

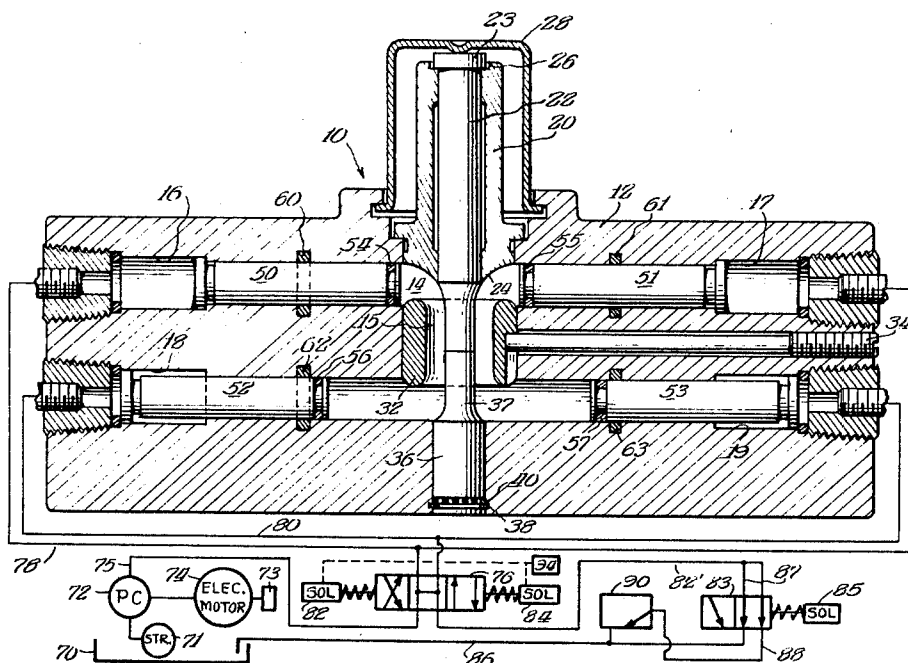
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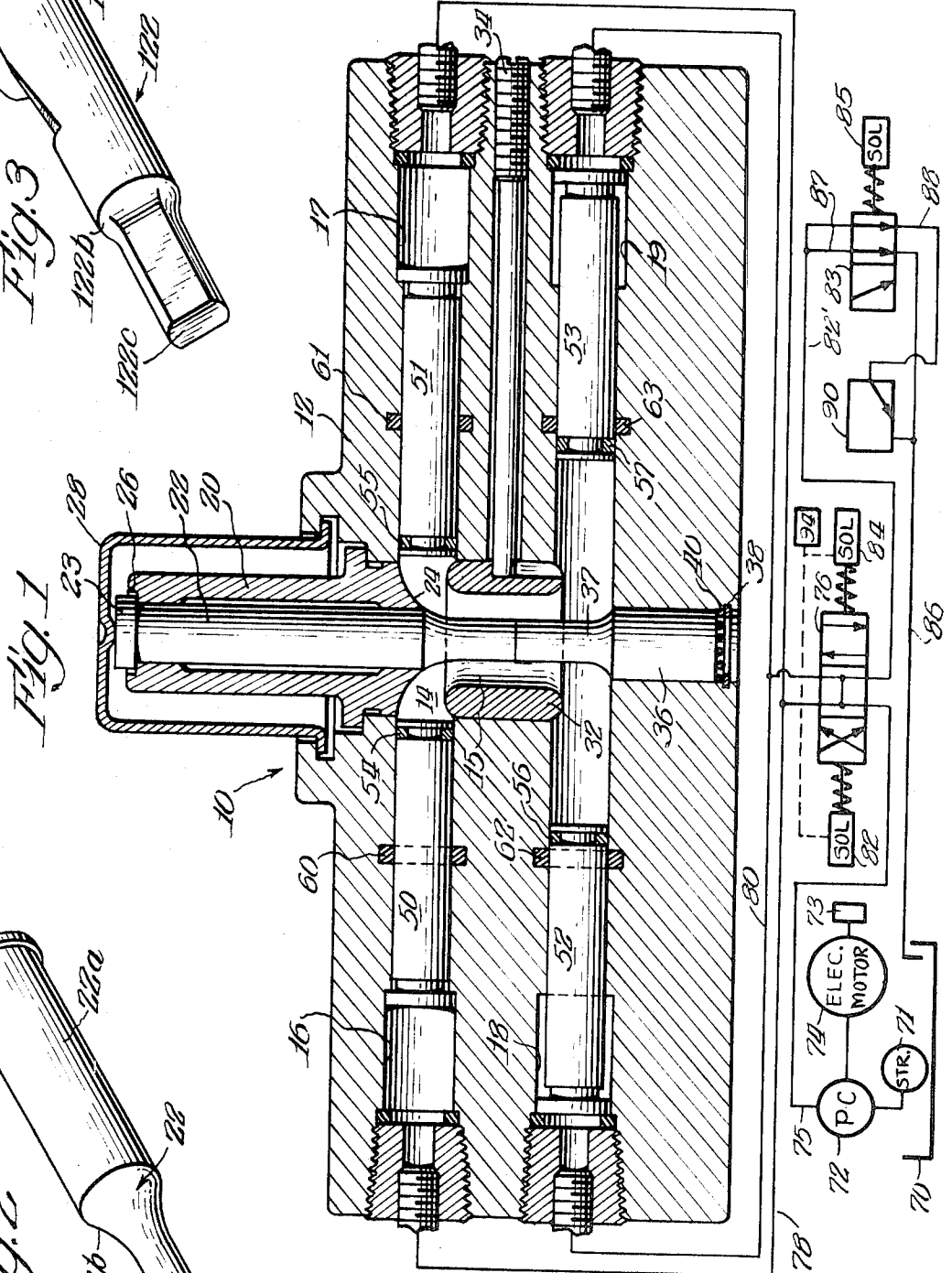
