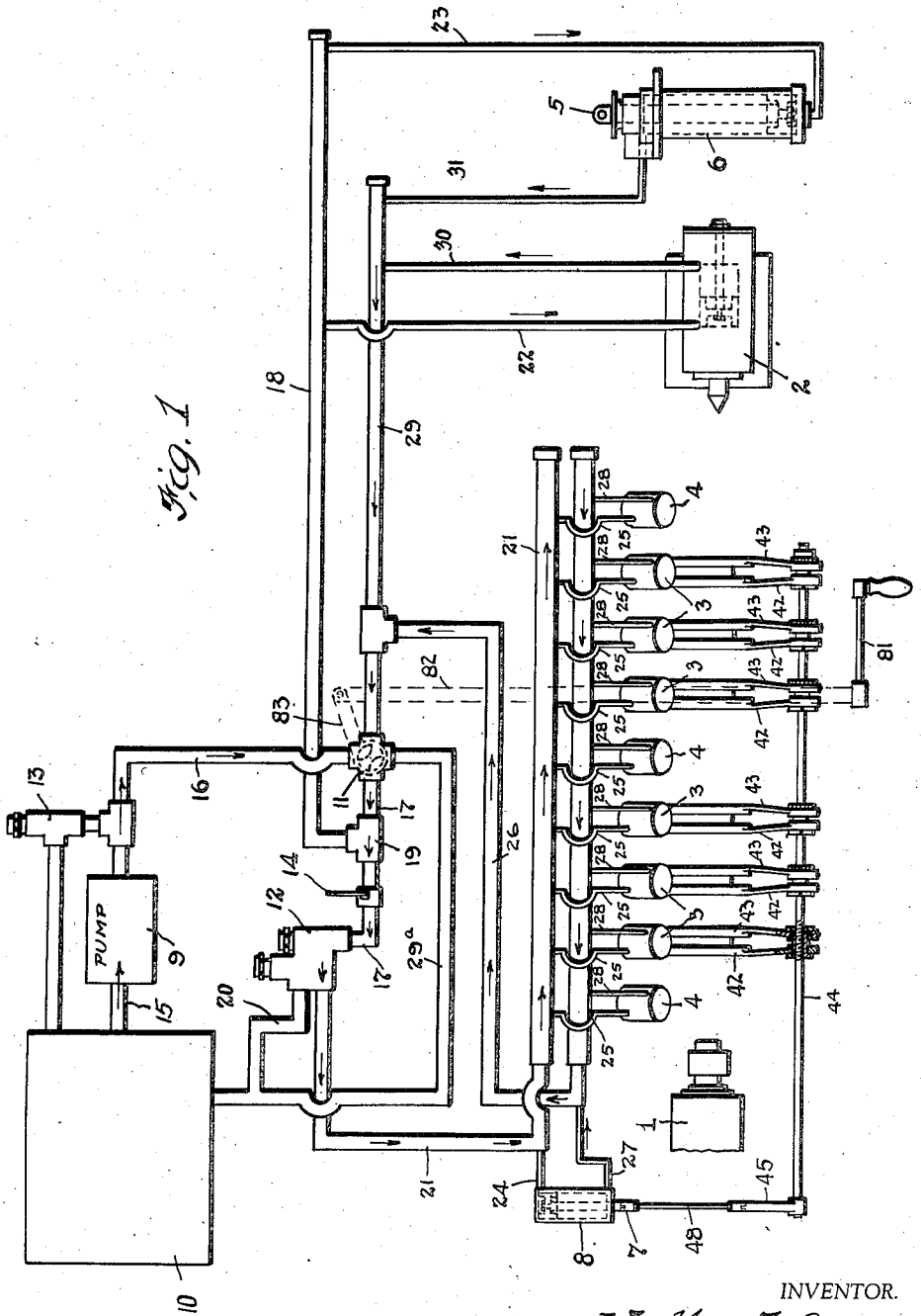
June 21, 1938. W. F. EGGER 2,121,025

LAPPING MACHINE

Filed May 1, 1936 4 Sheets-Sheet 1

Fig. 1



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June 21, 1938. W. F. EGGER 2,121,025

