

Jan. 29, 1963

W. P. KUSHMUK ET AL

3,075,412

RIDGE REAMER

Filed June 27, 1960

2 Sheets-Sheet 1

Fig. 1.

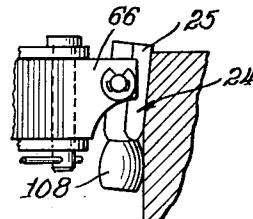
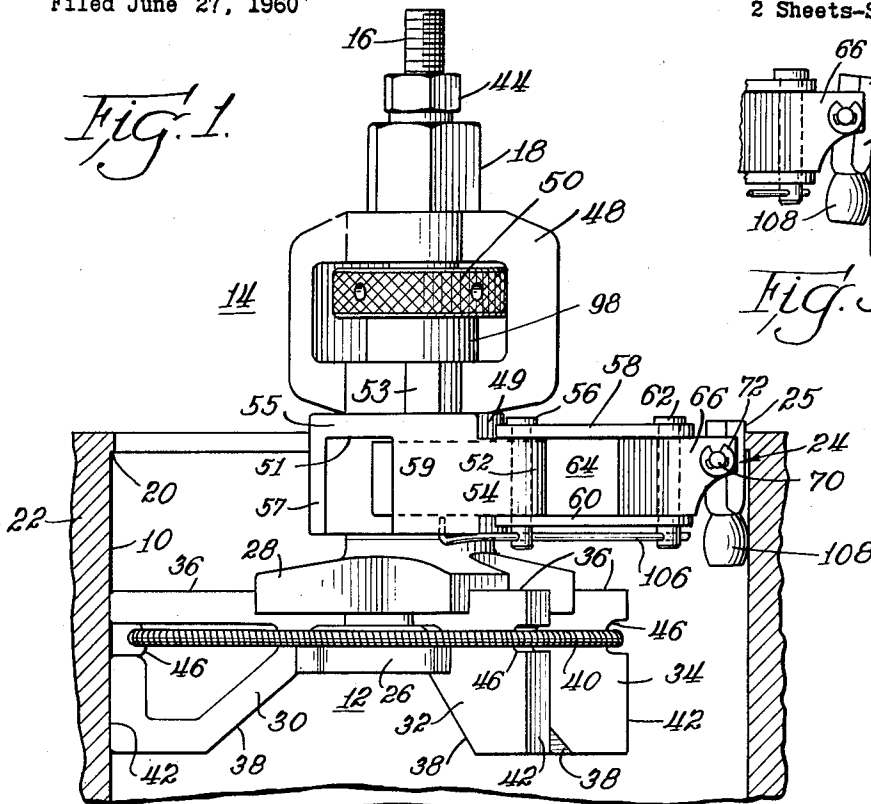


Fig. 3.

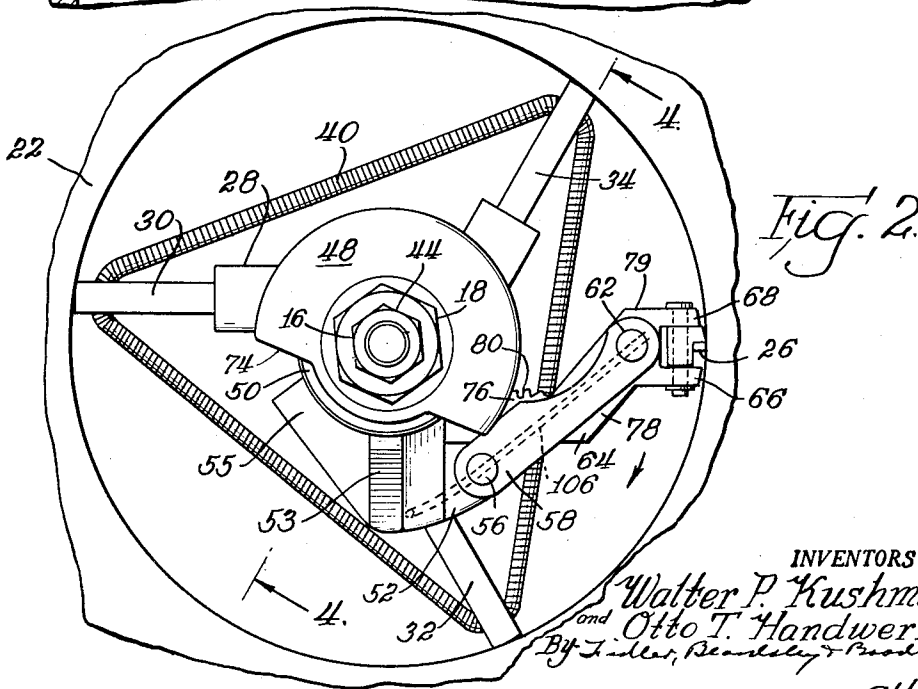


Fig. 2.

