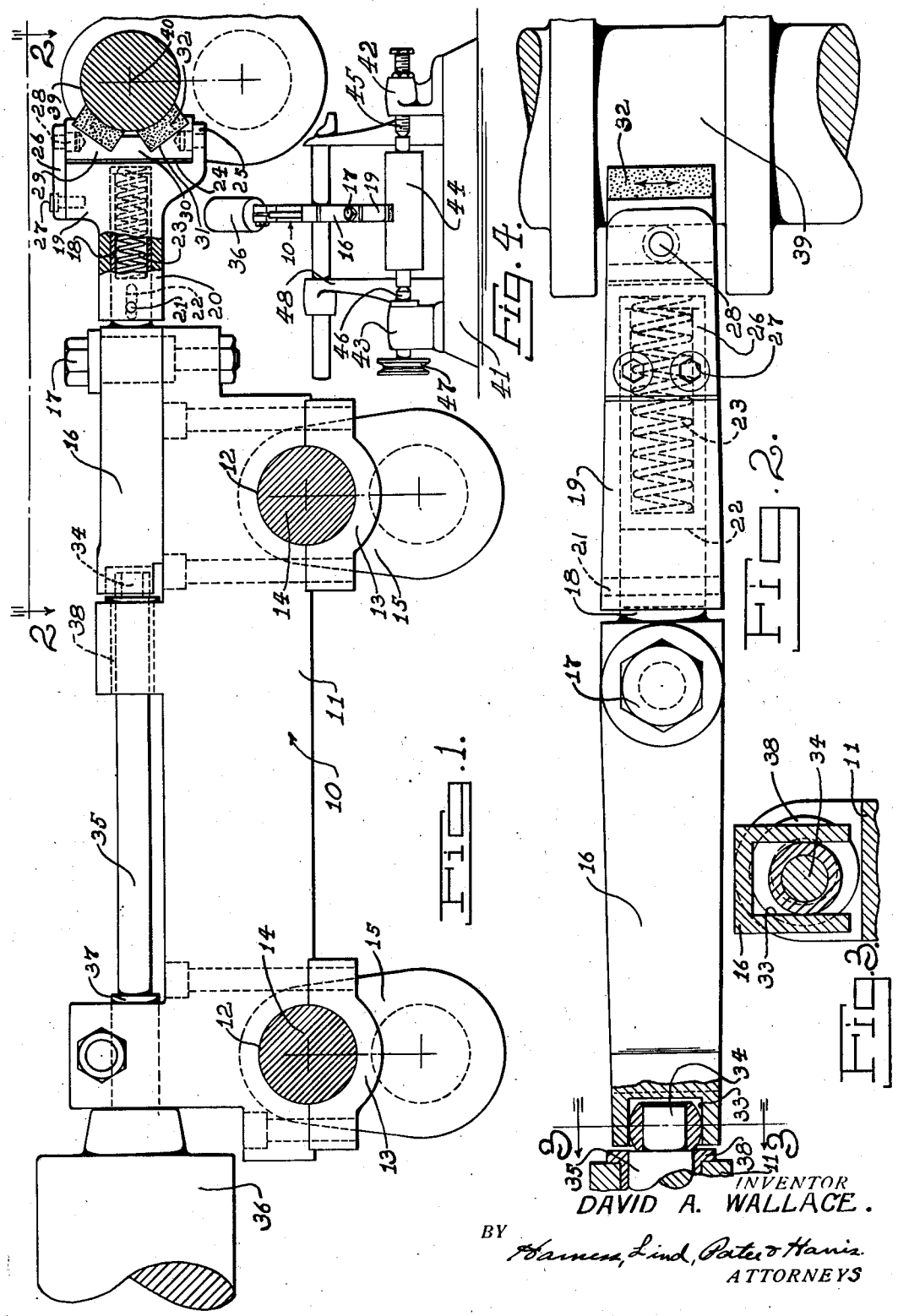
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LAPPING APPARATUS

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INVENTOR
DAVID A. WALLACE.

