O. L. DOSCH.

POLISHING MACHINE.

APPLICATION FILED APR. 29, 1909.

1,048,137.

Patented Dec. 24, 1912.

4 SHEETS—SHEET 1.

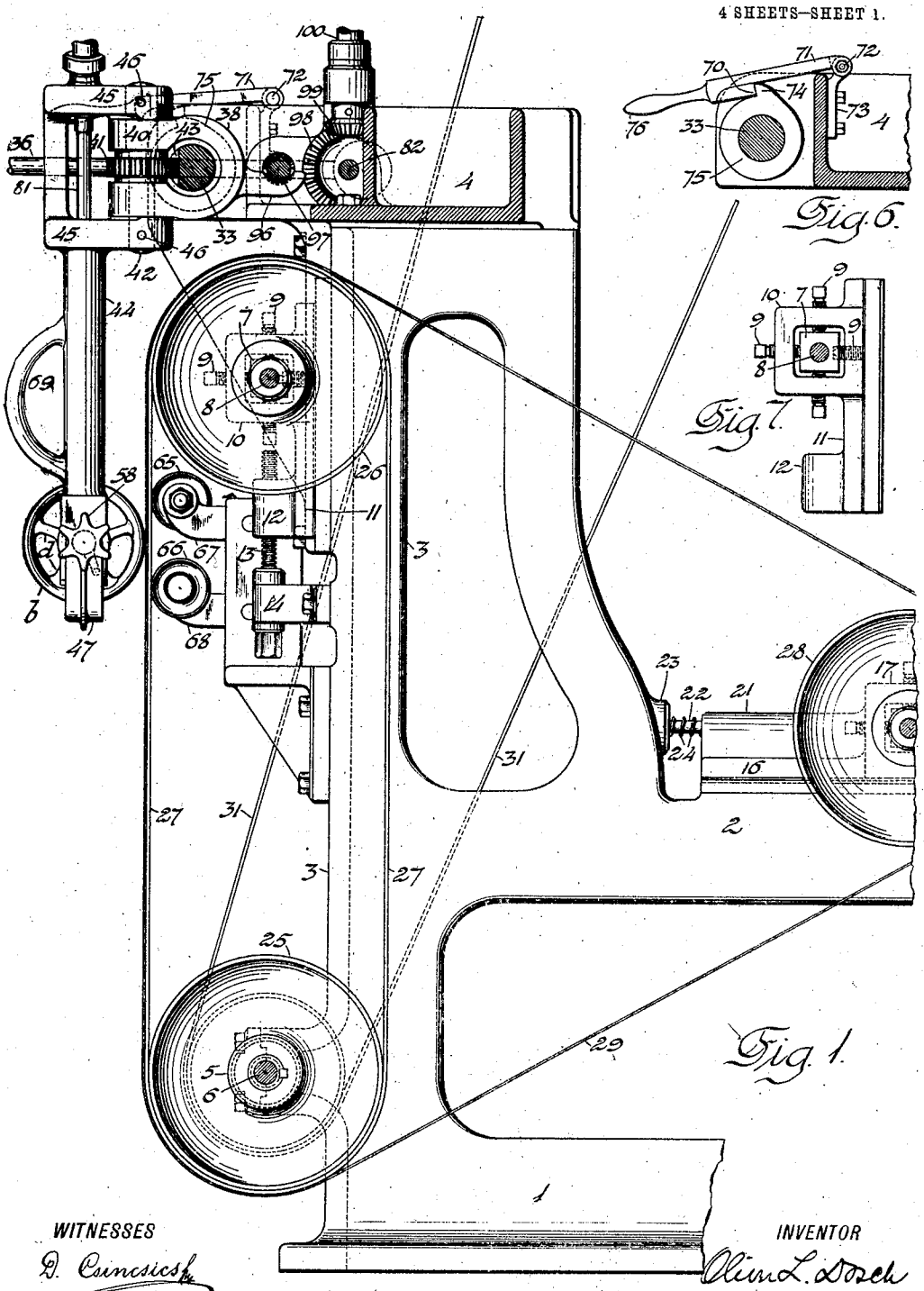

Fig. 1.

Fig. 6.

Fig. 7.

