

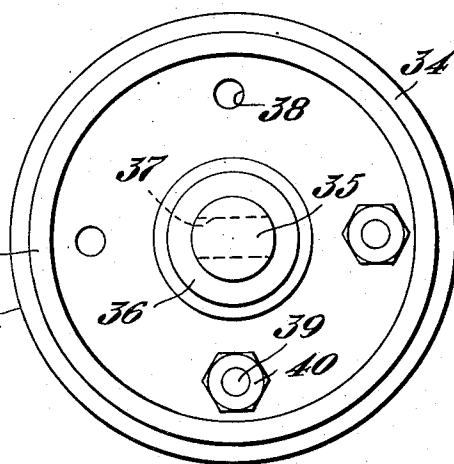
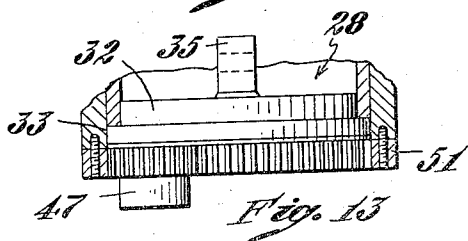
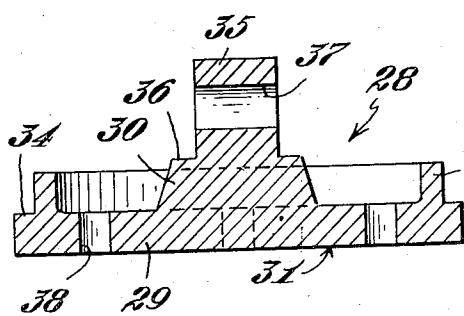
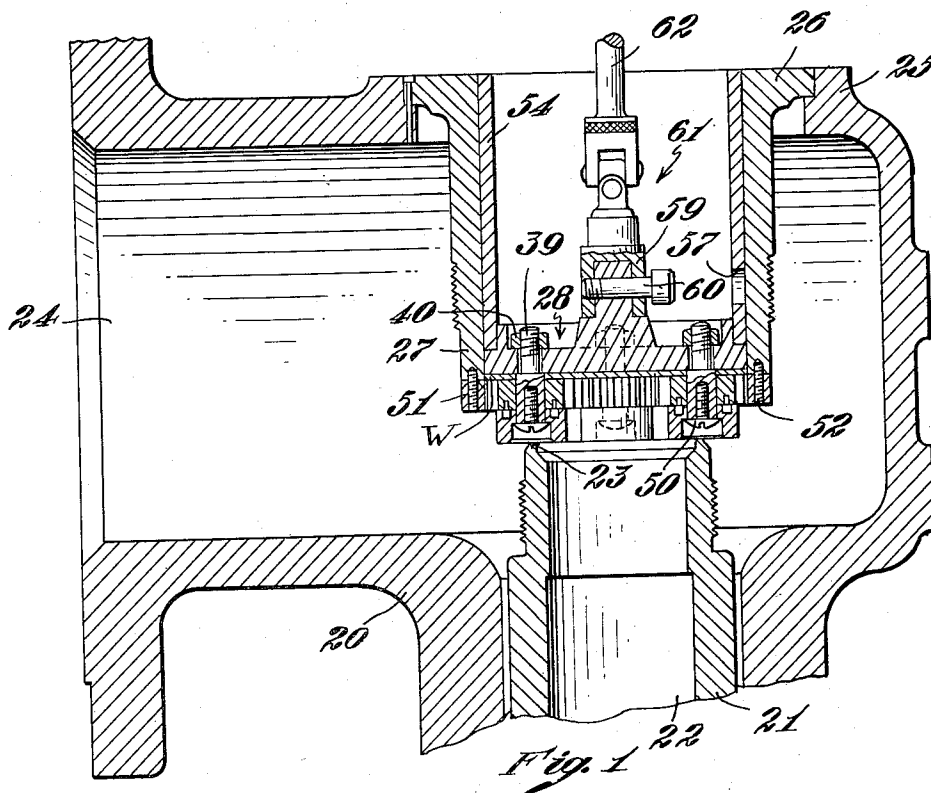
Aug. 25, 1953

