Dec. 14, 1937. T. F. QUIGLEY 2,102,093

HONING AND LAPPING MACHINE

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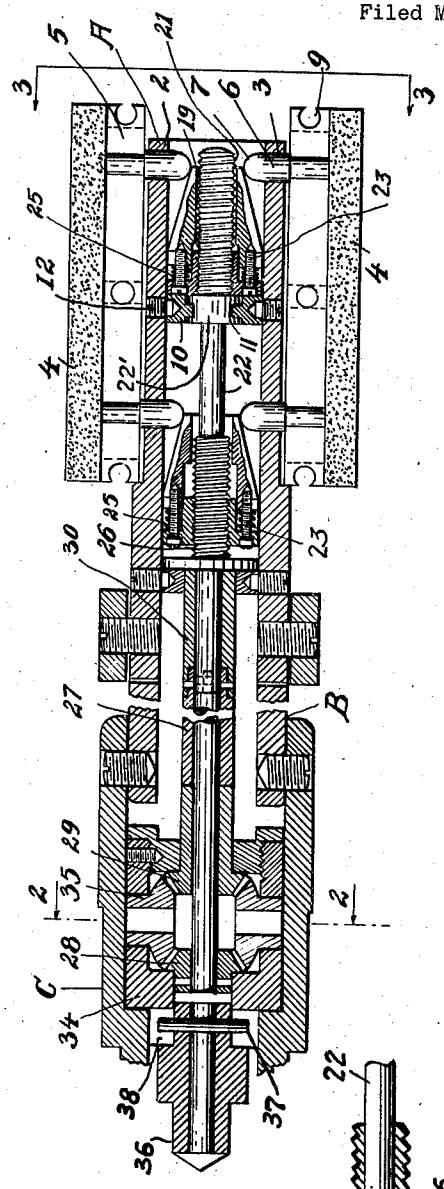


Fig. 1.

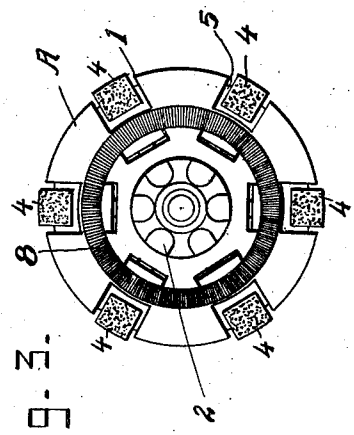


Fig. 3.

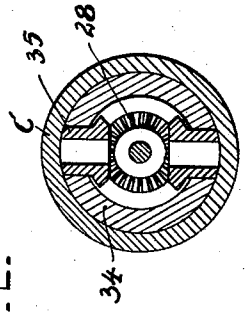


Fig. 2.

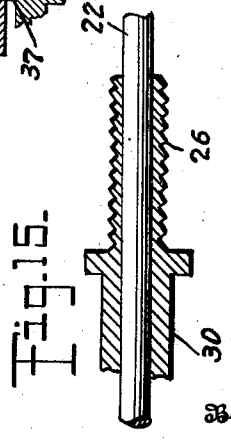


Fig. 15.

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Fig. 4.

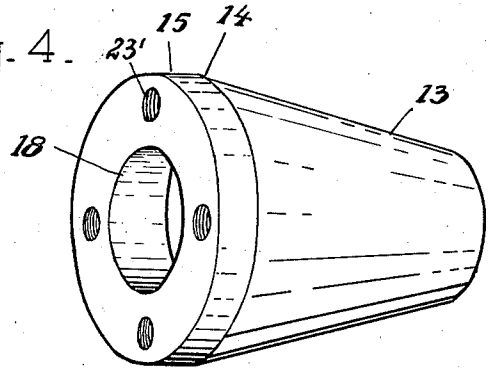


Fig. 5.