BY Harness, Lind, Paten & Harris
ATTORNEYS

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LAPPING APPARATUS

David A. Wallace, Detroit, Mich., assignor to Chrysler Corporation, Highland Park, Mich., a corporation of Delaware

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This invention relates to improved lapping apparatus and is a further development of the invention set forth in my copending application, Serial No. 91,851, filed July 22, 1936.

More particularly the invention pertains to improvements in the driving mechanism by which lapping elements may be drivingly reciprocated at a relatively high speed approaching a vibratory order while in contact with a simultaneously rotating piece of work.

One of the main objects of the invention is to provide an operative driving connection between lapping element reciprocating mechanism and a driving member which is located in spaced relation to the lapping element and so far remote from the location at which the lapping elements operate upon the surface of the work as to avoid the exposure of the mechanically driven parts of the driving connection to abrasion by particles of the material of which the lapping element is formed.

Another object of the invention is to provide a lapping element reciprocating member which is pivotally mounted intermediate its end for oscillatory movement about a fixed axis and which has a longitudinally extensible section on one end by which movement of the lapping element in a substantially linear course is accommodated during oscillatory movement of the member.

A still further object of the invention is to provide a pivotally mounted lapping element reciprocating member having extensible parts yieldably urged apart in order to predetermine the force of application of the lapping element carried thereby upon the work.

Illustrative embodiments of the invention are shown in the accompanying drawing, in which:

Fig. 1 is a side elevational view, partly in section, of a lapping tool embodying the invention which is adapted to be employed for lapping of either main or crank bearings of internal combustion engine crank shafts or of any rotatably mounted, generally cylindrical, pieces of work.

Fig. 2 is an enlarged, fragmentary plan view showing the right end portion of the lapping tool illustrated in Fig. 1 as viewed from line 2—2 thereof.

Fig. 3 is a transverse, sectional view taken on the line 3—3 of Fig. 2.

Fig. 4 is a diagrammatic, illustrational view showing the application of a lapping tool embodying the invention to a rotatably mounted piece of work.

In the form of the invention illustrated in the drawing, the lapping tool, generally designated by the numeral 10, comprises a shank portion 11, having spaced bearing recesses 12 and provided with cooperating bearing caps 13 for revolvably mounting the tool on a pair of crank throw bearings 14 of crank shafts 15 which are rotatably mounted in a frame structure (not shown) and adapted to be drivingly operated by suitably driven mechanism (not shown).

A lever 16 is pivotally mounted at a location intermediate its end on the shank portion 11 of the tool 10 by a bolt 17 as illustrated in Fig. 1. The lever 16 is provided with a reduced, tubular end portion 18 on which a tool head 19 is axially slidably mounted. The tool head 19 has a tubular extension 20 telescoped on the reduced end portion 18 of the lever 16, and held against removal from the latter by a pin 21 extending through a slot 22 formed in the reduced end portion 18 of the lever 16. The elongated slot 22 accommodates limited relative axial movement of the tool head 19 with respect to the lever 16. Disposed in the interior of the tubular reduced end portion 18 of the lever 16 is a coil spring 23 which bears between the levers 16 and the tool head 19 in order to yieldably urge the tool head outwardly with respect to the lever.

The outer end portion of the tool head 19 is provided with a channel shaped recess 24 having a side wall 25 formed integral with the tool head and a detachable side wall, or flange 26 removably mounted on the tool head 19 by bolts 27. The side walls 25 and 26 of the recess 24 are provided with inwardly extending trunnions 28 on which a lapping member 29 comprises a block 30 having recesses 31 therein in which are securely mounted lapping elements 32 comprising natural stone or artificial compressed stone or other lapping material. The lapping member 29 may be conveniently installed and removed from the tool head 19 by removal of the plate 26, the right end of which constitutes one wall of the recess 24.

Formed in the left extremity of the lever 16 is an elongated slot 33 having its maximum dimension extending in the direction of the axis provided by the bolt 17. The slot 33 accommodates a pin 34 eccentrically located on the lower extremity of a shaft 35 of a motor 36, mounted on the shank portion 11 of the tool. The motor shaft 35 is rotatably journaled in spaced bearing members 37 and 38 carried by the shank 11 of the tool. The eccentrically located pin 34 of the motor shaft 35 has an external surface of generally spherical curvature which is adapted to

operate upon the side walls of the elongated slot 33, during operation of the motor, in such a manner as to oscillate the lever 16 about the axis provided by the bolt 17.