LAPPING MACHINE

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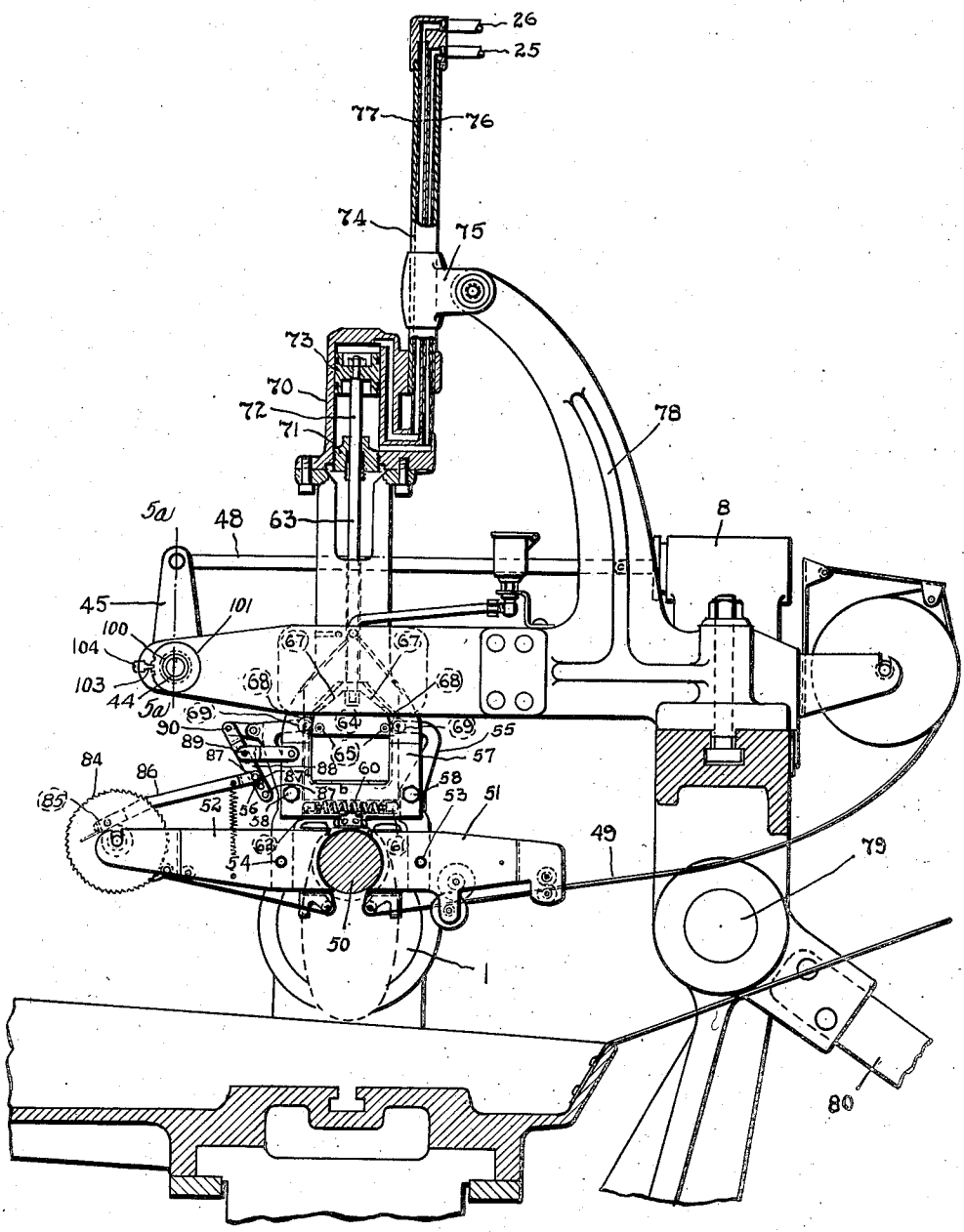


Fig. 2.

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LAPPING MACHINE

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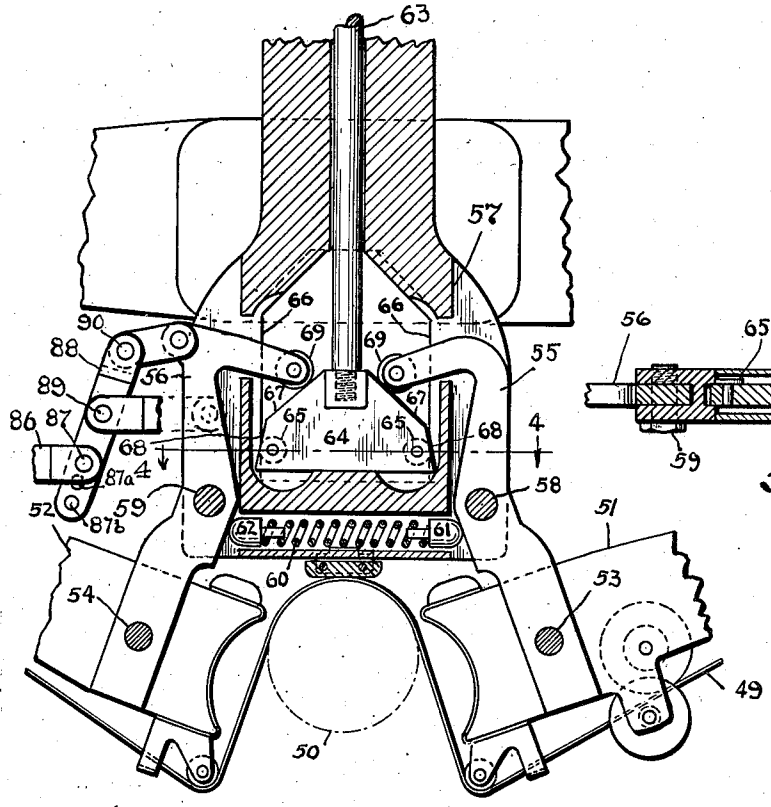


Fig. 3.