R. A. TOBIS
APPLIANCE FOR LAPPING FLAT ANNULAR
SURFACES OR DISKS

2,649,669

Filed June 1, 1951

2 Sheets-Sheet 1



Inventor
Robert A. Tobis
by *Robert C. Cushman & Co.*
Attys

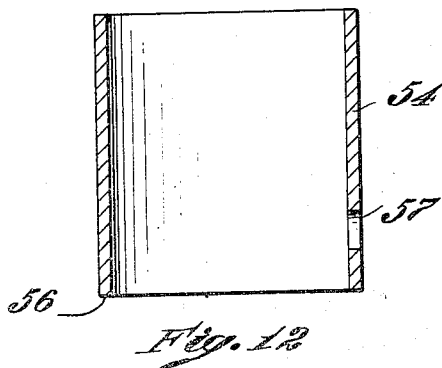
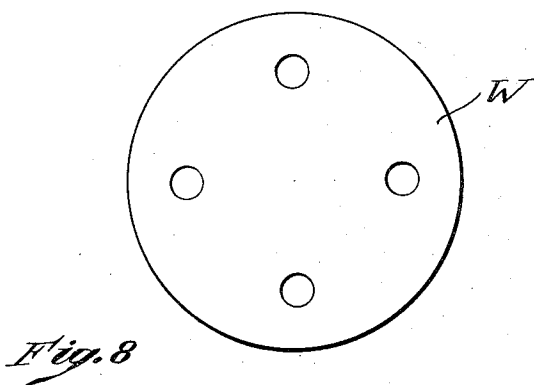
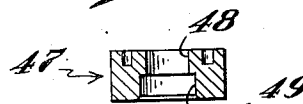
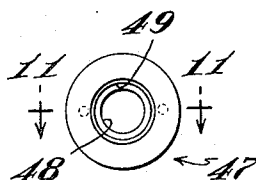
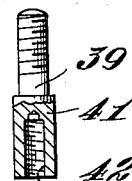
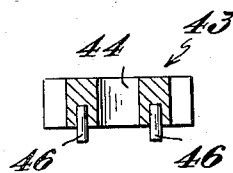
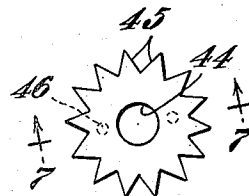
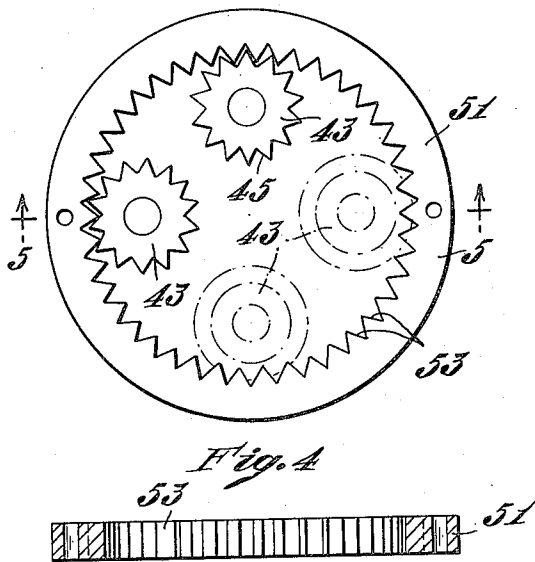
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APPLIANCE FOR LAPPING FLAT ANNULAR
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2 Sheets-Sheet 2