WITNESSES

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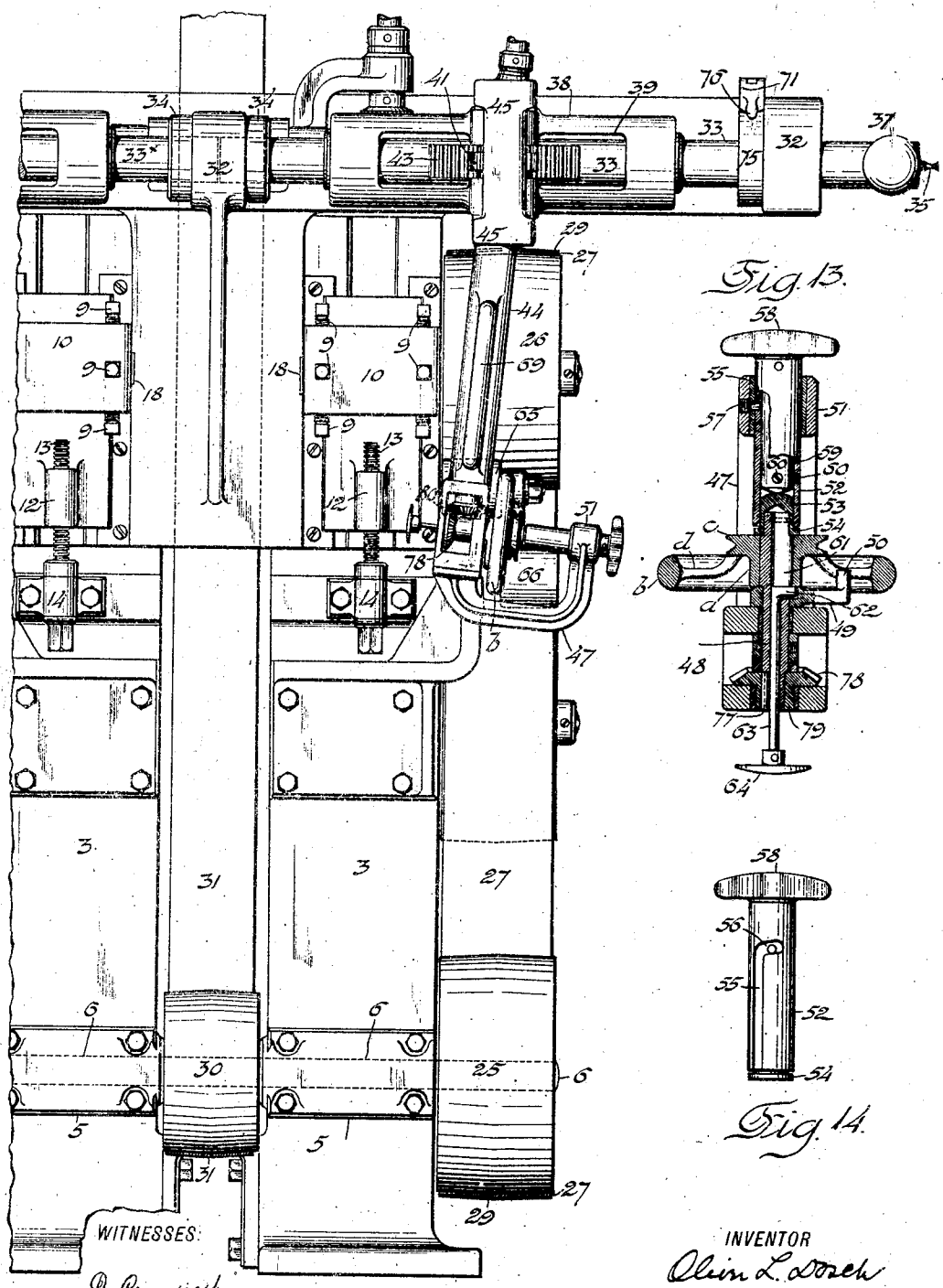

Fig. 2.

Fig. 13.

Fig. 14.

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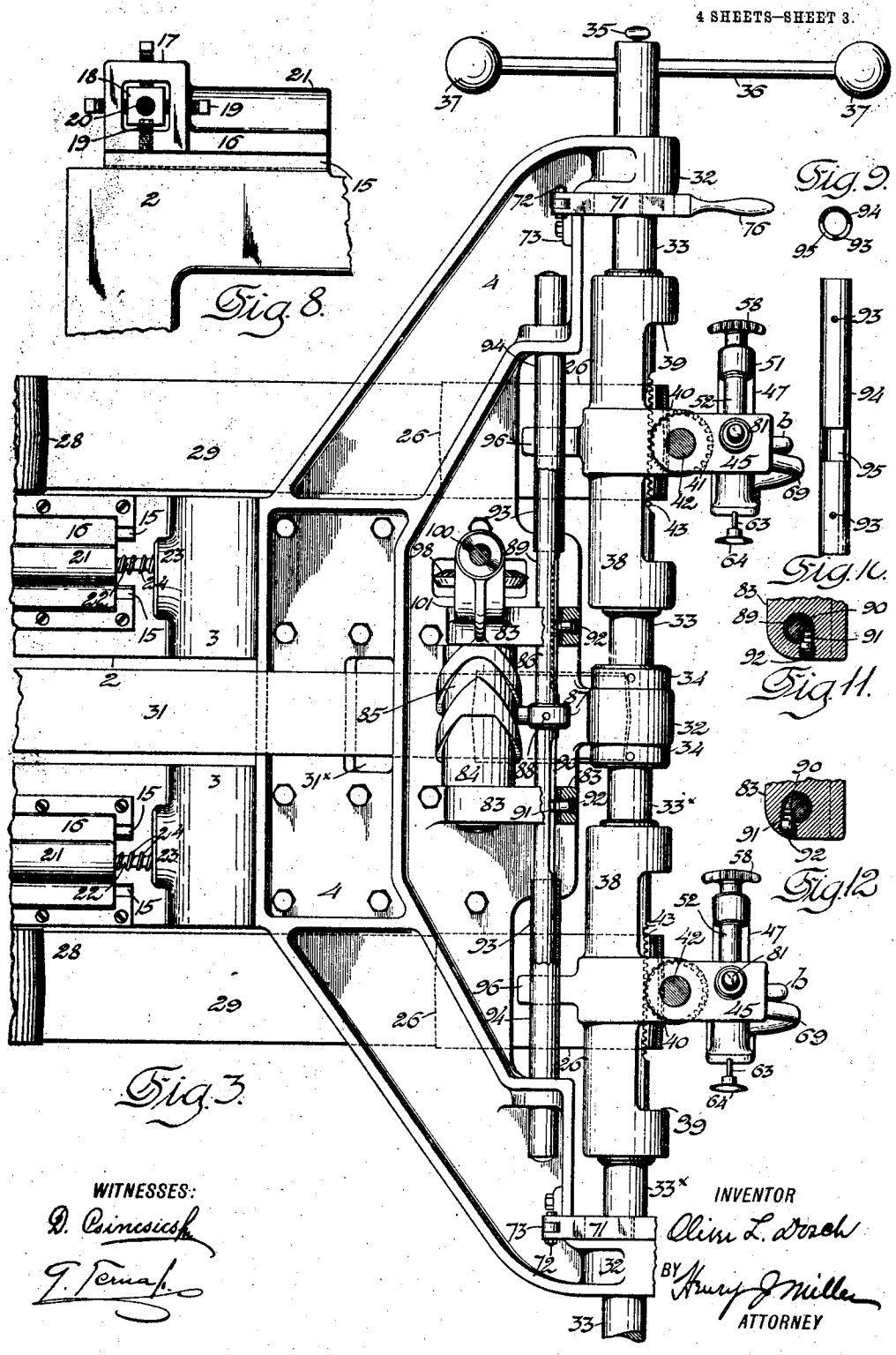

Fig. 8.

Fig. 9.