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2 Sheets-Sheet 2

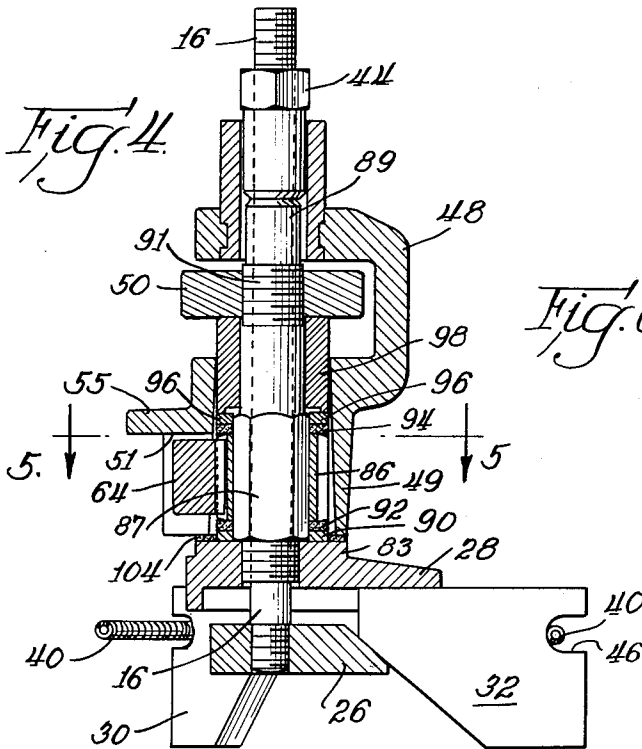
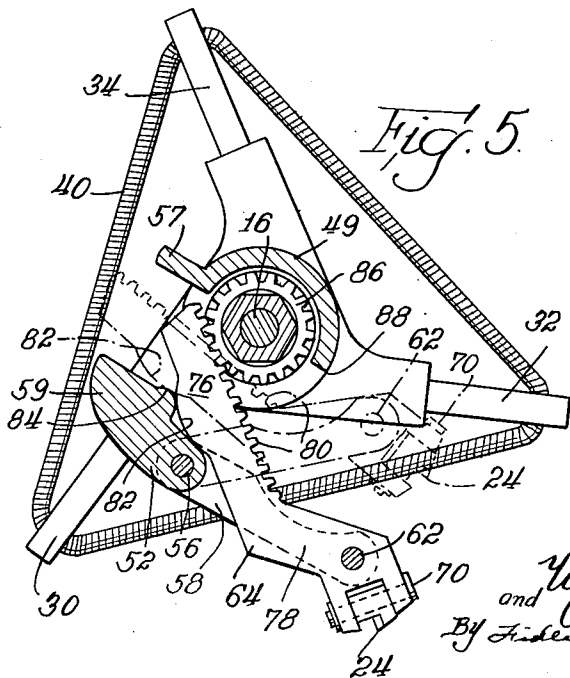
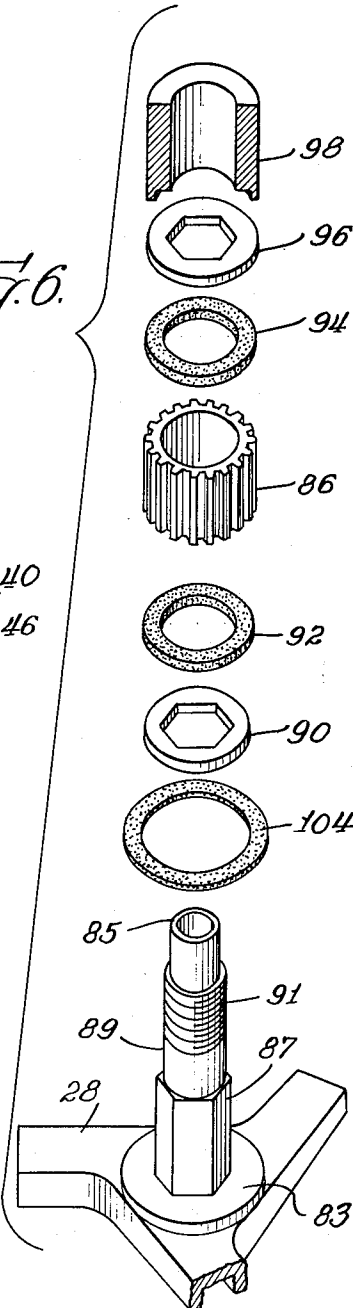


Fig. 6.



