April 15, 1941. H. S. INDGE 2,238,646

LAPPING MACHINE

Filed Sept. 25, 1940 2 Sheets-Sheet 1

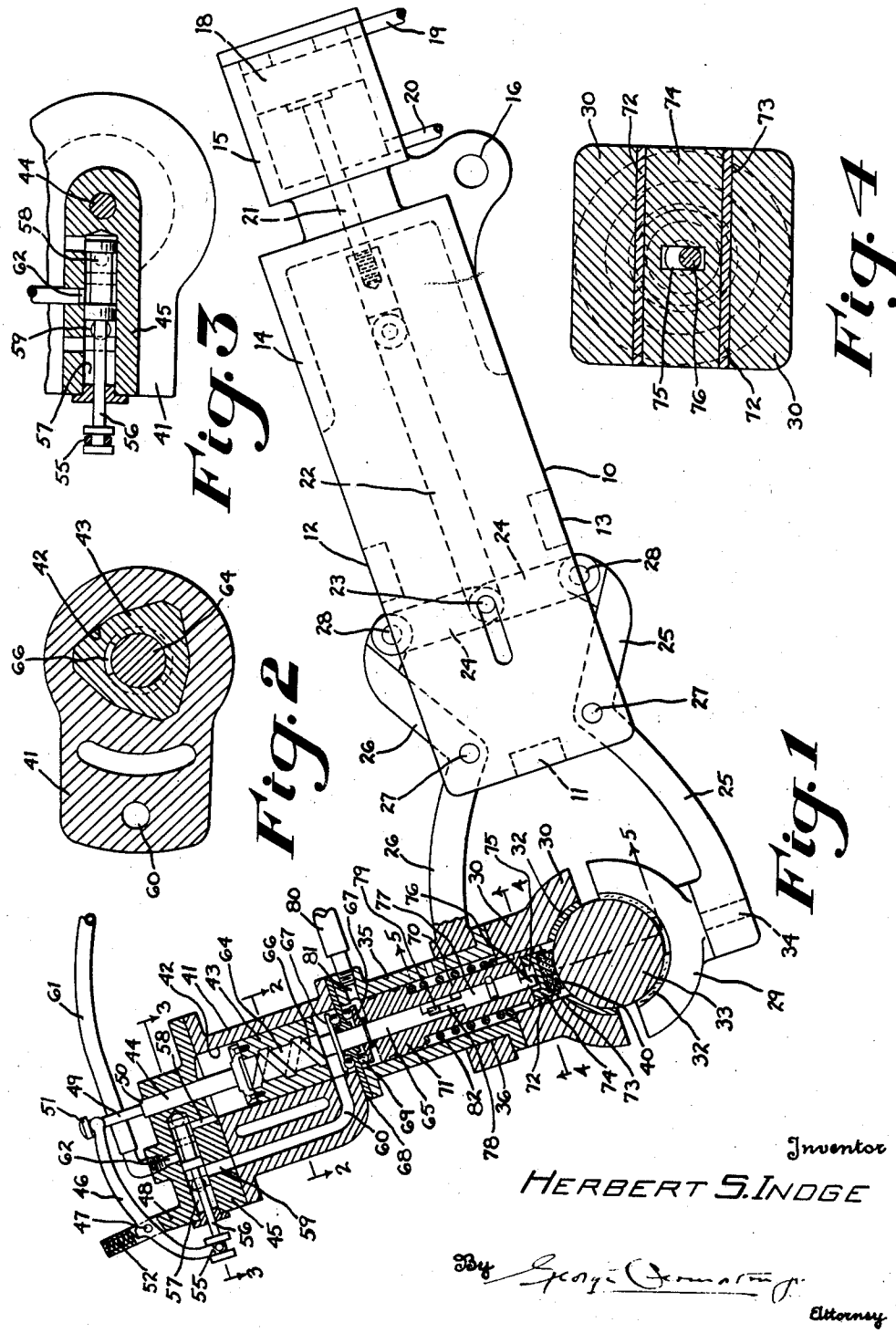

Fig. 1

Fig. 2

Fig. 3

Fig. 4

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LAPPING MACHINE

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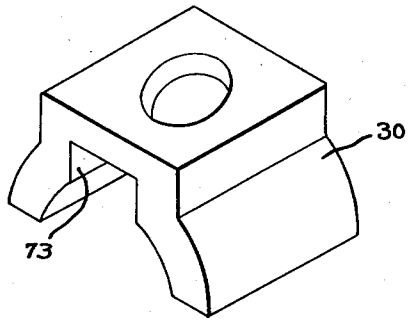