Inventor
Robert A. Tobis
by Robert C. Anderson & Company
Attys

UNITED STATES PATENT OFFICE

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APPLIANCE FOR LAPPING FLAT ANNULAR SURFACES OR DISKS

Robert A. Tobis, Bridgeport, Conn., assignor to Manning, Maxwell & Moore, Incorporated, New York, N. Y., a corporation of New Jersey

Application June 1, 1951, Serial No. 229,387

14 Claims. (Cl. 51—241)

1

This invention pertains to apparatus for lapping flat disks or flat annular surfaces. While of more general application it is here illustrated, by way of example, in its application to the lapping of the seats of pop safety valves. In such valves the head or feather is urged toward the seat by a spring and lifts from the seat when the fluid pressure beneath the head or feather overcomes the spring force. As the fluid pressure rises toward the popping point, the effective force which holds the valve head to the seat diminishes, eventually becoming zero. Thus the prevention of leakage and consequent injurious erosion resultant from wire-drawing at pressures near the popping point depends solely upon the accuracy of the opposed faces of the valve head and seat. In valves of the better grades, particularly those intended for high pressure work, the degree of flatness of the seat surface must be within light band limits, and the only way of obtaining such flatness mechanically is by a lapping operation. If it be attempted to lap a flat surface by the use of laps which turn constantly in the same direction and about the same axis, the surface being lapped will be rounded off. Thus when it is attempted to lap the flat annular seat of a safety valve by the use of a solid, rotating lap, the edges of the seat bushing will become rounded and the lap itself will develop worn spots. Heretofore, so far as is known to me, no portable mechanical device has been available for lapping the seats of pop safety valves, installed in the position of use, with the desired degree of accuracy, and prior practice has been to lap them by hand.

In hand-lapping, the lap may be given an irregular combined reciprocating and rotating motion which does not wear the lap locally or cause a rounding of the surface being lapped. However, this hand operation is laborious and expensive and requires experience and skill. The principal object of the present invention is to provide portable mechanical means which may be power or hand driven, and which is capable, in use, of so lapping the seat of a pop safety valve (without removing the valve from its place of use) as to obtain a flat surface, accurate within light band limits. A further object is to provide a lapping appliance which may be operated by unskilled and inexperienced persons but without sacrifice of the accuracy of result. A further object is to provide a lapping appliance so designed that in lapping a disk or flat annulus no fins are produced at the edge as a result of the action of the lapping element. A further object is to provide a lapping appliance of such design that the lapping ele-

2

ments re-condition themselves during the lapping operation so that they always remain within light band limits of accuracy. A further object is to provide a lapping appliance in which a lap may readily be replaced whenever it is desired to renew it or to change the type of lap or abrasive to be employed. Other and further objects and advantages of the invention will be pointed out in the following more detailed description and by reference to the accompanying drawings wherein:

Fig. 1 is a fragmentary, vertical section through the casing of a safety valve of a well known type (the bonnet of the valve being removed) showing, in diametrical section, the seat-lapping implement and accessory parts of the present invention;

Fig. 2 is a diametrical, vertical section through the carrier which forms a part of the improved seat-lapping implement;

Fig. 3 is a plan view of the part shown in Fig. 2;

Fig. 4 is a plan view of an internal gear annulus forming an element of the improved lapping implement, showing some of the pinions assembled therewith;

Fig. 5 is a section on the line 5—5 of Fig. 4 but omitting the pinion;

Fig. 6 is a plan view of lap-driving pinion forming an element of the appliance;

Fig. 7 is a section on the line 7—7 of Fig. 6;

Fig. 8 is a plan view of a washer forming a desirable element of the appliance;

Fig. 9 is a diametrical section, through a holding screw employed for connecting certain of the parts;

Fig. 10 is a plan view of a lap illustrative of the type of lap which may be employed in the appliance;

Fig. 11 is a diametrical section on the line 11—11 of Fig. 10;

Fig. 12 is a diametrical section of a positioning cylinder forming an accessory to the appliance of the present invention; and

Fig. 13 is a side elevation of the lap-supporting assembly, illustrating the possible use of a single lap.