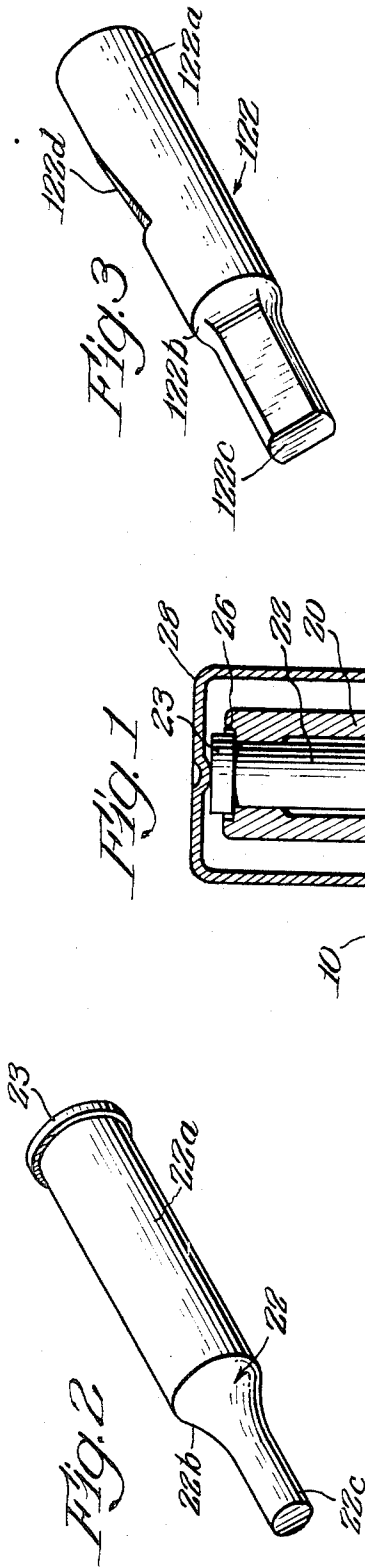
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[54] METHOD AND MEANS FOR LINEARLY LAPPING
PUNCHES
6 Claims, 3 Drawing Figs.