Fig. 10.

Fig. 11.

Fig. 12.

Fig. 3.

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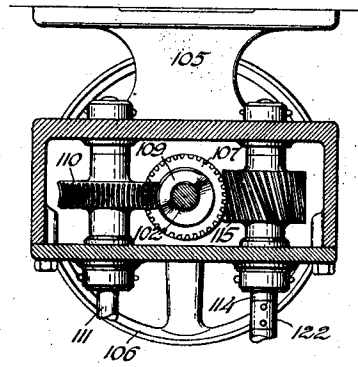

Fig. 5.

Fig. 4.

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UNITED STATES PATENT OFFICE.

OLIVER L. DOSCH, OF ELIZABETH, NEW JERSEY, ASSIGNOR TO THE SINGER MANUFACTURING COMPANY, A CORPORATION OF NEW JERSEY.

POLISHING-MACHINE.

1,048,137. Specification of Letters Patent. Patented Dec. 24, 1912.

Application filed April 29, 1909. Serial No. 492,929.

To all whom it may concern:

Be it known that I, OLIVER L. DOSCH, a citizen of the United States, residing at Elizabeth, in the county of Union and State of New Jersey, have invented certain new and useful Improvements in Polishing-Machines, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention has for its object to provide a polishing machine adapted for rapidly and effectively producing a smoothed polished surface upon various metallic objects, and particularly circular objects with rounded surfaces, such as sewing machine balance-wheels; and the invention consists in the construction and arrangement of parts herein shown and described and set forth in the appended claims.

The machine embodying the present improvement is of that type comprising supporting pulleys connected by a belt serving as a backing over which is applied a second belt provided upon its exposed face with abrading material such as emery, the article to be polished being pressed against the abrading belt in undergoing the polishing operation.

In its preferred form, the present improvement includes a gyratory work-supporting arm provided with a carrier for holding the work, such arm being pivotally mounted upon the machine frame in such manner as to maintain the work by gravity pressed against the abrading belt, the gyratory movements of the work-supporting arm causing the work to be moved to-and-fro across the abrading belt transversely of its direction of movement, whereby the entire surface of said belt is brought at different times into contact with the object to be polished. Special means are provided for oscillating the work-supporting arm so as to subject to the action of the abrading belt the outer half of the rounded balance-wheel pulley rim to be polished, and the said arm is mounted upon a laterally sliding carriage provided with suitable actuating means, whereby the work is caused to travel bodily across the operative face of the abrading belt in addition to its described oscillatory movement. The work-supporting arm is provided with a special form of work-holder with means for turning its work-engaging member in the opposite direction from the travel of the abrading belt, the axis of rotation of the work being inclined to the direction of movement of the abrading belt, whereby the smoothness of the cut or abrasion is increased.

In the accompanying drawings, Figure 1 is a partial end elevation of a polishing machine embodying the present improvements, Fig. 2 a partial front elevation and Fig. 3 a partial plan view of the same. Fig. 4 is an elevation, partly in section, of the driving mechanism of the machine and Fig. 5 a transverse sectional elevation of the gearing and the casing inclosing the same. Fig. 6 is a detached sectional view of the means for maintaining the work-supporting arm retracted from operative position for introduction and removal of the work. Fig. 7 is a detached side elevation of one of the adjustable bearings of the upper supporting pulley for the backing and abrading belts. Fig. 8 is a side view showing the manner of mounting the adjustable bearing of the rearward pulley for the abrading belt. Figs. 9, 10, 11 and 12 are detached views representing different parts of the transverse feeding mechanism for the work-supporting arm. Fig. 13 is an enlarged sectional plan view of the work-holding device carried by the work-supporting arm, and Fig. 14 a detached side elevation of the work-retaining member thereof.

The machine is shown constructed with a frame comprising the base 1, a rearwardly extending member 2 and a standard 3 rising from the base and surmounted by the head or cross-beam 4. At the front of the standard 3 are disposed the fixed bearings 5 in which is journaled the driven shaft 6, and the adjustable bearing blocks 7 in which is journaled the parallel shaft 8. As represented in Fig. 7, each bearing block 7 is supported at opposite ends upon each of its four faces by the point of one of the adjusting screws 9 of two parallel series which are tapped through the walls of the housing block 10 apertured to receive the block 7 and itself formed upon the slide-plate 11 fitted to a suitable slide-way upon the front face

of the standard 3 and provided with a projecting boss 12 having an internally threaded aperture entered by the adjusting screw 13 swiveled in the lug 14 which is bolted to the front of the standard 3. As will be readily observed, the turning of the adjusting screw 13 will cause the raising or lowering of the slide-plate 11, and hence of the bearing 7, which is adjustable both vertically and sidewise by means of the adjusting screws 9.

The bifurcated member 2 of the frame is provided with parallel seats 15 to which are fitted the side-plates 16, each being formed with a housing block 17 embracing the bearing block 18 adjustably supported therein at opposite ends, similarly to the bearing block 7 before described, upon the points of the screws 19 of two parallel series and affording a bearing for the rearward pulley shaft 20. The slide-plates 16 are each provided with a longitudinal boss 21 entered by a guide-rod 22 extending from a hub 23 formed upon the standard 3, between which hub and the bottom of a longitudinal socket in the boss 21 is interposed a spring 24 acting to yieldingly press the slide-plate 16, and with it the shaft 20, rearwardly from the shafts 6 and 8. As will be observed, the shaft 20 can be accurately alined by adjustment of the two bearing blocks 18 carried by the two slide-plates 16, by means of the adjusting screws 19.

As indicated in the drawings, the machine forming the subject of this application is substantially duplex, the work-holding and polishing members being duplicated, and a description of one of the duplicated groups of mechanisms will therefore be sufficient.

