March 30, 1937. V. MANCUSO 2,075,216

VALVE SEAT LAPPING MACHINE

Filed Oct. 14, 1935 2 Sheets-Sheet 1

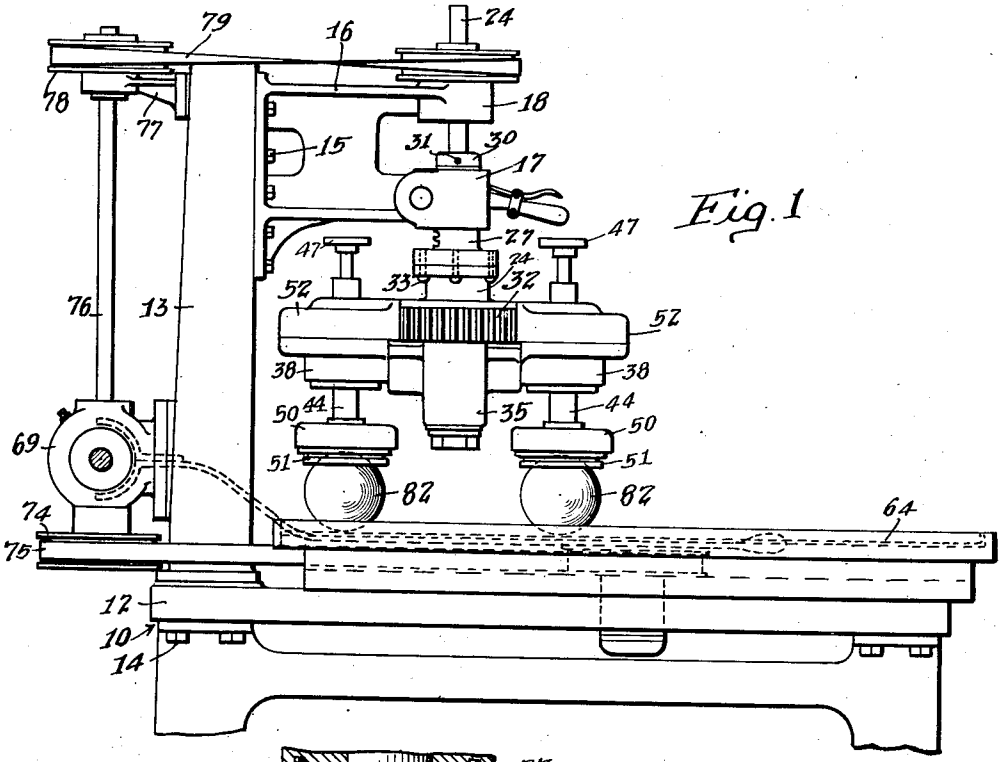


Fig. 1

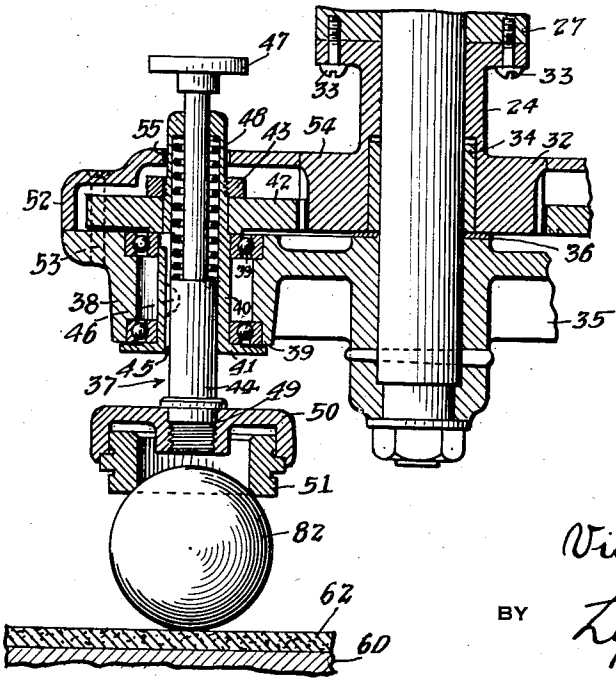


Fig. 2

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Fig. 3

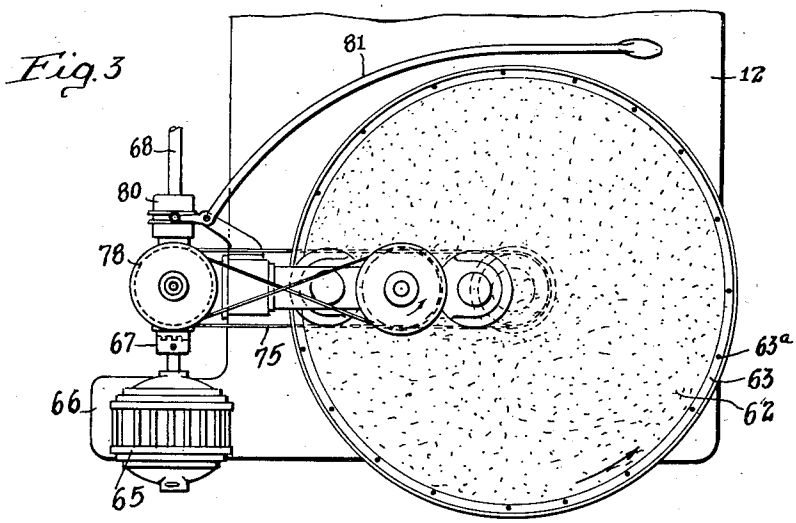
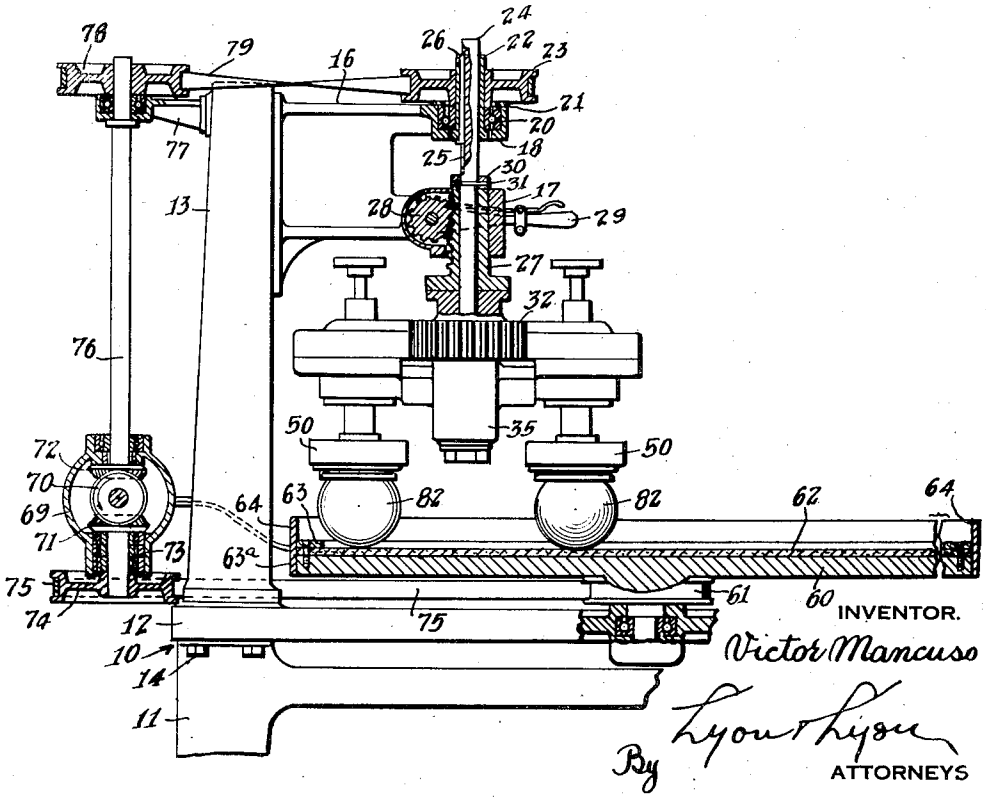


Fig. 4



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VALVE SEAT LAPPING MACHINE

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2 Claims. (Cl. 51—27)

My invention relates to a valve seat lapping machine and more particularly to a machine for rapidly and accurately lapping ball valves and seats into fluid-tight sealing relation.

It is one of the principal objects of this invention to provide a machine for rapidly and accurately lapping the seat of a valve by universal rotation of its related ball valve to form therebetween a fluid-tight sealing relation.