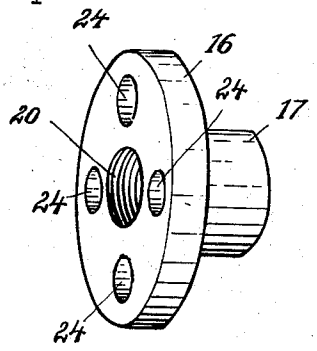


Fig. 6.

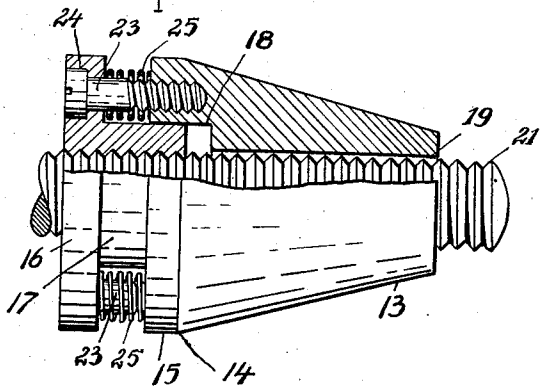
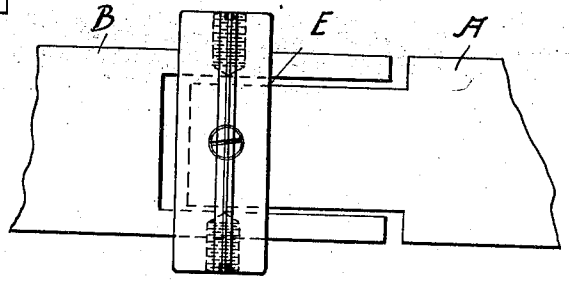


Fig. 7.



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Fig. 13.

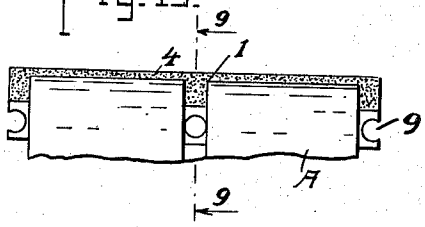


Fig. 9.

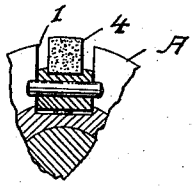


Fig. 10.

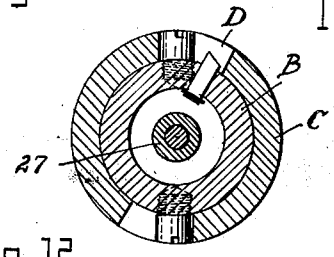


Fig. 11.

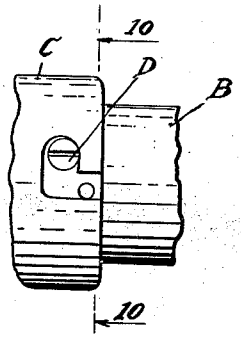
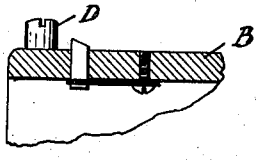


Fig. 12.



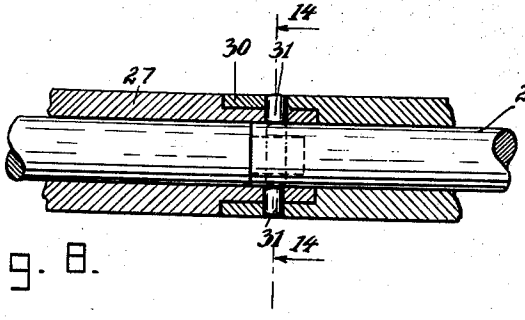


Fig. 8.

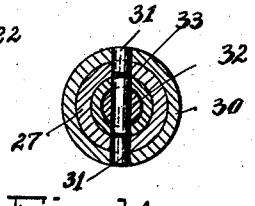


Fig. 14.