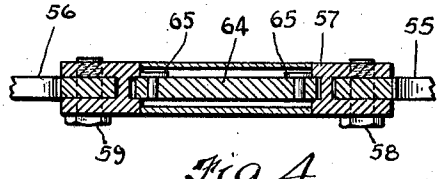


Fig. 4.

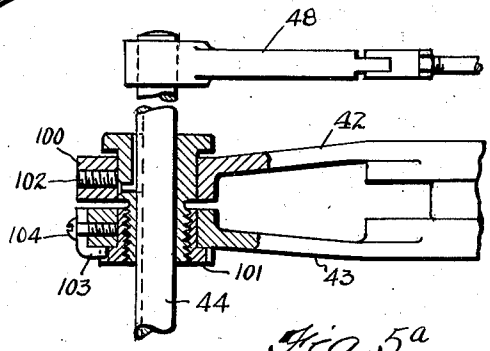


Fig. 5a

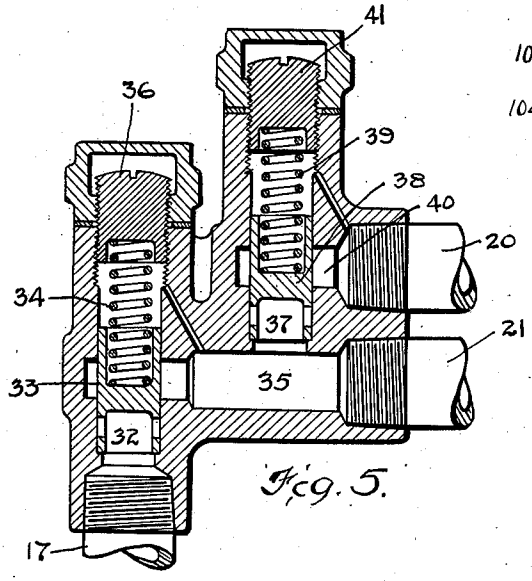


Fig. 5.

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LAPPING MACHINE

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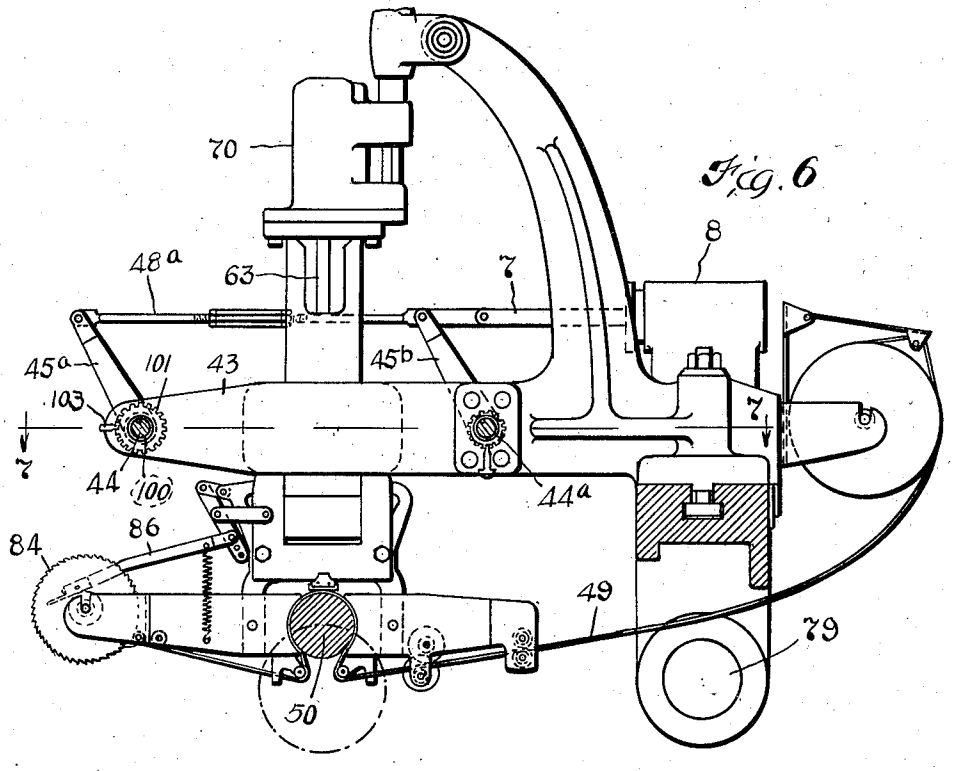