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1

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RIDGE REAMER

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10 Claims. (Cl. 77-2)

This invention relates generally to reamers and has to do particularly with reamers of the type adapted to remove ring-wear ridges from internal combustion engine cylinders.

The movement of a piston in a cylinder wears the cylinder wall, increasing the diameter of the cylinder, and since the uppermost piston ring does not reach the top of the cylinder, a ridge is left adjacent the top of the cylinder wall. In reconditioning cylinders, it is often necessary to remove this ridge to permit removal of the piston and in all instances removal of the ridge is desirable to insure proper functioning of the newly installed rings.

Ridge reamers of the type to which the present invention relates have a cutting blade which is forceably maintained in contact with the ridge to be reamed, and movable between the limits of the initial and final diameters of the ridge and cylinder, respectively. Such motion is often provided for by the mounting of the cutting blade on a member supported in a slideway, which permits the member to slide along a chord of the circular cross section of the cylinder, toward the cylinder wall and the ridge thereon. These reamers of the prior art are, however, limited to use on a narrow range of cylinder diameters, the minimum and maximum being fixed by the length of the member supported in the slideway, which member must be shorter than a particular chord of the cylinder cross section, and at the same time greater than one half the corresponding chord of the final cylinder diameter.

Another limitation of the versatility of prior ridge reamers is that as the ridge is reamed away and the cutting blade is extended along a chord of the circular cross section, the blade changes its attitude with respect to the ridge, and the cutting efficiency is lowered.

Still another limitation of prior ridge reamers is that the cutting blade and its supporting member are subject to relatively large bending moments exerted by the resistance of the ridge to reaming, which also tend to change the attitude of the cutting blade with respect to the ridge being reamed, particularly at relatively large cylinder diameters.

Accordingly, it is a principal object of the invention to provide a ridge reamer in which bending moments acting on the cutting blade and its supporting member are reduced to a minimum.

Another object of the present invention is to provide a ridge reamer having a cutting blade so mounted and supported that the reamer is adapted for cutting a wide range of ridge diameters in a wide range of cylinder diameters.

A further object is to provide a ridge reamer wherein the cutting blade is forced against the ridge being reamed by a constant, radially directed force.

Yet another object is to provide a ridge reamer wherein the cutting blade is pivotable about a horizontal axis, and the cutting blade has a spherical portion on one end thereof adapted for sliding contact with the cylinder wall.

Another object is to provide a ridge reamer wherein means is provided for supplying a radially directed force to the cutting blade, which force is independent of radial position of the cutting blade.

Other objects and advantages will be apparent upon reference to the following detailed description and to the accompanying drawings wherein,

2

FIG. 1 is a side elevational view of the ridge reamer of the present invention shown in position in an engine cylinder, the latter being shown fragmentarily and in section;

FIG. 2 is a top plan view of the ridge reamer;

FIG. 3 is a fragmentary view showing the cutting blade of the ridge reamer in position against the cylinder wall after removal of the ridge;

FIG. 4 is a vertical sectional view of the ridge reamer taken on the line 4-4 of FIG. 2;

FIG. 5 is a horizontal sectional view taken on line 5-5 of FIG. 4; and

FIG. 6 is an exploded perspective view, partly in section, of the elements disposed on the main shaft of the ridge reamer.

In carrying out the present invention, the cylinder ridge reamer may be provided with a base portion adapted to support the device internally of an engine cylinder 10 for relative rotation of a head portion about the axis of the cylinder such as, for example, the base portion of the ridge reamer disclosed in the Wallace F. Mitchell Patent No. 2,380,605, issued July 31, 1945. The rotatable head portion provides support for a reamer cutting blade which is connected to a blade arm, the arm in turn being coupled to the head portion. The blade arm has a rack on its inwardly extending end, which rack engages a pinion within the head portion. The blade arm, attached to the head portion by link members, is forced outwardly by the pinion when rotated about the pinion with the head portion.

Referring now more particularly to the ridge reamer shown in the drawings, such reamer comprises a base portion 12 adapted to engage portions of the cylinder wall and to fixably support the device therein. A head portion 14 is supported for rotation about a shaft 16, which is fixed to the base portion. The head portion 14 has a polygonal shank 18 adapted to receive a wrench (not shown) or other means which a workman may use to rotate the head portion 14 when removing a ring-wear ridge such as the ring-wear ridge 20 located adjacent the top of cylinder wall 10 inside cylinder 22. The head portion 14, having a blade portion 25, adjustably supports the reamer cutting blade 24 in accordance with the present invention, and will be more fully described hereinafter.

