Sept. 23, 1941. J. A. RIOUX 2,256,495

LAPPING TOOL

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Fig. 1.

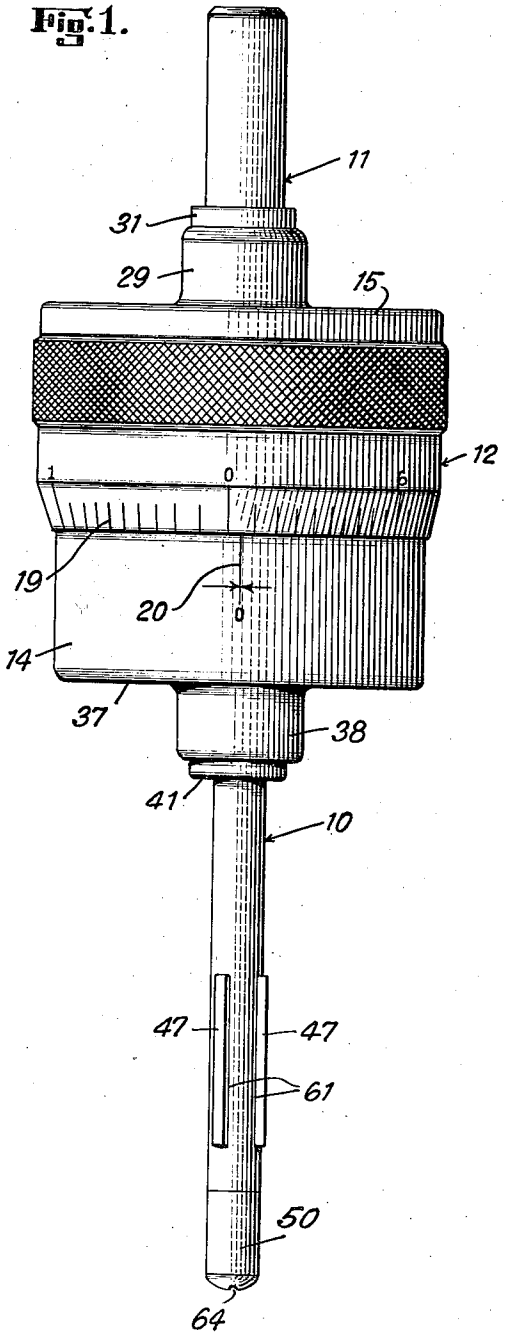

Fig. 2.

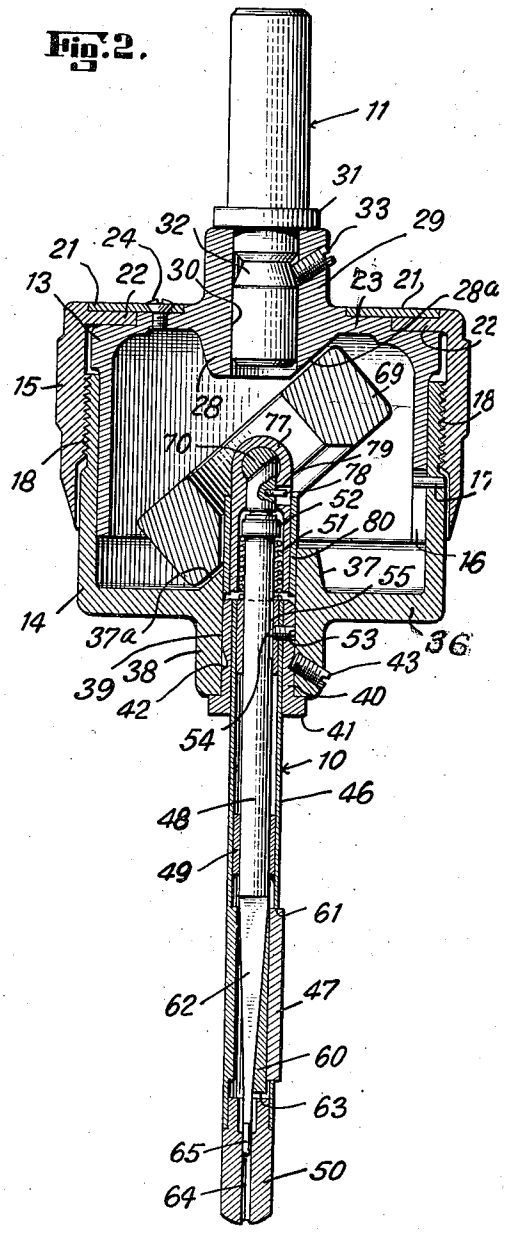

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Fig. 3.