Upon the outer ends of the lower or driving shaft 6 are disposed the driving pulleys 25, the upper shafts 8 having secured thereon the supporting pulleys 26. These pulleys are embraced by the vertically arranged backing belts 27 which may be of leather or of any other usual or suitable material. Encircling each of the belts 27 with their supporting pulleys 25 and 26, and embracing also the rearward idler pulley 28 fixed upon the rearward shaft 20, is the abrading belt 29, which is in practice composed of emery cloth, or of leather or of other fibrous material having upon its outer face emery or other suitable abrading material. As will be observed by reference to Fig. 1, each belt 29 is in contact with its respective backing belt 27 only at the front of the machine and around portions of the supporting pulleys 25 and 26, the rearward portion of such belt being engaged by the spring-pressed idler pulley 28 which maintains it taut independently of the belt 27, under the action of the springs 24.

As represented in Fig. 2, the shaft 6 carries, intermediate the bearings 5 and between the spaced upright members 3 of the frame, the pulley 30 which serves to transmit to the driving pulleys 25 their operative movements through the belt 31 extending upwardly with one member passing through the aperture $31^{\times}$ in the cross-beam 4, to the line-shafting or other source of power.

The cross-beam 4 is provided with the forwardly projecting spaced bearing bosses 32 within which is journaled the oscillating sectional rock-shaft composed of the members 33 $33^{\times}$, each of the independent sections of which is provided adjacent the intermediate central bearing member 32 with the fixed thrust-collar 34 and adjacent its other bearing member 32 with the thrust-collar 75 to prevent endwise movement of the shaft section. These rock-shaft sections are provided upon their opposite ends each with a transverse aperture in which is secured by means of the set-screw 35 the endwise adjustable cross-bar 36 provided upon opposite ends with spherical counter-balance weights 37.

Mounted upon the shaft 33 are the sleeves 38 which are formed with openings 39 in the front side intermediate the end portions, which latter are fitted upon the shaft so as to slide thereon. Each sleeve 38 is provided intermediate its ends with a forwardly projecting horizontally bifurcated bearing boss 40 embracing a pinion 41 fixed upon a vertical rock-shaft 42 journaled in said bearing boss and meshing with a series of rack-teeth 43 cut in the partially flatted forward side of the rock-shaft 33.

The work-support comprises a depending arm 44 having at its upper end a yoke with spaced laterally extending members 45 embracing the bearing boss 40 and rigidly attached to the opposite ends of the shaft 42 by means of the transverse pins 46. The members 45 of the yoke are disposed substantially in the plane of the rock-shaft 42, but the depending work-supporting arm 44 is arranged at a slight inclination with said yoke and rock-shaft as indicated in Fig. 2. The rock-shaft 42 thus affords an axis disposed longitudinally of but offset from the work-supporting arm 44 upon which the latter is caused to oscillate by engagement of the rack-teeth 43 with the pinion 41.

The arm 44 is formed at its lower end with a laterally extending bracket 47, and is provided near the adjacent end of said bracket with an aperture through which extends the hollow transverse shaft 48 upon which is fixed the crank-arm 49 carrying the outwardly extending crank-pin 50. The shaft 48 is shown formed in its outer end with a slight enlargement to receive the hub *a* of a sewing machine balance wheel with rim *b* connected with the belt-wheel afforded by the flanged and peripherally grooved hub portion *c* by means of the spokes *d* between

which the crank-pin 50 enters to insure the turning of the balance-wheel in the normal operation of the polishing machine.

The bracket 47 is provided with a bearing boss 51 in which is journaled the sleeve 52 provided in its outer end with a bushing or thimble 53 adapted to receive the reduced outer end of the shaft 48 and formed with a flange 54 to engage the adjacent end of the balance-wheel hub to maintain the same in position upon the supporting shaft 48. The sleeve 52 is provided with a longitudinal slot 55 having a transverse portion 56 inclined at nearly a right angle to the portion 55 and extending in the direction of rotation of the shaft 48, which slot is entered by the reduced end portion of a locking screw 57 tapped into the hub 51 of the bracket 47. The sleeve 52, which constitutes the "dead spindle" of the work-holder, is provided with a knob 58 by which it may be turned and moved endwise into and out of contact with the work; and it is fitted with a plug 59, secured adjustably therein by means of set-screws 60 to adjust the position of the thimble 53 longitudinally in relation to the shaft or "live spindle" 48.

The forward portion of the shaft 48 is formed in one side with a longitudinal slot 61 to receive the laterally extending finger 62 of the push-pin 63 extending through the hollow shaft 48 and provided at its opposite end with the knob 64. The finger 62 is normally housed within a recess in the outer end of the crank-arm 49, but in order to eject the balance-wheel at the completion of a polishing operation, the rod 63 is thrust forward by pressure of the hand upon the knob 64, which causes the finger 62 to engage the inner end of the balance-wheel hub and force the same off the end of the shaft 48; the knob 58 having previously been turned to disengage the stop-screw 57 from the transverse portion 56 of the slot 55, and the sleeve 52 then withdrawn to release the work.

As will be observed, the work-supporting arm 44 is pivotally mounted by means of the yoke 45 and sleeve 38 upon the rock-shaft 33, which is disposed above the forward portion of the belt-pulley 26, and the rim of the balance-wheel is thus maintained by gravity in contact with the outer abrasive face of the polishing belt, resting against the same intermediate and opposed to the idler pulleys 65 and 66 mounted upon suitable brackets 67 and 68, respectively, attached to the front of the standard 3.

As will be seen by reference to Fig. 2, the faces of the pulleys 65 and 66 are narrower than those of the belt supporting pulleys 25 and 26, and they are arranged upon opposite sides of the polishing point in relation to the direction of movement of the polishing belt, and at the opposite sides of said belt in relation to the width of the latter, so as to lie in an oblique arrangement. By this means, in one half of the travel of the work across the polishing belt, the latter presents a yielding abrading surface intermediate the upper idler pulley 65 and the lower supporting pulley 25, and in the other half of said travel a similarly yielding abrading surface is presented by the belt extending from the lower idler pulley 66 to the upper supporting pulley 26. It will thus be seen that the side-thrust of the work upon the polishing belt is sustained almost entirely by these idler pulleys, and that its pressure upon the belt causes the latter to conform to the periphery of the circular object (such as a sewing machine balance wheel) to insure a much larger arc of contact than would be afforded without the use of these idler pulleys.