The base portion 12 is composed of a bottom end member 26 and a top end member 28, which members are both positioned on shaft 16. Shaft 16 is fixedly secured to the bottom end member 26 by being tightly screwed into threads provided on the inside surface of a hole therethrough, while top end member 28 is free to slide longitudinally with respect to the shaft 16.

The top end member 28 is provided with three radially extending grooves on the bottom surface thereof each of which receives blade-like clamping jaws 30, 32 and 34 in sliding relation thereto. Bottom end member 26 is provided with an equal number of radial grooves in its top surface, which also receive said blade-like clamping jaws 30, 32 and 34 in sliding relation thereto.

The grooves in the bottom end member, however, are inclined in downwardly extending fashion, with respect to the center of the bottom end member 26.

Top end member 28 is prevented from rotating relative to bottom end member 26 by the clamping jaws which fit snugly into the grooves of both the end members 26 and 28. The fit of the clamping jaws into the grooves is not so tight, however, as to prevent them from freely sliding in such grooves in response to the pressure exerted by garter spring 40, the purpose of which is more fully discussed hereinafter.

The three clamping jaws 30, 32 and 34 each have a horizontal top surface, and a bottom cam surface 38

which is inclined upwardly at an angle corresponding to that of the grooves in the bottom end member 26.

Each of the clamping jaws 30, 32 and 34 is wedged into position in the grooves between top end member 28 and bottom end member 26, and retained in such position by means of garter spring 40, which forces all of the clamping jaws inwardly.

Each of the blade-like elements 30, 32 and 34 has a vertical outer surface 42, adapted to abut different portions of cylinder wall 10, and thus retain the base portion in fixed relation to the ridge 20.

The base portion of the ridge reamer is locked into position within the cylinder 22 through the action of a nut 44 located on a threaded portion of shaft 16. Turning nut 44 on shaft 16 shortens the length of shaft 16 between the top end portion 28 and the bottom end portion 26. The distance between these end members is therefore shortened and the wedge-shaped clamping jaws 30, 32 and 34 are forced outwardly, to engage portions of the cylinder wall 10. A considerable amount of outwardly directed force can be exerted on the clamping jaws 30, 32 and 34 through their bottom cam surfaces 38, and this force is sufficient to fixedly retain the base portion in any cylinder.

Each of the clamping jaws has on its surface 42 a notch 46 which receives garter spring 40. Thus, garter spring 40 does not contact the cylinder wall 10 at any point but merely serves to retain clamping jaws 30, 32 and 34 in position in the grooves of the top and bottom end members of the base portion.

The head portion 14 is disposed on the shaft 16 for rotation thereabout and also for rotation with respect to the base portion 12, in which shaft 16 is fixed. The upper part of head portion 14 is provided with an enlarged cage-like head 48 within which is housed knurled wheel 50, the purpose and operation of which will be explained hereinafter. The lower part of head portion 14 is a hollow cylinder 49, being cut away at its bottom portion to provide an opening 51 extending for about half the circumference of the cylinder 49. The upper portion of the cylinder 49 is attached by a fillet 53 to a radially extending horizontal portion 55, which is also joined to a radially extending vertical portion 57, extending radially from the cylinder 49. To the horizontal portion 55 is attached a downwardly extending vertical portion 59. The portion 59 is provided with a laterally extending projection 52 having a vertical aperture 54 which receives a pin 56.

The inner end of each of two link members 58 and 60 is secured to projection 52 by means of a pin 56 and both link members are adapted to pivot about the pin 56. Another pin 62 is passed through the opposite, outer ends of the link members 58 and 60, and serves to pivotably secure said link members to an angled portion 78 of a blade carrying or "blade" arm 64. Arm 64 is a unitary member having three portions, namely straight portions 76 and 79, and an angled portion 78. The portion 79 is provided with two laterally extending projections 66 and 68, which are disposed in parallel vertical planes. Between these projections, a cutting blade 24 is pivotably secured by a pin 70. The pin 70 is disposed horizontally between projections 66 and 68, and is held in position by a C ring 72.

FIG. 2 is a top view of the ridge reamer in position in a cylinder 22 and shows particularly the manner in which rocker arm 64 and the link members 58 and 60 are arranged with respect to other components of the head portion 14.

The projection 52 which extends laterally in relation to the head portion 14 is shown in FIG. 2 as having pivotally connected thereto link members 58 by means of pin 56. Thus, the link member 58, and the link member 60 (similar to the link member 58) are free to rotate about the pin 56. The pin 62, disposed at the other end of the link members 58 and 60, connects these link members to the blade arm 64, and likewise permits rotation of the blade arm 64 and link members 58 and 60.