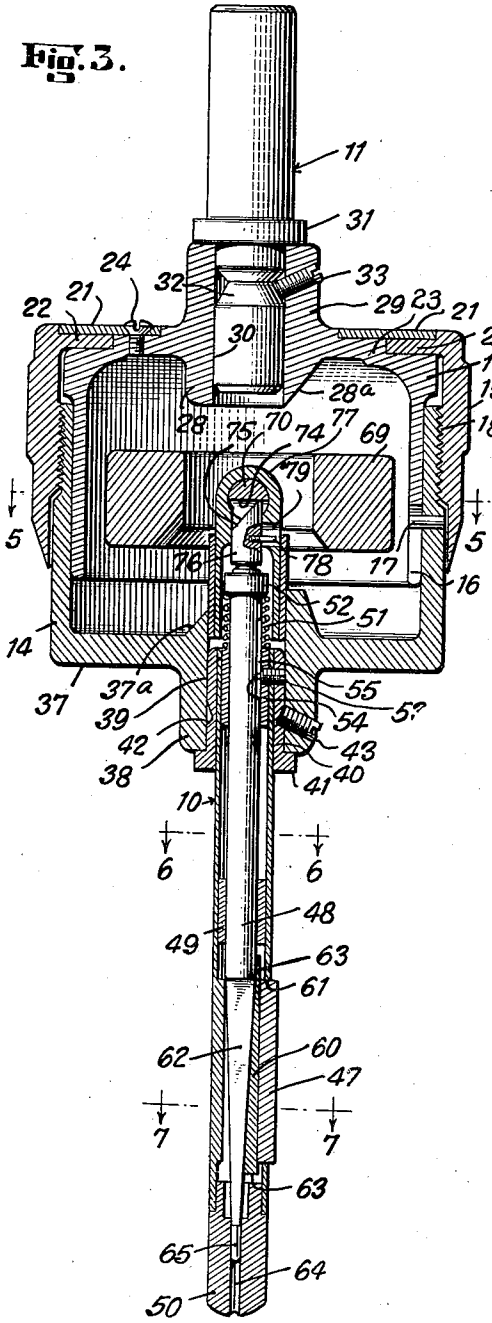

Fig. 4.

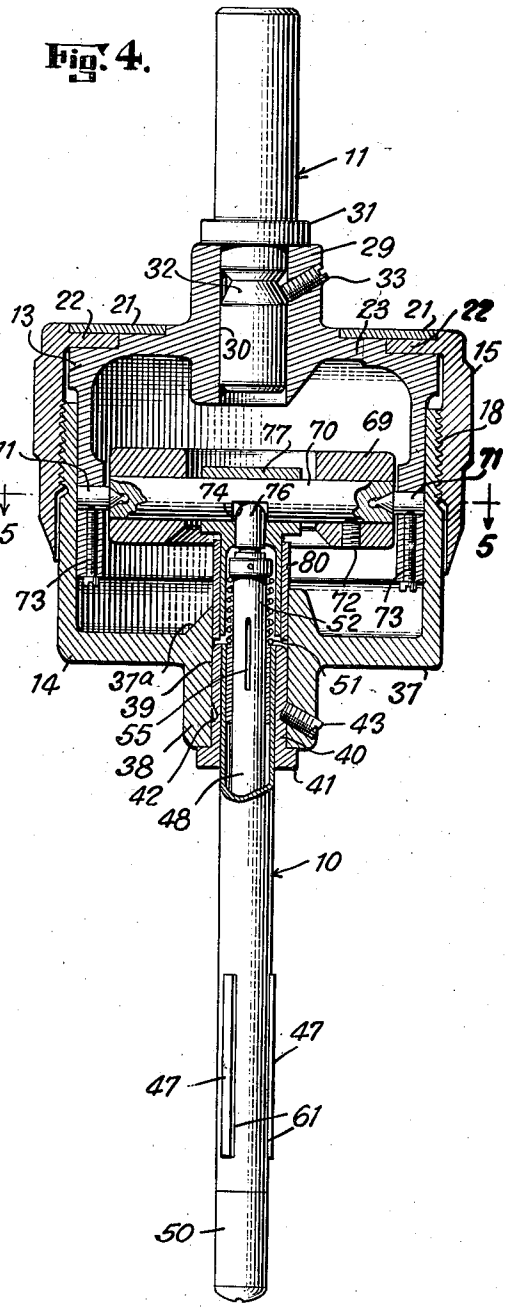

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Fig. 5.