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UNITED STATES PATENT OFFICE

2,102,093

HONING AND LAPPING MACHINE

Thomas F. Quigley, Cleveland, Ohio, assignor to Micromatic Hone Corporation, a corporation of Michigan

Application May 18, 1928, Serial No. 278,883

27 Claims. (Cl. 51—184.3)

This invention is directed to the finishing of cylindrical openings wherein smooth, accurately dimensioned surfaces are requisite in view of the fitting into such bodies of members adapted to operate therein by reciprocatory or oscillating motion, an example of such being engine cylinders in which pistons operate. Instrumentalities for the purposes noted are conventionally designated lapping heads or hones and their modus operandi should be such as to effect the grinding and polishing of the surface operated upon with a high degree of accuracy. The improvements provided by this invention are primarily intended to be employed in conjunction with those types of hones or lapping devices for cylinder grinding objectives wherein there is employed a head carrying abrading devices arranged exteriorly thereof. The head shown herein is of hollow construction and has therein instrumentalities for controlling the adjustment of the abrading devices with the required nicety requisite for the grinding and finishing operations of the body with which the tool is to be used.

For the most effective and accurate operation of grinding devices of this character, it is essential that the abrading members be capable of such adjustment as to be expanded outwardly at their upper ends for proper alignment with the walls of whatever body is being finished. In fact the conditions particularly surrounding engine cylinder grinding dictate that at the commencement of the grinding operation on each cylinder, the abrading members be aligned with the walls thereof.

Conditions arise as a result of continued service of one of these tools wherein the abrading members become worn more at one end than at the other, and it is an object of this invention to provide instrumentalities associated with the abrading members for maintaining the alignment of the surfaces thereof with the cylinder walls regardless of unequal wear at the ends of a set of the said abrading members.

A highly important objective of the invention is to provide instrumentalities within the head, as above noted, for expanding the abrading members and which act at opposite ends of the abrading members independently of each other. More particularly, these instrumentalities include mechanisms each of which is adapted to control expanding movement at one end of the abrading devices.

A particularly noteworthy feature included in this invention is the provision of means for operating the expanding devices. While substantially only one major actuating system or means for causing this action need be provided, said means being common to both expanding mechanisms, the disclosed means permits of the independent operation of either one, or the simultaneous operation of both of said mechanisms in compensation for wear. For example, I herein show a differential gear arrangement and operative connections between said gear and the operating mechanisms. A novel method of supplying power for operating the differential gear construction is also provided, but this is a separate invention forming the subject matter of a separate application for Letters Patent and is not an essential part of this invention inasmuch as any suitable driving means for the gears may be provided.

A specific detailed feature of novelty resides in the provision of flexible joints in the operative connections between the gearing and expanding mechanisms. A somewhat similar flexible connection is also included in the mounting of the head on the main driving or carrier member. These flexible connections are necessary inasmuch as they accommodate a certain amount of whip or play or misalignment between the actual honing device and the supporting or operating means used therewith.

In the actual operation of the now known types of honing or lapping tools of this character, it may be necessary to manually adjust or expand the abrading devices one or more times during their operation on a given piece of work. This is due to the fact that the cylinder bore is to be ground to certain dimensions. Obviously, the tool cannot originally be expanded to the dimensions which the cylinder bore is to have upon its completion. In view of the above noted condition I propose by this invention to provide a hone which includes instrumentalities for automatically expanding the abrading members to the finished dimension of the work on which it is operating and in which the automatic adjustment is gradual and uniform and takes place during the entire operation of the tool.

A practical embodiment in carrying out this idea includes separate resilient or spring means, or their equivalent, against which respective expanding devices are initially forced by means capable of expanding the abrading members to the desired final shape and size of the bore in which they operate, and in which said resilient means are effective as the walls are ground, to further expand the abrading members to the desired finished dimensions of the bore.