A wire spring 106 is provided which has the dual purpose of retaining pins 56 and 62, and also of normally urging the arm 64 in an outward direction. Thus the cutting blade 24 of the ridge reamer will always rest against the ridge 20 and cylinder wall 10 as long as the ridge reamer is in position in said cylinder. This operation brings about the desirable feature of preventing scarring of the cylinder wall by the cutting blade 24.

Referring now to FIG. 5, which is a horizontal section of the ridge reamer, it will be seen that blade arm 64 is provided with a straight portion 76, an angled portion 78, and another straight portion 79. The two straight portions 76 and 79 are parallel and offset and are joined together by angled portion 78. On one side of the straight portion 76, at the end opposite angled portion 78, there is formed a rack 80 comprised of a number of teeth linearly arranged along a vertical surface of the blade arm. On the opposite side of straight portion 76 of blade arm 64 from the rack 80, there is disposed a cam surface 82 which bears against a complementary cam surface 84 formed on the inner face of the vertical portion 59. The function of these two cam surfaces will be more fully described hereinafter.

Referring to FIG. 5, the rack 80 engages the teeth of a pinion 86 which is mounted for rotation about shaft 16 as hereinafter explained.

When the pinion 86 rotates in a counter-clockwise direction, relative to rack 80, its teeth exert a tangential force on the engaging teeth of rack 80, and force the rack, and blade arm 64, outwardly. The angled portion 78 of the blade arm 64 is of such a length and angle, with respect to the straight portions 76 and 79, as to permit the straight portion 79 to be aligned radially with respect to the center of shaft 16. It will be remembered that projections 66 and 68 extend from the straight portion 79, which projections pivotally support the cutting blade 24 on pin 70. The alignment of the pin 70, and the cutting blade 24, is in a vertical plane extending radially from the shaft 16 and passing longitudinally through the straight portion 79 of the blade arm 64. Thus, although the rotation of the pinion 86 will force the rack 80 outwardly in a direction tangential to pinion 86, this force is applied to the cutting blade 24 in a radial direction. One advantage of this arrangement is that the cutting blade 24 is always maintained in the same attitude in relation to the ridge being reamed, for all radial positions of cutting blade 24. Another advantage is related to the shape of the three sectioned blade arm 64. This shape permits the ridge reamer to be employed on a larger variety of cylinder sizes because it does not move only in a single chord of the circular cross section of the cylinder. The straight portion 76 of rocker arm 64 moves in a chord, while the straight portion 79 at the opposite end of rocker arm 64 moves along a radius and not a chord.

Referring again to FIG. 2, the link members 58 and 60 connect the straight portion 79 of the rocker arm to the projection 52 of the head member 14. When the blade arm 64 is extended from the head portion by virtue of the relative rotation of pinion 86, the pin 62 moves about an arc having its center at pin 56. The link members 58 and 60 join pins 56 and 62 and transfer loading forces, present on pin 62 during the operation of the reamer, to pin 56 and thence to head portion 14. This operation, carried out by permitting tensional stresses in link members 58 and 60, balances all tangentially directed forces at pin 62, and relieves blade arm 64 of the bending strain which would otherwise result.

It will be appreciated that the blade arm 64 is relieved of substantially all bending moments, due to the orientation of the link members 58 and 60. The force acting on the cutting blade 24 as a result of the reaming operation will have two components, one in a radial direction toward the center of shaft 16, and the other in a tangential direction tending to resist the scraping movement of cutting blade 24 along the ridge. The radial component of

5

this force is balanced by the force transmitted to the rack 80 by pinion 86; and the tangential component of this force is balanced by tension existing in the link members 58 and 60. Moreover, these forces are balanced at the position of pin 62, which is located in close proximity to the cutting blade 24. Thus, the only bending moment acting on the blade arm 64 is exerted over the moment arm existing between the cutting blade 26 and the pin 62. Since this moment arm is a fixed distance, any bending moment which may be produced is constant for a given value of friction, no matter what the radial position of cutting blade 24 may be. And, as this distance is very short, the bending moment is quite small. By virtue of the elimination of this bending moment, cutting blade 26 remains in substantially the same attitude with respect to the ridge for all values of tangentially directed frictional forces, and maximum efficiency can be realized in the cutting of ridge 20. The amount of tensional forces exerted on link members 58 and 60 is substantially constant for different radial positions of cutting blade 24, because the angle formed between the blade arm and the link members is only slightly different at these positions, due to the position of pin 56 with respect to arm 64.

The attitude of the cutting blade 26 with respect to ridge 20 is also constant for all values of radial extension of the cutting blade 24, as pointed out hereinbefore. Thus, the present invention is capable of operating effectively in reaming the ridge from a cylinder wall over a very great difference in diameter between the ridge of the cylinder wall. At all such diameters, however, and at all values of friction encountered, the attitude with the cutting blade 26 remains the same.

