Feb. 22, 1944. V. W. PETERSON ET AL 2,342,599

CYLINDER HONING

Filed March 9, 1940

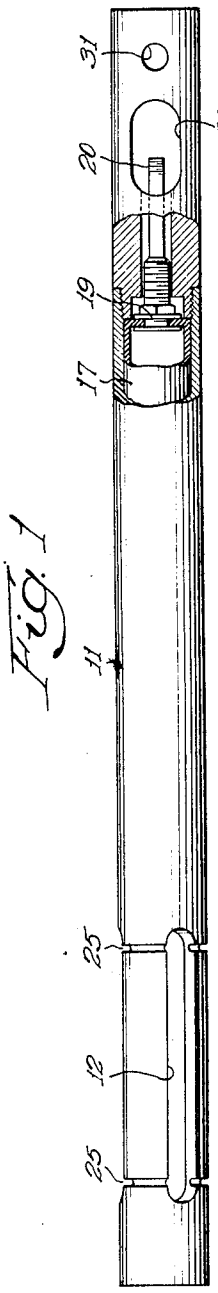


Fig. 1

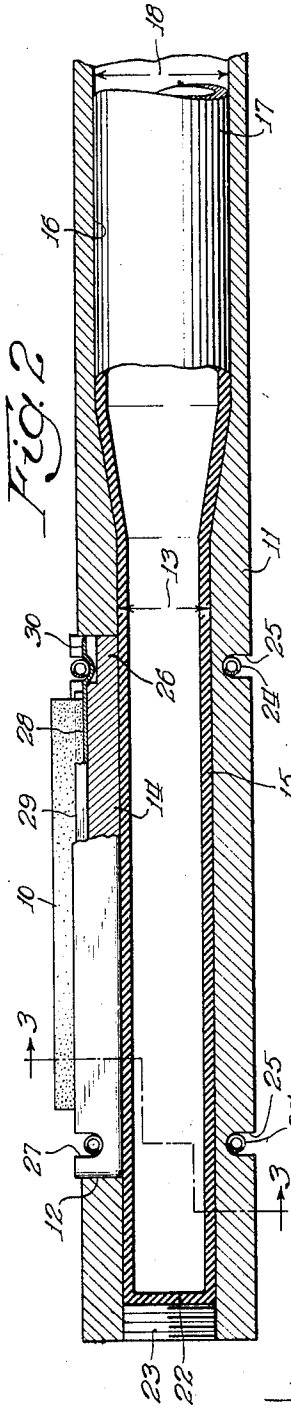


Fig. 2

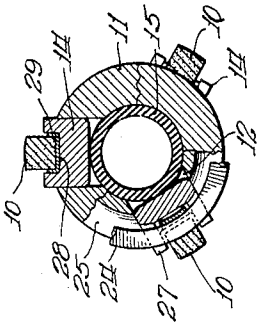


Fig. 3

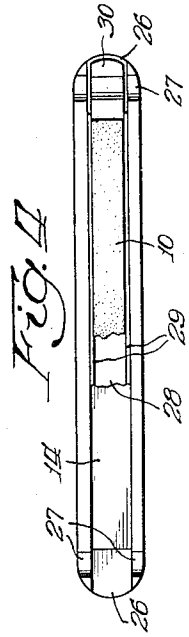


Fig. 4

Inventors:
Victor W. Peterson and
Frank J. Daley

By: Roland C. Rehm
Atty.

Patented Feb. 22, 1944

2,342,599

UNITED STATES PATENT OFFICE

2,342,599

CYLINDER HONING

Victor W. Peterson and Frank J. Daley, Chicago, Ill., assignors to Hannifin Manufacturing Company, Chicago, Ill., a corporation of Illinois

Application March 9, 1940, Serial No. 323,086

8 Claims. (Cl. 51—184.1)

This invention relates to honing cylindrical bores and the like and, among other objects, aims to provide a hone for small diameter bores.

The nature of the invention may be readily understood by reference to one illustrative apparatus embodying the invention and shown in the accompanying drawing.

