Nov. 25, 1941. J. E. G. KLINE 2,263,781

CYLINDER GRINDING DEVICE

Filed Oct. 2, 1936 2 Sheets-Sheet 1

Fig. 2.

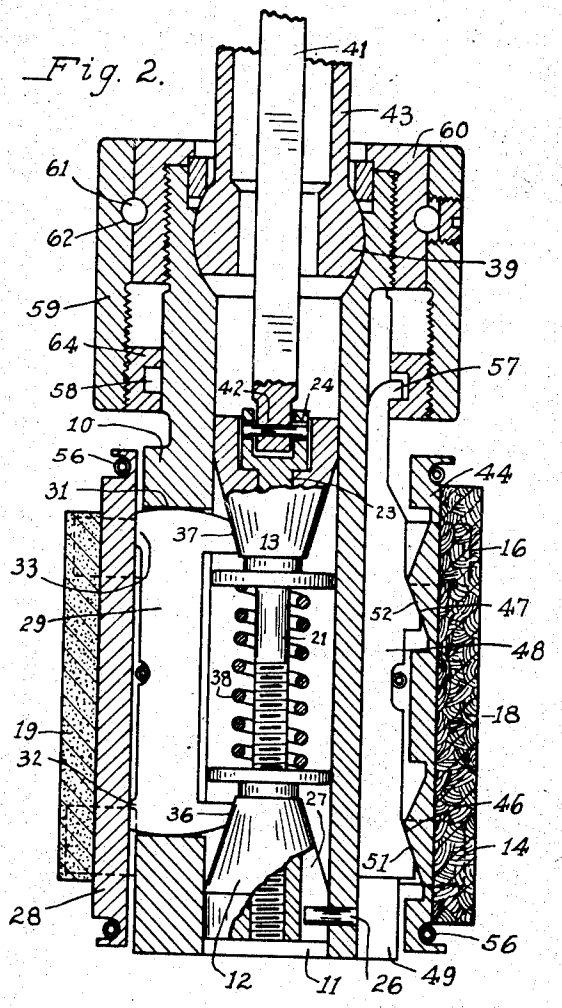
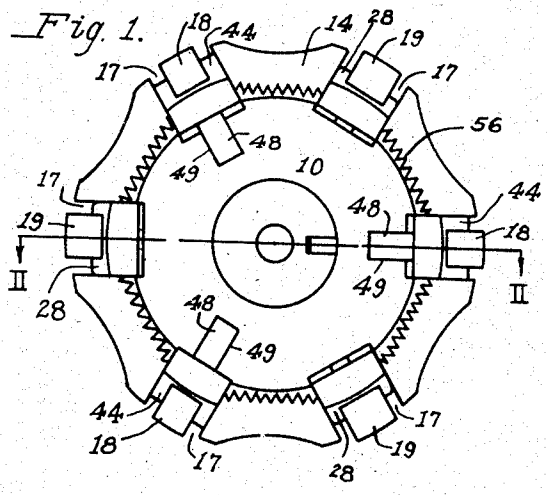


Fig. 2A



Fig. 1.



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Fig. 4.