To prevent the tool from grinding the bore of the cylinder to an oversize, means for limiting the action of the spring means described in the previous paragraph are provided. By this arrangement the tool may be initially set so that it will gradually grind the bore to the desired dimension without entailing any manual adjustment thereof.

Various other more detailed objects and advantages arising from the application of my inventive idea to commercial working conditions will in part become apparent and in part be hereinafter stated as the description of the invention proceeds.

For a full and more complete understanding of the invention, reference may be had to the following description and accompanying drawings in which,

Fig. 1 is a longitudinal section through a tool made in accordance with my invention.

Fig. 2 is a detailed showing in transverse section bringing out features of the differential gear arrangement.

Fig. 3 is a view in end elevation of the tool showing clearly the arrangement of the spring means for retaining the abrading devices in the head.

Fig. 4 is a detailed view in perspective of one of the expanding cones.

Fig. 5 is a perspective view showing one of the flange bushings on which a cone is mounted.

Fig. 6 is a view partly in elevation and partly in section bringing out the details of the assemblage of a cone on one of the bushings.

Fig. 7 is a fragmentary illustration in elevation of a flexible connection between the head and shank carrying the same.

Fig. 8 is a fragmentary and diagrammatic showing in section of the flexible connection in the driving connectors between the differential gear arrangement and the expanding devices.

Fig. 9 is a fragmentary view in section through the head, taken about on the line 9—9 of Figure 13.

Fig. 10 is a transverse section through the shank and housing bringing out the construction of the bayonet joint between these parts.

Fig. 11 is a fragmentary view of the bayonet joint.

Fig. 12 is a fragmentary view, partly in elevation and partly in section, of the locking means included in the joint between the housing and the shank.

Fig. 13 is a fragmentary view, partly in section, bringing out the manner in which the abrading members are mounted on the head.

Fig. 14 is a transverse section through the operative connections between the differential gearing and expanding members taken about on the line 14—14 of Figure 8.

Figure 15 is a longitudinal sectional view showing the relation between the two driving shafts.

While a preferred specific embodiment of the invention is herein set forth, it is understood that I am not to be limited to the exact constructions illustrated and described because various modifications of these details may be provided in putting the invention into practice within the purview of the appended claims.

Throughout the various figures of the drawings and the specification, corresponding parts are denoted by like reference characters.

A tool made in accordance with this invention comprises generally a head A which carries the abrading members and expanding instrumentalities therefor, a hollow shank B on which the head A is mounted, and a housing C operatively connected with the shank B and including a differential gear arrangement for driving the expanding instrumentalities in the head A.

The head A is cut away to provide longitudinal grooves 1 which communicate with bore 2 of the head through the medium of openings 3. Abrading members comprising stones 4 and carriers 5 have pins 6 passing through the openings 3, and these abrading members are located in the grooves 1 and are adapted for relative movement with respect to the head. The ends of the pins 6 are rounded off as shown at 7 whereby they are adapted for engagement with expanding members in a manner to be hereinafter described. A ring-like coiled spring 8 is fitted in undercut notches 9 in the carriers 5 and functions to retain the abrading members assembled with the head, there being a spring 8 at each end of the abrading members.

A ring-like abutment member 10, having an internal flange 11, is held in position in the bore 2 in any suitable manner such as by screw pins 12. This member 10 is designed to function as a means for limiting movement of the expanding devices as will later become apparent.

Two independently operable expanding mechanisms are employed, each being adapted to cause a control movement of one end of the abrading members. These mechanisms may be substantially identical in construction with the exception that the driving shaft for one of the mechanisms is of hollow construction to permit the passage therethrough of the drive shaft of the other.