In said drawing:

Fig. 1 is a longitudinal view partly in section of the hone with the cutting stones removed;

Fig. 2 is an axial section through a portion of the hone on an enlarged scale;

Fig. 3 is a cross-section taken on the broken plane **3—3** of Fig. 2; and

Fig. 4 is a plan view of a honing stone and its carrier.

Heretofore it has been difficult and impractical to hone bores of small diameter, that is, bores of two inches and less. Physical limitations made it impossible to employ honing stones of adequate size or to apply or maintain proper stone pressure. Such physical limitations preclude both the use of conventional mechanism for applying and maintaining stone pressure and the use of stones of adequate size and thickness. Efficient honing is not possible unless there is an adequate stone wear, that is, breaking away of the stone to expose fresh cutting edges. To secure this result, the stone must be adequate in size, and pressures sufficient to produce the proper stone wear must be maintained. Neither has been possible heretofore in hones for small bores.

The illustrative apparatus is capable of efficiently honing small bores which heretofore could not be honed by conventional methods. There is adequate stone wear, and stone pressures are maintained without the necessity of adjustment. Moreover, the pressure is resilient and is maintained independently on each stone, thereby avoiding breakage by making it possible for a stone to yield independently of the others when passing a high spot. High spots are efficiently reduced without affecting other portions of the bore or normal action of the stone thereon.

In the illustrative device, the stones are forced outwardly by resilient pressure developed in this instance pneumatically. The stones **10** are carried in a hollow cylindrical shell or housing **11** whose external diameter is, of course, less than the diameter of the bore to be honed. For honing a bore of approximately 1½", the external diameter of the holder is advantageously about 1⅜". Recesses **12** in the form of slots are provided in the holder to receive and guide the stones. The holder wall is made sufficiently thick in the region of the slots to provide adequate bearing surface for guiding the stones. For a holder of 1⅜" external diameter, the internal diameter **13** may advantageously be about ¾ of an inch. In the present instance, the stones are seated in carriers **14** which themselves slidably fit in and are guided by the slots **12**.

Pressure is delivered to the stones by an inflated elastic tube **15** extending within the bore of the shell. This tube may be made of molded rubber or similar materials. An oil resisting material, such as chloroprene, may advantageously be used in place of rubber. One form of material of this character is sold on the market under the trade-name "Neoprene." Substantial variation in stone pressure through stone wear is prevented by giving the tube **15** a substantially greater volume than that represented by the small volume within the zone of the stones. As here shown beyond the end of the stones, the internal bore of the shell **11** is substantially enlarged as at **16** and the extension of tube **15**, correspondingly enlarged as at **17**, lies in this space. The tube has a substantial wall thickness, in this case $\frac{3}{32}$", to provide adequate strength and to withstand hard usage. In the present instance, the enlarged portion of the housing **11** beyond the stones extends sufficiently to provide an added volume for the tube **15** at least double that represented by the small portion of the tube which, for the tool illustrated, is only about ¾ of an inch in diameter. In the extended portion of such tool the internal diameter **18** is about $1\frac{1}{16}$". The large end of the tube is provided with a valve fitting **19** similar to that used on inner tubes for pneumatic tires by means of which the tube may be inflated. The housing opposite the end **20** of the fitting is provided with an opening **21** by means of which the end of the fitting may be reached to inflate the tube. The housing at the opposite end **22** of the tube is closed in any appropriate manner as by a threaded plug **23**.

The enlarged pneumatic volume provided as above described permits the maintenance of substantially uniform pressure on the stones regardless of their radial position, and it is not necessary to adjust the pressure in the tube repeatedly as the stones wear down, as would be the case if the tube volume were limited to that within the zone of the stones. Furthermore the stones may yield inwardly substantially upon striking a high spot without materially increasing the pressure in the tube. Despite the very small diameter of the tube in the region inside the stones, the same uniformity of pressure throughout the honing

operation can be maintained (by means of the added volume in the enlarged extension of the shell) as would be the case for a tool designed to hone a large diameter bore; an adjustment to compensate for stone wear need be made no more frequently than with a large diameter hone. The small portion of the tube directly underneath the stones may be reduced still farther (for honing still smaller diameter bores) so long as sufficient space remains for the insertion of a reduced portion of the tube, the resilient action of the tube and uniformity of pressure despite stone wear being maintained by the auxiliary volume beyond the ends of the stones. Such volume should be great enough to permit radial movement of the stones within their normal range of movement for a given honing operation without substantial variation in stone pressures.