Referring now again to FIG. 5, the purpose of the complementary cam surfaces 82 and 84 will now be discussed.

It will be seen that as the blade arm 64 progresses (because of relative rotation of pinion 86) from the contracted position shown in dashed lines in FIG. 5, to the extended position shown in solid lines in FIG. 5, the pinion 86 will have rotated and different teeth of rack 80 and pinion 86 will be engaged at a different portion of the periphery of pinion 86. The blade arm may then be said to have "walked" part way around the pinion 86.

The complementary cam surfaces 82 and 84 are designed to insure that rack 80 remains in engagement with pinion 86 in all of its possible positions, whether retracted or extended. In the position shown in solid lines in FIG. 5, the blade arm is shown in its fully-extended position with the rack 80 in engagement with the pinion 86 and the two complementary cam surfaces 82 and 84 in contact. The cam surface 82, however, is also in contact with part of the laterally extending projection 52, thus preventing the blade arm 64 from extending further than the position shown. The position shown in the dashed lines in FIG. 5 is an intermediate position of the blade arm. The complementary cam surfaces 82 and 84 remain in engagement, as shown, although a different portion of the cam surface 82 is now contacting a different portion of the cam surface 84. So it is throughout all positions of the blade arm 64, that the cam surfaces 82 and 84 retain the teeth of the rack 80 in engagement with the teeth of the pinion 86. The inwardmost position which may be occupied by the blade arm 64 is that in which the angled portion of the blade arm 64 abuts against the corner 88, formed at one side of the opening 51 of cylinder 49 of the head portion 14.

It has been described above that the pinion 86 is mounted for rotation on the shaft 16, and is responsible for transmitting force through the rack 80 which extends the blade arm 64. The force which is supplied via the pinion 86 to the rack 80 is derived from a clutch which yieldably couples the pinion 86 to a hollow tube 85 connected to top end member 28. It will be remembered that the shaft 16 is fixed to the bottom end member of the base portion and does not rotate, since the base portion

6

is firmly positioned inside the cylinder 22. Therefore, when the clutch is engaged, the position of pinion 86 tends to be held fixed with respect to the base portion 12. However, the rotation of the head portion 14 and its several component parts about tube 85, with respect to the base portion 12, produces the relative effect of rotating the pinion 86 with respect to the head portion, thus forcing the blade arm 64 outwardly as described above in connection with FIG. 5.

In FIG. 4, which is a vertical sectional view of the ridge reamer, the parts of the clutch member, and other elements forming head portion 14, are shown in assembled relation and partly in section. In FIG. 6, the elements of the clutch are shown in an exploded view and partly in section.

The upper end member 28 of the base portion 12 has a horizontal platform 83 and a hollow tube 85 extending normally from the center of the platform 83 and having a polygonal portion 87 and a cylindrical portion 89. The cylindrical portion 89 is provided with a thread 91 extending over a portion of its length. The shaft 16 extends through the tube 85 in sliding relation and is free to move longitudinally therein without resistance, which it does in response to rotation of nut 44 as described hereinbefore.

The polygonal portion 87 of the tube 85 holds in a nonrotatable position a washer 90, having a polygonal shaped aperture 93 corresponding to the polygonal portion 87 of tube 85. Above this washer is an annular fiber washer 92, having a circular aperture, which washer is free to rotate about the polygonal portion of tube 85. Above the fiber washer 92, the pinion 86 is disposed, which also has a circular aperture and is rotatable with respect to the tube 85. Above the pinion 86 are two more washers 94 and 96, which are identical to washers 92 and 90, respectively, but disposed in reverse, so that pinion 86 is held in position between two rotatable fiber washers 92 and 94, which are in turn held in position by two nonrotatable washers 90 and 96. The force tending to move these elements closer together determines the amount of resistance to rotational motion about the tube 85 which is offered by the pinion 86. This resistance is directly proportional to the force urging the surfaces of these elements together, and is independent of the angular velocity of the washers 92 and 94 or pinion 86. Thus the radially directed force applied to the blade arm 64 via rack 80 and pinion 86 is also proportional to this resistance.

Above the washer 96 is located a metal spacer 98, above which is located a knurled wheel 50, disposed in threaded engagement with the shaft 16. The act of turning the wheel 50, with respect to tube 85, forces the metal spacer downwardly with respect to the tube 85 onto the washer 96, thus exerting a force tending to press the washers 90, 92, 94 and 96, and pinion 86 together. The position of the entire assembly is fixed on tube 85 between the top end member 28 and the knurled wheel 50, and turning of the knurled wheel 50 on the tube 85 further and further will continuously increase this force and give rise to a corresponding increase in the resistance offered by the pinion 86 to rotation about the tube 85. It will be apparent therefore that the function of the knurled wheel 50 is to vary the tension of the friction clutch which determines the amount of force urging cutting blade 24 radially toward the ridge 20.