Fig. 6

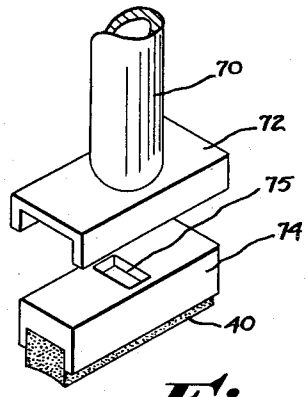

Fig. 7

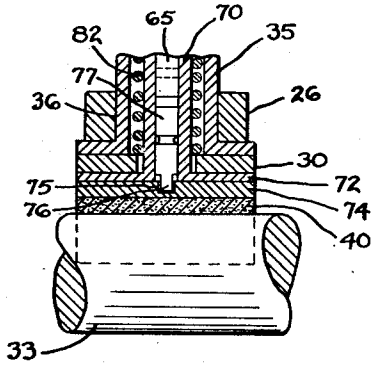

Fig. 5

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UNITED STATES PATENT OFFICE

2,238,646

LAPPING MACHINE

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Application September 25, 1940, Serial No. 358,324

8 Claims. (Cl. 51—59)

The invention relates to lapping machines, and more particularly to a lapping machine to lap the pins of crankshafts.

One object of the invention is to provide an attachment, which can be applied to existing machines, to lap crankpins of automotive crankshafts and the like. Another object of the invention is to provide a compact prime mover to oscillate an abrasive stick, the prime mover being fastened to a movable part. Another object of the invention is to provide a crankshaft lapper which shall produce an accurate pin polished to a mirror finish. Another object of the invention is to provide a lapping attachment for machines of the type shown in Patent No. 2,166,084 to Wallace H. Wood. Other objects will be in part obvious or in part pointed out hereinafter.

The invention accordingly consists in the features of construction, combinations of elements, and arrangements of parts, all as will be illustratively described herein, and the scope of the application of which will be indicated in the following claims.

In the accompanying drawings illustrating one of many possible embodiments of the mechanical features of the invention,

Figure 1 is a side view of a lapping arm constructed in accordance with the invention, showing the driving mechanism in axial section;

Figures 2, 3 and 4 are cross sectional views taken, respectively, on the lines 2—2, 3—3 and 4—4 of Figure 1, and showing the parts on somewhat enlarged scales;

Figure 5 is an axial sectional view of the lapping stick and associated parts, showing the crankpin in elevation, the plane of the section being perpendicular to the plane of the section in Figure 1;

Figure 6 is an isometric view of one of the half bearings; and

Figure 7 is an exploded view, showing the lapping stick, its holder, and the guide in which it reciprocates.

The lapping arm of the invention may be utilized in a machine constructed according to United States Letters Patent No. 2,166,084 to Wallace H. Wood, and may also be applied to other machines. The machine of the Wood patent provides means for supporting a plurality of arms, allowing them to oscillate with the lapping heads following the rotation of the crankpins. The machine of the Wood patent has sandpaper lapping heads whereas according to the present invention I provide lapping sticks and means to reciprocate them rapidly. The lapping stick according to my present invention is resiliently held with a firm pressure against the crankpin and rapidly reciprocated; this reciprocation may be compounded into a slower reciprocation of the crankshaft as a whole.

Referring now to Figure 1, I provide a lapping arm in the form of a pair of plates 10 spaced apart by blocks 11, 12, 13 and a bracket 14 extending from a cylinder 15. Associated with the bracket 14 is a boss 16 which corresponds to the pivotal connection 168 of the Wood patent for pivotal connection of the lapping arm to an oscillating arm, not shown, whereby the lapping head may follow the appropriate crankpin.

In the cylinder 15 is a piston 18 which can be moved to either one of two extreme positions by fluid pressure through the pipes 19 and 20. A piston rod 21 is connected to a rod 22 which is connected at 23 to a pair of links 24 operating toggle levers 25 and 26 pivotally mounted on pins 27 extending between the plates 10 and connected to the links 24 by means of pins 28. This constitutes a toggle mechanism whereby the levers 25 and 26 may be separated or urged together with powerful pressure.