In the present instance the stones are held in place prior to insertion of the tool into a bore by springs **24** which encircle the tool. Such springs are helical springs in circular form and are seated in recesses **25** in the shell. Preferably the stone carriers **14** extend as at **26** beyond the ends of the stone and are correspondingly recessed as at **27**. The stones themselves are advantageously carried in sheet metal clips **28** whose side flanges **29** grip the stones and whose ends **30** extend beyond the stones in position to be engaged by the springs **24**. This arrangement prevents the stones from falling out when the tool is withdrawn from the bore. After insertion of the stones into the bore, the tube is inflated to the desired pressure.

In a given case the pressure to be maintained on the stone, i. e., the pressure to which the tube is inflated, depends upon the size of the stones, their degree of coarseness, the hardness of the abrasive material and the character of the binder which binds the abrasive material together. A fine stone generally requires more pressure for efficient operation than a coarser stone. This is because it requires more pressure to break away the binder to expose fresh cutting edges of the stone. For a three stone tool, such as that here illustrated, in which the stones are 3¼'' long and ¼'' wide, a stone pressure of about 35 pounds per square inch may advantageously be employed. Since the stone carriers are a little more than double the area of the stones, the air pressure in the tube need be something less than half of that of the desired unit stone pressure. In the illustrative tool, wherein the external diameter of the shell is 1⅜'', the small bore of the tube opposite the stones is about 6 inches long and the larger bore for supplementary tube volume about 9 inches long. Pressure may be transmitted to the stone by inflating the tube wholly or partially with liquid, but this is generally not desirable, particularly for small bore hones, since it reduces the volume of the resilient medium.

A single tool of the type herein illustrated may be employed to hone a substantially larger range of bore diameters than other types of hones, the limiting factor being that of adequate bearing for the stone carriers in the slots **12**. An adaptor sleeve having slots therein registering with the slots **12** may be slipped over the holder **11** to provide adequate bearing for the stone carriers **14** as they are moved radially outward.

The hone may be rotated and reciprocated inside a cylinder by means of conventional apparatus referred to more particularly in our copending application, Serial No. 248,213, filed December 29, 1938, and which matured as Patent 2,320,747 on June 1, 1943. A transverse hole **31** is provided in the end of the tool for connecting it to driving apparatus. As explained in the aforesaid copending application, such connection should preferably allow the hone to float, i. e., to adjust itself freely inside the bore independently of the apparatus for rotating and reciprocating the hone. The cutting speed, as well as the ratio of rate of rotation to rate of reciprocation, should be adjusted to the particular operation performed. Preferably this rate should be such that the helical marks or scratches formed by the stones on their forward strokes should cross those formed on the return strokes at angles between 40° and 60°.

Obviously the invention is not limited to the details of the illustrative apparatus since these may be variously modified. Moreover it is not indispensable that all features of the invention be used conjointly since various features may be used to advantage in different combinations and sub-combinations.

Having described our invention, we claim:

1. A honing device for small diameter bores comprising in combination a hollow stone holder whose external diameter is less than two inches, said holder having a plurality of radially movable honing stones, said holder having a hollow interior extending substantially beyond the ends of the stones, a flexible tube inside said holder adapted when distended to press said stones against the surface to be honed, said tube also occupying the extending hollow interior, said hollow interior being at least double that of the interior of said holder inside said stones.

2. A honing device for small diameter bores comprising in combination a hollow stone holder whose external diameter is less than two inches, said holder having a plurality of radially movable honing stones, said holder having a hollow interior extending substantially beyond the ends of the stones and being of substantially larger internal diameter than that opposite said stones, a flexible tube inside said holder adapted when distended to press said stones against the surface to be honed, said tube also occupying the extending hollow interior, said hollow interior being at least double that of the interior of said holder inside said stones.