Referring now to Figures 4, 5, and 6, the rounded ends 7 of the pins 6 are in operative engagement with a conical surface 13 of an expanding member 14, which member has a cylindrical surface 15 in engagement with the cylinder wall of the bore 2. A bushing 16 has a cylindrical flange 17 extending axially with respect to the head and this flange enters into an enlarged portion 18 of a bore 19 extending through the expanding member 14. The bushing 16 has a threaded bore 20 extending through the entire bushing. Screwed in the bore 20 is the threaded end 21 of a drive shaft 22. It is obvious that rotation of the shaft 22 may through the medium of the threaded connection between its end 21 and bushing 16, cause relative longitudinal movement of the last named part, the shaft 22 being incapable of longitudinal movement by reason of the swivel connection between its collar 22' and the member 10.

In establishing a longitudinally yieldable operative connection between the expanding member 14 and bushing 16, I may employ means including an appropriate number of screws 23, which have their ends threaded into screw openings 23' in the member 14. In the present instance I have shown four of these screws, although any desired number may well be utilized. The bushing 16 is provided with smooth countersunk openings shown at 24 through which the screws 23 pass, their heads fitting in the countersinks. Relative movement between the bushing 16 and screws 23 is provided, which movement is limited in one direction by the heads and in the other direction by the expanding member 14. Interposed between the bushing 16 and expander 14 are fairly powerful coiled springs 25. These springs are preferably arranged with

the screws 23 running therethrough, thereby maintaining them in proper position. The springs 25 constantly exert a force tending to separate the members 16 and 14.

The expanding member just described in the preceding paragraphs is the one located adjacent the free end in the head. The other expanding mechanism is shown as of identically the same construction except that the bore 20 of the bushing 16 is of slightly larger dimensions to accommodate a larger threaded end 26 of a hollow drive shaft 27. The drive shaft 22 extends through the shaft 27 and carries at its free end a bevel-gear 28, while the shaft 27 terminates in a bevel-gear 29. These gears 28 and 29 constitute part of a differential gear arrangement to be later set forth.

The shank B and housing C are operatively connected in a detachable manner by the bayonet joint construction shown in detail in Figures 10, 11, and 12, this joint being referred to generally by the reference character D. The construction and operation of this bayonet joint is practically self-evident and is described in detail in my copending application, Serial Number 256,244, filed February 23rd, 1928. When the parts B and C are connected, rotation of the housing C causes rotation of the shank B to rotate the head A for operation of the tool.

A flexible connection between the head A and shank B is provided, such a connection being brought out in Figures 1 and 7, designated generally by the reference character E. This connection is fully described in my above identified copending application. Located at substantially the same place in the actual arrangement of the tool as the flexible joint E, are flexible driving joints in the driving shafts 22 and 27. Referring now to Figures 8 and 14, the drive shaft 27 has an interlocking male and female joint shown at 30, and extending through the overlapping portions of this connection are pins 31. There is a relatively loose relation between the parts of the drive shaft 27 at the joint 30, to allow for a certain amount of play. It is this feature which lends the property of flexibility to the connection.

Likewise the drive shaft 22 is provided with a male and female joint shown at 32 and extending through the overlapping portions of the shaft 22, at which is a pin 33. By arranging these parts so there is a certain amount of looseness the desired feature of flexibility is afforded.

Within the housing C is a differential gear housing member 34 which is adapted to be rotated in any preferred manner. The member 34 is driven from the driving spindle 36 in any suitable way, as by a pin and slot connection, the pin 37 in this case projecting from the spindle and into a slot 38 in the member 34. At diametrically opposite points of the gear housing 34 and extending interiorly thereof, are bevel-gears 35, each of which is in engagement with the bevel-gears 28 and 29 carried by the shafts 22 and 27. It is apparent that upon rotation of the gear housing 34, the expanding mechanism meeting the greater resistance, will cause its associate gear to remain stationary, which results in a driving by the differential gear of the expanding member meeting the lesser resistance. If neither one should encounter any resistance, that is, if the resistance of both should be equal, both expanding members will be moved at the same time.