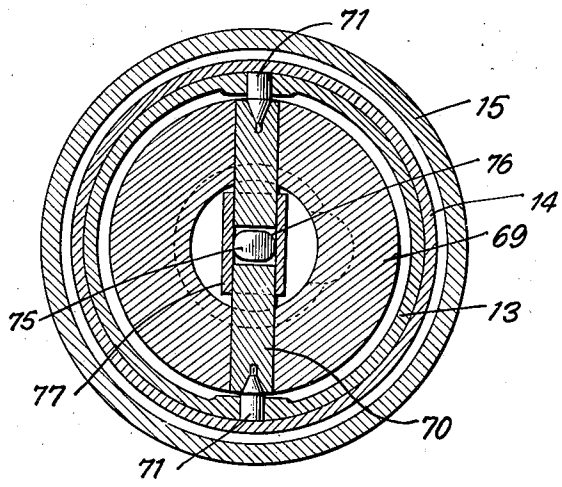


Fig. 6.

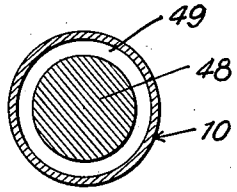
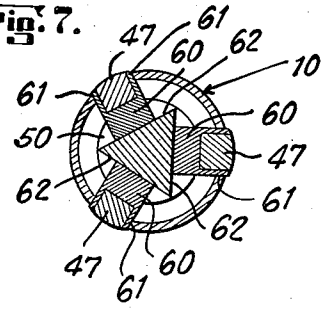


Fig. 7.



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Patented Sept. 23, 1941 2,256,495

UNITED STATES PATENT OFFICE

2,256,495

LAPPING TOOL

John A. Rioux, Jamaica, N. Y.

Application February 18, 1939, Serial No. 257,041

14 Claims. (Cl. 51—184.3)

This invention relates to a lapping tool or abrading apparatus and has for an object the provision of improvements in this art. The invention may advantageously be embodied in a portable tool which is adapted to be secured in drill presses, lathes, boring machines, milling machines, hand drills and the like by adapter chucks designed to fit the various driving machines. One of the purposes or uses for which the invention is designed is that of lapping out the inside surfaces of holes, bores, bearings and the like and to do this in a very accurate and effective manner without marring the surface of the hole during lapping or during insertion or removal of the tool, and also without injury to the tool even after long use. The tool is designed to be very quickly adjustable or interchangeable to fit different sizes of holes within a very wide range.

Lapping operations as practically carried out in most shops at present are slow and tedious and require the most highly skilled workmen, often experts; and for this reason the honing or lapping operations on parts having several holes which require very accurate size finishes, are very expensive. Indeed, a single honing or lapping operation on a part may often amount to three or four times as much as the combined cost of material and labor of all preceding operations on the part. This may be understood when it is considered that it is first necessary for a toolmaker or machinist to make a lapping plug of cast iron or copper to dimensions very close to the size hole required. The plug usually has to be especially designed for the type of work which it is to do. For example, where several parts are to be lapped and the hole is relatively small it becomes necessary to make the plug adjustable on a taper arbor so that it will last for the duration of the complete operation. Then the lapping operation itself requires operators of great skill and experience. It is necessary to charge the plug with powdered abrasive and oil. Too much will spoil the work. And if the hole itself becomes charged with abrasive material, the lapping plug instead of the hole is cut, thereby irreparably ruining the entire part. It is therefore seen that in addition to the expense of performing the operations there is also considerable expense due to scrapping of parts, even when the greatest care is exercised.

The present invention aims to eliminate these excessive costs and difficulties by providing a simple tool which may be operated by relatively unskilled operators but which at the same time will perform its work with the greatest accuracy and in almost an automatic manner. The tool comprises a rotating mandrel or spindle carrying a plurality of abrasive members which are normally retracted when the spindle is not rotating, thus permitting easy insertion and removal of the spindle in a hole; and which are automatically expanded to a predetermined and micrometrically accurate size when the spindle is rotated. The size may be adjusted in all gradations, however slight, through a very wide range of sizes, in a rapid and accurate manner.