3. A honing device for small diameter bores comprising in combination a hollow stone holder whose external diameter is less than two inches, said holder having a plurality of radially movable honing stones, said holder having a hollow interior extending substantially beyond the ends of the stones, a flexible tube inside said holder adapted when distended to press said stones against the surface to be honed, said tube also occupying the extending hollow interior, said hollow interior being at least double that of the interior of said holder inside said stones, and resilient means operative when said tube is inoperative to press said stones inwardly to permit insertion of the honing device into a bore.

4. A honing device for small diameter bores comprising in combination a tubular stone holder having slots therein for carrying and guiding honing stones, stone carriers having honing stones radially slidable in said slots, said holder having a supplementary hollow interior extending substantially beyond the ends of the stones, a flexible impervious tube inside said holder in operative relation to said stones, said tube also occupying the supplementary hollow interior of said holder and having therein a volume of gas

such as air under substantial compression to force said stones outwardly under honing pressure against the bore to be honed, the volume of said supplementary hollow interior and that of the tube occupying the same providing space for sufficient additional volume of compressed gas to provide an inflated volume sufficient to prevent substantial reduction of stone pressure through stone wear.

5. A honing device for small diameter bores comprising in combination a tubular holder adapted to enter the bore to be honed and carrying honing stones, and a flexible tube containing gas under pressure and having a portion inside said tubular holder to force the honing stones against the surface of the bore under honing pressure, the volume of said portion of the tube being insufficient to carry enough gas to maintain substantially constant stone pressure despite stone wear, said holder having an adjacent hollow extension also occupied by said tube, the volume of the portion of said tube in said hollow extension together with the volume of the portion inside said tubular holder being adapted to contain enough gas under pressure to maintain substantially constant stone pressure despite stone wear.

6. A honing device for small diameter bores comprising in combination a tubular holder adapted to enter the bore to be honed and carrying honing stones, and a flexible tube having a portion inside said tubular holder and inflated with gas under pressure to force the honing stones against the surface of the bore under honing pressure, the volume of the portion of the tube inside said holder being insufficient alone to carry enough gas to maintain substantially constant stone pressure despite stone wear, said holder having an adjacent hollow extension of less outer diameter than the bore to be honed and also occupied by said flexible tube, the volume of said tube inside said hollow extension together with that inside said tubular holder providing a space for enough gas under pressure to maintain substantially constant stone pressure despite stone wear.

7. A honing device for small diameter bores comprising in combination a tubular holder adapted to enter the bore to be honed and carrying honing stones, a flexible tube having a portion inside said tubular holder inflated with gas under pressure to force the honing stones against the surface of the bore under honing pressure, the volume of the portion of the tube inside said holder being insufficient alone to carry enough gas to maintain substantially constant stone pressure despite stone wear, said holder having an adjacent hollow extension of less outer diameter than the bore to be honed and also occupied by said flexible tube, the volume of said tube inside said hollow extension together with that inside said tubular holder providing a space for enough gas under pressure to maintain substantially constant stone pressure despite stone wear and means lying within said honing device for closing said tube against the escape of said gas under pressure.

8. A honing device for small diameter bores comprising in combination a tubular holder adapted to enter the bore to be honed and carrying honing stones, a flexible tube containing gas under pressure and having a portion inside said tubular holder to force the honing stones against the surface of the bore under honing pressure, the volume of said portion of the tube being insufficient to carry enough gas to maintain substantially constant stone pressure despite stone wear, said holder having an adjacent hollow extension also occupied by said tube, the volume of the portion of said tube in said hollow extension together with the volume of the portion inside said tubular holder being adapted to contain enough gas under pressure to maintain substantially constant stone pressure despite stone wear, and valve means connected with said tube through which gas may be introduced into and released from said tube to adjust the pressure in the tube.

VICTOR W. PETERSON.
FRANK J. DALEY.