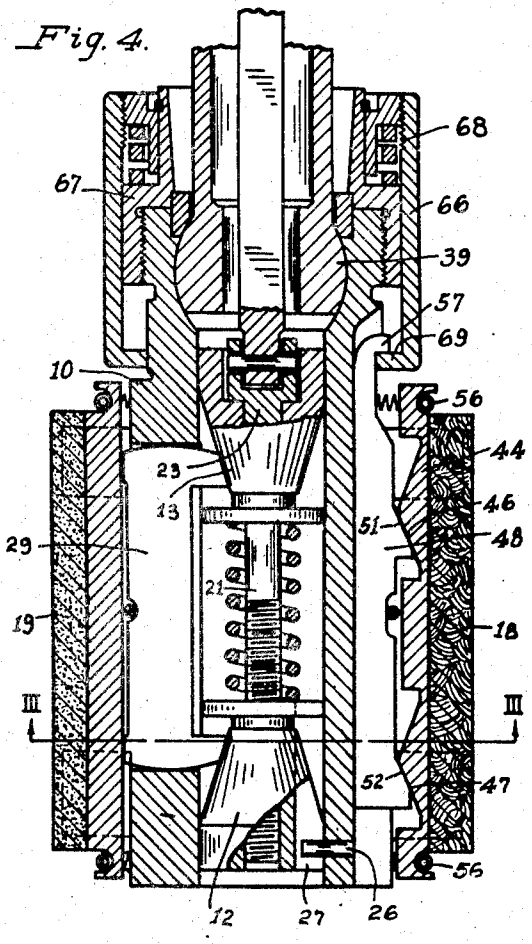


Fig. 5.

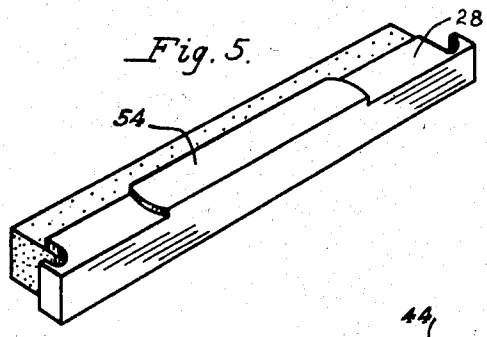


Fig. 6.

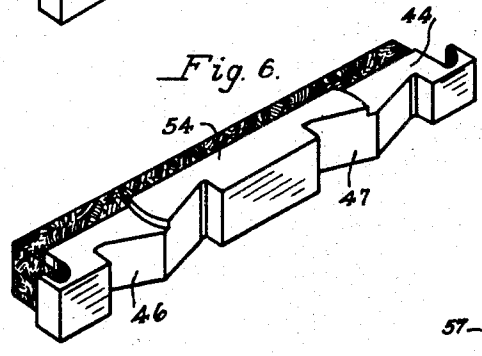


Fig. 7.

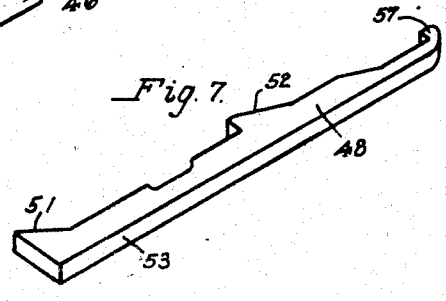


Fig. 3.

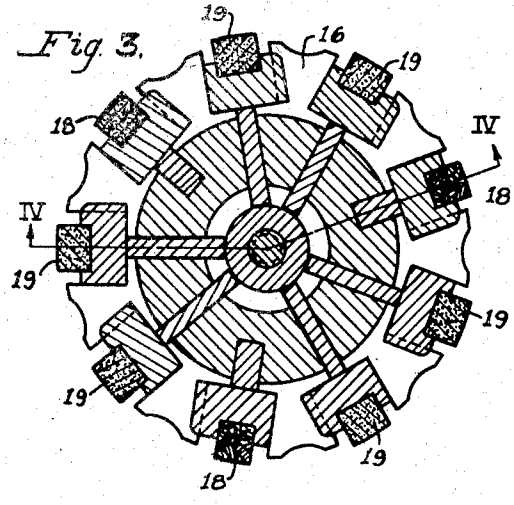
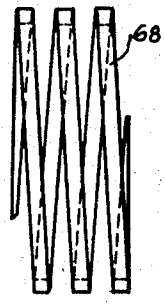


Fig. 8.



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UNITED STATES PATENT OFFICE

2,263,781

CYLINDER GRINDING DEVICE

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Application October 2, 1936, Serial No. 103,656

1 Claim. (Cl. 51—184.3)

This invention relates to cylinder grinding devices and particularly to a device often referred to as a honing tool of the rotatable type adaptable to finishing the inner surface of a cylindrical member such as the cylinders of internal combustion engines and the like.