The use of the friction clutch associated with pinion 86 for deriving the radially directed force applied to the cutting blade 24 also produces the advantageous result of making such radially directed force independent of the speed of rotation of the head member 14. This is so, because the radial force on cutting blade 24 is a function of the frictional force on the pinion 86, which force is independent of velocity.

One other element is disposed on tube 85 and shown in FIGS. 5 and 6. That element is fiber washer 104 which furnishes a bearing surface on the platform 83 for the rotation of head portion 14 about the base portion 12.

It has been described that cutting blade 24 is pivotable about horizontally disposed pin 70, supported by laterally extending projections 66 and 68 of the blade arm 64. When the ridge reamer is in position inside a cylinder 22 the rotational position of the cutting blade, about this horizontal axis, is determined by the blade 24 resting against the ridge 20 and the spherical surface 108 of the cutting blade resting against cylinder wall 10. The spherical surface 108 rubs against the cylinder wall continuously while the ridge 20 is being reamed out, and permits the cutting blade 24 to rotate about pin 70 in response to increasing diameter of the ridge. Thus, the portion 25 is initially entirely free of the cylinder wall 10, but approaches it gradually as the ridge is removed. Not until the ridge is entirely removed can there be any removal of material making up cylinder wall 10. When the cutting portion 25 reaches the position shown in FIG. 3, it is inclined at a slight angle to the vertical, and thus cuts-back the top portion of the cylinder wall 10. This angle is not critical and is provided only to insure that under no circumstance can a "step" be cut into the cylinder wall 10 which would interfere with the subsequent insertion of a piston and rings (not shown) into cylinder 22. Of course cutting blade 24 may be designed to remove the ridge 20 flush with cylinder wall 10, but great care must be used to stop the reaming after the ridge is removed and before a step is cut into the wall. No disadvantages in the operation of the piston and cylinder arise from a slight cutting-back of the top portion of the cylinder wall, and accordingly this is preferred in the interest of expediency and ease of operation.

Inasmuch as the radius of curvature of surface 108 is much less than that of the cylinder wall, surface 108 makes substantially a point contact with cylinder wall 10, and is therefore not fouled by chips of metal being reamed from the ridge by the cutting blade 24.

In the operation of the ridge reamer to remove ridge 20 from wall 10 of cylinder 22, base portion 12 is fixably secured within the cylinder by tightening nut 44, and head portion 14 is rotated with respect to the base portion 12 and cylinder 22 by the application of a rotational force to shank 18. The entire head portion will then rotate, including the cage-like head 48 and the projection 52 extending from the head portion 14. This force is transmitted to blade arm 64 by means of link members 58 and 60, and causes the rotation of blade arm 64 with respect to the center shaft 16 and around pinion 86. The clutch means, controlled by knurled wheel 50, tends to resist rotation of pinion 86 with respect to shaft 16, and forces blade arm 64 outwardly. The cutting blade 24, supported by blade arm 64, is forced radially outwardly as it is rotated with respect to ridge 20. The cutting blade thus scrapes against the ridges as it is rotated and gradually removes the ridge until it is flush with the remainder of the cylinder wall. Then nut 44 is loosened, and the ridge reamer is removed from the cylinder.

While we have shown a preferred embodiment of the invention, it is understood that certain changes may be made within the scope of the appended claims.

We claim:

1. A cylinder ridge reamer of the type adapted to remove a ring-wear ridge formed on the wall of an engine cylinder, comprising a base portion, a head portion supported for rotation on said base portion, a reamer blade unit supported on said head portion for rotative movement therewith and for movement transverse of said head portion toward and away from the ring-wear ridge to be removed, said reamer blade unit having a toothed rack, a cutting blade carried at the outer end of said rack, a link pivotally connected at one end to said head portion and at the other end to said rack adjacent said blade carrying end, and a friction transmission supported on said base portion and operatively connected to said toothed rack to move said reamer blade unit into yieldable reaming relation with the ring-wear ridge as said head portion is ro-

tated in one direction and to move said reamer blade unit away from the ring-wear ridge as said head portion is rotated in the other direction.