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		51/317
[51]	Int. Cl.....	B24b 19/00,
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ABSTRACT: Improved method and means for linearly lapping machine parts, as, for example, punches, by confining the surface to be lapped in a closed chamber and forcing lapping compound under pressure linearly back and forth over said surface.





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METHOD AND MEANS FOR LINEARLY LAPPING PUNCHES

BACKGROUND OF THE INVENTION

This invention relates to linearly lapped punches, and, more particularly, to improved method and means for effecting linear lapping of such punches.

It is generally accepted in industry that linear lapped or linear ground punches such as are used in die sets are greatly superior to cylindrically ground punches. Basically, in a cylindrically ground punch, the circumferential exterior surface is defined by ridges wrapped spirally or helically thereon. The ridges, not being backed by metal, can be compared to a file or a thread and are subject to fracture on vertical impact. When a cutting ridge breaks down, punch life is materially reduced. A worn punch with cutting edge breakdown pierces with a lesser diameter causing radial compression, hole shrinkage, excessive heat and galling. Withdrawal of the punch that is cylindrically ground through the punched material subjects the microscopic ridges to wear. The instant the first ridge breaks down, a wedge remains. This immediately changes the punch action from a straight shear to a combination of shear and radial compression of the material, resulting in hole shrinkage and increased stripping pressure, as well as "floating" of the punch, loss of concentricity, dimpling of the stock and rollover when stripping comparatively thin materials.

In contrast to a cylindrically ground punch where the grind lines run perpendicular to the axis of the punch, the linearly ground punch has grind lines running parallel to the punch axis. The parallel ridges formed in the surface of the punch surface are parallel to the line of piercing action and withdrawal. The straight grinding provides a multiple cutting edge which distributes the force needed to fracture the material over more linear inches of cutting edge thereby keeping the punch sharp longer. The vertical ridges of linear or straight grinding are backed up by metal and supported against breakdown, resisting chipping and cutting edge wear. This type of punch has greater wear resistance during the stripping action and minimizes material pickup at this time point. Therefore, the life of the punch is increased.

The present invention is concerned with linear lapping which is similar to linear grinding and offers the advantages thereof as compared to cylindrical grinding. The grain of the finely finished surface is linear under microscopic examination. External laps for linear lapping are commonly made in the form of rings—an outer ring or holder and an inner shell which forms the lap proper. The inner shell is made of a metal, as, for example, copper, brass or lead. Ordinarily, the lap is split and screws are provided in the holder for adjustment. These laps are usually moved back and forth on the work manually and adjustment is frequently required due to wear on the surface of the lap. The operation is slow and costly, with extreme care and skill required to obtain the necessary accuracy, which is on the order of 0.0001 inch. This arrangement requires careful checking and rechecking for size during the lapping operation. An improved arrangement comprises mechanizing the up and down movement of the holder, but this still requires time-consuming checking for size. Furthermore, changing of the laps is time-consuming and, therefore, costly.

An object of the present invention is to provide improved method and means for effecting linear lapping of a punch surface in an efficient and expedient manner.

Another object of this invention is to provide an improved method for lapping punches which includes moving lapping compound under pressure linearly over the surface of a punch retained in a closed chamber to work same to a precise desired finish.

Yet another object of this invention is to provide an improved linearly lapped punch formed by utilization of the method of the present invention.

Still another object of this invention is to provide improved means for linearly lapping a punch by pressurized movement of lapping compound linearly over the surface of the punch.

Yet another object of this invention is to provide improved means capable of linearly lapping punches of different configurations and sizes by means of pressurized movement of lapping compound back and forth over the surface of the punch that is retained in a closed chamber. Other objects and advantages of the present invention will be made more apparent hereinafter.

BRIEF DESCRIPTION OF THE DRAWING

The attached drawing illustrates a preferred embodiment of the apparatus for carrying out the present invention.

FIG. 1 is a cross-sectional view of the punch lapping means of the present invention, with the control means therefore being shown schematically;

FIG. 2 is a perspective view of one form of punch made in accordance with the present invention, such punch having a punch end of cylindrical cross section; and

FIG. 3 is a perspective view of a modified punch made in accordance with the present invention, such punch having a punch end oblong in cross section.

DESCRIPTION OF THE PREFERRED EMBODIMENT OF THE PRESENT INVENTION

Referring to FIG. 1, there is illustrated a linear pressure-lapping device 10 embodying the present invention. The device 10 comprises a body 12 having a chamber 14 defined centrally thereof and pairs of bores 16, 17 and 18, 19 in said body 12 communicating with the chamber 14.