In carrying out such a grinding operation the abrasive elements of the conventional type of hone are retracted and the tool is thus inserted in the bore of a cylinder to be ground. After the tool has been positioned in the cylinder the abrasive elements are expanded by suitable means into contact with the cylinder wall. The hone is then rotated and longitudinally reciprocated to abrade the bore. The purpose of the honing operation is to provide a perfect cylindrical surface which is free from machining ridges or in other words highly polished. When the grinding operation is complete it is desirable to retract the abrasive elements from engagement with the cylinder wall in order that the tool may be withdrawn from the cylinder without scoring or marking the bore. When the abrasive elements are retracted the axis of the tool is no longer maintained in the center of the bore and the device often goes into what may be termed a pendulum action, during the longitudinal movement of the same out of the cylinder. The swinging action of the tool often causes one or more of the abrasive elements to reingage the polished walls of the cylinder with the result that the surface thereof is damaged and a refinishing operation is necessary.

One of the objects of the present invention is therefore to provide a honing tool with means for maintaining the axis of the same concentric with the center of the cylinder after the abrasive elements have been retracted and thus prevent injury to the polished cylinder wall while the tool is being removed from the bore.

Another object of the invention is to provide a cylinder grinding tool with means for retaining the axis of the tool in the center of the cylinder during the abrading operation and thereby insure even or uniform wear of the abrasive elements.

A still further object of the invention is to provide a cylinder hone with non-abrasive guide elements for properly positioning the tool within the bore including novel means for separately actuating the non-abrasive elements so that a burnishing action will be effected on the cylinder wall during the honing operation.

Other and further features and objects of the invention will be more apparent to those skilled in the art upon a consideration of the accompanying drawings and following description wherein several exemplary embodiments of the invention are disclosed.

In the drawings:

Figure 1 is an end view, in elevation, of a honing tool constructed in accordance with the invention showing one arrangement of the cylinder wall engaging elements.

Figure 2 is a longitudinal view partly in section and partly in elevation taken generally on the lines II—II of Figure 1.

Figure 2A is an enlarged detailed view of the screws and one of the balls associated with the adjustment mechanism shown in Figure 2.

Figure 3 is a sectional view taken on the line III—III of Figure 4 of a modified tool showing another arrangement of the abrasive and non-abrasive elements.

Figure 4 is a view taken on the lines IV—IV of Figure 3 showing a modified mechanism for actuating one group of the cylinder wall engaging elements.

Figure 5 is a general view in perspective of one type of mount.

Figure 6 is a similar view of another type of mount.

Figure 7 is a view in perspective showing a cam for actuating one of the mounts.

Figure 8 is a view in side elevation of the spring employed to move one group of cylinder wall engaging elements.

Referring to the drawings there is shown generally at 10 a cylindrical shaped body member or head having a longitudinally extending central aperture 11 for housing and supporting a pair of oppositely arranged spaced cams or cones 12 and 13. The outer or peripheral surface of the head is provided with a pair of slotted spiders 14 and 15 arranged in a fixed spaced relation adjacent the respective ends of the body member. The head is usually formed of metal and any number of spiders may be rigidly mounted thereon or they may be integrally formed from the body of the head. Each of the spiders is provided with a complementary number of circumferentially spaced slots 17 which should be displaced with respect to each other at substantially equidistantly spaced intervals therearound. The slots are adapted to receive and support a plurality of abrasive and non-abrasive mounts in radial planes that are coincident with the axis of the tool and for this reason the slots 17 provided in the spiders should be aligned with respect to each other. Any number of aligned slots

may be provided for receiving the cylinder wall engaging elements however, six or more properly arranged in each spider have been found to be particularly advantageous in fulfilling the objects of the invention as hereinafter described.