The operation of the tool herein described is substantially as follows:

The head A carrying the abrading members is inserted in a bore which is to be finished. The abrading members have been collapsed to permit of the insertion of the tool into the bore. The gear housing 34 is now rotated to cause expanding action of the expanding mechanisms located within the head A. The exact mode of operation of these expanding members in aligning the abrading members with the wall of the cylinder is varied, that is, one member in one case might meet resistance whereupon the other member would be initially operated to move the ends of the abrading members adjacent thereto into engagement with the walls of the cylinder. It is obvious that this method of moving outwardly the respective ends of the sets of abrading members, by independent expanding means such as the respective longitudinally movable cones 14, insures the alignment of these devices with the walls of the cylinder bore, or its equivalent, by reason of the differential movement given said cones by the concentric shafts 30 and 22, regardless of any inequality in the rates of wear at the respective ends of the abrading members during use; and this action will have entailed a like compression and an equal or unequal release of the springs 25,—whose separateness and mode of interposition assures a resilient application of outward pressure up to a predetermined limit.

As the shank B, housing C, and head A, are rotated and reciprocated in the finishing operations, the walls of the cylinder bore are ground smooth and the abrading members are forced outwardly under the action of the springs 25. This automatic expansion of the abrading members is limited by the headed screws 23 to inhibit the grinding of the bore to an oversize. When the tool is to be removed from the bore, the differential gear housing C may be rotated to cause retraction of the expanding cones 14, whereupon the abrading members will be collapsed under the action of the ring springs 8.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States, is:

1. In a honing tool of the class described, the combination with a head and abrading devices carried thereby, of instrumentalities for expanding the abrading devices, said instrumentalities including expanding members which affect the abrading devices at opposite ends thereof, driving means for causing operation of the expanding instrumentalities, and driving metallic connecting elements between the driving means and the expanding members permitting of the independent operation of each of the expanding members.

2. In a grinding tool of the class described, the combination with a head adapted to be inserted in a bore, the cylinder walls of which are to be finished, and abrading devices carried by the head, of instrumentalities for causing expanding action of the abrading devices, said instrumentalities comprising cones arranged within the head to affect the abrading devices at opposite ends thereof, and differentially associated gearing for causing longitudinal movement of the cones in the head, and which movement of each cone is independent with respect to movement of the other cone.

3. In a grinding tool of the class described, the combination with a hollow head adapted to be inserted in an opening, the cylindrical wall of which is to be finished, and abrading devices car-

ried by the head and including pins projecting into the hollow portion of the head, said pins being located at opposite ends of the abrading devices, of conical expanding members arranged for longitudinal movement in the hollow head, and having conical surfaces in engagement with the pins aforesaid, and differential gear mechanism for causing independent operation of the conical members for imparting expanding action to the abrading devices.

4. In a grinding tool of the class described, the combination with abrading devices whose ends are outwardly movable, and separately movable instrumentalities for expanding the respective ends of said abrading devices, of means for rotatively operating the tool, driving means for varying the expanding pressure applied through said instrumentalities, during the operation of the tool, and a plurality of resilient means for causing further expanding operation of said instrumentalities,—said resilient means being independently responsive to said driving means to a predetermined limit, even after discontinuance of the operation of said driving means and as pressure upon the abrading members becomes released.

5. A grinding tool of the class described, comprising, in combination, abrading devices, conical expanding members arranged to affect the abrading devices in expanding action at opposite ends thereof, driving means for causing independent operation of the expanding members, said expanding members including means for causing expanding operation of the same independent of the driving means.

6. A grinding tool of the class described, comprising, in combination, an abrading device having pins at opposite ends thereof, expanding instrumentalities having conical members in engagement with the pins and which conical members are arranged so that longitudinal movement thereof in one direction imparts expanding action to the pins, differential gear mechanism for causing differential operation of the expanding instrumentalities for imparting longitudinal movement to the conical members, and means between the differential gear mechanism and said conical members to impart expanding movement to the abrading devices as pressure thereon becomes released due to grinding action of the tool.