Referring to the drawings, the numeral 20 designates a valve casing, usually a casting, of a conventional type having the seat bushing 21 which defines the inlet passage 22 and which is shaped at its upper end to provide the horizontal, annular, flat valve-seat surface 23. The casing is also shaped to provide the outlet passage 24 and has a flange portion 25 to which the usual valve bonnet (not here shown) is attached and which defines an opening leading into the valve cham-

ber within the casing. This flange 25 is provided with an internal, annular, horizontal shoulder which forms a support for a flange 26 at the upper end of a stationary valve-guiding sleeve 27. This sleeve is in accurate axial alignment with the axis of the valve seat.

In accordance with the present invention the seat-lapping appliance comprises a carrier or support 28 (Fig. 2) having a disk portion 29 of a maximum external diameter substantially equal to the internal diameter of the valve-guiding sleeve 27, and provided with a coaxial hub 30 at its upper side and having a substantially flat lower surface 31 perpendicular to its axis. The disk is provided with an annular upstanding flange 32 spaced inwardly from its peripheral edge 33 so as to provide a horizontal annular shoulder 34. A short stem 35 (here shown as integral with the hub 30) extends upwardly from the hub, the stem being of an external diameter less than that of the hub so as to provide the horizontal, annular abutment shoulder 36. This stem has a diametrically extending aperture 37 for the reception of a connecting bolt, as hereafter described, and the disk 29 is provided with a plurality of vertical bores 38, four of these bores here being illustrated, the axes of these bores being on a circle which is concentric with the axis of the disk, the several bores being located between the flange 32 and the hub 30. These bores 38 are designed to receive the shank portions 39 of shouldered holding screws (Fig. 9) which extend up through the bores 38 and whose shanks are screw threaded to receive the retaining nuts 40 (Fig. 1) by which the holding screws are held rigidly in assembled relation to the disk 29. Each of the holding screws has an elongate cylindrical head portion 41 whose peripheral surface is finished to provide a journal for a lap-driving pinion 43 (Figs. 6 and 7) the head portion 41 of the holding screw having an axial, internally screw threaded bore 42. Preferably a washer W (Fig. 8) of antifriction material, for example, hard fibre is interposed between the lower face of disk 29 and the upper faces of the pinions. Each of the pinions 43 is provided with an axial bore 44 designed to turn on the head 41 of the holding screw, and is provided with peripheral teeth 45 which are hereinafter referred to as "gear teeth" although they need not be accurately developed gear teeth such as are used in properly designed gear trains. As here shown, these teeth are triangular. Teeth of other shapes may be employed, and accurately developed gear teeth may be used if desired. On the other hand, coarse knurling may be sufficient for the purpose which is to prevent slippage between the pinion and the complemental element hereinafter referred to as an "annular gear" with which the pinion meshes during use. Each of these pinions 43 is provided with two diametrically arranged downwardly projecting dowel pins 46 which are designed to enter corresponding sockets in the upper surface of a lap 47 (Fig. 11). These laps, as here illustrated, are disk-like in general shape, each lap having a bore 48 which is designed to turn on the lower portion of the head 41 of the corresponding holding screw, the bore having an enlargement 49 at its lower end for the reception of the head 50 (Fig. 1) of a screw whose shank is engaged with the threaded bore 42 in the holding screw. The length of the upper, smaller part of the bore 48 is such that the head 50 of the screw does not contact

the shoulder at the junction of the larger and smaller parts of the bore, so that the lap is free to move axially to a limited extent, for example $\frac{1}{64}$ of an inch. When the parts are assembled, the lap is constrained to turn with the corresponding pinion 43 by the dowel pins 46. Preferably the axes of the laps are located on a circle of a radius substantially equal to that of the valve seat.