Instead of providing all of the mounts with abrasive elements as has been the conventional practice in the past, non-abrasive guide elements are carried by and supported in some of the spider slots preferably in an alternately arranged manner with respect to the abrasive elements. The non-abrasive elements are employed for the purpose of maintaining the axis of the tool in the center of the cylinder bore during the grinding operation. When the abrasive elements have been retracted from engagement with the cylinder wall prior to the removal of the tool from the cylinder the non-abrasive elements maintain the axis of the device in the center of the bore to prevent swinging of the head and inadvertent engagement of the abrasive elements with the cylinder wall and thus avoid scoring of the finished cylinder surface when the device is removed from the bore. It is for these purposes that at least three non-abrasive elements 18 are provided in spider slots at substantially equal spaced annular intervals. In other words, when three guide members are employed they are displaced with respect to each other by approximately 120°.

As shown in Figure 1 the non-abrasive elements 18 are alternately arranged with respect to a selected number of abrasive elements 19 but it will be appreciated that any number of guide elements in excess of three may be employed. Since three non-abrasive elements will maintain the axis of the tool in the center of the cylinder one or more abrasive elements may be employed to properly abrade the cylinder wall. However, for efficient operation it is desirable to provide a plurality of abrasive elements arranged around the tool between the non-abrasive elements in a manner as indicated in Figures 1 and 3.

In carrying out the invention two actuating mechanisms are provided, one for moving the abrasive elements into engagement with the cylinder wall and another separate mechanism for adjusting the non-abrasive elements. Either of the adjusting means may be operated independently of the movement or position of the other so that the non-abrasive elements may be moved and maintained in engagement with the cylinder bore to hold the axis of the tool in the center thereof during the grinding operation and after the abrasive elements have been retracted at the end of the abrading operation.

One group of cylinder wall engaging elements and preferably the abrasive elements 19 are actuated by the cones 12 and 13 mounted for longitudinal movement within the central aperture 11 of the tool body 10. The cones are adapted to be moved towards and away from each other in any well known manner as for example by means of a shaft 21 which is threaded at the lower end to engage an internally threaded portion of the cone 12. The upper end of the shaft 21 is adapted to pass freely through an opening 23 provided in the cone 13 in such a manner that an annularly formed collar 24 will engage a recess formed in the inverted base portion of the cone 13. In order that the cone 12 may move longitudinally of the aperture 11 and held against turning about the shaft 21 a pin or similar means 26 is provided to extend inwardly from the head 10, near the lower end thereof, into a slot 27 arranged in the cone 12.

The abrasive elements 19 carried by the mounts 28 and arranged in certain of the slots 17 are moved radially outward or expanded to increase the effective diameter of the tool by means of plate members 29. Each plate 29 is movably mounted in an elongated radially extending aperture 31 which communicates the inner surfaces of certain slots 17 with the central bore 11. The outer ends 32 and 33 of the plates engage the mounts 28 while the inner tapering ends 36 and 37 are shaped to match and adapted to respectively engage the cones 12 and 13.

By turning the shaft 21 in a direction to cause the cones 12 and 13 to move toward each other will therefore move the mounts 28 and the abrasive elements carried thereby outwardly into engagement with a cylinder wall by reason of the wedge action of the cones acting on the inner ends 36 and 37 of the plates 29. A spring 38 encircling the shaft 21 is provided for yieldably urging the cones away from each other and by turning the shaft 21 in a direction opposite to that indicated above the spring will move the cones to a position permitting the abrasive elements to retract.

The tool or body of the device is adapted to be rotated by a power driven spindle (not shown) connected to the head 10 through a hollow sleeve 43 and a universal coupling 39. In order that the shaft 21 may be rotated while the head is positioned within the cylinder to properly adjust the abrasive elements a rod 41 is connected to the upper end of the shaft 21 by means of a flexible joint 42. The rod 41 may extend upwardly within the driving sleeve 43 to a point where it may be conveniently operated.

The non-abrasive guide elements 18 are preferably formed of a tough material such as vulcanized fiber and shaped to dimensions similar to those of the abrasive elements 19. The guide elements, as hereinabove set forth, are employed to maintain the axis of the tool in the center of the bore and since the stock removed during a grinding operation is often measured in thousandths of an inch the material employed in making the non-abrasive elements should preferably be relatively incompressible. The non-abrasive elements in addition to maintaining rotary axis of the hone concentric with the axis of the cylinder to insure uniform wear of the abrasive elements should also effect a burnishing finish to the cylinder wall and materials such as vulcanized fiber have been found to satisfactorily fill such requirements.