Fig. 6

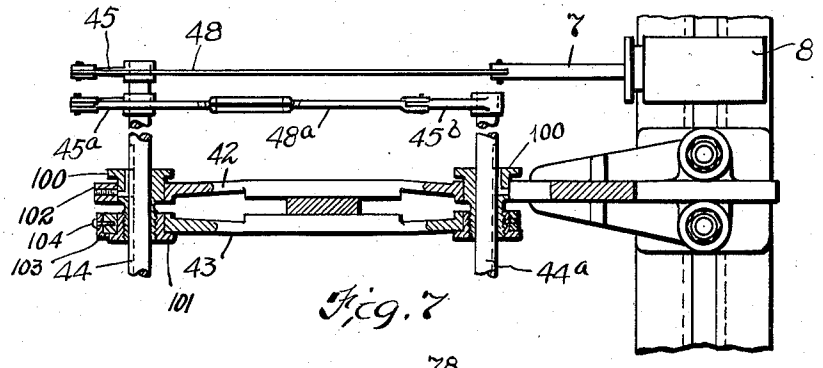


Fig. 7

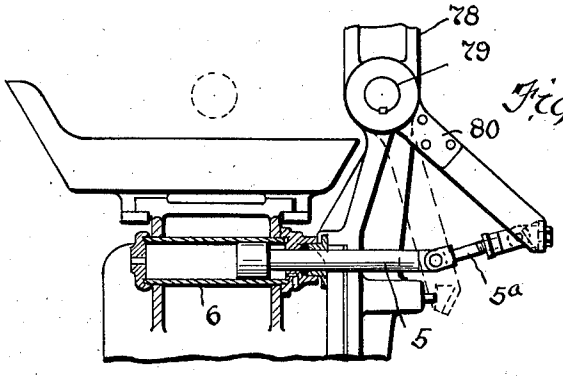


Fig. 8.

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Patented June 21, 1938 2,121,025

UNITED STATES PATENT OFFICE

2,121,025

LAPPING MACHINE

Walter F. Egger, Lakewood, Ohio, assignor to The A. P. Schraner Company, Cleveland, Ohio, a corporation of Ohio

Application May 1, 1936, Serial No. 77,375

7 Claims. (Cl. 51—73)

This invention relates, as indicated, to improvements in lapping machines and relates in general to the type of lapping, honing or polishing machine such as is illustrated in my prior Patent No. 1,993,543, dated March 5, 1935.

It is among the objects of the present invention to provide an improved means for actuating from a single control station and by means of a single control device the various elements of the apparatus so that they may be actuated in the proper sequence required during the operation of the machine.

A further and more particular object of my invention is to provide an improved means for effecting an engagement between the jaws which carry the abrasive element and the article such as the crank shaft to be lapped or polished, whereby such engagement may be most efficiently effected from a single source of power such as a hydraulic jack.

As will be noted from an examination of the disclosures in my above identified patent, an apparatus of the character to which the present invention relates usually comprises work supporting elements between which the crank shaft to be honed or lapped is rotatably supported with one of such elements commonly called the tail-stock relatively movable to the other, whereby the securing of the work article in the machine is made possible.

The apparatus also includes a movable mounted head upon which is supported a plurality of work units, each unit adapted to engage one of the crank pins of the crank shaft so that upon subsequent rotation of the crank shaft, the crank pin areas thereof will be operated upon by such units. The apparatus also includes means for locking said units in predetermined relation to the tilting or movable head, whereby at the end of a particular lapping operation, all of such units may be locked in predetermined relation to each other as well as to the head so that when a new crank shaft is placed in the machine and the head lowered into operative engagement, the various work units will occupy the proper position relatively to the crank pins of the new crank shaft.

Heretofore, these various steps of placing the machine in operation have been performed manually and in proper sequence by an operator. It is, as above indicated, one of the principal objects of my invention to provide means for effecting all of the above named operations from a single station and furthermore, by means which although utilizing a single source of power such as fluid under pressure, will perform the various operations in the predetermined desirable sequence.

With the advent of larger crank pin areas due particularly to increased diameters of the crank pins, it has become necessary to provide means which may occupy the limited space available between the axially spaced crank pins on the crank shaft and which will, at the same time, be effective to impart the necessary working pressure on the jaws which carry the abrasive elements and engage the crank pins during the lapping or honing operation.

It is, as above indicated, another principal object of my invention to provide an actuating device for the jaws which carry the abrasive elements into engagement with the crank pins whereby a single piston of minimum diameter may be employed to first move the jaws at a relatively rapid rate and with a small amount of force towards the work and thereupon at a considerably slower rate but with a corresponding increase in the amount of force, move the jaws into working engagement with the crank pins.

Other objects of my invention will appear as the description proceeds.

To the accomplishment of the foregoing and related ends, said invention, then consists of the means hereinafter fully described and particularly pointed out in the claims.

The annexed drawings and the following description set forth in detail certain mechanism embodying the invention, such disclosed means constituting, however, but one of various mechanical forms in which the principle of the invention may be used.

In said annexed drawings:

Fig. 1 is a schematic diagram of an apparatus constructed in accordance with the principles of my invention and showing in particular the pipe system and connecting units or power jacks employed to accomplish the various movements of the apparatus which occur incidentally to the loading and unloading of the machine; Fig. 2 is a side elevational view in section of an apparatus constructed in accordance with my invention and showing in particular the means for bringing the jaws carrying the abrasive into and out of engagement with the crank shaft; Fig. 3 is an enlarged part sectional, part elevational view of a portion of the apparatus illustrated in Fig. 2; Fig. 4 is a transverse sectional view of a portion of the apparatus illustrated in Fig. 3 taken on a plane substantially indicated by the line 4—4; Fig. 5 is a sectional view of the control

valve forming a part of the system illustrated in Fig. 1; Fig. 5a is a fragmentary sectional view, taken on the line 5a—5a of Fig. 2; Fig. 6 is a side elevational view, similar to Fig. 2, but stressing a modified form of the particular apparatus adapted to lock various working units relatively to each other; Fig. 7 is a part plan, part sectional view of a portion of the apparatus illustrated in Fig. 6, taken on a plane substantially indicated by the line 7—7; and Fig. 8 is a view showing the head actuating or tilting means.