Cast iron laps may be used, each lap having an accurately smooth lower surface in a plane perpendicular to the axis of the lap, and it will be understood that, in use, the lower surfaces of the laps will be supplied with suitable abrasive material such as is customarily employed for the purpose of lapping parts which are to be very accurately finished. While cast iron is a desirable material for forming the laps, it is contemplated that other materials may be employed and that if desired, abrasive disks may be substituted for the iron laps.

The lap-driving pinions 43 all mesh with a stationary gear annulus 41 (Figs. 1, 4 and 5) which is secured temporarily, during the lapping operation, to the lower edge of the valve guiding cylinder 27 by means of screws 52. This gear annulus 51 is provided with internal teeth 53 of suitable shape for cooperation with the teeth 45 of the pinions 43. As here illustrated, these teeth 53 are triangular but as noted in connection with the teeth 45, they may be of other shapes so long as they function in cooperation with the teeth 45 of the pinions to insure positive rotation of the pinions without substantial slippage between the gear 51 and the pinions 43. The relative arrangement of the several pinions 43 and the gear 51 is illustrated in Fig. 4, it being noted that there are four pinions having their axes 90° apart which all mesh at the same time with the gear 51. A greater or lesser number of pinions may be used according to the number of laps employed.

In order to position the appliance properly when in use, there is provided a hollow cylinder or journal member 54 (Fig. 12) whose outer surface is accurately finished for a rotating fit within a bearing constituted by the stationary valve guiding sleeve 27. The lower edge of the cylinder or journal member 54 rests upon the shoulder 34 of the disk 29, with the flange 32 of the disk fitting snugly, for example with a press fit, within the lower end of the cylinder so that the cylinder or journal member and disk rotate as a unit. The cylinder and disk are so designed that when they are assembled, and the cylinder has been slid down into the valve guide 27, the lower face of the disk, which is accurately flat, will be in a plane perpendicular to the axis of the valve seat. The cylinder 54 has an opening 57 in its wall at a point so spaced from its lower edge as to provide access to a connecting screw 60 by means of which the stem 35 is attached to the actuating device. As illustrated in Fig. 1, there is provided an inverted cup-like member 59 which fits over the stem 35 and whose lower end rests upon the shoulder 36, this cup-like member having a diametrically extending opening which, in assembling the parts, is arranged in axial alignment with the opening 37 in the stem 35. When the part 59, the cylinder 54 and the supporting member 28 have been assembled, the bolt 60 is inserted, the bolt having a screw threaded portion which engages screw threads in the wall of the cup member 59. This cup member is

5

connected, preferably by a universal joint 61, with an operating shaft 62.

In use, the gear 51 is first secured to the lower edge of the valve guiding sleeve 27. Then the appliance, comprising the support 28 and cylinder 54, with the pinions 43 and corresponding laps assembled therewith, and with the driving shaft 62 coupled with the stem 35, is pushed down into the sleeve 27 until the pinions 43 mesh with the teeth of the gear 51. It being assumed that the lap members 47 have been provided with abrasive or that they are of abrasive character, rotation of the shaft 62 turns the support 28 and thus causes the pinions 43 and the corresponding laps to revolve in an orbit about the axis of the valve seat and while so revolving the engagement of the pinions with the fixed gear 51 causes the pinions to turn on their own axes and thus rotate the several laps. Desirably, the number of teeth 53 in the fixed gear 51 is an uneven multiple of the number of teeth in the pinions, and if desired, the number of teeth in the several pinions may differ as is permissible when the teeth are not accurately developed gear teeth, the net result being that during the lapping operation the same point in any given lap seldom if ever touches the same point on the valve seat surface while moving in the same direction. Thus the possibility of scoring the seat surface is substantially eliminated and furthermore, there is no tendency to wear the surfaces of the laps unevenly.