Mounts 44 which are somewhat similar to the abrasive element carrying mounts 28 are provided for receiving and supporting the non-abrasive elements. Instead of having a flat base as is the case with the mounts 28, the bases of the non-abrasive carrying mounts 44 are each provided with a series of inwardly projecting sloping surfaces 46 and 47 (as shown particularly in Figure 6). A slidable cam 48 is provided for each of the mounts 44 and each cam is adapted to be guided in a longitudinally extending groove 49 arranged in the periphery of the head 10 under each of the mounts 44. Each cam (Figure 7) carries a pair or series of integrally formed tapered projections such as 51 and 52 which are adapted to respectively engage a like number of sloping surfaces 46 and 47 carried by the base of a mount 44. The inner edge 53 of each cam is straight and rests respectively in each groove 49 so that sliding

movement of each cam towards the upper end of the head will cause the tapered projections 51 and 52 of each cam to respectively engage the sloping surfaces 46 and 47 and thus move the mounts 44 radially outward. The mounts 44 are held against longitudinal movement with respect to the head by means of a shoulder 54 the ends of which are adapted to fit between the opposed faces of the spaced spiders 14 and 16.

The abrasive and the non-abrasive carrying mounts are moved inwardly or against their respective adjustment mechanisms by means of two elastic bands or garter springs 56. One of the elastic garters encircles and engages the hooked ends of all of the cylinder wall engaging elements at one end of the tool and the other spans the mounts at the opposite end thereof.

The upper ends of the cams 48 are each hook shaped as indicated at 57 to engage a race associated with the inner lower portion of a rotatable sleeve. The sleeve may be mounted on the head in various arrangements of associated parts adapted upon rotation to longitudinally move the slidable cams 48 toward or away from the upper end of the head and accordingly cause the mounts 44 to move laterally outward or inward with respect to the body of the tool.

One construction for simultaneously actuating the cams 48 is shown in Figure 2 wherein the sleeve 59 is rotatably mounted in such a manner as to prevent the same from moving longitudinally by means of a plurality of balls 61 carried between a collar 60 fixed to an extended portion of the head 10 and which engage an annular groove 62 formed in the inner upper portion of the sleeve 59 and peripheral surface of collar 60. The lower inner portion of the sleeve 59 is threaded and adapted to engage the threads of a ring member 64 which is provided with an annular groove or race 58. The groove 58 is formed to receive the hooked ends of the slidable cams 48 so that rotation of the sleeve 59 in one direction will cause the ring 64 to move longitudinally pulling all of the cams towards the upper end of the head and accordingly move the mounts 44 laterally outward. Turning the sleeve 59 in an opposite direction will cause the cams 48 to slide downwardly with respect to the body of the tool which permits the garter springs 56 to move the mounts 44 radially inward.

In performing the grinding operation with a tool embodying the hereinabove described features the abrasive elements should be retracted to permit the head to be inserted in the cylinder, by moving the cones 12 and 13 apart which will allow the elastic bands 56 to move the stones inwardly. The sleeve 59 of the adjusting mechanism described in connection with Figure 2 is also turned to cause the cams 48 to move downwardly so that the non-abrasive elements will be retracted by the garter springs 56. After the head is positioned within the bore the abrasive elements are expanded into engagement with the cylinder wall by turning the rod 41 to move the cones towards each other. The non-abrasive elements may also be expanded into contact with the bore by rotating the sleeve 59 in such a manner as to cause the cams 48 to move upwardly.

The engagement of the non-abrasive elements with the cylinder wall will cause the axis of the tool to be maintained in the center of the bore by reason of the equal spaced arrangement of at least three guide elements. Inasmuch as the guide elements will not readily wear away, the tool upon rotation will constantly revolve around the axis thereof and insure even wear of the abrasive stones. The non-abrasive elements also provide a burnishing effect on the walls of the cylinder to further enhance the finish thereon.

