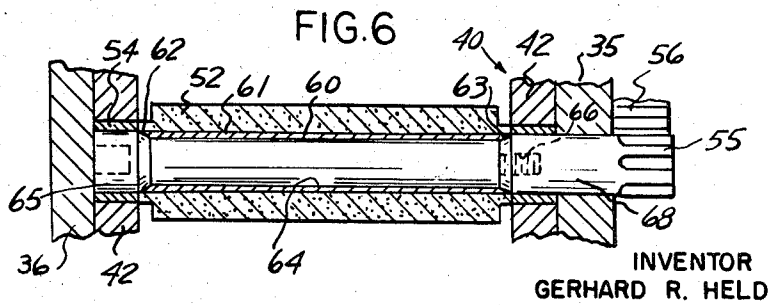


FIG. 6



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3,548,548

HONING TOOL AND POWER DRIVE THEREFOR

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U.S. Cl. 51—90 11 Claims

ABSTRACT OF THE DISCLOSURE

A honing tool which includes a housing power rotated at a first speed with a series of cylindrically shaped honing wheels rotatably journaled in said housing on axes paralleled to the housing axis, and capable of radial adjustment relative to the housing, and means for rotating the honing wheels at a different speed relatively to the housing. Also, an r.p.m. changer by which the honing tool is connected to a power drive for rotating the housing and said honing wheels at different speeds.

BACKGROUND OF THE DISCLOSURE

Heretofore, in honing tools of the conventional type, there is provided a power rotated housing which mounts normally a plurality of circularly spaced honing stones of square or rectangular shape which are capable of simultaneous radial outward and inward adjustment with respect to the housing. The housing is usully of a solid body construction with milled and ground in slots for the honing stones and guides.

The honing surface of the honing stones conform to the shape of the article being honed. They are pressed flat and hard against the wall of the article and will stay there at all times during the honing cycle. Since the honing stone are pressed flat against the surface metal particles become trapped between the stones and the honed surface. For this reason the stones are so constructed that they will gradually break down when more and more particles are trapped and the stress on the individual cutters on the honing stone becomes too great to hold any longer.

If the honing stones would be too hard and would not break down then they would load up and would cause more heat, no more honing action, may even break the honing tool. If the honing stones would be too soft they would break down too fast.

If the honing stones have hard spots, these spots will load up and cause streaks in the work piece. In this way of honing where the stones produce a lot of rubbing and little cutting, much heat is developed and the removal of metal is very small. The high pressure needed with these tools can twist them or may even break them. The solid body construction makes repairs difficult and expensive. The removal of particles from within the bore is done by a cooling and lubricating fluid.

BRIEF DESCRIPTION OF THE INVENTION

It is an object of the present invention to overcome the aforesaid difficulties in honing by providing an improved honing tool by which metal particles cannot be trapped between the honing wheels and the surface. Pressure and heat are reduced to a minimum. More metal can be removed faster and there is greatly reduced streaking. The honing wheels may be harder since metal removal is done by the rotation of the wheels. They also will last longer. The construction of the present honing tool permits fast and easy repair.

It is another object to provide an improved honing tool by which in addition to the ordinary conventional radial adjustment provided in conventional honing tools, the honing tool itself is individually rotatable as a cylindrical

wheel to thus provide a compound honing engagement with the bore.

It is a further object of the present invention to provide an improved honing tool which includes a chambered housing normally rotatable within a bore to be honed which chambered housing mounts a plurality of circularly spaced honing wheel holders which are pivotally mounted within the said housing and which are capable of radial adjustments relative to the housing inwardly and outwardly thereof and with power means provided by which the honing tool housing is itself individually rotatable within the bore and wherein the individual honing wheels are themselves, rotatable with respect to the supporting housing.

It is another object to provide a power means for transmitting rotative power to the honing wheel housing at a first speed and speed changing means by which rotative driving power may be directed to the honing wheels for rotation at a second speed.