7. An expanding device for the purpose specified, comprising, in combination, a bushing, a conical member carried by the bushing, and resilient means interposed between the conical member and bushing for causing relative expanding action therebetween.

8. An expanding device for the purpose specified, comprising, in combination, a bushing having a flange thereon, a hollow conical expanding member mounted on the bushing, means interposed between the expanding member and the flange for causing relative separative movement between the bushing and the conical member, and means for limiting the action of said separating means.

9. An expanding device for the purpose specified, comprising, in combination, a flanged bushing, an expanding member carried by the bushing, screw members connecting the flanged portion of the bushing with the expanding member, and springs interposed between the expanding member and the flange for causing relative separative movement between the bushing and the expanding member, said screws constituting means for limiting expanding action of the springs.

10. A grinding device of the class described, comprising, in combination, a head having a bore, an abrading device carried by the head having pins located at opposite ends of the abrading device projecting into the bore of the head, expanding instrumentalities in the bore of the head having conical surfaces in engagement with the pins and adapted for longitudinal movement in the head to cause expanding action of the abrading device, driving means for imparting independent operation to the expanding instrumentalities for aligning the abrading device with the work to be finished, and means to cause subsequent expanding action of the abrading members to move the expanding device outwardly as pressure thereon becomes released due to the grinding operation of the tool.

11. A grinding tool of the class described, comprising, in combination, a head, abrading devices carried by the head, instrumentalities for expanding the abrading devices, and operative to expand the abrading devices at opposite ends thereof, said instrumentalities being movable longitudinally in the head in one direction to cause expanding action, screw means associated with the instrumentalities for causing longitudinal movement thereof, and differential gear mechanism for causing independent operation of the screw means associated with the expanding instrumentalities, and means included in the instrumentalities for causing longitudinal movement of a portion thereof to impart further expanding action to the abrading members independent and subsequent to the expanding action caused by operation of the differential gear mechanism.

12. A grinding tool of the class described, comprising, in combination, abrading devices, expanding cones for imparting expanding action to the abrading devices and affecting the latter at opposite ends thereof, drive shafts for the expanding cones rotated one within the other, and a differential gear mechanism operative through the drive shafts causing independent operation of the expanding cones.

13. A grinding tool of the class described, comprising, in combination, a hollow shank, a hollow head carried by the shank, a flexible connection between the head and shank, abrading devices carried by the head, expanding instrumentalities in the head and movable therein to expand the abrading devices at opposite ends thereof, drive shafts arranged one within the other for causing operative movement of the expanding instrumentalities, a flexible joint for the drive shafts and arranged at substantially the same place as the flexible connection between the shank and head, and a differential gear mechanism for causing independent operation of the expanding instrumentalities.

14. In a grinding tool of the class described, the combination with a carrier member and abrading devices thereon, of instrumentalities for expanding the abrading devices at opposite ends thereof, threaded drive shafts associated with the expanding instrumentalities for causing longitudinal operative movement thereof, differential gear mechanism for imparting driving actions to the drive shafts, and which driving actions of the drive shafts are independent and spring means included in the expanding instrumentalities for causing operation thereof independent of the driving shafts, to expand the abrading devices as pressure thereon becomes released.

15. A grinding tool of the class described, comprising, in combination, a head having a bore, abrading devices having pins projecting into the bore, and which pins are located at opposite ends of the abrading devices, conical expanding members movable in the bore to expand the abrading devices, means for maintaining the pins in contact with the conical expanding members, means for causing independent longitudinal movement of the conical expanding members in the head, and separate means for causing expanding action of the expanding members as pressure on the abrading devices becomes released.

16. In a grinding tool of the class described, the combination of a carrier member which is adapted to be inserted in a bore, the cylindrical walls of which are to be finished, and abrading devices thereon, of instrumentalities for expanding the abrading members against the walls to be finished, and which instrumentalities include means for aligning the abrading devices with the cylindrical walls, means included in said instrumentalities for further expanding the abrading devices and maintaining them in alignment with the cylindrical walls during the entire grinding action, and means for limiting the expanding action of said last named expanding means.