It will be observed that the sleeves 38 constitute reciprocating and rocking carriers for the work-holders which are movable upon supporting fulcra afforded, in the present embodiment of the improvement, by the rock-shaft sections 33 and $33^{\times}$; and it is evident that the form of such carriers is not confined to that shown and described herein, so long as they perform the functions ascribed to them herein.

For convenient introduction and removal of the work, the work-supporting arm 44 is provided with a lateral handle 69 by means of which it is drawn forwardly, which causes the sleeve 38 and its supporting shaft 33 to be oscillated sufficiently to permit the shoulder 70 of the detent lever 71, pivoted at 72 upon a bracket 73 bolted to the member 4, to engage the tooth 74 of the collar 75 fixed to said shaft, whereby the arm 44 is maintained in retracted position until the detent lever 71 is lifted by its handle 76, when the arm 44 is again permitted to gravitate to its operative position. As shown in the drawings, one side of the tooth 74 is inclined in relation to the detaining shoulder engaging the shoulder 70 of the lever 71, whereby the detaining lever is adapted to rest normally upon said tooth when the arm 44 is in operative position; but when the work-supporting arm is retracted, and its supporting sleeve 38 rocked with the oscillatory rack-bar 33, the collar 75 is turned sufficiently to permit the shoulder 70 of the lever 71 to drop behind the abrupt shoulder of the detaining tooth 74, whereby the parts are retained in retracted position until the lever is raised to release the tooth 74 as previously described.

As indicated in the drawings, and more particularly in Figs. 2 and 13, upon the end of the shaft 48 opposite that upon which the work is supported is secured by means of the spline 77 the bevel-wheel 78 whose hub 79 is journaled in the base of the arm 44; and meshing with this bevel-wheel is a similar gear 80 fixed upon the lower end

of an actuating shaft 81 extending through the hollow arm 44 and journaled in suitable bearings provided at opposite ends thereof, this shaft being driven by means which will later be described to turn the work-holding shaft 48, and hence the object to be polished, in a direction opposite to that of the polishing belt 29.

Fixed upon the horizontally disposed cam-shaft 82 which is mounted in suitable bearings 83 rising from the cross-beam 4 is the feed cam-cylinder 84 provided with the substantially heart-shaped cam-groove 85 which is entered by a roller-stud 86 carried by the collar 87 secured by means of the pin 88 upon the reciprocating bar 89 slidingly supported upon the cross-beam 4 parallel with the feed-cam shaft 82 and the rock-shaft 33. As represented in Figs. 3, 11 and 12, the reciprocating bar 89 is provided upon opposite sides of the collar 87 with laterally disposed longitudinal angular grooves 90 each of which is entered by a roller-stud 91 carried by a screw 92 tapped into the forward end of the bearing member 83. As the angular slots 90 are arranged respectively above and below the center of the rod 89, it will be observed that the roller-studs 91 serve to prevent the turning of the same in either direction, while permitting its free endwise movement.

Fixed adjustably upon the opposite end portions of the bar 89 by means of set-screws 93 are tubular sleeves 94 each provided in its lower side with a transverse notch 95 adapted to be entered by the rearwardly projecting lug 96 upon one of the sliding sleeves 38, said lug being formed with a notch 97 conforming in curvature with the surface of the reciprocating bar 89, and being substantially of the width of the notch 95 in the sleeve 94. As will be observed the opposite ends of the slot 95 in the sleeve 94 constitute coupling shoulders which are normally engaged by the shoulders afforded by the opposite ends of the lug 96 extending from the sleeve 38, the members of the coupling so constituted being disengaged by the rocking of the sleeve 38 in the withdrawal of the work-supporting arm 44 from operative relation with the abrading member afforded by the polishing belt 29. It is evident that any other suitable device may be employed for detachably connecting the oscillatory and reciprocating sleeve 38 with the actuating feed-cam 84 85.

Fixed upon one end of the cam-shaft 82 is a bevel-wheel 98 with which meshes the similar bevel-wheel 99 fixed to the lower end of the vertical shaft 100 mounted in the bearing bracket 101, rising from one of the bearings 83, and driven by means which will be later described.

As will be observed, the rotation of the cam-cylinder 84 causes the endwise travel of the rod 89 to-and-fro which is communicated by means of the notched sleeves 94 and lugs 96 upon the sleeves 38 to impart similar movements to said sleeves, which causes the work-supporting arms 44 to be carried bodily crosswise of the direction of movement of the abrading belt 29; while the engagement of the pinions 41 with the racks 43 cut in the sides of the rock-shaft 33 induces a simultaneous oscillatory movement of said work-supporting arms, which serves to turn the work-holding bracket-arm 47 around the rock-shaft 42 as an axis, so as to progressively present to the operative face of the belt 29 the exposed semi-circular surface of the balance-wheel rim *b* for the polishing operation. As will be readily observed, by loosening the set-screws 35, the weighted counter-balance rods 36 may be shifted endwise in one or the other direction so as to adjust the pressure of the article to be polished upon the abrading belt, this being accomplished through the rock-shaft 33 and the depending arm 44, which is locked from turning upon the same by the engagement of the pinions 41 with the rack members 43.

While both the abrading belts 29 may be provided with operative faces of the same degree of coarseness, in practice they are sometimes made of different character, so that one may be employed as a "roughing" member and the other as a "finishing" member, for successive use upon each object to be polished. By forming the rock-shaft for sustaining the work-supporting arms in independent sections, it will be observed that the work-holders may be retracted and returned to operative position alternately, in order to prevent the loss of time of having one portion of the machine idle while the work is being introduced or withdrawn from the other portion.

When one of the work-supporting arms 44 is retracted, it is obvious that the lug 96 is disengaged from its slot 95 in the reciprocating sleeve 94, and the bodily and oscillating movements of the work-holder are suspended. After the renewal of work in the work-holder, the raising of the detent-lever permits the arm 44 to gravitate toward the abrading belt 29, until the lug 96 rests upon the exterior of its propelling sleeve 94, in which position it remains to maintain the work still out of contact with the abrading member until the notch 95 comes into register with said lug, when the latter enters the notch and permits the rocking of the sleeve 38 sufficiently to cause the work to assume its operative relation with the abrading member, the travel of the sleeve 38 and oscillation of the arm 44 thereon being simultaneously reassumed.