2. A rotatable cylinder ridge reamer comprising a body member, supporting means for supporting said head member for rotational movement, a tubular shaft connected to said supporting means extending through said body member, a pinion rotatably mounted for rotation about said shaft, said body member having an enlarged portion to accommodate said pinion, friction clutch means located on said shaft for yieldably rotating said pinion with said shaft, said body member having a laterally extending projection, a plurality of link members, each of said link members being pivotally connected at one end to said projection, a cutting blade, a rocker arm supporting said cutting blade at one end thereof, said one end of said arm being pivotally connected to each of said link members at the end which is free of said projection, the other end of said arm having a rack and a cam surface on opposite sides thereof, said rack engaging said pinion, said arm being movable in response to relative rotational movement of said pinion so as to transport said cutting blade radially inwardly and outwardly, said projection having a complementary cam surface engaging the cam surface of said arm and adapted to keep said rack engaged with said pinion, and a shank member connected to said head member, whereby a rotational force applied to said shank member rotates said body member and its said projection about said shaft, said links impart a corresponding rotational force on said arm just sufficient to oppose tangentially directed frictional forces generated at said cutting blade, and the arm in being rotated about said pinion is forced radially outward by virtue of the resistance offered by said friction clutch to the rotation of said pinion about said shaft.

3. A cylinder ridge reamer comprising means including a base for supporting said ridge reamer in a cylinder, a head rotatably mounted on said base, a reamer blade unit including an arm and a blade at one end of said arm, means including a link pivoted at one end to said arm and at the other end to said head supporting said arm for rotative movement with said head and sliding movement transversely of said head, and drive means for moving said blade unit in one direction transversely of said head upon rotation of said head in one direction and in the opposite direction upon rotation of said head in the opposite direction, said drive means including a drive member rotatable on said base, inter-engaging means on said drive member and said arm and a yieldable drive between said head and said drive member.

4. A cylinder ridge reamer as set forth in claim 3 wherein means are provided for maintaining said inter-engaging means in engagement throughout the movement of said arm, said means including cam surfaces on said arm and on said head respectively.

5. A cylinder ridge reamer as set forth in claim 3 wherein said arm has a first portion movable radially relatively to said head, a second portion offset from said first portion and carrying a portion of said inter-engaging means and the third portion connecting said first and second portions.

6. A cylinder ridge reamer comprising means including a base for supporting said ridge reamer in a cylinder, a head rotatably mounted on said base, a reamer blade unit including an arm and a blade at one end of said arm, means including a link pivoted at one end to said arm and at the other end to said head supporting said arm for rotative movement with said head and sliding movement transversely of said head, and drive means for moving said blade unit in one direction transversely of said head upon rotation of said head in one direction and in the opposite direction upon rotation of said head in the opposite direction, said drive means including a drive pinion rotatable one said base, a rack on said arm engaging said

9

pinion and a friction drive between said head and said pinion.

7. A cylinder ridge reamer comprising means including a base for supporting said ridge reamer in a cylinder, a head rotatably mounted on said base, a reamer blade unit including an arm and a blade at one end of said arm, means including a pair of parallel links on opposite sides of said arm and pivoted at one end to said arm and at the other end to said head supporting said arm for rotative movement with said head and sliding movement transversely of said head, and drive means for moving said blade unit in one direction transversely of said head upon rotation of said head in one direction and in the opposite direction upon rotation of said head in the opposite direction, said drive means including a drive member rotatable on said base, inter-engaging means on said drive member and said arm and a yieldable drive between said head and said drive member.

8. A cylinder ridge reamer comprising means including a base for supporting said ridge reamer in a cylinder, a head rotatably mounted in said base, a reamer blade unit including an arm and a blade at one end of said arm, means including a link pivoted at one end to said arm adjacent said blade and at the other end to said head supporting said arm for rotative movement with said head and sliding and swinging movement transversely of said head, and drive means for moving said blade unit in one direction transversely of and swingably relative to said head upon rotation of said head in one direction and in the opposite direction upon rotation of said head in the opposite direction, said drive means including a drive member rotatable on said base, inter-engaging means on said

10

drive member and said arm and a yieldable drive between said head and said drive member.

9. A cylinder ridge reamer of the type adapted to remove a ring-wear ridge formed on the wall of an engine cylinder, comprising a head member, means for supporting said head member for rotational movement relative to said cylinder, an arm, means coupling said arm to said head member at both of the ends of said arm and including at least one link member pivotally connected to said head member and to said arm, a cutting blade carried by said arm and including a rack on said arm and a pinion engageable therewith and means responsive to the rotation of said head member for applying a radially directed force to said cutting blade.

10. A ridge reamer according to claim 9 wherein is provided a pair of link members, pins extending through corresponding ends of each of said link members, one of which pins extends also through a portion of said arm and the other of which pins extends also through a portion of said head member, and a spring member engaging and retaining said pins and urging said arm outwardly with respect to said head member.

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