The enumerated and other aims, objects, advantages and features of the invention, will be apparent to those skilled in the art from the following description of an exemplary embodiment thereof, reference being made to the accompanying drawings, wherein:

Fig. 1 is a side elevation of a lapping tool or honing head embodying the invention;

Fig. 2 is a longitudinal section showing the parts in retracted or non-rotative position;

Fig. 3 is a view like Fig. 2 but showing the parts in expanded or rotative position;

Fig. 4 is a view like Fig. 3 but taken at right angles to the plane of Fig. 3;

Fig. 5 is a transverse section taken on the line 5—5 of Figs. 3 and 4;

Fig. 6 is a transverse section through the spindle taken on the line 6—6 of Fig. 3; and

Fig. 7 is a transverse section through the spindle taken on the line 7—7 of Fig. 3.

The exemplary embodiment of honing head or lapping tool illustrated herein is designed to be placed like a drill in the chuck of a drill press or the like. It is made as a portable unit which may be kept in various sizes like drills and carried about for use in such machines, whether fixed or portable as are adapted to use it. As stated above, almost any rotating machine may employ it to advantage, whether a drill press, lathe, milling machine, jig boring machine, electric motor, or the like. The tool is also relatively inexpensive and may, without undue outlay, be kept in various grades as well as various sizes. That is to say, there may be various types of stones varying from very fine to very coarse for performing successive operations in shaping a hole. But as the tool is designed, it is not necessary to have a great number of complete units, because the mandrel with the lapping or cutting stones is arranged to be readily removable from the body of the tool; and the chuck adapter is likewise readily replaceable for different sizes and types of adapters to fit a great va-

riety of chucks. The tool may be used in any position, either vertical upward or downward, horizontal, or inclined at any angle. For simplicity it will be assumed that the tool is used in a vertical position pointing downward, as when secured in a conventional drill press; and all parts will be described in this setting.

In general, the tool comprises a replaceable mandrel 10, a replaceable chuck adapter 11, and a casing 12 which houses the larger operating parts and which includes the size adjusting mechanism. The casing, as most clearly shown in the longitudinal sectional views, comprises an upper shell 13, a lower shell 14, and an adjusting sleeve 15.

The upper and lower shells 13 and 14 are adjustable relative to each other in a longitudinal or axial direction but not in a circumferential direction, for this purpose the upper shell 13 being provided with a plurality of longitudinal slots 16 and the lower shell 14 being provided with corresponding dowel pins 17 slidable in the slots. Preferably the slots open to the end of the shell so the two shells may be readily taken apart.

The sleeve 15 is adjustable relative to the shells 13 and 14 in a circumferential direction and is also adjustable relative to the lower shell 14 in a longitudinal direction, having cooperating threaded engagement therewith as shown at 18. For clearness, coarse threads are shown, but it is understood that very fine micrometer threads may be used. The tapered skirt of the sleeve 15 may be provided with a micrometer scale 19 adapted to be read by reference to a zero line 20 on the lower shell 14. The sleeve 15 has only circumferential movement relative to the upper shell 13, being frictionally secured thereto by an annular retaining plate 21 which embraces the inturned annular flange 22 of the sleeve 15. The plate 21 is secured to the head 23 of the shell 13 by a plurality of screws 24.

The upper shell 13, specifically the head 23 thereof, may be provided with an inner hub 28, an outer hub 29, and a bore 30 therethrough for receiving the lower end of the shank adapter 11. The adapter may be provided with a stop collar 31 and an annular groove 32, the latter being adapted to cooperate with a set screw 33 for holding the adapter in the bore 30.

The lower shell 14, specifically the head 36 thereof, may be provided with an inner hub 37, an outer hub 38, and a bore 39 therethrough for receiving the upper end of the mandrel 10. A mandrel adapter sleeve 40 may be provided for permitting the use of different sizes of mandrels, it being understood that different adapters will be used for different mandrels, all of the adapters having the same outside diameter to fit the bore 39. The adapter sleeves 39 have a flange 41 for limiting the inward movement and an annular groove 42 cooperating with a set screw 43 for holding the adapter and mandrel in the bore.