As herein above described, four laps, symmetrically arranged, are used. However, a lesser or greater number of laps may be employed. For specific example, as shown in Fig. 13, but one lap is used. This is made possible by the use of the sleeve 54 which holds the carrier 28 so rigidly and so accurately centered with reference to the axis of the valve seat that even though the pressure is applied unsymmetrically, perfect lapping is obtainable.

While the apparatus herein disclosed is particularly useful, by reason of its portable character, for resurfacing worn seats of valves already in use, and without necessitating the removal of the valve from the pipe connection, it is obviously useful in the lapping of seats of new valves in the process of manufacture.

While one desirable embodiment of the invention has been illustrated and described by way of example, it is to be understood that the invention is broadly inclusive of any and all modifications falling within the terms of the appended claims.

I claim:

1. A lapping appliance comprising a disk-like support having an under surface which is accurately flat and perpendicular to the axis of the support, a hollow journal member coaxial with and fixed to the support, the journal member and support being of the same external diameter, a plurality of annular laps arranged at the under side of the support, a journal for each lap on which the lap may turn, the axes of the several journals being spaced apart circumferentially of the support, means for rotating the support, and means, including a fixed annular gear coaxial with said journal member operative as the support turns to turn each of the laps on its own journal.

2. A portable lapping appliance comprising a disk-like support having a flat under surface perpendicular to its axis, said support having a plurality of bores whose axes are perpendicular to the

6

lower surface of the support and spaced axially from the axis of the support, a shoulder screw fixed in each of said bores, each screw having a journal portion projecting down below the under surface of the support, a lap mounted to turn upon the journal portion of each of said shoulder screws, a pinion coaxial with each lap, drive connections between each pinion and its lap, a rigid hollow cylinder having a finished outer surface designed to turn in a stationary bearing with its axis perpendicular to the plane of the surface to be lapped, the disklike support having an upstanding annular flange which fits tightly within the lower end of the cylinder, the edge of the disk-like support being flush with the outer surface of the cylinder, an annular internal gear coaxial with the cylinder and with which all of said pinions mesh, means whereby said annular gear may be fixed relatively to the stationary bearing in which the cylinder turns, and means for rotating the disk-like support thereby bodily to revolve the laps about the axis of the support, the engagement of the pinions of the annular gear causing the individual laps to rotate as they revolve.

3. A portable lapping appliance comprising a disk-like support having a flat under surface perpendicular to its axis, a journal member projecting down below the under surface of the support, a lap mounted to turn upon said journal member, a pinion coaxial with said lap, the lap being free to move axially of its journal member for a limited distance, a drive pin projecting from the pinion into a socket in the associated lap, an internally toothed annular gear coaxial with the disk-like support and with which all of said pinions mesh, a rigid hollow cylinder coaxial with the disk-like support and to one end of which the latter is secured, the cylinder having a finished outer surface and being designed to turn in a stationary bearing with its axis perpendicular to the plane of the surface to be lapped, means whereby the annular gear may be fixed relatively to said bearing, the disk-like support having an axial stem arranged within the cylinder, and means for turning said stem thereby to rotate the disk-like support and thus to revolve the lap in a circular orbit while the lap is rotated about its own axis by engagement of the pinion with the annular gear.

4. A portable lapping appliance comprising a disk-like support having a flat under surface perpendicular to its axis, a plurality of journal members carried by and projecting down from the support, the axes of the journal members being equally spaced circumferentially of the support, a lap and a lap-driving pinion mounted to turn on each journal member, each lap being free to move axially to a limited extent, means for transmitting motion from each pinion to its associated lap while permitting such axial movement of the lap, an annular internal gear which simultaneously engages the several lap-driving pinions, the support having an upstanding axial stem and having an upstanding annular flange spaced inwardly from its outer edge, a rigid hollow cylinder within whose lower end said upstanding flange fits tightly, the outer edge of the disk-like support being flush with the outer surface of the cylinder, the outer surface of the cylinder being finished and designed to turn within a stationary bearing whose axis is perpendicular to the plane of the surface to be lapped, means whereby the annular gear may be fixed relatively to said stationary bearing, a drive rod, and a

7

universal joint connection between the drive rod and the stem of the disk-like support.