The top of the chamber 14 is closed by a sleeve 20 adapted to retain therein the punch 22 to be lapped. The lower surface 24 of the sleeve 20 is contoured, so as to blend smoothly with the tapering surface of the punch 22. The lower surface 24 of the sleeve 20 determines the upper boundary of the chamber 14 within the device 10. The sides of the sleeve 20 cooperate with the wall of the body or housing 12 defining the top entry bore and are in sealing engagement therewith, so as to prevent discharge or escape of lapping compound from within the closed chamber 14 in the housing. As shown, the punch 22 may have a head or shoulder 23 thereon which engages within a recess 26 in the top of the sleeve 20. The sleeve 20 and the punch 22 are retained in position by means of a retainer cover 28 adapted to be connected to the body or housing 12 by means of a bayonet type or like connection.

Disposed within the closed chamber 14 is a replaceable sleeve 32. The sleeve 32 which has a characterized internal configuration is adapted to be retained in place by means of the screw member 34 which extends through the housing transversely from an end thereof.

Extending upwardly into the housing 12 and into the closed chamber 14 is a pin 36 which has an end 37 in the chamber 14. The pin 36 is constructed and arranged to provide a mirror-image of the end of the punch 22 in chamber 14. The pin 36 is adapted to be retained in place by means of a retaining ring 38 and by a spring 40 disposed between the retaining ring 38 and the lower end of the pin 36.

Provided in the bores 16, 17 and 18, 19 of the housing 12 are cooperating pairs of pistons 50, 51 and 52, 53. The pistons 50, 51 are adapted to move simultaneously inwardly toward the chamber 14 and outwardly therefrom. The pistons 52, 53 function in a similar manner, but in an opposite sequence. Thus, as the pistons 50, 51 move inwardly, the pistons 52, 53 move outwardly, whereas when the pistons 52, 53 move inwardly, 50, 51 move outwardly. Thus, it is seen that the closed chamber 14 is defined within the housing by the ends of the pistons 50, 51, 52 and 53, the lower surface 24 of sleeve 20, the internal surface of insert 32, the internal walls of the body 12, punch 22 and pin 36.

Seal means are provided about the pistons 50—53. Such seal means may comprise piston rings 54, 55, 56 and 57 on the

pistons 50—53, respectively, and external seal rings 60, 61, 62 and 63 disposed in recess in the body 12 about the pistons 50—53, respectively. The piston rings and real rings may be made from a suitable material such as Teflon, that is not affected by the lapping compound.

The control means for the lapping device 10 are illustrated schematically at the bottom of FIG. 1. A supply of hydraulic fluid for actuating the pistons 50—53 is retained in the reservoir 70. Fluid is drawn from the reservoir through a strainer 71 by the pump 72 operatively driven by the electric motor 74. Motor 74 may be actuated responsive to a suitable control 73. The fluid is forced through the line 75 by the pump 72 to a solenoid actuated four-way valve 76 which controls the flow of fluid from the line 75 to either the line 78 or 80. The line 78 is connected with the bores or passages 16 and 17 at the outer ends of the pistons 50 and 51 and the line 80 is connected to the passages 18 and 19 at the outer ends of the pistons 52 and 53. The solenoid actuated control valve 76 is illustrated in the neutral position. For operation, the solenoids 82 and 84 are selectively actuated to move the spool of the four-way valve either right or left, so as to direct hydraulic fluid from conduit 75 selectively to conduit 78 and 80.

The passage of pressurized fluid into the passages 16 and 17 will cause the pistons 50 and 51 to move toward one another to the position shown in FIG. 1, so as to move the lapping compound from the inner ends of passages 16 and 17 into the passages 18 and 19. The force of the lapping compound within the closed chamber will cause the pistons 52 and 53 to move outwardly away from one another. At this time, the hydraulic fluid at the rate of each of the pistons 52, 53 will be forced through the conduit 80 into the conduit 82' for return to the reservoir 70 through the solenoid actuated valve 83 and the return line 88. The valve 83 is shown in the neutral position. Normally, the solenoid 85 associated with the valve 83 will be actuated so as to move the valve to the right and direct the fluid returning through conduit 82' to conduit 88 for passage to the reservoir 70 through the relief valve 90 and return line 86. The relief valve may be set a predetermined pressure on the order of 20—40 pounds and cooperates with the valve 83 to maintain a pressure of 20—40 pounds within the hydraulic system.