During operation of the lapping tool, the motor 36 is preferably operated at a speed sufficiently high to cause oscillatory movement of the lever 16 throughout a relatively short stroke and at a comparatively high speed approaching that of a vibratory order. The lever 16 in turn reciprocates the lapping member 29 and lapping elements 32 at a correspondingly high speed.

The work to which the lapping elements 32 are applied is preferably rotatively mounted with respect to an axis extending in a direction generaly normal to the axis of oscillatory movement of the lever 16, and thus as the work, designated by the numeral 39 in Fig. 1, turns about the axis indicated at 40, the lapping elements 32 are reciprocated axially of the work. The lapping elements 32 are yieldably urged against the surface of the work being operated upon by the spring 23 which accommodates expansion and retraction of the tool head during oscillation of the lever 16 so as to permit the lapping elements 32 to be moved in a substantially linear course parallel to the axis of rotation of the work. The driving and sliding engagement occurring between the eccentrically mounted pin 34 and walls of the elongated recess 33 takes place at a location sufficiently remote from the location at which the lapping element engages the work, to effectively guard against the exposure of the operative driving connection provided by the pin 34 and slot 33 to the abrasive action of particles of the lapping elements which are removed during normal operation thereof. While the trunnions 28 pivotally supporting the lapping tool 29 are located in relatively close proximity to the location at which the lapping elements operate upon the work, the exposure of these parts of the device to the abrasive action of particles of material removed from the lapping element is not hazardous, for the pivotal action between the surfaces of the trunnions 28 and the walls of the recesses of the lapping member 29 in which they are received, is not of a driving, sliding nature.

In Fig. 4 of the drawing is diagrammatically illustrated a work support 41 having upstanding flanges 42 and 43 between which a piece of work 44 is receivable. The work 44 is rotatably mounted between a dead spindle 45 carried by the flange 42 and a live spindle 46 rotatably mounted on the flange 43 and provided with a pulley 47, or other suitable means by which the live spindle 46 may be driven. The lapping tool 10 which may conform in structure, substantially identically to the structure of the lapping tool shown in Fig. 1, may be mounted upon an independent support (not shown) or supported by a bracket 48 carried by the face portion of the work support 41.

Although but several specific embodiments of the invention have herein been shown and described, it will be understood that various changes in the size, shape and arrangement of parts may be made without departing from the spirit of my invention.

What I claim is:

1. In lapping apparatus including means for rotatably supporting and drivingly rotating a piece of work, a lapping tool including a shank portion, a lever portion pivotally mounted at a location intermediate its ends on said shank portion and having a pivotal axis extending in a direction substantially normal to the rotative axis of said work, one end of said lever portion being adjacent said work, a lapping element on the latter end of said lever portion engaging a surface of said work, and a driving member on said shank portion operatively connected with the opposite end of said lever portion at a location remote from said work and said lapping element for oscillating said lever portion and reciprocating said lapping element relative to said work during rotation of the latter.

2. In lapping apparatus including means for rotatably supporting and drivingly rotating a piece of work, a lapping tool including a shank portion, a lever portion pivotally mounted at a location intermediate its ends on said shank portion and having a pivotal axis extending in a direction substantially normal to the rotative axis of said work, a lapping element pivotally mounted on the latter end of said lever portion engaging a surface of said work and having a pivotal axis substantially parallel to the pivotal axis of said lever portion, and a driving member on said shank portion operatively connected with the opposite end of said lever portion at a location remote from said work and said lapping element for oscillating said lever portion and reciprocating said lapping element relative to said work during rotation of the latter.

3. In lapping apparatus including means for rotatably supporting and drivingly rotating a piece of work, a lapping tool including a shank portion, a lever portion pivotally mounted intermediate its ends on said shank portion and having a pivotal axis extending in a direction substantially normal to the rotative axis of said work, one end of said lever portion being adjacent said work, a lapping tool head longitudinally shiftably mounted on the latter end of said lever, a lapping element on said tool head, a resilient member bearing between said lever portion and said tool head for yieldably urging said lapping element into engagement with a surface of said work, and a driving member on said shank portion operatively connected with the other end of said lever at a location remote from said lapping element and said work for oscillating said lever portion and reciprocating said lapping element relative to said work during rotation thereof.