The toggle levers 25 and 26 hold half bearings 29 and 30, respectively, which press babbitt shoes 32 against a work piece crankpin 33. The half bearing 29 is pivotally mounted by means of a pin 34 extending therefrom into the toggle lever 25. A cylinder 35 is received in an annular portion 36 of the toggle lever 26. This cylinder 35 holds the reciprocating mechanism to be described and also positions the half bearing 30 to hold a pair of the shoes 32 against the crankpin. By the pivotal mounting of the half bearing 29 and the indirect pivotal mounting of the half bearing 30, binding of the shoes against the work piece when the entire crankshaft slowly reciprocates is prevented. It must be understood that the entire lapping arm is held against reciprocation at the pivot 16 which is remote from the crankpin 33. I have found that pivotal mounting of the half bearings prevents binding and allows the relative reciprocation.

Referring to Figures 1, 5 and 7, I provide a lapping stick 40. This may be made of any desired abrasive, such as fused alumina or silicon carbide bonded with any suitable bond, such as vitrified clay or an organic bond, for example phenolic resin. The mechanism of the invention rapidly reciprocates the lapping stick 40 in contact with the work piece. This rapid reciprocation is thereby distinguished from the slow

reciprocation due to the reciprocation of the entire crankshaft by the mechanism described in the Wood patent referred to. A fast reciprocation of one part is superimposed upon a slow reciprocation of another part so that the relative motion between the crankpin 33 and the lapping stick 40 is the resultant of the two reciprocations compounded into the rotation of the crankpin. The driving mechanism rapidly to reciprocate the lapping stick is not geared to the mechanism which reciprocates the crankpin, so there is no definite or fixed ratio between the two motions. As a result of all these factors, a highly irregular motion of the lapping stick relative to the crankpin is achieved, thus breaking up any lines and scratches and achieving a good lapping action to produce a smooth bearing surface on the crankpin. The mechanism whereby the rapid reciprocation of the lapping stick 40 is achieved will now be described.

Referring now to Figures 1 and 3, I provide a casing 41 for a pneumatic motor which is suitably attached to the cylinder 35. In the casing 41 is a shaped bore 42, shown in Figure 2 as having a generally triangular shape in cross section. In the bore 42 fits a shaped piston 43 for reciprocation. A rod 44 is attached to the piston 43 and extends through a motor head 45. A valve arm 46 is pivotally mounted at 47 on a projection 48 from the head 45. The rod 44 has a reduced portion 49, leaving at one end a shoulder 50 and at the other end a head 51. The end of the lever 46 fits between the shoulder 50 and the head 51 close to the reduced portion 49. A snapover spring 52 tries to urge the lever 46 into either one of its extreme positions. The lever 46 is connected by a yoke and spool connection 55 to a slide valve 56 working in a valve bore 57. The valve bore 57 has ports 58 and 59, the former leading directly to the top of the shaped bore 42 and the latter connecting to a long passage 60 in the casing 41 which leads to the lower end of the shaped bore 42. An air connection 61 leads air to a port 62 in the central part of the valve bore 57.

This mechanism rapidly reciprocates the shaped piston 43 in the shaped bore 42 of the casing 41. The shaped piston 43 is internally threaded and contains the threaded head 64 of a rod 65 which extends into the cylinder 35. The internal threads in the shaped piston 43 and the external threads 66 on the head 64 are not of the ordinary machine screw variety but have a high pitch and are more or less rectangular in cross section. Thus reciprocation of the shaped piston 43 rotates the head 64 which is held from reciprocation by means of bearing plates 67 attached to the shaft 65, a stationary bearing plate 68 between the cylinder 35 and the casing 41 and interposed bearing balls 69.

The net result of the foregoing is that the rod 65 is rapidly rotated, first in one direction, and then in the other direction. With an air motor as described, the angular velocity of the rod 65 quickly reaches maximum and the stop is very sudden. This feature further helps in breaking up the grinding lines.

In the cylinder 35 is a short hollow shaft 70 having an upper cylindrical head 71 and a channel-shaped head 72 at the lower end. Referring now to Figures 1, 4, 5, 6 and 7, the channel-shaped head 72 fits in a rectangular parallelopipedal slot 73 in the half bearing 30. In the channel-shaped head 72 fits an abrasive stick holder 74 into which the lapping stick 40 is cemented. A slot 75 is provided in the top of the holder 74 and a pin 76 fits in the slot 75. The pin 76 extends eccentrically from a short shaft 77 which is connected by a projection 78 thereon and a slot 79 in the rod 65 to the rod 65. Thus the short shaft 77 partakes of the rotation of the rod 65 and the pin 76 fitting in the slot 75 reciprocates the holder 74 which is guided in the channel-shaped head 72.