To reverse the flow of the lapping compound within the closed chamber 14, solenoid 84 is energized moving the valve spool within the valve 76 to the right. Hydraulic fluid from the pump 72 will then pass through the line 80 to the rear of the pistons 52 and 53, so as to force the pistons toward one another, thereby moving the lapping compound upwardly within the closed chamber 14 as seen in FIG. 1 and forcing the pistons 50 and 51 outwardly away from one another. The fluid at the rear of the pistons 50 and 51 outwardly away from one another. The fluid at the rear of the pistons 50 and 51 in passages 16 and 17 will pass through the line 78, through the control valve 76, conduit 82', valve 83, conduit 88, relief valve 90 and conduit 86 to the reservoir 70. Conduit 87 will conduct flow of return oil from conduit 82' to valve 83 for free flow to reservoir 70 when the solenoids are deenergized.

The solenoids 82 and 84 may be operatively connected to a timer 94 for controlling the number of strokes so as to control the stock removal from the surface of the punch being worked. The number of strokes to remove 0.0001 inch, 0.0002 inch or 0.0003 inch of stock, for example, can be accurately determined and the timer 94 can be set to stop the actuation after a given number of strokes.

The punch 22 in the lapping device may be of the type between shown, for example, in FIG. 2. The punch 22 comprises a main cylindrical body portion 22a having an intermediate tapering portion 22b which runs into a lesser diameter portion 22c cylindrical in cross section. A shoulder or head 23 is provided on the end of the punch opposite end 22c.

It is noted that the pin 36 has a portion 37 which corresponds in configuration to the portion 22c and 22b of the punch to be lapped. Portion 37 of pin 36 is the mirror-image of portions 22c and 22b of punch 22. The punch 22 is fixedly

retained in position within the lapping device by the sleeve 20, the cover 28 and the pin means 36. The sleeve insert 32 is adapted to be spaced from the exterior surfaces of punch 22 and pin 36 a predetermined distance, so as to provide a characterized annular passage between the punch 22 and pin 36 and the annular insert 32 which assures laminar motion of the lapping fluid, free from any turbulence. In a presently preferred form of the invention, it is desired that the space between the outside diameter of the punch 22 and the pin 36 and the inner diameter of the annular insert 32 be on the order of seven thirty-seconds inch. The annular insert 32 is detachably supported with the closed chamber 14 by means of the pin 34, so as to accommodate punches of different diameter and external configuration. For example, if the punch diameter is reduced, then the internal diameter of the annular insert would be reduced to maintain approximately a seven thirty-seconds inch spacing between the outside diameter of the punch and the inside diameter of the insert.

The sleeve 20 is likewise designed to accommodate punches 22 of different sizes and the sleeve is contoured at its bottom to provide for a streamlined flow of the lapping compound through the upper region of closed chamber 14 without creating any turbulence.

It is desired that the sleeve 20, the insert 32 and the pin 36 be fabricated from a hardened metal which will withstand the effects of the lapping compound, for example, the material may be hardened steel. In use, a punch 22 to be lapped is retained within appropriately sized sleeve 20. The cooperating mated insert 32 is installed into the body 12 and retained in place by means of the fastener means 34. The sleeve 20 with the punch 22 therein is installed into the body 12 and retained in place by means of the retaining cover 28. The pin 36 is installed in a lower opening within the body 12 and retained in place by the telescoping-type spring 40 and the retaining ring 38. The chamber 14 is then filled with a lapping compound through a passage (not shown) in the housing 12.

Upon actuation of the motor control 73, the pump 72, which is of the constant displacement type, will be operative to pump hydraulic fluid or oil from the reservoir 70 through line 75 to the control valve 76. The timer 94 will control the operation of the solenoids 82 and 84, so as to alternatively port fluid to the ports connected to passages 16 and 17 for moving the pistons 50 and 51 inwardly and then to the ports communicating with passages 18 and 19 for moving the pistons 52 and 53 inwardly toward one another. The lapping compound within the closed chamber 14 surrounds the punch end to be lapped and will be moved to and fro or back and forth linearly or generally parallel to the axis of the end portion 22c of the punch 22 for effecting linear lapping of the exterior surface of the punch 22. The annular passage 15 within closed chamber 14 is streamlined, as is the configuration above and below such passage, so as to assure laminar motion free within the closed chamber that is form any turbulence. The result is a precision lapped exterior surface of the punch 22 without creation of any undesirable surface skin which might result from frictional contact with a tool against the punch surface. Ordinary machining processes, such as centerless grinding, cause elevated temperatures at the surface of the part being machined and what has been termed an "amorphous" skin is developed on the part being machined. The punch having an amorphous skin would have to be "run-in" for a lengthy period before it would be ready for use. The present process does not produce elevated temperature and will readily remove the amorphous skin resulting from prior centerless grinding of the punch part. Thus, the punch lapped by the present method is ready for immediate use. The surface to be lapped is entirely surrounded by lapping compound and as a result, there is a uniform stock removal around the entire punch surface.