Referring now more specifically to the drawings and more especially to Fig. 1, the diagrammatic illustration here shown includes substantially all of the elements of the apparatus shown in my previously mentioned issued patent, the various working parts of the machine being shown only diagrammatically connected, however, by the control system which forms part of the present invention.

The head stock 1 and the tail stock 2 between which the work piece to be operated upon is removably clamped and rotated, are shown diagrammatically and correspond generally, however, to the head and tail stocks 5 and 6, respectively, of Fig. 1 in my above identified patent.

Each of the work units adapted to engage and operate upon one of the crank pins of the crank shaft is provided with an actuating piston or jack generally indicated by the numerals 3 and 4, the numeral 3 denoting the jacks of work units which operate upon the connecting rod pins of the crank shaft and the ordinals 4 denoting the pistons or jacks of the units which operate upon the main bearings of the crank shaft.

As the operating units carrying the pistons or jacks 3 and 4 are mounted on a movable head, the construction of which is more fully explained, and such head is actuated by means of a piston generally indicated at 5 forming a part of the hydraulic jack unit 6, the means for locking the various work operating units relatively to each other, as well as to the movable head, which construction will be explained hereinafter in greater detail, is energized by means of a piston 7 forming a part of the hydraulic jack assembly 8. Other component parts of the circulatory system for the fluid which energizes the previously mentioned jacks and thus actuates the various parts of the machine, are a hydraulic pump 9, a collecting sump or tank 10, a control valve 11, a pressure regulating valve 12, an overload relief valve 13 and a shut-off valve 14. The pipe 15 leads from the sump 10 to the pump 9; the pipe 16 from the pump 9 to the control valve 11; the pipe 17 leads from the control valve 11 to the manifold 18 on one branch of the T 19 and through the pressure regulating valve 12 to return line 20 and manifold 21.

The manifold 18 has supply lines 22 and 23 respectively leading therefrom to the tail stock 2 and the hydraulic jack 6 for actuating the head of the machine. The manifold 21 has a conduit 24 leading to the locking jack 8 and a plurality of conduits 25 respectively leading to one side of the jacks 3 and 4. A return manifold 26 is connected by means of a pipe 27 to the jack 8 and a plurality of pipes 28 to the jacks 3 and 4. The return manifold 26 is connected through a T to another return manifold 29 which is connected by means of pipes 30 and 31 respectively to the tail stock 2 and the jack 6 for actuating the head.

The valve 13 is a simple overload relief valve, i. e., a closure member, not shown, is held onto the seat in the valve 13 by means of an adjustable spring so that when the pressure in the system exceeds a predetermined value, the fluid in the system will be vented back to the sump 10.

The construction of the valve 12 is shown in detail in Fig. 5 and such construction and its operation will now be described in detail.

It will be noted that the fluid supply to the valve 12 is through conduit 17 which leads into the bore 32 in which is slidably mounted a movable valve member 33 normally under the influence of spring 34 closing the passage between bores 32 and 35. The tension of the spring 34 may be adjusted by means of the nut 36. Communicating with the bore 35 is a branch bore 37 in which is slidably mounted a plunger 38 normally under the influence of spring 39 sealing the passage between the branch bore 35 and the relief bore 40, the relief bore being in communication with the pipe 20. The tension of the spring 39 regulating the pressure at which the relief bore 40 is opened is adjustably controlled by means of the nut 41.

It will be noted that the manifold 21 will not have fluid admitted thereto from the pipe 17 until after the pressure in the last-named pipe is sufficient to elevate the plunger 33 against the spring 34. The primary function of the valve 12 is, therefore, to insure that the fluid in the manifold 18 is built up to a predetermined value and also after the fluid is admitted to the manifold 21, to vent such fluid back to the sump in case the pressure on the same reaches a predetermined amount. It will, therefor, be seen that the pressure required to move the plunger 33 upwardly and to provide communication between the bore 32 and the branch bore 35 will be less than the pressure required to move the plunger 38 upwardly to provide communication between the branch bore 35 and the relief bore 40. The fluid pressure at which the jacks 3, 4 and 8 operate will, therefore, preferably be some value lying between the pressure which will move the plunger 33 upwardly and that pressure which will move the plunger 38 upwardly to open the passages respectively controlled thereby. The provision of the valve 12 insures that there will be no building into the jacks 3, 4 and 8 to cause a partial energization of the same until the apparatus is in such condition that the devices respectively controlled by such jacks may be safely operated.

The function of the valve 14 is to close off the manifold 21 which may be desired on occasion if a crank shaft or similar work article is to be inserted in the machine and held there by the tail stock 2 but without engagement thereof by the abrasive holding jaws. When the valve 14 is closed, then the relief valve 13 is relied upon to guard against damage to the apparatus in case of the building up in the machine of unexpected pressures.