A further object is to provide a resilient relatively flat tractive surface to insure rotation of the valve ball during the lapping operation and to provide a means for operatively giving the valve seat under treatment a planetary motion while in lapping relation with the ball.

A further object is to rotate the flat ball-engaging surface about a center spaced from the center of rotation of the planetary valve seat carrying means whereby the ball will be universally turned to present all portions thereof into lapping relation with its related seat and whereby the cycloidal-like path scribed by the ball upon said surface will roll along ever changing paths upon said surface so as to avoid wearing grooves in said surface.

A further object is to arrange the machine whereby a plurality of valve seats may be lapped by their related balls simultaneously during the operation of the machine.

A further object is to provide the machine with removable valve seat chucks whereby the machine may be utilized for lapping a wide range of sizes of seats and balls.

A further object is to provide means for yieldingly urging the valve seats into lapping relation with their related balls during the lapping operation whereby an even and accurate lapping effect is obtained.

Other objects and advantages of the invention will become apparent as the nature of the same is more fully understood from the following description and accompanying drawings, wherein is set forth what is now considered to be a preferred embodiment. It should be understood, however, that this particular embodiment of the invention is chosen principally for the purpose of exemplification and that variations therefrom in details of construction or arrangement of parts may accordingly be effected and yet remain within the spirit and scope of the invention as the same is set forth in the appended claims.

In the drawings:

Figure 1 illustrates a side elevational view of the lapping machine of this invention.

Figure 2 illustrates an enlarged fragmental sectional view of the planetary head.

Figure 3 illustrates a top plan elevational view of Fig. 1, and

Figure 4 illustrates a view similar to Fig. 1 but showing portions of the machine in section.

The preferred embodiment of the invention, as illustrated in Figures 1 to 4, may include a frame 10 having a base section 11 (only partially shown in Fig. 1), a base plate 12, and a standard 13. These three portions of the frame may be securely fastened together by suitable screw means 14. Fastened to the upper front face of the standard 13 by cap screws 15 is a bearing bracket 16, which bracket is provided with spaced bearing bosses 17 and 18. As may be observed in Fig. 4, the bearing boss 18 may be counterbored to receive an anti-friction bearing 20 and by means of bearing plate 21 may be fastened to the bearing boss. The bearing plate may be fastened upon the bearing boss in any suitable manner, not shown.

A shouldered sleeve 22 is tightly fitted into the bore of the antifriction bearing in such manner that the shoulder of the sleeve engages the under side of the bearing while the cylindrical portion of the sleeve extends above the bearing to receive the pulley 23. The pulley is fastened to the sleeve in any suitable manner, not shown, so as to insure the rotation of the sleeve with the pulley. The hub of the pulley may be extended to engage the side of the bearing opposite to that engaged by the shoulder of the sleeve, whereby the assembly of the bearing, sleeve and pulley forms a compact unit. The upper end of a planetary drive shaft 24 is slidably mounted in sleeve 22. The shaft is provided with a keyway 25 while the sleeve is provided with a corresponding keyway in which a key 26 is mounted. The ends of the key may be shouldered to extend over the ends of the sleeve for locking the key against displacement during sliding movement of the shaft. By the arrangement just described, the planetary drive shaft 25 may be positively rotated by pulley 23 and yet is free for longitudinal movement relative thereto.

The bearing boss 17 is bored to slidably receive the rack sleeve 27 and is transversely counterbored to receive rack pinion 28. It will be understood that the teeth of the pinion mesh with the teeth formed upon the rack sleeve and that by means of the operating handle 29 the pinion may be rotated to cause the rack sleeve to be shifted with relation to its bearing boss 17. The planetary drive shaft 24 passes freely through rack

sleeve 27 and, therefore, the rotation of the shaft has no effect upon the sleeve which is held against rotation by means of the engagement of its rack teeth with the lifting pinion 28. A collar 30 is fastened to shaft 24 by a taper pin 31, or other suitable means, whereby an upward movement of sleeve 27 will cause a corresponding movement of the shaft. A planetary gear 32 is fastened to the flanged lower end of sleeve 27 in any suitable manner, as for example by the screw means 33, as shown most clearly in Fig. 2. The planetary gear is bored to receive shaft 24 while the lower end of the gear bore may be counterbored to receive a bearing bushing 34 for journally supporting the shaft. By fastening the planetary gear 32 to the rack sleeve 27, it will not rotate during the operation of the machine but may be lifted or lowered with sleeve 27 by means of the actuating handle 29.