The replaceable mandrel assembly 10 comprises, in addition to the mandrel adapter sleeve 40, a mandrel tube 46, a plurality of stones 47, a stone expanding wedge plunger 48, spacing bearing or guide rings 49 between the sleeve 46 and the plunger 48, a pilot plunger guide tip 50, and a spring 51 disposed between the head 52 of the plunger and the upper end of the mandrel tube 46. The tube 46, ring 49, and adapted sleeve 40 may be held together by a sunken set screw 53. The set screw may have a tip extension 54 adapted to cooperate with a longitudinal groove 55 in the plunger to prevent rotation of the latter.

The pilot tip 50 may be pressed into the end of the mandrel tube 46. As shown in Fig. 7, three grinding or abrading stones 47 may be provided, these being set in mountings 60 as by being cemented therein. The mountings 60 are radially movable in elongated slots 61 formed in the mandrel tube 46. The mountings 60 are moved outward by the tapered wedge portion 62 of the wedge plunger 48 and are retained by their end extensions 63 which engage the interior of the tube 46 beyond the ends of the slots 61. If desired, the wedge plunger and stone mountings may be provided with connecting elements to cause both retractive and expansive movement of the mountings from the cam plunger. The pilot tip 50 is provided with an axial bore 64 adapted to receive and guide the reduced straight end portion 65 of the wedge plunger 48. The spring 51 normally retracts the wedge plunger 48 so that the stones 47 are positioned in their inner or retracted position. Only when the mandrel is rotated are the stones moved to their outer or expanded position.

Means are provided for moving the wedge plunger 48 downward and expanding the stones to a predetermined position when the mandrel is rotated. The means herein illustrated comprises a gyro wheel 69 mounted upon a gyro shaft 70 which is free to oscillate upon pintles 71 secured in the upper shell 13. The shaft 70 is rigidly secured to the gyro wheel by set screws 72 and the pintles 71 are rigidly secured in the shell 13 by set screws 73.

The central portion of the gyro shaft 70 is adapted to cause axial movement of the wedge plunger 48, and for this purpose the central portion of the shaft is cut away to form a flat cam face 74 adapted to cooperate with the inclined cam face 75 of a short cam plunger 76. The lower end of the cam plunger 76 engages the upper end of the wedge plunger 48. The cam plunger is slidably mounted in the tubular bore of a T-shaped yoke 77, the other bore of which embraces the central portion of the gyro shaft 70 within the opening of the annular gyro wheel 69. A stud 78 which is secured in the cam plunger 76 and which moves in a longitudinal slot 79 formed in the yoke 77, retains the plunger 76 in the yoke when the wedge plunger 48 is removed, that is, when the mandrels are removed. The stem portion of the yoke 77 is slidably mounted in a sleeve 80 which is press fitted or otherwise secured in the bore 39 in the head of the lower shell 14.

It will be seen that when the micrometer adjusting sleeve 15 is turned it will cause the casing shells 13 and 14 to be telescoped together or pulled apart. The inner shell 13 carries the gyro shaft and gyro wheel with it. But the mandrel and wedge plunger 48, being secured in the lower casing shell 14, tend to separate from the gyro shaft when the shell 13 is moved away from the shell 14. This allows the wedge plunger 48 to move upward to follow the cam plunger 76 and gyro shaft 70 and withdraw the tapered portion 62 of the wedge plunger 48 from the stone mountings 60, thus permitting the stones to assume a more retracted position. The reverse movement of the shells causes reverse movement of the wedge plunger 48 and the stones 47. The adjustment affects both the initial or retracted position of the stones as well as their final or expanded position.

In operation, the honing head or lapping tool, having been provided with a suitable chuck adapter 11 and mandrel 10, is placed in a selected driving machine, say a drill press, and the part or work piece having the hole to be ground out is brought into position. Then either the mandrel is moved down to enter the hole or the work piece or stock is moved up to embrace the mandrel. At this time the mandrel is not rotating and the gyro wheel 69 stands in the inclined position in which it is shown in Fig. 2. The stones 47 are fully retracted because the plunger 48 is held in its uppermost position by the spring 51. If desired, means may be provided for resiliently holding the stones and their holders toward inner position when the wedge plunger 48 is retracted. The hubs 28 and 37 may be cut away on an angle on one side, as at 28a and 37a respectively for forming broad surface stops for the gyro wheel.