The work units presently to be described and which incidently form a part of the present invention are movably mounted and laterally supported between arms 42 and 43, the outer ends of which are adapted to be actuated to release or clamp the work units. For this purpose, the arm 42 has journalled in its outer end a nut 100, which is in threaded engagement with a nut 101 in the outer end of arm 43, the nut 100 being restrained from axial movement with respect to arm

42 by means of a set screw 102, and the nut 101 being locked in adjusted position by means of a locking detent 103 secured to the arm 43 by screw 104 and engaging teeth on a flange of nut 101. A rock shaft 44 extends through nut 100 and is keyed thereto, so that upon rotation of this shaft, the arms 42 and 43 are relatively moved to clamp or release the work unit. The shaft is rocked by means of a lever 45, to the rod 48 forming an extension of the piston 7. Energization of the jack 8 resulting in a movement of the piston 7 will, therefore, be translated into rotation of the shaft 44, and depending upon the direction of such rotation, the arms 43 will be moved either towards or away from arms 42. If the arms 43 are moved towards the arms 42, they will grip and hold the work units supported therebetween, thus locking the same relatively to each other as well as the head by which they are supported.

A modification of this locking device has been found to be advantageous and particularly useful when the work units supported between the arms 42 and 43 are stopped near the rear or inner ends of said arms. The gripping action which takes place at the outer ends of arms 42 and 43 may be insufficient to hold the units in place when they are stopped in such position, particularly if a relatively heavy specimen is being lapped, and to insure the holding in place of the units when they are so stopped the modification most clearly illustrated in Figs. 6 and 7 has been constructed.

To attain the desired result, nuts identical with those at the outer ends of arms 42 and 43 are located at the inner ends of said arms and secured thereto in identical manner. Through these innermost nuts passes an auxiliary shaft 44a to which the nuts 100 are keyed. The two shafts 44 and 44a are connected by means of the rod 48a and auxiliary levers 45a and 45b so that a rotation of shaft 44 by the energization of the jack 8 will cause simultaneously a corresponding rotation of shaft 44a moving the inner ends of arms 43 toward or away from the arms 42 in the same manner described above for the operation of the outer ends, thus gripping and holding in place the work units supported therebetween regardless of the position in which they are stopped.

The construction of the work unit forming a part of this invention will now be explained by having reference to Figs. 2 to 4.

As previously indicated, the machine to which the present invention relates is generally similar to that illustrated in my previously mentioned prior patent. The work piece such as a crank shaft to be lapped is rotatably supported between the head and tail stocks 1 and 2. The work units which are employed to maintain successive sections of a strip of abrasive material 49 in engagement with the crank pin 50 to be lapped or honed are likewise generally similar to those illustrated in my prior patent in that they comprise movably mounted arms 51 and 52 having jaws fashioned on their inner ends so as to snugly engage a circumferential section of the crank pin. The arms 51 and 52 are connected by means of pins 53 and 54 to arms 55 and 56 in such fashion that limited pivotal movement between the two sets of arms is permitted. The arms 55 and 56 are respectively pivotally secured to the head 57 by means of pins 58 and 59. The head 57, at its lower end, has a transverse extending bore within which is mounted a compression spring 60 having contact buttons 61 and 62 which respectively engage the arms 55 and 56 to force apart the lower ends of the same as well as the arms 51 and 52 respectively carried thereby.

Extending upwardly through the head 57 is a piston rod 63 to the lower end of which there is secured a cam plate 64. The cam plate 64 carries guide rollers 65 which engage the opposite sides 66 of the opening in the head 57 for the purpose of guiding the cam plate 64 in its vertical reciprocation in such opening. The cam plate 64 is provided with two pairs of oppositely disposed faces 67 and 68, the first pair being arranged at a considerably greater angle to the longitudinal axis of the rod 63 than the latter.

The arms 55 and 56 extend inwardly adjacent the cam plate 64 and carry rollers 69 which engage the cam faces 67 and 68.

Obviously, various specimens, such as crankshafts or camshafts, will vary in size, the circumference to be lapped of certain ones being less than that of others; consequently, if the same length of strip of abrasive be used to lap those specimens of lesser circumference as is used to lap those of greater circumference, a certain amount of waste results. This waste has been reduced to a minimum in my present modified construction of the unit which operates to intermittently feed a new length of strip, by providing means whereby said length of strip may be varied to accommodate the varied circumferences of particular specimens. This unit comprises a ratchet 84 located at the end of arm 52, a one-way driving or ball clutch device 85 fixed to an arm 86 pivoted at 87 to an arm 88 which is pivoted at a stationary point 89 and a movable point 90.

The detailed operation of this unit is fully described in my above identified prior patent and it is therefore believed necessary to describe here only my improvement thereon which is as follows:

As the cam plate 64 is lowered, the roller 69, which engages the left cam faces 67 and 68 is moved toward the right carrying with it the pivotal point 90 thus moving that portion of arm 88, below the stationary point 89, toward the left, actuating arm 86 and clutch 85 in the same direction to feed into place a new length of strip. Obviously, the longer the stroke of arm 86, the longer will be the new length of strip and to the accomplishment of this end additional pivotal points have been provided in the arm 88 such as at 87a and 87b so that when the arm 86 is connected to one of these points more remote from the pivotal point 89 such as 87a, said arm will be moved through a greater distance due to its pivotal point moving in an arc of greater radius which results in a longer piece of abrasive being fed to accommodate an increase in circumference of the specimen.