It is another object to provide an r.p.m. changer by which the present honing tool may be adapted to existing honing or other machine tools having a driving spindle for achieving rotative power as required for the operation of the present honing tool.

These and other objects will be seen from the following specification and claims in conjunction with the appended drawings in which:

FIG. 1 is a fragmentary partly sectioned and broken away view of the r.p.m. changer for the present honing tool.

FIG. 2 is a longitudinal section of the present honing tool partly broken away for illustration.

FIG. 3 is a fragmentary section taken in the direction of arrows 3—3 of FIG 2.

FIG. 4 is a fragmentary section taken in the direction of arrows 4—4 of FIG. 2.

FIG. 5 is a fragmentary sectional view taken in a direction of arrows 5—5 of FIG. 4.

FIG. 6 is a longitudinal section illustrating the mounting of the honing wheel.

With respect to the present honing tool such as shown in FIG. 2, the power drive, therefore, may be provided by a machine which incorporates power driving means for rotating the main drive shaft of the honing tool at a first speed and with additional power means for rotating the power driven hone drive shaft at a different or preferably increased speed.

As illustrative of possible speeds which might be employed, but without limitation, the main drive shaft may be rotated in operation at a speed in the area between 300 and 400 r.p.m. whereas, the spindle drive shaft may be rotated at speeds in the area generally between 1,000 and 2,000 r.p.m., for illustration. For better results, under some conditions, it may be advisable to run the honing wheels backward constantly.

Such power drive to main drive shaft and the hone drive shaft may be available in a machine designed for that purpose or alternately, the present honing tool can be adapted to existing machines by employing an r.p.m. changing device such as illustrated with respect to FIG. 1.

In view of the fact that there are many honing machines already on the market, these can be adapted to drivingly engage the present honing tool merely by the use of an r.p.m. changing device such as shown for illustration in FIG. 1. Thus, the spindle of the conventional honing machine will drive the r.p.m. changer for two driving speeds. One speed will be for the main drive shaft which will be the same r.p.m. as the spindle on the conventional honing machine, and at a second speed for the hone drive shaft, which exact r.p.m. within the ranges above indicated will be determined by the gear relationship in the gear housing of the r.p.m. changer hereafter

described. Thus, the main drive shaft will be rotated at a first speed as transmitted by the spindle of the honing machine directly to the r.p.m. changer housing whereas the gearing within the r.p.m. changer will be such as to drive the power driven hone drive shaft at normally in increased speed.

As shown in detail in FIG. 1, the conventional honing machine includes a housing fragmentarily shown in dotted lines at **23** and which includes a conventional spindle **12** fragmentarily shown having a bore **13** into which projects the hub **14** of the r.p.m. changer generally indicated at **11**.

Said r.p.m. changer includes a gear housing **16** having disc **17** terminating in an axial hub **14** including radially extending pins **15** which project into and interlock within bore **13** of the spindle **12**.

Said gear housing includes a second disc **18** in axial alignment with disc **17** and interconnected by a series of parallel pins **19**, there being a suitable gear chamber within the gear housing between the discs **17** and **18**.

A series of circularly spaced pinion gears **20** are journaled upon the respective pins **19** within said gear housing with portions of said gears projecting radially outward of the housing at all times in mesh with the stationary ring gear **21** which surrounds said housing and is anchored to support **22** mounted upon the honing tool or other support housing **23**.

Thus, the pinions **20** are circularly arranged and spaced within and around gear housing **16** and are adapted to rotate on axes parallel to the gear housing axis.

Driven gear **24** is rotatively nested and axially mounted within the gear housing and is in mesh with the respective pinions **19**.

The hone drive shaft **26** projects axially into said gear housing and is slidably keyed or splined as at **25** to the driven gear **24**. This hone drive shaft corresponds to the hone drive shaft **26** shown in FIG. 2.