As before explained, the power for actuating the backing and abrading belts is

derived from the driving shaft 6 by means of the pulley 30 connected by the belt 31 with an overhead pulley of suitable line shafting; and the movements of the work in relation to the abrading belt are derived from an overhead counter-shaft 102 mounted in end bearings 103 of a gear case or housing 104 supported by brackets 105 attached to the ceiling. The shaft 102 is provided at one end with a pulley 106 from which it derives its rotary movements, and it has fixed thereon the spiral gears 107 and 108, and intermediate worm-gear 109 which meshes in turn with a worm-wheel 110 fixed upon the vertical sectional shaft 111 112, the upper section of which is journaled in the gear case 104. The shaft section 111 is provided externally with the longitudinal groove 111^x which is entered by the inwardly extending spline or key 112^x of the tubular lower shaft section 112 connected at its lower end by means of the cross-pin 113 with the shouldered upper end of the feed drive shaft 100.

Fixed upon the vertical shaft-sections 114 journaled in the gear casing 104, are the spiral gears 115 meshing with the similar gears 107 108, respectively, upon the counter-shaft 102. Each of these vertical shafts 114 is connected by a universal joint 116, of any well-known or suitable construction, with the upper end of a shaft-section 117 provided externally with a longitudinal groove 118 entered by the inwardly projecting key or feather 119 of the tubular shaft section 120 entered in the upper portion by the section 117 and having at its lower end a universal joint connection 121, through a suitable coupling 122 with the upper end of the inclined work-holder actuating shaft 81. As will be observed, the gear casing 104 is in practice so located above the machine that the shaft section 111 is in direct alinement with the shaft 100 for communicating operative movements to the feed-cam; but as the work-holder actuating shafts 81 have gyratory and lateral movements upon the machine frame, it is obviously necessary to employ connections between the shaft members 81 and 114 which shall accommodate such movements, but it is evident that the telescopic sections 117 and 120 may be readily replaced by flexible shafting of other kinds, if desired.

In order to expose the entire outer face of the pulley rim *b* to the action of the abrading belt 29, it is requisite that the work-holding bracket 47 should have a bodily movement exceeding the width of the operative face of the abrading belt, so that the pulley-rim may be at all times directed from the hub portion toward the belt. By offsetting the bracket 47 from the rock-shaft 43, and hence from its axis of movement, and imparting to the arm 44 the lateral traveling movements as well as turning movements upon the shaft 42, the work is constantly maintained in operative contact with the abrading belt and in progressively varying angular relation therewith.

Having thus set forth the nature of the invention, what I claim herein is:—

1. In a machine of the class described, the combination with an abrading member and driving means therefor, of a work-holder for sustaining the work in contact with said abrading member, feeding means connected with said work-holder for causing it to travel transversely of the direction of movement of said abrading member a distance greater than the width of the operative face of the latter, and means connected with the work-holder whereby the work is constantly directed upon the abrading member and from which it derives circular movements upon angularly arranged axes one of which is disposed in a plane substantially parallel with the direction of operative movement of the abrading member.

2. In a machine of the class described, the combination with an abrading member and driving means therefor, of a work-holder, sustaining means therefor including two angularly disposed rock-shafts one of which is arranged in a plane parallel with the direction of movement of the abrading member, means for imparting to the work-holder swinging movements upon said rock-shafts to expose the work mounted therein to the abrading member in different angular relations, and means for imparting to the work-holder feeding movements transverse to the direction of movement of the abrading member.

3. In a machine of the class described, the combination with an abrading member having a yielding operative face and driving means therefor, of a movable work-holder, a swinging arm for supporting the same, a fulcrum for said arm, a second arm supported by said fulcrum in angular relation with the first-named arm, a weight secured upon the second-named arm and adjustable toward and from said fulcrum, and feeding means connected with said work-holder for causing the work to travel transversely of the direction of movement of said abrading member.

4. In a machine of the class described, the combination with an abrading member, and means for sustaining and driving the same including a rotary shaft, of a work-holder for sustaining the work in contact with said abrading member, means for moving the work-holder crosswise of the face of the abrading member substantially parallel with said shaft, and means for simultaneously imparting to said work-holder circular movements upon axes respectively

parallel with and in angular relation with that of said shaft to present different portions of the work to the abrading member.

5. In a machine of the class described, the combination with an abrading member and driving means therefor, of a movable work-holder, feeding means connected therewith for causing it to travel transversely of the direction of movement of said abrading member, and mechanism, including a rack-bar with means for sustaining it against endwise movement and a pinion meshing therewith and sustained in operative relation with the work-holder, for imparting an oscillatory movement to the latter.

6. In a machine of the class described, the combination with an abrading member, and means for sustaining and driving the same including a rotary shaft, of a carrier, a supporting fulcrum for said carrier substantially parallel with said shaft and along which the carrier is adapted to travel, a swinging work-holder pivotally mounted upon said carrier transversely of said fulcrum, and means for moving said carrier lengthwise of its fulcrum.

7. In a machine of the class described, the combination with an abrading member and driving means therefor, of a swinging work-holder having a pivotal support and adapted to hold the work by gravity in operative relation with the latter, and feeding means connected with said work-holder to cause the work to travel transversely of the direction of movement of said abrading member.

8. In a machine of the class described, the combination with an abrading member and driving means therefor, of a rock-shaft, a swinging work-holder mounted thereon to partake of its rocking movements, an arm fixed upon said rock-shaft in angular relation with said work-holder, and a weight adjustably secured upon said arm to cause the work-holder to maintain the work in yielding contact with said abrading member.

9. In a machine of the class described, the combination with an abrading member and driving means therefor, of a work-supporting arm mounted to vibrate upon a fixed fulcrum, means for turning said arm upon an axis in angular relation with said fulcrum, and work-holding means carried by said arm and offset from said axis.