As most clearly illustrated in Fig. 2, the upper end of the head 57 has a cylinder 70 mounted thereon in axial alignment with the rod 63, the lower end of which cylinder is closed by means of a packing gland 71 through which extends the upper end 72 of the piston rod 63. To the upper end of such piston rod there is secured a double acting piston 73. A stem generally indicated at 74 which is slidably supported in a knuckle 75 has two passages 76 and 77 respectively formed therein, the former providing communication between the pipe 25 and the space within the cylinder below the piston 73 and the passage 77 providing communication between the pipe 26 and the space within the cylinder above the piston 73. The

head 78 which is pivotally supported on the pin 79, as well as the various other details of construction of the apparatus included in the drawings but which form no part of the present invention are believed to be explained in sufficient detail in my above identified patent, that a further description of their construction and mode of operation is believed unnecessary herein, it being noted, however, that the piston 5 of the jack 6 is connected as by means of an adjustable connecting rod 5a to the bar or link 80 by means of which movement of the head 78 about its supporting pin 79 is effected and controlled.

The operation of the above described construction with regard to the control system shown in Fig. 1, as well as the construction of the particular work unit best illustrated in Fig. 3, is as follows:—

A control handle 81 is provided and through which rod 82 is connected to arm 83 for the purpose of actuating the valve 11.

Let it first be assumed that the machine is idle and it is desired to place in the machine a work article such as a crank shaft to be lapped and to then bring the work units carrying the abrasive elements into engagement with the crank pins of the shaft:—The operator will first actuate the lever 81 in such a fashion as to cause a clockwise rotation of the plug in the valve 11 so that communication is afforded between the conduits 16 and 17 and 29 and 29a. Fluid under pressure from the pump 9 will then flow through the valve 11 into the conduit 17 building up a pressure therein against the pressure of spring 34 in the valve 12. The valve 12 will, therefore, cause a pressure to be built up in the manifold 18 from which the fluid will flow through conduits 22 and 23 respectively to the tail stock 2 and the head actuating jack 6.

It is essential, of course, that the tail-stock engage the work piece before the head is moved into engagement therewith. Accordingly, the work factor of the tail-stock jack will be less than the work factor of the head jack 6.

At this point I wish to explain what is meant by the term "work factor" as used in the ensuing description, as well as in the appended claims. The term "work factor" as used herein is the proportional relationship between the area of the piston of a particular jack divided by the force of the apparatus tending to resist the movement of the jack. Thus, for purposes of illustration, assume the cross sectional area of the tail-stock piston to be 4 and the force required to move the tail-stock to be 2; thus the work factor of the tail-stock jack is 2.

Let is now be assumed that the area of the piston 5 of the head jack 6 is 6 with the force tending to oppose movement of the piston 5 as 2; then the work factor of the head jack 6 will be 3.

As previously indicated, the effective cross sectional area of the piston of the tail-stock 2 is so proportioned relatively to the force required to be exerted thereby that the work factor of the tail-stock 2 will be less than the work factor of the head jack 6. Accordingly, even though fluid through a common source of supply is introduced to both the tail-stock 2 and the head jack 6, the tail-stock 2 will be first energized, thereby clamping the work in the machine between the head and tail-stocks before the head jack 6 causes the head to move into operative position with respect to the work piece.

As soon as the tail stock 2 and the head jack 6 have thus been actuated in sequence, pressure will build up in the manifold 18 and 17 to a value sufficient to cause the plunger 33 to be moved upwardly against the action of spring 34, thus admitting the fluid under pressure to the manifold 21. Fluid under pressure from manifold 21 is, therefore, simultaneously admitted to the space below the piston 73 of the work unit jacks 70 and the space behind the piston 7 of the work unit clamping jack 8. The work factor of the jacks 3 and 4 will preferably be less than the work factor of the jack 8 and accordingly, the piston 73 will be forced upwardly causing an upward movement of the cam plate 64, which will result in an engagement of the arms 51 and 52 with the crank pin adjacent the particular work unit and as soon as such engagement takes place, the jack 8 will cause a rotation of the shaft 44 in such direction as to free the work units between the arms 42 and 43 placing the machine in condition for operation.

The work unit to be operated upon is thereupon rotated by means of the head stock 1 and the lapping or honing operation continued for the desired length of time.

The arrows which have been placed on the various conduits of the fluid circuit shown in Fig. 1 indicate the direction of fluid flow during the course of the operation just described, i. e., while the machine is being loaded and placed in condition to operate upon a work piece. After the conclusion of the lapping or honing operations, the valve 11 will be restored to the position substantially indicated in Fig. 1 and the fluid flow through the system will then be reversed to the direction indicated by the arrows restoring the various units to an inoperative position.

As previously indicated, one of the principal features of the present invention is the provision of a novel means whereby the arms 51 and 52 may be brought into engagement with the work piece to be operated upon.