When the punch hits the work and starts piercing, a tremendous amount of heat is created and often results in fusion of the punch material to the punch. On cylindrically ground punches with their circumferential grinding ridges, this fusion

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often results in a buildup on the punch. Fusion is particularly troublesome with materials in the lower range of melting points, such as aluminum. This is very troublesome when the punch is withdrawn from the work. With linear lapped punches, there are no circumferential ridges for the fused material to stick to. A linear lapped punch is basically a broach.

In FIG. 3, there is illustrated a modified punch 122 having a substantially cylindrical main body portion 122a and an oblong end portion 122c joined to one another by an intermediate curve surface portion 122b. A recess 122d may be provided in the surface of the main body portion 122a to permit affixation of the punch within its support by means of a set screw. Should the punch of FIG. 3 be utilized in the device of FIG. 1, then it will be understood that the end of the pin would be of a mirror-image configuration with respect to the end of the punch and that the insert 32 would be appropriately modified to conform in configuration to the punch, so as to provide a uniform annular space between the punch and the annular insert. In this way, there will be a uniform streamlined channel provided about the punch to assure laminar motion free from turbulence as in the case of the punch of circular cross section of FIGS. 1 and 2.

Though a hydraulic control system is illustrated in FIG. 1, it will be appreciated that a suitable compressed air system may be utilized to control the operation of pistons 50—53 in desired sequence.

There has been provided by the present invention an improved method and means for linearly lapping machine parts, for example, punches or pistons. The machine part produced by the method of the present invention is superior to prior constructions in that it has a fine precision linearly lapped finish on the exterior surface thereof, without an amorphous skin, the exterior surface being formed by fluidized lapping compound under pressure. The superior machine part can be produced at considerably less cost than by prior known lapping methods. The lapping compound is commercially available and is of different characteristic, dependent upon the application as is apparent to persons skilled in the art.

Though two pairs of opposed pistons are shown for moving the lapping compound within the closed chamber, other numbers of opposed sets of piston or like pressure members may be used, for example, three or more opposed sets. Also, a second machine part or punch may be substituted for the pin

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36 so that two punches may be lapped simultaneously.

While a preferred embodiment of the invention has been described and illustrated, it should be understood that the invention is not limited thereto, but may be otherwise embodied within the scope of the following claims.

I claim:

1. A method of pressurized lapping of a machine part which is disposed in a closed chamber filled with lapping compound comprising the steps of positioning in the closed chamber in mirrorlike disposition with respect to the machine part form means that are complementary in configuration to the machine part, and forcing the lapping compound under pressure through the closed chamber to effect linear lapping of the machine part surface.
2. The method of claim 1 including the step of moving the lapping compound back and forth over the surface so as to remove any amorphous skin from the surface and thereby render the surface ready for immediate use without any run-in.
3. A lapping device for effecting linear lapping of a surface of a machine part comprising a housing having a closed chamber adapted to retain a surface of a machine part therein, said chamber being filled with lapping compound, and means for moving the lapping compound under pressure over the said surface of the machine part to work same to a precise desired finish, said housing having an opening for receiving a machine part having a surface to be lapped, such surface extending into the closed chamber, pin means complementary in configuration to the machine part and arranged in mirror-image disposition with respect to the machine part to provide a smoothly merging surface with said surface of the machine part, the moving means forcing the lapping compound under pressure through the closed chamber to effect linear lapping of the machine part surface.
4. A lapping device as in claim 3 wherein the moving means forces the lapping compound linearly over the said surface to be lapped to effect linear lapping of the said surface.
5. A lapping device as in claim 3 wherein the moving means comprises piston means adapted to be reciprocated so as to move the lapping compound back and forth over the said surface of the machine part.
6. A lapping device as in claim 3 wherein said smoothly merging surface is the exterior surface.

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