5. Portable lapping apparatus adapted to be used in lapping the seat of a pop safety valve of that kind wherein a cylindrical guide for the valve head is fixed relatively to the valve casing and in coaxial relation to the valve seat, said appliance comprising a sleeve which fits accurately within said cylindrical guide for rotation relatively to the latter, a carrier fixed to the sleeve, said carrier supporting a plurality of independently movable rotary laps, a pinion coaxial with and connected to each lap, an annular, internal gear which simultaneously meshes with all of the pinions, means for fixing said gear to the lower edge of the cylindrical guide, and means for rotating said sleeve within the cylindrical guide.

6. Portable lapping apparatus adapted to be used in lapping the seat of a pop safety valve of that kind wherein a cylindrical guide for the valve head is fixed relatively to the valve casing and in coaxial relation to the valve seat, said appliance comprising a cylindrical sleeve so dimensioned as to accurately fit and to rotate within the head guiding cylinder, a carrier fixed to the lower end of said cylindrical sleeve, a plurality of journal members projecting down from said carrier, the axes of the journal members being equally spaced circumferentially of the carrier, an annular lap turning on each journal member, a pinion coaxial with each lap and having driving connection therewith, an internal, annular gear which simultaneously meshes with all of the pinions, means for attaching said gear to the lower edge of the head guiding cylinder in coaxial relation to the latter, and means for rotating the sleeve and carrier.

7. Portable lapping apparatus adapted to be used in lapping the seat of a pop safety valve of that kind wherein a cylindrical guide for the valve head is fixed relatively to the valve casing and in coaxial relation to the valve seat, said appliance comprising a cylindrical sleeve so dimensioned as to fit and rotate within the cylindrical guide, a carrier fixed to the lower end of the cylindrical sleeve, the carrier having a flat under surface which is perpendicular to the axis of the sleeve, a stem projecting up from the upper face of the carrier, an antifricition washer engaging the under surface of said carrier, a plurality of pinions supported by the carrier and arranged below said washer with their axes perpendicular to the lower face of the carrier, an annular lap coaxial with each pinion, each lap being capable of slight axial movement, means for transmitting motion of each pinion to its associated lap, an annular, internal gear which meshes simultaneously with all of the pinions, means connecting the annular gear to the lower edge of the cylindrical guide, and a shaft connected to the stem for rotating the disk and its cylindrical sleeve relatively to the cylindrical guide.

8. Portable lapping apparatus useful in the resurfacing of worn seats of used pop safety valves, of the kind in which there is a stationary valve-guiding sleeve within the valve casing, without necessitating the removal of the valve from its pipe connections, said apparatus comprising a hollow journal member designed to fit accurately and rotatably within the valve-guiding sleeve of the valve casing, a carrier fixed to the lower end of the cylinder, an internal annular gear, means for temporarily attaching said gear in coaxial

8

relation to the lower end of the valve-guiding cylinder, a pinion rotatably supported by the carrier and which meshes with said internal gear, a lap fixed in coaxial relation to the pinion, and means for rotating the cylinder.

9. A portable lapping appliance comprising an internally toothed gear annulus having provision for rigidly securing it to a stationary part with its axis perpendicular to the plane of the surface to be lapped, a hollow cylinder, having a finished outer surface, designed to turn in a stationary bearing which is coaxial with the gear annulus, a disk-like support coaxial with the cylinder and gear annulus and which is fixed to one end of the cylinder, a plurality of journal members fixed to and projecting downwardly from the under surface of the support, the axis of each of said journal members being spaced from the axis of the support, a lap mounted to turn on each journal member, a pinion associated with and having driving connection with each lap, and means for rotating the support, the several pinions meshing with the teeth of the gear annulus, whereby, as the support is rotated, each lap is turned about the axis of its own journal member.