The main drive shaft **27** for the honing tool of FIG. 2 is furthermore shown in FIG. 1 as including a hub **28** of reduced dimensions splined or otherwise secured at **29** within disc **18** axially thereof for rotation therewith.

The r.p.m. changer shown in FIG. 1 thus shows one structure by which the power driving source which includes a spindle such as the spindle **12** transmits rotative power to the main drive shaft **27** for the honing tool of FIG. 2 and a secondary different speed of rotation to the hone drive shaft **26** shown in FIGS. 1 and 2.

HONING TOOL

The present improved honing tool illustrated in FIGS. 2 through 6 as at **30**, FIG. 2 includes the longitudinally spaced bearings **31** which are interposed between main drive shaft **27** and the hone drive shaft **26** which is axially journaled therethrough. The bearings may be brass, ball or roller bearings.

The main drive shaft **27** includes the drive pins **15'** by which driving engagement is established with a suitable drive source such as the gear housing or the spindle **12** from a honing machine or other machine tool for achieving a rotatable power drive to the main drive shaft **27** at a predetermined speed.

The hone drive shaft **26** which is journaled through said main drive shaft is adapted for connection to a secondary power drive such as the r.p.m. changer shown in FIG. 1. It is contemplated that some other power drive can be employed for the hone drive shaft **26** which is adapted for driving said shaft at a speed different and normally in access of the speed of the main drive shaft as set forth above.

The honing tool includes a chambered housing as designated generally at **30** defined by gear housing **32** having a chamber or bore **33** and which has an axial hub splined or otherwise secured as at **34** axially to the main drive shaft **27**.

Said gear housing includes cover plate **35**.

The chambered housing of the honing tool also includes spaced from the gear housing **32**, the axially arranged bottom plate **36**. Bottom plate **36** is interconnected with the gear housing by a series of parallel spaced honing wheel holder pivot pins **39** anchored within corresponding recessed bores **37** and secured by Allen screws **38**, FIG. 2. The said pins are arranged in a circle parallel to the housing axis and outwardly thereof.

A plurality of circularly spaced honing wheel holders **40** are nested within the chambered housing **30** and are pivotally mounted off center within and around the said housing on axes parallel to and outward of the housing axis and which include the mounting pins **39**.

As best shown in FIGS. 4 and 5, the individual honing wheel holders **40** include the elongated outwarding diverging side plates **41**, FIG. 5, end plates **42** and the arcuate bottom plate **43**.

The respective honing wheel holders **40** are pivotally mounted upon their respective pins **39** which extend through end plates **42** so that a means is provided by which the respective honing wheel holders are adapted for radial inward and outward adjustments with respect to the main honing tool chambered housing **30**.

For this purpose, projecting radially inward from each of the bottom walls of the respective holders are a pair of longitudinally spaced adjusting cam pins **44**. These pins project through corresponding radial apertures or bores **45** formed through and around cylindrical sleeve **46** as best shown in FIG. 2.

Sleeve **46** is axially joined to the gear housing plate **35** within the counter bore **47** or recess and at its other end, is snugly projected within the tapered flange **48** formed axially within the bottom plate **36** forming a part of the honing tool housing.

A pair of axially aligned expansion cones **49** are slidably nested within the bore of the sleeve **46** and secured axially to one end of the hone drive shaft **26** by the transverse pin **50**.

The respective expansion cones **49** are in operative engagement with the corresponding radial adjustment pins **44** whereby longitudinal adjustment of the hone drive shaft in a conventional manner as desigated by the arrow **51** is adapted to effect radial in and outward adjustments of the respective honing wheel holders **40** pivotally with respect to their mounting pins **39**. As shown, fragmentarily in FIG. 4, suitable leaf springs **67** are provided for normally biasing the respective holders **40** and the corresponding pins **44** into operative engagement with expansion cones **49**.