A planetary head 35 is securely fastened upon the lower end of shaft 24 in any suitable manner. One example of such a mounting is clearly shown in Fig. 2. A thrust washer 36 (Fig. 2) is provided between the adjacent faces of the planetary gear 32 and head 35. Due to this arrangement, a downward movement of the rack sleeve 27 will be transmitted through the planetary gear 32, thrust washer 36, planetary head 35, and finally to shaft 24. It will be remembered that an upward movement of sleeve 27 acted against collar 30 to lift shaft 24. Thus, due to the construction described, each reciprocatory movement imparted to the sleeve by the actuating handle 29 will cause a direct and equal movement of the drive shaft and as the planetary head 35 is securely fastened thereto an equal movement of this head.

The planetary head 35 may be provided with one, two, or any desired number of valve seat collar spindles 37, which have their rotative axes parallel to the rotative axis of the head and are spaced therefrom a suitable distance. As all of the spindles may be alike, the description of one will do for all.

The spindle 37 may be journaled in a suitable boss 38 formed on the head and may be arranged for rotary motion only, however, as illustrated in Fig. 2, the spindle is arranged so that a limited amount of longitudinal movement relative to the head may be had. As illustrated in Fig. 2, the boss 38 of the planetary head is bored to accommodate a pair of spaced antifriction bearings 39. A sleeve 40 is carried by bearings 39 and is provided at its lower end with a flange 41 which acts to retain the sleeve and lower antifriction bearing in operative relation while the sleeve adjacent the upper surface of the upper antifriction bearing is shouldered to receive a planetary pinion 42. The pinion is clamped against the sleeve shoulder by means of the nut 43 screw threaded upon the sleeve. The hub of the pinion also overlies the inner portion of the antifriction bearing, thus retaining the upper bearing in operative position. Due to the mounting of sleeve 40, it may be rotated freely by its related pinion but is locked against longitudinal movement. The spindle shaft 44 is slidably mounted in the bore of sleeve 40 and is caused to rotate with the spindle by providing the sleeve with a suitable keyway 45 and shaft 44 with a suitable key 46. The upper portion of shaft 44 is of reduced diameter and has secured upon its extreme upper end a lifting knob 47. The upper end of sleeve 40 has a bore of reduced diameter to accommodate the corresponding portion of the shaft. A spring 48, mounted with sleeve 40, surrounds that portion of the shaft having the reduced diameter and acts between the inwardly directed shoulder of the sleeve and the shoulder of the shaft, as is clearly illustrated in Fig. 2, to yieldingly urge the shaft downwardly.

The lowermost end of shaft 44 is shouldered and threaded as at 49 to receive a valve seat chuck 50. The chuck 50 is bored to receive a valve seat 51. The valve seat is of standard form and it is to be understood that chuck 50 may be replaced by a larger or smaller chuck when seats of larger or smaller size are to be lapped in the machine.

The teeth of planetary pinion 42 mesh with the teeth of the planetary gear 32 and as the planetary gear is held stationary during the rotation of the planetary head 35 the planetary pinion travels around the planetary gear and thus causes the rotation of the spindle. By this arrangement, spindle 37 receives a rotary motion about its own axis and simultaneously therewith rotation around the axis of the planetary drive shaft 24.

As may be observed in Fig. 2, the teeth of the planetary gear 32 are not formed across the full width of the gear, thereby leaving a smooth peripheral edge around the top edge of the gear. A protective casing 52 may be fastened upon the upper surface of boss 38 as by means of screws 53. The casing is appropriately formed to substantially inclose the planetary pinion and is provided with an arcuate edge 54 which closely fits the peripheral edge of the planetary gear. An opening 55 is provided in the casing to permit the upper end of the spindle sleeve to project therethrough.

By reference to Fig. 4, it may be observed that a turntable 60 is suitably journaled upon a base plate 12 and is provided with a driving pulley 61, by means of which the table may be rotated. It should be noted that the rotative axis of the table is parallel to and spaced from the rotative axis of the planetary drive shaft 24, however, this relation may be modified to suit such other conditions as may be desired.

The surface of the table which is directed toward the planetary head is relatively flat and smooth and may be covered with a resilient tractive material 62, as for example rubber. The resilient material may be fastened to the table by means of an annular ring 63 and screws 63a. A guard ring 64 may be fastened to the peripheral edge of the table by any suitable means, not shown.