10. A portable lapping appliance comprising a disk-like support, a journal member fixed to and projecting downwardly from the under surface of the support, the axis of said journal member being spaced from the axis of the support, a lap mounted to turn on said downwardly projecting journal member, a pinion associated with and having driving connection with said lap, an annular internal gear coaxial with the support and with which said pinion meshes, a hollow cylinder having a finished outer surface designed to turn in a stationary bearing coaxial with the annular gear, the disk-like support being fixed to one end of the cylinder, means whereby the annular gear may be rigidly secured to a stationary part with its axis perpendicular to the plane of the surface to be lapped, and means for rotating the disk-like support.

11. Portable valve seat lapping apparatus comprising a hollow journal member designed to turn within a stationary cylindrical valve guide coaxial with but of an internal diameter exceeding the diameter of the valve seat, a support fixed to said journal member, the support carrying a rotary lap whose axis is parallel but eccentric to that of the journal member, an annular gear coaxial with the journal member, a pinion connected to the lap to rotate with the latter and which constantly meshes with said annular gear, means for fixing the annular gear relatively to said valve guide, and means for rotating the journal member.

12. A portable valve seat lapping apparatus comprising a hollow journal member designed to turn within a stationary hollow, cylindrical valve guide coaxial with the seat to be lapped, a support fixed to said hollow journal member, the support carrying a plurality of annular laps whose axes are arranged in a circle coaxial with but of less diameter than that of the hollow journal member, the axes of the several laps being parallel to that of the journal member, a pinion associated with each lap and having driving connection with its respective lap, an internal annular gear with which all of the pinions mesh, means for temporarily fixing the gear to said valve guide in coaxial relation to the latter, and means for rotating the journal member within the valve guide, the several pinions having differ-

ent numbers of teeth respectively, whereby their speeds of rotation are different.

13. A portable lapping device adapted to be used in lapping an annular surface, said device comprising a circular, rotatable support which, in use, is coaxial with the surface to be lapped, a lap carried by and which is rotatable relatively to the support, the lap being of a diameter exceeding the radial width of the annular surface to be lapped and having its axis parallel to that of the support but eccentric thereto, the axis of the lap being at a radial distance from the axis of the support such that the lap extends beyond both the inner and outer edges of the annular surface to be lapped, a hollow journal of an external diameter exceeding the external diameter of the surface to be lapped, said journal being coaxial with and rigidly secured to the support and being designed to turn in a stationary bearing coaxial with the annular surface to be lapped, and means for rotating the lap about its own axis while it is revolved about the axis of the annular surface to be lapped, including means for rotating the support and a stationary annulus of an internal diameter exceeding that of the annular surface to be lapped.

14. A portable lapping device adapted to be used in lapping a flat annular surface, said device comprising a circular, rotating support which, in use, is coaxial with the surface to be lapped and which is of a diameter exceeding the external diameter of said annular surface, a plurality of laps carried by the support, each lap being of a diameter exceeding the radial width of the surface to be lapped and turning about an axis parallel to but eccentric with respect to the axis of the support, the axes of the several laps being spaced symmetrically about the axis of the support and each being located at such a radial

distance from the axis of the support that each lap extends beyond both the inner and outer edges respectively of the annular surface to be lapped, a toothed annulus coaxial with and fixed relatively to each lap, a hollow, cylindrical journal of an outside diameter exceeding the external diameter of the annular surface to be lapped, said journal being coaxial with and fixed at its lower edge to the support, the journal being designed to turn in a stationary bearing coaxial with the annular surface to be lapped, means for rotating the support about its own axis thereby revolving the several laps about said axis, and a stationary, annular, internal gear of an internal diameter exceeding the external diameter of the annular surface to be lapped, said gear meshing simultaneously with the toothed annuli of the several laps.

ROBERT A. TOBIS.

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