The lapping stick 40 is held against the work piece 33 with an even pressure. In this embodiment of the invention I use air pressure. As shown in Figure 1, another flexible air pipe 80 leads air to a port 81 at the upper end of the cylinder 35. The air acts against the upper cylindrical head 71 which is thus a piston, pressing the hollow shaft 70, the channel-shaped head 72, the holder 74, and the stick 40 downwardly. I provide a spring 82 extending between the under side of the head 71 and the upper side of the half bearing 30 which lifts the hollow shaft 70, taking the pressure off the stick 40, whenever the air is turned off.

The air pipes 61 and 80 may be connected and a single valve may be used to cause the reciprocation and the pressure, or they may be independently operated, as desired. The bore 42 and piston 43 are what I call tri-lobed in shape, having actually nine surfaces. The shape is such that very little friction is generated by the torque due to the reaction of the threaded head 64. An external shape, such as that of the shaped piston 43, may be readily generated on a cam grinder. On the cam grinder a broach of the same shape can also be made and with the broach the shaped bore 42 can readily be formed.

It will thus be seen that there has been provided by this invention apparatus in which the various objects hereinabove set forth together with many thoroughly practical advantages are successfully achieved. As various possible embodiments might be made of the mechanical features of the above invention and as the art herein described might be varied in various parts, all without departing from the scope of the invention, it is to be understood that all matter hereinbefore set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

I claim:

1. Apparatus of the class described comprising an arm, a pair of toggle levers mounted on said arm, means on said arm to actuate said toggle levers, a pair of half bearings each one connected to one of said levers, a pneumatic motor connected to one of said levers, an abrasive stick in one of the half bearings, and connections between the motor and the abrasive stick to reciprocate the stick.

2. Apparatus of the class described comprising an arm, a pair of toggle levers mounted on said arm, a cylinder and piston unit connected to said arms to actuate them, a pair of half bearings each one connected to one of said levers, a prime mover connected to one of said levers and movable with it, an abrasive stick in one of the half bearings, and connections between the prime mover and the abrasive stick to reciprocate the stick.

3. Apparatus of the class described comprising an abrasive stick, mounting means to hold the abrasive stick against a cylindrical object but permitting reciprocation, and mechanism to reciprocate the abrasive stick in contact with the cylindrical object attached to the means to hold the abrasive stick and comprising a part having a

shaped bore, a shaped piston fitting in said shaped bore, the shape of said shaped parts being such as to prevent rotation of the piston in the bore, a threaded bore in the shaped piston, an externally threaded head in said threaded bore, thrust bearing means to prevent the externally threaded head from reciprocating, a shaft extending from the threaded head, an eccentric pin connected to the shaft, a holder for the abrasive stick, a slot in the holder, the eccentric pin fitting in the slot, and valve means to admit fluid to the shaped bore alternately to opposite sides of the shaped piston to reciprocate the piston, oscillate the threaded head and the pin, and reciprocate the holder and the abrasive stick.

4. In apparatus as claimed in claim 3, the combination with the parts and features therein specified, of a cylinder and piston unit, the piston connected to the abrasive stick holder, and fluid pressure connections whereby to urge the abrasive stick against the cylindrical object by fluid pressure.

5. In apparatus of the class described, an abrasive stick, a mounting for the abrasive stick, toggle means to clamp the mounting against a cylindrical member, pressure means in the mounting to press the abrasive stick against the cylindrical member, and fluid pressure means to reciprocate the abrasive stick in the mounting.

6. In apparatus of the class described, an abrasive stick, a clamp mounting for the abrasive stick, toggle means to clamp the mounting, fluid pressure means to hold the stick against a work piece, and fluid pressure means to reciprocate the stick.

7. In apparatus of the class described, a pair of half bearings, toggle means to move the half bearings relative to each other, fluid pressure means to move the toggle means, an abrasive stick mounted in one of the half bearings, fluid pressure means to press the abrasive stick against a work piece, and fluid pressure means to oscillate the abrasive stick.

8. Apparatus as claimed in claim 7, in which the fluid pressure means to reciprocate the stick and to hold it against the work piece is pneumatic.

HERBERT S. INDGE.