When operating upon devices such as crank shafts, cam shafts and the like, the distance between crank pins is usually very short and such distance determines, of course the diameter of the piston usable for the purpose of closing the arms or jaws 51 and 52 onto the work. It is to the solution of this particular problem that the apparatus most clearly illustrated in Fig. 3 has been devised. The cam plate 64, it will be noted, on each side of its longitudinal axis has two angularly related faces respectively extending at different angles to the line of movement of the plate. The face 67 is relatively steep so that when the piston moves at a uniform rate, the arms 51 and 52 will be brought towards the work at a relatively rapid rate. This is possible for the reason that little work is done in thus moving the arms towards the work; however, as soon as the arms approach the work rather closely, the roller 69 of the arm 55 rides over onto the face 68 of the cam plate. Continued movement of the piston 73 at a uniform rate will, therefore, cause the arms 51 and 52 to move into engagement with the work at a relatively slower rate but with greater force. By this novel connection between the piston 73 and the arms 51, I am able to utilize a relatively small piston as required by the distance between crank pins of the work and yet sufficiently displace the arms 51 and 52 laterally of the work so as to sufficiently clear the same and at the same time, exert sufficient pressure on the crank pin for the lapping or honing operation.

The relatively flat inclination of the cam surface with respect to the axis thereof results in a structure in which the lap is substantially positively held in a predetermined fixed relation with respect to the work surface so that as the lap encounters slight imperfections in such surface, it will have a greater tendency to cut away such imperfections as desired instead of yieldably riding over the same.

The function of the spring **60** is, of course to maintain the roller **69** in engagement with the cam plate **64** so that the position of the arms **51** and **52** will, at all times, be determined by the contour of the cam plate **64**.

It should be noted at this point that instead of providing a cam plate such as **64** with two angularly disposed straight faces such as **67** and **68**, I may, for certain types of apparatus, prefer to make the operative faces of the cam plate in a continuous curve with the upper portion of the face as viewed, for example, in Fig. 3, at a lesser angle to the longitudinal axis of the rod **63** than the lower portions of the cam face with which the rollers **69** contact, while the arms **51** and **52** are forced into engagement with the work.

Other modes of applying the principle of my invention may be employed instead of the one explained, change being made as regards the mechanism herein disclosed, provided the means stated by any of the following claims or the equivalent of such stated means be employed.

I therefore particularly point out and distinctly claim as my invention:—

1. In apparatus of the character described, the combination of a plurality of lapping units, a movably supported head carrying said lapping units, locking means for securing said lapping units relatively to said head, a movable work engaging member, a plurality of fluid actuated operating devices respectively connected to said work engaging member, said head, said lapping units and said locking means, and a single control valve for simultaneously connecting all of said operating devices to a single source of fluid under pressure, the work factor of said operating devices being so proportioned as to be effective in proper sequence.

2. In apparatus of the character described, the combination of a plurality of lapping units, a movably supported head carrying said lapping units, locking means for securing said lapping units relatively to said head, a movable work engaging member, a plurality of fluid actuated jacks respectively connected to said work engaging member, said head, said lapping units and said locking means, and a single control valve for simultaneously connecting all of said jacks to a single source of fluid under pressure, the fluid volume capacity of the several jacks being so proportioned that the same operate the devices connected thereto in predetermined sequence.

3. In apparatus of the character described, the combination of a plurality of lapping units, a movably supported head carrying said lapping units, locking means for securing said lapping units relatively to said head, a movable work engaging member, a plurality of hydraulic jacks respectively connected to said work engaging member, said head, said lapping units and said locking means, and a single control valve for simultaneously connecting all of said jacks to a single source of liquid under pressure, the hydraulic volume capacity of said jacks being so proportioned that the same operate the devices connected thereto in predetermined sequence.

4. In apparatus of the character described, the combination of a plurality of relatively movable work engaging jaws, actuating arms connected to said jaws, a movable cam member adapted to engage said arms to actuate said jaws, said cam member so formed that upon movement thereof at a uniform rate said jaws will be moved toward the work at a relatively rapid rate and into engagement therewith at a slower rate.

5. In apparatus of the character described, the combination of a plurality of relatively movable work engaging jaws, actuating arms connected to said jaws, a movable cam member adapted to engage said arm to actuate said jaws, said cam provided with angularly related work faces whereby upon movement thereof at a uniform rate said jaws will be moved toward the work at a relatively rapid rate and into engagement therewith at a slower rate.

6. In apparatus of the character described, the combination of a plurality of relatively movable work engaging jaws, actuating arms connected to said jaws, a movable cam member adapted to engage said arms to actuate said jaws, said cam member so formed that upon movement thereof at a uniform rate said jaws will be moved toward the work at a relatively rapid rate and into engagement therewith at a slower rate and means for moving said cam member.

7. In apparatus of the character described, the combination of a plurality of relatively movable work engaging jaws, actuating arms connected to said jaws, a movable cam member adapted to engage said arms to actuate said jaws, said cam provided with angularly related work faces whereby upon movement thereof at a uniform rate said jaws will be moved toward the work at a relatively rapid rate and into engagement therewith at a slower rate and a fluid actuated piston for moving said cam member.

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