After the mandrel is placed in the hole to bring the stones in the proper longitudinal zone, the machine is started so as to get the tool into rotation. Whereupon, the centrifugal forces acting upon the gyro wheel 69 cause it to assume the transverse or horizontal position in which it is shown in Fig. 3. This causes the flat cam face 74 of the gyro shaft 70 to change its position with respect to the inclined cam face 75 on the end of the cam plunger 76 and force the wedge plunger 48 downward against the action of the spring 51 to expand the stones 47 to their outer position. During this movement the plunger 48 is guided by the spacing rings 49 and the bore 65 of the pilot tip 50. The expanded size will have a very definite predetermined value because the gyro wheel will move to a definite position which it will maintain for all working speeds of the tool except as resistance of the stock may prevent until the full cut is made. If the finished hole is too small, it is only necessary to screw the micrometer sleeve 15 down on the casing shell 14 to initially force the wedge plunger 48 further down between the stone holders or mountings 60; and if the expanded size of the stone diameter is too large, it is only necessary to screw the sleeve upward on the casing shell 14. It will be assumed that a mechanic will make the hole undersized first and then increase its diameter if necessary rather than to make it too large in the beginning, as the latter plan would make the hole useless and thus cause the entire part of stock or work piece to be scrapped.

After the hole has been finished for any expanded size of the stones, the rotation of the tool is stopped to permit the stones to assume their retracted position, whereupon the mandrel may be removed from the hole without scratching or marring the finished surface of the hole.

In non-rotated position the gyro wheel plane stands at approximately an angle of 45 degrees relative to the central axis of the tool; and when the tool is rotated it takes an angle of 90 degrees. The latter is a natural limiting position, and the angle may be different if definite stops are provided for limiting the rotated position. Likewise, the non-rotated position may be affected by the position of the stops. In some cases it may be desirable to provide adjustable stops or stops which can be changed while the tool is rotating. The latter arrangement is advantageous when changing rapidly from one hole to another as may be permitted when doing relative coarse work under high production conditions. For doing finish work of the highest accuracy, of course, it is necessary to measure the hole by suitable micrometer instruments after each entry of the mandrel and then to expand the mandrel the necessary amount by a new setting of the sleeve 15 before the next entry of the mandrel and stones into the hole. In the latter case it is necessary to stop the rotation of the tool for the re-adjustment, by the specific mechanism shown herein, at least.

The invention has been explained in connection with an embodiment which is designed to finish the inside of holes; but the same principles may be applied to tools which finish the outside of shafts, though the demand for the latter type of tool is probably not so great as the one illustrated, because of the ease with which the outside diameters of shafts may ordinarily be finished by conventional lathes and the like. When a gyro-wheel is mentioned it will be understood that it need not be of uniform section throughout its circumference and that spaced weights on each side of shaft 77 might be used.

The use of tools with stones of the present type for lapping holes is far superior to and cheaper than the old method of lapping by the use of a plug with oil and abrasives. It is easy to finish a hole of accurate diameter which is uniform in size from one end to the other, that is, one having truly parallel sides, with the present device; whereas the same grade of work is very difficult to attain by the old methods. The present tool may be operated with completely satisfactory results by unskilled operators; whereas the old methods required operators of the highest skill, and even then the results were often unsatisfactory. Unskilled operators using the present invention can attain satisfactory results in far less time than highly skilled operators could attain similar results by the old methods. Moreover, the present invention largely avoids the scrap loss which was almost unavoidable by the old methods, no matter how skilled the operators. In the enumerated and other respects the invention is believed to provide a very definite and pronounced improvement in the art.

While one embodiment of the invention has been described in some detail in order to illustrate the principles of the invention, it is to be understood that the invention may assume various embodiments within the limits of the prior art and the scope of the subjoined claims.