4. In lapping apparatus including means for rotatably supporting and drivingly rotating a piece of work, a lapping tool including a shank portion, a lever portion pivotally mounted intermediate its ends on said shank portion and having a pivotal axis extending in a direction substantially normal to the rotative axis of said work, one end of said lever portion being adjacent said work, a lapping tool head longitudinally shiftably mounted on the latter end of said lever, a lapping element pivotally mounted on said tool head, a resilient member bearing between said lever portion and said tool head for yieldably urging said lapping element into engagement with a surface of said work, and a driving member on said shank portion operatively connected with the other end of said lever at a location remote from said lapping element and said work for oscillating said lever portion and reciprocating said lapping element relative to said work during rotation thereof.

5. In lapping apparatus including means for rotatably supporting and drivingly rotating a piece of work, a lapping tool including a shank portion, a lever portion pivotally mounted inter-

mediate its ends on said shank portion and having a pivotal axis extending in a direction substantially normal to the rotative axis of said work, one end of said lever portion being adjacent said work, a lapping tool head longitudinally shiftably mounted on the latter end of said lever, a lapping element on said tool head having a pivotal axis substantially parallel to the pivotal axis of said lever portion, a resilient member bearing between said lever portion and said tool head for yieldably urging said lapping element into engagement with a surface of said work, and a driving member on said shank portion operatively connected with the other end of said lever at a location remote from said lapping element and said work for oscillating said lever portion and reciprocating said lapping element relative to said work during rotation thereof.

6. In lapping apparatus including means for rotatably supporting and drivingly rotating a piece of work, a lapping tool adjacent said work including a lever, means for pivotally supporting said lever for oscillation about a pivotal axis extending in a direction substantially normal to the rotative axis of said work, a holder having a lapping element thereon carried by said lever and shiftable relative to the latter for accommodating engagement of said lapping element and a surface of said work, means for oscillating said lever to reciprocate said lapping element, and means bearing between said holder and said lever for yieldably urging said lapping element against said work.

7. In lapping apparatus including means for rotatably supporting and drivingly rotating a piece of work, a lapping tool including a lever, means for pivotally supporting said lever, said lever having a pivotal axis extending in a direction substantially normal to the rotative axis of said work, a lapping element pivotally mounted on the latter end of said lever engaging a surface of said work and having a pivotal axis substantially parallel to the pivotal axis of said lever portion, and means for oscillating said lever to reciprocate said lapping element relative to said work during rotation of the latter.

8. In lapping apparatus including means for movably supporting and drivingly moving a piece of work, a lapping tool including a lever, means for pivotally supporting said lever, one end of said lever being adjacent said work, a lapping tool head longitudinally shiftably mounted on the latter end of said lever, a lapping element on said tool head, means bearing between said tool head and lever for yieldingly urging said lapping element into engagement with a surface of said work, and means for oscillating said lever to reciprocate said lapping element relative to said work during movement of the latter.

9. In lapping apparatus including means for movably supporting and drivingly moving a piece of work, a lapping tool including a lever, means for pivotally supporting said lever, one end of said lever being adjacent said work, a lapping tool head longitudinally shiftably mounted on the latter end of said lever, a lapping element pivotally mounted on said tool head, means for yieldingly urging said lapping element into engagement with a surface of said work, and means for oscillating said lever to reciprocate said lapping element relative to said work during movement thereof.

10. In lapping apparatus including means for movably supporting and drivingly moving a piece of work, a lever, means for pivotally mounting said lever at a location intermediate its ends, one end of said lever portion being adjacent said work, a lapping tool head longitudinally shiftably mounted on the latter end of said lever, a lapping element on said tool having a pivotal axis substantially parallel to the pivotal axis of said lever, means for yieldingly urging said lapping element into engagement with a surface of said work, and means for oscillating said lever to reciprocate said lapping element relative to said work during movement thereof.

DAVID A. WALLACE.