Within each of the honing wheel holders, **40**, there is provided a cylindrical honing stone **52** of conventional honing material such as various carbides including silicon carbide, for illustration, which honing wheels are journaled within the respective honing wheel holders for power driven rotation therein. As shown best in FIGS. 2 and 4, the said cylindrical honing wheels are power driven and journaled within the respective honing wheel holders upon axes parallel to the axis of the hone drive shaft and project radially outward of the housing **30** adapted for operative engagement with the bore to be honed.

The specific mounting of the cylindrical honing wheel or stone **52** is illustrated in FIGS. 5 and 6. Each of the honing wheel holders includes a central elongated chamber **53** with the respective end walls **42** of the said holder mounting bearings **54** for the bolt or shaft **65**, FIG. 6 journaled within the said bearings and providing a rotative power drive for the honing wheel **52**.

The composite shaft **65** in the nature of an Allen bolt, FIG. 6 is journaled, therefore, within and upon the honing wheel holder **40** and projects into the chamber or bore **33** of the gear housing and has secured thereon and within said housing the pinion gear **55**.

Pinion **55** is in mesh with the idler pinion **56**, one such pinion being mounted upon each of the pins **39** within the gear housing.

Drive gear **57**, FIG. 2, is also mounted within said gear housing; is slidably keyed as at **58** upon the hone drive shaft **26** and is in mesh simultaneously with all of the pinions **56** such as shown in FIGS. 2 and 3.

Since the honing wheel holders **40** are capable of pivotal adjustment upon the housing by virtue of their off center mounting with respect to the pins **39**, FIG. 2, it follows that the power driven shafts **65** for the individual honing wheels in projecting into the gear housing are, therefore, adapted for arcuate adjustments with respect to the cover plate **35** of the gear housing. For this purpose and as shown in FIG. 3, said cover plate is provided with a series of arcuate slots **59** or clearance slots adapted to receive portions of the honing wheel drive shaft **65** with the pinion **55** at all times remaining in mesh with the corresponding idler pinion **56**.

The specific construction showing the assembly and mounting of the cylindrical honing wheel **52** is illustrated in detail in FIG. 6.

The abrasive cylindrically shaped honing wheel **52** has secured therein as by cement **61** an elongated sleeve **60** thus fixedly secured thereto and said sleeve at its outer ends being tapered at **62** and **63** to provide tapered seats for the assembly upon and securing to drive shaft **65** which is made in two parts.

The drive shaft for the respective honing wheel is in the nature of an Allen bolt **65** having a head with a taper corresponding to taper **62**, FIG. 6, and a shank which extends through the bore **64** of sleeve **60**. The Allen bolt **65** includes a threaded end portion **66** which extends into a corresponding threaded portion of the shank **68** which projects axially from the drive gear **55**. The shank **68** is journaled within a suitable bushing within the corresponding end plate of the wheel holder.

The shank **68** also has a tapered end portion corresponding to taper **63**, FIG. 6, so that upon tightening of the Allen bolt **65** with respect to sleeve **68**; the said Allen bolt assembly tightly and snugly engages sleeve **60** secured within the honing wheel **52** to complete the assembly.

Sleeve **68** forming a part of the drive shaft for the honing wheel terminates in the pinion **55** which is nested within the bore of the gear housing and is in mesh with the idler pinion **56** for function and operation in the manner above described.

Thus, while the individual wheel housings **40** are thus capable of pivotal movement about the respective pins **39**, the respective drive shafts for the honing wheels are at all times in power drive engagement with the driven pinions **56**, FIG. 3, regardless of the amount of radial adjustment of the respective wheel housings with respect to the hone housing **30**.

Having described my invention, reference should now be had to the following claims.