It is desirable to simultaneously drive the table and planetary head for which purpose any suitable form of driving means may be provided. A simple and effective driving means is shown in the drawings and includes an electric motor 65 mounted upon a rearwardly extending base plate bracket 66. The motor drives through a suitable coupling 67 (Fig. 3) a line shaft 68 which may be extended sufficiently to drive a series of lapping machines. Mounted upon the rear face of standard 13 is a gear box 69 through which the line shaft extends. Journally mounted upon the line shaft within the gear box is a bevel gear 70 which meshes with two other bevel gears 71 and 72. The bevel gear 71 is fixed to the upper end of the stub shaft 73, which shaft is suitably journaled in the gear box. The lower end of stub shaft 73 extends below the gear box a distance sufficient to have a pulley 74 fixed thereon. The stub shaft pulley 74 and the table pulley 61 are in substantial alignment and are operatively connected by a suitable driving belt 75.

The bevel gear 72 is fixed upon the lower end of the upper shaft 76. One end of shaft 76 is journaled in the gear box while its upper end is journaled in a bearing bracket 77, which bracket is appropriately fastened to the rear face of standard 13. A pulley 78 is fastened upon shaft 76 above the bearing bracket and is operatively connected to pulley 23 of the planetary drive shaft by means of a belt 79.

The bevel gear 70 which is journaled upon the line shaft 68 may be releasably connected thereto by means of an ordinary form of clutch 80 (Fig. 3). A clutch handle 81 extends forwardly into convenient reach of the attendant. By means of clutch handle 81, the clutch 80 may be rendered active to establish a driving connection between the line shaft 68 and the bevel gear 70. The rotation of bevel gear 70 will in turn simultaneously drive the bevel gears 71 and 72 and thereby simultaneously drive the turntable and the planetary head. Upon completion of the lapping operation, the machine may be stopped by actuating the clutch handle 81 to release the clutch and thereby interrupt the driving connection between the line shaft and bevel gear 70.

In the operation of the lapping machine of this invention, a chuck 50 of proper size will be mounted upon the end of each spindle 37. The lapping machine illustrated in the drawings is provided with two spindles 37 but it is to be understood that the planetary head may be provided with a greater number of spindles if desired. After the chucks have been mounted upon the spindles, the valve seats 51 may be inserted in the chucks. Next the planetary head may be elevated by means of handle 29 to permit a valve ball 82 to be positioned between the lower-most seat of each valve member and the resilient tractive surface of the turntable, whereupon the planetary head may be lowered until the seats engage their related balls. After the seats and balls have been brought into engagement, the planetary head may be lowered still further which additional movement of the head is permitted due to making the spindle shafts 44 longitudinally movable relative to the planetary head and will result in compressing the spindle springs 48 whereby these springs will now act to yieldingly urge the valve seats into close contact with the surface of their related balls. When the spindle springs 48 have been tensioned sufficiently to cause the valve seats to seat against their re-respective balls with sufficient force further lowering of the planetary head may be stopped. The machine is now set for operation. Before starting the machine, a small amount of lapping compound may be applied to each ball or, if preferred, the lapping compound may be applied to the balls or seat, or both, before the balls are placed in the machine.

The machine may now be placed into operation by rendering the motor 65 active and then placing the table and planetary head driving means into operation by means of the clutch handle 81. During the operation of the machine, the turntable 60 and planetary head will be rotated. It is to be understood that in some instances it may be desirable to rotate only the table and in others only the head, however, it is preferred to rotate both the head and table. During the rotation of the planetary head, the valve seat spindles will travel around the rotative axis of the planetary head and while so traveling will be rotated around their own axes by their planetary pinion 42 traveling around the stationary planetary gear 32. Due to the compound motion of each spindle and the rotation of the table, the seat of each of the valve seats will be quickly and accurately lapped into fluid-tight sealing relation with its related ball. It will be appreciated that each of the balls is driven along its cycloidal-like path by the contact of the ball with the valve seat of its related seat and, therefore, that portion of the valve seat which acts to push the ball along will be lapped to a greater extent than that portion of the seat directly opposite unless the valve seat is continuously rotated so as to continuously present to the ball a different portion of the valve seat whereby a very even and accurate lapping effect is obtained.