10. In a machine of the class described, the combination with an abrading member and driving means therefor, of a traveling work-support provided with work-holding means, a fulcrum-bar upon which said work-support is mounted for laterally swinging and sidewise traveling movements, and a connection between said work-support and fulcrum-bar for progressively varying the angular relation of the work to the abrading member.

11. In a machine of the class described, the combination with an abrading member and driving means therefor, of a traveling work-support provided with work-holding means, a fulcrum-bar disposed rearward of the operative face of the abrading member and upon which said work-support is suspended to maintain the work by gravity in contact with the abrading member, means for moving the work-support lengthwise of said fulcrum-bar and across the operative face of the abrading member, and a connection between said work-support and fulcrum-bar for varying the angular relation of the work to the abrading member.

12. In a machine of the class described, the combination with an abrading member and driving means therefor, of a traveling work-support movable transversely of the direction of movement of the abrading member, a rotary work-holding spindle carried by said traveling work-support and inclined in relation to the direction of movement of the abrading member, and means for turning said work-holding spindle.

13. In a machine of the class described, the combination with an abrading member and driving means therefor, of a work-support comprising a bracket formed with spaced bearing members, a live spindle mounted in one of said bearing members and provided with a bearing portion to receive the work and with a crank-arm for positive engagement with the work, a retractable retainer mounted in another bearing member of said bracket and adapted to hold the work in position upon said spindle, and an ejector acting in opposition to said retainer for discharging the work after retraction of the retainer from operative relation therewith.

14. In a machine of the class described, the combination with an abrading member and driving means therefor, of a movable work-support, a tubular live spindle mounted therein and provided with a longitudinally slotted work-supporting portion, means for driving said live spindle, a retractable retainer for holding the work in position upon said live spindle, and a push-rod entering the hollow live spindle and provided with a lateral work-ejecting finger extending through the longitudinal slot of said spindle.

15. In a machine of the class described, the combination with an abrading member and driving means therefor, of a movable work-support, a live spindle mounted therein for carrying the work, means for driving said live spindle, an endwise and circularly movable cylindrical work-retaining member also mounted in said work-support and provided with a longitudinal slot with a transverse extension at one end, and a stop-pin carried by said work-support and entering the longitudinal slot of said retaining member.

16. In a machine of the class described, the combination with an abrading member and driving means therefor, of a movable work-support, a live spindle mounted therein for carrying the work, means for driving said live spindle, an endwise and circularly movable tubular work-retaining member also mounted in said work-support and provided with locking means for holding it in operative position, and a work-engaging thimble fitted loosely within the operative end of said work-retaining member and formed with an axial cavity to receive the adjacent end of said live spindle.

17. In a machine of the class described, the combination with an abrading member and driving means therefor, of a movable work-support, a live spindle mounted therein for carrying the work, means for driving said live spindle, an endwise and circularly movable tubular work-retaining member also mounted in said work-support and provided with locking means for holding it in operative position, and a work-engaging thimble fitted loosely within and longitudinally adjustable in the operative end of said work-retaining member and formed with an axial cavity to receive the adjacent end of said live spindle.

18. In a machine of the class described, the combination with a polishing belt provided with an abrasive operative face, supporting pulleys for said belt, and means applied to one of said pulleys for driving the same, of a work-holder for presenting the work to the operative face of said belt intermediate its supporting pulleys, and spaced idler pulleys adjustable toward and from each other and disposed at opposite sides of the point of application of the work and at the back of the abrading belt for sustaining the thrust of the work.

19. In a machine of the class described, the combination with a polishing belt provided with an abrasive operative face, supporting pulleys for said belt, and means applied to one of said pulleys for driving the same, of a work-holder for presenting the work to the operative face of said belt intermediate its supporting pulleys, and idler pulleys disposed at opposite sides of the width of the belt and spaced apart in the direction of movement of the belt upon opposite sides of the point of application of the work to said belt.

20. In a machine of the class described, the combination with an abrading member and driving means therefor, of a movable work-supporting arm, a rack-bar mounted upon a fixed support transversely of the direction of movement of the operative face of said abrading member, a reciprocating sleeve adjacent said rack-bar, a rock-shaft journaled in said sleeve and having said work-supporting arm fixed thereto, a pinion fixed upon said rock-shaft and adapted to mesh with the teeth of said rack-bar, and means for reciprocating said sleeve to impart bodily reciprocatory and oscillating movements to said work-supporting arm.

21. In a machine of the class described, the combination with an abrading member and driving means therefor, of a movable work-supporting arm formed with a yoke with spaced laterally projecting members, a rack-bar mounted upon a fixed support transversely of the direction of movement of the operative face of said abrading member, a reciprocating sleeve movable parallel with and adjacent said rock-shaft and provided with a lateral bifurcated bearing boss, a rock-shaft journaled in the bearing boss of said sleeve and having the spaced members of the yoke of said work-supporting arm fixed thereon and embracing said boss, a pinion fixed upon said rock-shaft intermediate the spaced members of said boss and adapted to mesh with the teeth of said rack-bar, and means for reciprocating said sleeve to impart bodily reciprocatory and oscillating movements to said work supporting arm.

22. In a machine of the class described, the combination with an abrading member and driving means therefor, of a movable work-supporting arm, a rack-bar mounted upon a fixed support transversely of the direction of movement of the operative face of said abrading member, a reciprocating sleeve mounted upon said rack-bar which affords a fulcrum upon which the same is adapted to oscillate, a rock-shaft journaled in said sleeve and having said work-supporting arm fixed thereto, a pinion fixed upon said rock-shaft and adapted to mesh with the teeth of said rack-bar, and means for reciprocating said sleeve to impart bodily reciprocatory and oscillating movements to said work-supporting arm.

23. In a machine of the class described, the combination with an abrading member and driving means therefor, of a rack-bar mounted for oscillation upon a fixed support transversely of the direction of movement of the operative face of said abrading member, a reciprocating sleeve mounted upon said rack-bar with which it is adapted to oscillate, a work-supporting arm pivotally mounted upon said reciprocating sleeve and having rigidly connected therewith a pinion meshing with said rack-bar, and means for reciprocating said sleeve to impart bodily reciprocatory and oscillating movements to said work-supporting arm.