17. In a tool for the grinding of curved surfaces: abrading devices whose ends are provided with separate means for transmitting expanding movement thereto; independently longitudinally movable means for effecting such expanding movement at said ends respectively; and means, including differential gearing, for imparting differential longitudinal movement to said expanding means respectively.

18. In a tool for the grinding of curved surfaces: abrading devices whose ends are provided with separate means for transmitting expanding movement thereto; independently longitudinally movable means for effecting such expanding movement at said ends respectively; and means, including differential gearing, and concentric shafts, extending therefrom to said expanding means, for imparting differential longitudinal movement to said expanding means respectively.

19. In a tool for the grinding of curved surfaces: abrading devices whose ends are provided with separate means for transmitting expanding movement thereto; independently longitudinally movable means for effecting such expanding movement at said ends respectively; and means, including differential gearing, and concentric shafts, extending therefrom to said expanding means, for imparting differential longitudinal movement to said expanding means respectively,—separate resilient means being interposed between said shafts respectively and said expanding means.

20. In a tool for the grinding of curved surfaces: abrading devices whose ends are provided with separate means for transmitting expanding movement thereto; independently longitudinally movable means for effecting such expanding movement at said ends respectively; and means, including differential gearing, and concentric shafts, extending therefrom to said expanding means, for imparting differential longitudinal movement to said expanding means respectively,—separate resilient means being interposed between said shafts respectively and said expanding means and provided with means limiting expanding action thereof.

21. In a honing tool, a pair of cones, abrading elements radially movable by said cones, a tubular element supporting one cone, a rod extending through the tubular elements and supporting the other cone, said rod and tubular element affecting the longitudinal movement of said cones within the tool, means for adjusting the rod and tube relative to each other, said means including a plurality of gears.

22. In a honing tool, a pair of abrading elements, expanding members movable toward and away from each other, a tubular element supporting one of said members, a rod extending through the tubular element and supporting the other member, and spring means for applying a pressure through said rod and tube for forcing said expanding members to apply an outward yielding force to said abrading elements during a honing operation.

23. In a honing tool, a pair of abrading elements, expanding members movable toward and away from each other, a tubular element supporting one of said members, a rod extending through the tubular element and supporting the other member, said rod and tubular element affecting the longitudinal movement of said members within the tool, and spring means for applying a pressure through said rod and tube for forcing said expanding members to apply an outward yielding force to said abrading elements during a honing operation.

24. In a honing tool, a pair of abrading elements, expanding members movable toward and away from each other, a tubular element supporting one of said members, a rod extending through the tubular element and supporting the other member, and spring means acting on said rod and tube for urging the expanding means to radially load the abrading elements.

25. In a honing tool, a pair of abrading elements, expanding members movable toward and away from each other, a tubular element supporting one of said members, a rod extending through the tubular element and supporting the other member, spring means acting on said rod and tubular elements for urging the expanding means to radially load the abrading elements, and means for adjusting the rod and tubular elements relative to each other.

26. In a honing tool, a pair of abrading elements, expanding members movable toward and away from each other, a tubular element supporting one of said members, a rod extending through the tubular element and supporting the other member, spring means acting on said rod and tubular element for urging the expanding means to radially load the abrading elements, means for adjusting the rod and tubular elements relative to each other, said adjusting means embodying a plurality of gear elements.

27. In a honing tool, a pair of abrading elements, expanding members movable toward and away from each other, a tubular element supporting one of said members, a rod extending through the tubular element and supporting the other member, said rod and tubular element affecting the longitudinal shifting of the members within said tool, spring means acting on said rod and tubular element for urging the expanding means to radially load the abrading elements, means for adjusting the rod and tubular elements relative to each other, said adjusting means embodying a plurality of gear elements.

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