I claim:

1. A honing tool comprising a chambered housing;
a main drive shaft axially connected thereto to rotate said housing;
a plurality of circularly spaced honing wheel holders pivotally mounted off center within and around said housing upon axes parallel to and outward of the housing axis;
cylindrically shaped honing wheels rotatively journaled within said wheel holders;
with portions of their surfaces projecting radially outward of said housing and adapted for simultaneous radial adjustments relative to said housing upon pivotal adjustment of said holders;
a power driven hone drive shaft rotatable at a different speed than said main drive shaft axially journaled through said main drive shaft and projecting into said housing;
and gear means on said hone drive shaft connected respectively to each of said honing wheels.

2. In the honing tool of claim **1**, said housing including a gear housing at one end, and at its opposite end, a bottom plate;
said wheel holders interposed between said gear housing and bottom plate.

3. In the honing tool of claim **2**, the pivot mounting of said wheel holders including a plurality of parallel spaced pins extending respectively through said gear housing to and secured to said bottom plate.

4. In the honing tool of claim **3**, the mounting of each honing wheel including a shaft parallel to and spaced from each pin and journaled upon a wheel holder and extending into said gear housing;
said gear means including a pinion gear secured on each shaft and nested in the gear housing, a drive gear in said gear housing secured to said hone drive shaft;
and idler gears in said gear housing, one idler gear journaled on each pin, said idler gears intermeshed respectively with said drive gear and one of said pinion gears.

5. In the honing tool of claim **4**, said gear housing having one wall with a series of arcuate slots receiving said shafts respectively, providing for arcuate adjustment of each of said shafts relative to said gear housing, with the respective pinion remaining in mesh with an adjacent idler gear.

6. In the honing tool of claim **2**, each wheel holder including a transversely arcuate bottom plate;
an axial sleeve interposed between the gear housing and bottom plate and including therethrough sets of radial slots corresponding to and adjacent said wheel holder bottom plates;
cam pins extending radially inward from said bottom plates through said slots and into said sleeve;
and expansion cone means guidably mounted within said sleeve, engaging said pins respectively and secured to said hone drive shaft;
longitudinal adjustment thereof causing radial and pivotal adjustment of said wheel holders.

7. In the honing tool of claim **6**, and means normally biasing said wheel holders inwardly against said expansion cone means.

8. In the honing tool of claim **1**, each honing wheel holder including apertured end plates;
the journal mounting of each honing wheel including a sleeve axially extending through and secured to a honing wheel;
a nut journaled in an end plate and extending into said gear housing including a pinion gear within said gear housing forming a part of said gear means;
a bolt at one end journaled in an end plate extending snugly through said honing wheel sleeve and axially secured to said nut;
said bolt and nut retainly gripping said honing wheel sleeve therebetween.

9. In the honing tool of claim **1**, a power means including a housing and a drive spindle connected to said main drive shaft;
and an r.p.m. changer including driven means connected to said hone drive shaft.

10. In the honing tool of claim **9**, said r.p.m. changer including a rotatable gear housing connected to said drive spindle and to said main drive shaft;
said hone drive shaft projected into said gear housing;
a driven gear in said gear housing slidably keyed to said hone drive shaft;
a series of circularly spaced pinions journaled within said gear housing respectively in mesh with said driven gear;
said pinions projecting radially outward of said gear housing;
and a stationary ring gear mounted on said power means housing;
extending around said gear housing and in mesh with said pinions respectively.

11. In a honing tool including a main drive shaft adapted to rotatably drive a hone housing at a first speed, and a hone drive shaft connected to a series of honing wheels for rotating the same with respect to said housing at a second speed;

an r.p.m. changer comprising a rotatable gear housing axially connected to a power drive source and to said main drive shaft;

said hone drive shaft projected into said gear housing;

a driven gear in said gear housing slidably keyed to said hone drive shaft;

a series of circularly spaced pinions journaled within said gear housing respectively in mesh with said driven gear;

said pinions projecting radially outward of the said gear housing;

and a stationary ring gear mounted on a stationary support, extending around said gear housing and in mesh with said pinions respectively.

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