24. In a machine of the class described, the combination with an abrading member and driving means therefor, of a rack-bar mounted for oscillation upon a fixed support transversely of the direction of movement of the operative face of said abrad-

ing member, a reciprocating sleeve mounted upon said rack-bar with which it is adapted to oscillate, a work-supporting arm pivotally mounted upon said reciprocating sleeve and having rigidly connected therewith a pinion meshing with said rack-bar, means for reciprocating said sleeve to impart bodily reciprocatory and oscillating movements to said work-supporting arm, a detent shoulder carried by said oscillatory rack-bar, and a movable stop mounted upon a fixed part of the machine and movable into and out of operative relation with said detent shoulder.

25. In a machine of the class described, the combination with an abrading member and driving means therefor, of a rack-bar mounted for oscillation upon a fixed support transversely of the direction of movement of the operative face of said abrading member, a reciprocating sleeve mounted upon said rack-bar with which it is adapted to oscillate, a work-supporting arm pivotally mounted upon said reciprocating sleeve and having rigidly connected therewith a pinion meshing with said rack-bar, means for reciprocating said sleeve to impart bodily reciprocatory and oscillating movements to said work-supporting arm, a collar fixed upon said oscillatory rack-bar and provided with a detaining tooth, and a stop-lever with a depending shoulder pivotally mounted upon a fixed part of the machine and adapted to normally rest upon said fixed collar and to operatively engage said tooth with its depending shoulder when said sleeve is rocked into extreme inoperative position with the work-support retracted from operative relation with said belt.

26. In a machine of the class described, the combination with an abrading member and driving means therefor, of a rack-bar mounted for oscillation upon a fixed support transversely of the direction of movement of the operative face of said abrading member, a reciprocating sleeve mounted upon said rack-bar with which it is adapted to oscillate, a work-supporting arm pivotally mounted upon said reciprocating sleeve and having rigidly connected therewith a pinion meshing with said rack-bar, a work-holding spindle carried by said work-supporting arm and adapted to present the work to the abrasive face of the belt, means connected with said sleeve to impart bodily reciprocatory and oscillating movements to said work-supporting arm, and means, including a shaft disposed longitudinally of said work-supporting arm, for imparting rotary movements to said work-holding spindle.

27. In a machine of the class described, the combination with an abrading member and driving means therefor, of a rack-bar mounted for oscillation upon a fixed support transversely of the direction of movement of the operative face of said abrading member, a reciprocating sleeve mounted upon said rack-bar with which it is adapted to oscillate, a work-supporting arm pivotally mounted upon said reciprocating sleeve and extending therefrom at an inclination to its supporting pivot and having rigidly connected therewith a pinion meshing with said rack-bar, a work-holding spindle carried by said work-supporting arm and adapted to present the work to the abrasive face of the belt, means connected with said sleeve to impart bodily reciprocatory and oscillating movements to said work-supporting arm, and means, including a shaft disposed longitudinally of said work-supporting arm, for imparting rotary movements to said work-holding spindle.

28. In a machine of the class described, the combination with an abrading member and actuating means therefor, of a supporting fulcrum-bar disposed above and parallel with the operative face of the abrading member and provided with means for sustaining it against endwise movement, an oscillating and reciprocating carrier mounted upon and movable longitudinally of said fulcrum-bar, a swinging work-supporting arm sustained by said carrier and adapted to present the work to the operative face of the abrading member, a feed-cam, means for actuating the same, and an operative connection intermediate the feed-cam and said carrier whereby reciprocatory movements are imparted to the latter independently of said supporting fulcrum-bar.

29. In a machine of the class described, the combination with an abrading member and driving means therefor, of a reciprocating carrier, a support upon which said carrier is adapted to move transversely of the direction of movement of said abrading member, a work-supporting arm sustained by said carrier and adapted to present the work to the operative face of the abrading member, a feed-cam, an endwise movable bar actuated by said feed-cam, a connection intermediate said bar and said carrier and provided with interlocking coupling members adapted to be shifted at will into and out of operative engagement, and means for actuating said feed-cam.

30. In a machine of the class described, the combination with an abrading member and driving means therefor, of a reciprocatory rocking carrier, a support upon which said carrier is adapted to reciprocate transversely of the direction of movement of said abrading member, a work-supporting arm sustained by said carrier and adapted to present the work to the operative face of the abrading member, a feed-cam, an endwise movable bar actuated by said feed-cam, a detachable connection between said

bar and said carrier, the same being thrown into operative and inoperative relation by the oscillatory movements of said carrier, and means for actuating said feed-cam.

31. In a machine of the class described, the combination with an abrading member and driving means therefor, of a reciprocatory rocking carrier, a support upon which said carrier is adapted to reciprocate transversely of the direction of movement of said abrading member, a work-supporting arm sustained by said carrier and adapted to present the work to the operative face of the abrading member, a feed-cam, an endwise movable bar provided with a lateral coupling shoulder and actuated by said feed-cam, a yoke extending from said carrier and normally engaging the coupling shoulder of said bar, but adapted to be detached therefrom when said carrier is rocked upon its support, and means for actuating said feed-cam.

32. In a machine of the class described, the combination with an abrading member and driving means therefor, of a traveling work-holder, means for rotating the same including a rotary shaft, a counter-shaft, a plurality of cross-shafts, angular gearing connecting the counter-shaft with one of said cross-shafts, an intermediate shaft with universal joint connections respectively with said cross-shaft and the actuating shaft of said work-holder, worm gearing connecting the counter-shaft with another of said cross-shafts, and means connected with the latter for effecting the travel of said work-holder crosswise of the abrading member.

In testimony whereof, I have signed my name to this specification, in the presence of two subscribing witnesses.

OLIVER L. DOSCH.

Witnesses:

HENRY J. MILLER,

JOSEPH F. JAQUITH.