A more important function of the separately actuated non-abrasive elements is to properly guide the tool out of the bore when the grinding operation is completed. After the bore has been properly finished the abrasive elements may be released or retracted from engagement with the bore and the tool safely withdrawn from the cylinder since the unretracted guide elements will maintain the tool in the center of the cylinder. The device cannot swing about the universal coupling in the driving sleeve by reason of the guiding action of the non-abrasive elements and inadvertent scoring of the finished surface is avoided when the device is withdrawn from the cylinder.

In order that the tool will be properly guided out of the cylinder without accidental lateral movement about the universal joint 39, the non-abrasive guide elements may be formed of a greater length than the abrasive elements as shown in Figure 2.

A modified mechanism for automatically moving and maintaining the non-abrasive elements against the cylinder wall is shown in Figure 4. During the finishing operation stock is removed from the bore by the abrasive elements and it is necessary to enlarge the effective diameter of the tool to continue the abrading operation by radiating the abrasive stones 19. The adjusting mechanism of the present modification is designed to continually and yieldably urge the guide elements 18 into contact with the enlarged bore thus constantly maintaining the axis of the tool in the center of the cylinder and at the same time burnishing the bore by reason of the wiping action of the non-abrasive elements.

For accomplishing such functions a sleeve 66 is slidably mounted on a bushing 67 and yieldably urged upward with respect to an extended portion of the head 10 by means of a relatively strong spring 68 shown in Figures 4 and 8. The sleeve 66 is provided with a depending collar 69 which engages the hooked ends of the cams 48 and slides them simultaneously upwardly causing the sloping surfaces 51 and 52 of each cam to respectively engage the tapered portions 46 and 47 of the mounts 44 and move the same laterally outward against the action of the garter springs 56. The mounts 44 may be moved laterally inward by moving the sleeve 66 downwardly against the action of the spring 68 which will permit the garter springs 56 to move the cams downward and the non-abrasive carrying mounts inwardly.

While the abrasive elements have been described as being carried by the mounts 28 and actuated as a group by the cones from within the longitudinal aperture 11, it will nevertheless be apparent that the non-abrasive elements may be substituted for the abrasive elements in the mounts 28 and adjusted by the central mechanism. Accordingly the abrasive elements may be arranged in the mounts 44 and actuated by the sliding cams 48. In other words the tool will function in accordance with the objects of the invention even though the two groups of cylinder wall engaging elements are interchanged.

While abrasive and non-abrasive elements have been described in connection with the tool for the purposes of grinding the device, by maintaining the rotary axis thereof concentric with

the bore, and providing a burnished finish to the cylinder wall it will nevertheless be apparent that the hone may be equally adapted to other uses. For example, the tool may be employed to function as a roughing and finishing hone. In other words, the device is capable of removing bulk stock with one set of cylinder wall engaging elements and polishing the bore with another set of such elements. That is to say, if the abrading elements **19** are formed of relatively coarse abrasive they may be used for the rough operation of removing the initial stock from the bore, and if the non-abrasive elements **18** are replaced with fine grit abrasive they may be utilized to finish the abrading operation and impart a high polish to the cylinder wall.

Such alternate operation of the tool is made possible without removing the device from the cylinder by means of the independent adjustment mechanisms described in connection with the mounts **28** and **44**.

Having thus described my invention, I claim:

A grinding device comprising, in combination, a head having a longitudinally extending central aperture and radial apertures opening thereinto, a central element comprising a pair of cam members arranged in opposed spaced relation freely movable in said longitudinal aperture, plate members slidable in said radial apertures, the inner ends of said plates engaging the respective cam members the outer ends of said plates engaging respectively a plurality of cylinder wall engaging elements, the peripheral surface of said head having longitudinally extending spaced grooves, a slidable cam longitudinally movable in each of said grooves, a rotatable sleeve having a race therein adapted to engage one end of said slidable cams, each of said cams engaging the respective grooves and a mount carrying a cylinder wall engaging element of another type whereby the mounts are simultaneously moved by turning said sleeve.

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