By providing the turntable with a flat surface, the balls may roll smoothly along the surface of the table during the lapping operation. It has been found that a better lapping action may be had by providing the table with a resilient surface, such as for example rubber, and that the rubber surface acts as a tractive surface, that is, it insures a more positive turning of the balls.

For some lapping conditions it may not be necessary to rotate the table. For heavy work if the table were not rotated the balls would continuously roll over the same path and would soon wear grooves in the table. By rotating the table the balls are given a greater turning movement, thus speeding up the lapping action. It is desirable to provide a turntable of sufficient size so that the balls will never cross the axial center of the table, whereby during the rotation of the planetary head and table the balls will roll along continuously changing paths on the table and, therefore, will not wear grooves in the surface of the table.

When the lapping operation has been completed, the planetary head need not be lifted to remove the balls and seats but instead each spindle shaft may be lifted sufficiently by means of its lift knob 47 against the action of its spring 48 to remove the ball and thereafter the valve seat may be removed from the chuck. As may be observed in the drawings, each of the valve seats is provided with two opposed seats and the seat members are symmetrical in all respects. The chucks are made to fit nicely over the body portion of the seat members to permit them to be easily placed in or removed from the chucks.

After one of the seats of the valve seat member has been fully lapped, the valve seat member may be removed from the chuck and replaced therein in reverse direction to present the other seat for lapping. Preferably the same ball which was used to lap the first seat of each valve member will be used to lap the second seat. By use of the spindle knobs 47, the spindles may be raised to enable the balls to be returned into lapping arrangement with their related valve members. The machine may be placed in operation, as previously described, to institute the lapping operation. When the second seat of each of the valve members has been fully lapped, the valve members may be removed from the machine and the balls which cooperated in the lapping operation are preferably retained and form the valve balls for each of their related valve members. The seats of the valve members, together with their related valve balls, may now be tested to determine if they are fluid-tight. If not, and no defects have shown up, the leaky valves may be replaced in the machine for further lapping. Usually very little additional lapping will be necessary. In most

cases the valves are lapped to a perfect seat during the lapping operation and it is in rare cases only that they need be returned to the machine for additional lapping. It is preferable to keep the valve members and ball which were lapped together as a pair forming a complete valve.

In use, when one of the seats of the valve member has worn sufficiently to justify a change, the valve member may be reversed, thereby presenting its second seat to the valve ball and in most cases it has been found that the valve ball wears so slightly that it will form a perfect seal with the second seat of the valve member. However, should for some reason the valve ball also need replacing, a new ball may be used in its place. The new ball will form a fluid-tight seal with the second seat of the valve member as it was lapped to a perfect seat with a new ball in the first instance. It will be appreciated that the balls wear very slightly during the lapping operation and that the same ball will seat perfectly upon both of the seats of the valve member after the lapping operations.

The lapping machine of this invention is relatively inexpensive of manufacture, simple in operation, and may be successfully operated by relatively unskilled attendants. The machine will quickly and accurately lap the seats of the valve members into perfect sealing relation with their related valve balls.

Having fully described the invention, it is to be understood that it is not to be limited to the details herein set forth but the invention is of the full scope of the appended claims.

I claim:

1. In a lapping machine, a planetary head having a plurality of spaced spindles, means for rotating the head, means for rotating each of said spindles during the rotation of said head, each of said spindles having means for operatively carrying a valve seat to be lapped, a valve ball for each of said seats, a rotative resilient tractive surface for causing the valve ball positioned between each of said seats and said surface to be rotated and turned so that all portions of each ball will be brought into engagement with its seat during the lapping operation, means for rotating said surface, and said tractive surface having a center of rotation beyond the cycloidal like path scribed by the balls upon said surface so that the balls will roll along ever changing paths.

2. In a lapping machine, a relatively flat tractive surface, means for rotating said surface, a planetary head opposed to said surface and rotatable about an axis parallel to but spaced from the rotative axis of said surface, a spindle rotatively and slidably mounted in said head and having its center of rotation spaced from the rotative axis of said head, means for rotating said head, means for rotating the spindle during the rotation of said head, said spindle having means for operatively carrying a valve seat to be lapped, a valve ball for said seat, and means for yieldingly urging the spindle toward said surface to in turn yieldingly urge the seat against said valve ball positioned between the seat and surface.

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