I claim:

1. A portable lapping tool or the like, comprising in combination, a mandrel, a plurality of abrading stones mounted for expansive and retractive movement on the mandrel, a wedge plunger slidably mounted in said mandrel for actuating said stones, spaced guide rings and a pilot tip having a bore therein for a reduced tip of the wedge plunger for guiding the plunger in the mandrel, a casing comprising two telescopic casing shells, and a micrometer adjusting sleeve rotatably mounted on one shell and threaded to the other shell, the sleeve having an inturned flange and the first said shell being provided with an annular plate for retaining said sleeve on said shell for frictional rotation thereon, a mandrel adapter sleeve secured to the mandrel and a set screw for securing the adapter sleeve removably in the second said shell, a gyro wheel mounted in the first casing shell, a gyro cam shaft rigidly secured to said gyro wheel, a cam on said shaft, a cam plunger mounted in a guide yoke on said shaft, the cam plunger acting on said wedge plunger, a spring for pressing said wedge plunger toward said cam plunger and away

from the expansive position of said stones, and a removable chuck adapter detachably secured in a bore in the first shell, the cam on the gyro shaft and the cam on the end of the cam plunger being flat and angular whereby to cooperate in the retracted and expanded positions of the gyro wheel to hold the stones in the two limiting positions when the tool and gyro wheel are stationary and rotating, and adjustment of said sleeve serving to move the gyro shaft from or toward said wedge plunger to vary the retracted and expanded positions of the stones.

2. A lapping tool or the like, comprising in combination, a mandrel, a plurality of abrading stones mounted for expansive and retractive movement on the mandrel, a wedge plunger slidably mounted in said mandrel for actuating said stones, a casing comprising two telescopic casing shells, and a micrometer adjusting sleeve rotatably mounted on one shell and threaded to the other shell, a gyro wheel mounted in one casing shell, the mandrel being removably mounted in the other casing shell, a gyro cam shaft rigidly secured to said gyro wheel, a cam on said shaft, a cam plunger mounted in a guide yoke on said shaft, the cam plunger acting on said wedge plunger, and a spring for pressing said wedge plunger toward said cam plunger and away from the expansive position of said stones, the cam on the gyro shaft and the cam on the end of the cam plunger being flat and angular whereby to cooperate in the retracted and expanded positions of the gyro wheel to hold the stones in the two limiting positions when the tool and gyro wheel are stationary and rotating, and adjustment of said sleeve serving to move the gyro shaft from or toward said wedge plunger to vary the retracted and expanded positions of the stones.

3. A lapping tool or the like, comprising in combination, a mandrel, a plurality of abrading stones mounted for expansive and retractive movement on the mandrel, a wedge plunger slidably mounted in said mandrel for actuating said stones, a casing comprising two telescopic casing shells, and a micrometer adjusting sleeve rotatably mounted on one shell and threaded to the other shell, a gyro wheel mounted in one casing shell, the mandrel being removably mounted in the other casing shell, a gyro cam shaft rigidly secured to said gyro wheel, a cam on said shaft, a cam plunger mounted in a guide yoke on said shaft, the cam plunger acting on said wedge plunger, and a spring for pressing said wedge plunger toward said cam plunger and away from the expansive position of said stones, the cam on the gyro shaft and the cam on the end of the cam plunger being flat and angular whereby to cooperate in the retracted and expanded positions of the gyro wheel to hold the stones in the two limiting positions when the tool and gyro wheel are stationary and rotating.

4. A lapping tool or the like, comprising in combination, a mandrel, a plurality of abrading stones mounted for expansive and retractive movement on the mandrel, a wedge plunger slidably mounted in said mandrel for actuating said stones, a casing comprising two telescopic casing shells, and a micrometer adjusting sleeve rotatably mounted on one shell and threaded to the other shell, a gyro wheel mounted in one casing shell, the mandrel being removably mounted in the other casing shell, a gyro cam shaft rigidly secured to said gyro wheel, a cam on said shaft, a cam plunger mounted in a guide yoke on said shaft, the cam plunger acting on said wedge plunger, and a spring for pressing said wedge plunger toward said cam plunger and away from the expansive position of said stones.

5. A lapping tool or the like, comprising in combination, a mandrel, a plurality of abrading stones mounted for expansive and retractive movement on the mandrel, a wedge plunger slidably mounted in said mandrel for actuating said stones, a casing comprising two telescopic casing shells, and a micrometer adjusting sleeve rotatably mounted on one shell and threaded to the other shell, a gyro wheel mounted in one casing shell, the mandrel being removably mounted in the other casing shell, a gyro cam shaft rigidly secured to said gyro wheel, a cam on said shaft, a cam plunger cooperating with the cam on said shaft, and means for pressing said wedge plunger toward said cam plunger and away from the expansive position of said stones.

6. A lapping tool or the like, comprising in combination, a mandrel, a plurality of abrading stones mounted for expansive and retractive movement on the mandrel, a casing secured to said mandrel, a gyro wheel mounted on said casing on an axis parallel to the plane of the gyro-wheel and perpendicular to the axis of the mandrel and gyro-wheel to permit the gyro-wheel to oscillate until its plane is substantially perpendicular to the mandrel axis when in operative rotation, means actuated by said gyro wheel for moving said stones to a definite predetermined expanded position, and means for varying the expanded position of the stones.

7. A lapping tool or the like, comprising in combination, a mandrel, a plurality of abrading stones mounted for expansive and retractive movement on the mandrel, a casing secured to said mandrel, a gyro wheel mounted on said casing on an axis parallel to the plane of the gyro-wheel and perpendicular to the axis of the mandrel and gyro-wheel to permit the gyro-wheel to oscillate until its plane is substantially perpendicular to the mandrel axis when in operative rotation, and means actuated by said gyro wheel for moving said stones to a definite predetermined expanded position.

8. A lapping tool or the like, comprising in combination, a mandrel, a plurality of abrading stones mounted for expansive and retractive movement on the mandrel, means for rotating said mandrel from a driving device, and means automatically moving said stones to a definite predetermined expanded position when said mandrel is rotated, said means comprising a gyro-weight mounted on an axis perpendicular to the axis of the mandrel, the effective arm of the weight turning in a plane substantially perpendicular to the axis of the mandrel when in operative rotation with the weight in outermost position, and positive means for moving the stones into active position as the weight moves to outer position.

9. A lapping tool or the like, comprising in combination, a mandrel, a plurality of abrading stones mounted for expansive and retractive movement on the mandrel, means for rotating said mandrel from a driving machine, and means for automatically moving said stones to a definite predetermined working position when said mandrel is rotated, said means comprising a gyro-weight mounted on an axis perpendicular to the axis of the mandrel, the effective arm of the weight turning in a plane substantially perpendicular to the axis of the mandrel when in operative rotation with the weight in outermost posi-

tion, and positive means for moving the stones into active position when the weight moves to outer position.

10. A lapping tool or the like, comprising in combination, a mandrel, a plurality of abrading stones mounted for expansive and retractive movement on the mandrel, a casing secured to said mandrel, centrifugal stone expanding and retracting means in said casing, said casing comprising an upper shell on which said centrifugal means is mounted and a lower shell to which said mandrel is secured, said shells being telescopic but non-rotatable relative to each other, separable operating means between said mandrel and said centrifugal means, and means for adjusting said shells relative to each other to change the limiting position of said stones as moved by said centrifugal means.

11. A device as set forth in claim 10 in which said shells are guided by a pin in one shell operating in a slot in the end of the other shell, and in which said adjusting means comprises a sleeve mounted for frictional rotation on one shell and threaded to the other shell.

12. A lapping tool or the like, comprising in combination, a rotable casing, a mandrel assembly detachably secured to said casing; said mandrel assembly comprising a mandrel tube, a plurality of abrading stones mounted for expansive and retractive movement on the mandrel tube, a wedge plunger mounted in said tube and operating on said stones to expand and retract them, and a spring between said tube and plunger tending to retract the stones; and centrifugal means on said casing for actuating said plunger.

13. A lapping tool or the like, comprising in combination, a sleeve shaft, lapping stones mounted for expansive and retractive movement on said sleeve shaft, a wedge plunger shaft inside said sleeve shaft and movable lengthwise therewith to cause said stones to move outwardly through said first shaft, and a centrifugal wheel mounted to rotate with said first shaft and operatively connected to said second shaft, said wheel when in normal non-rotating position being at an angle to said second shaft and when rotated it moves to a new position substantially perpendicular to said second shaft where no further change of movement from its new position will be made when the speed of rotation is further increased, said second shaft being moved lengthwise relatively to said first shaft by said centrifugal wheel.

14. A lapping tool or the like, comprising in combination, a rotatable shaft, lapping stones expansibly mounted on said shaft, centrifugal means for expanding said stones positively to a given limiting position when the centrifugal means reaches a natural limiting position under the action of centrifugal force, and means for adjusting the outer limiting position of the stones for the same natural outer limiting position of said centrifugal means.

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