Nov. 24, 1942. J. E. O'NEILL 2,302,712

GRINDING WHEEL DRESSING ATTACHMENT

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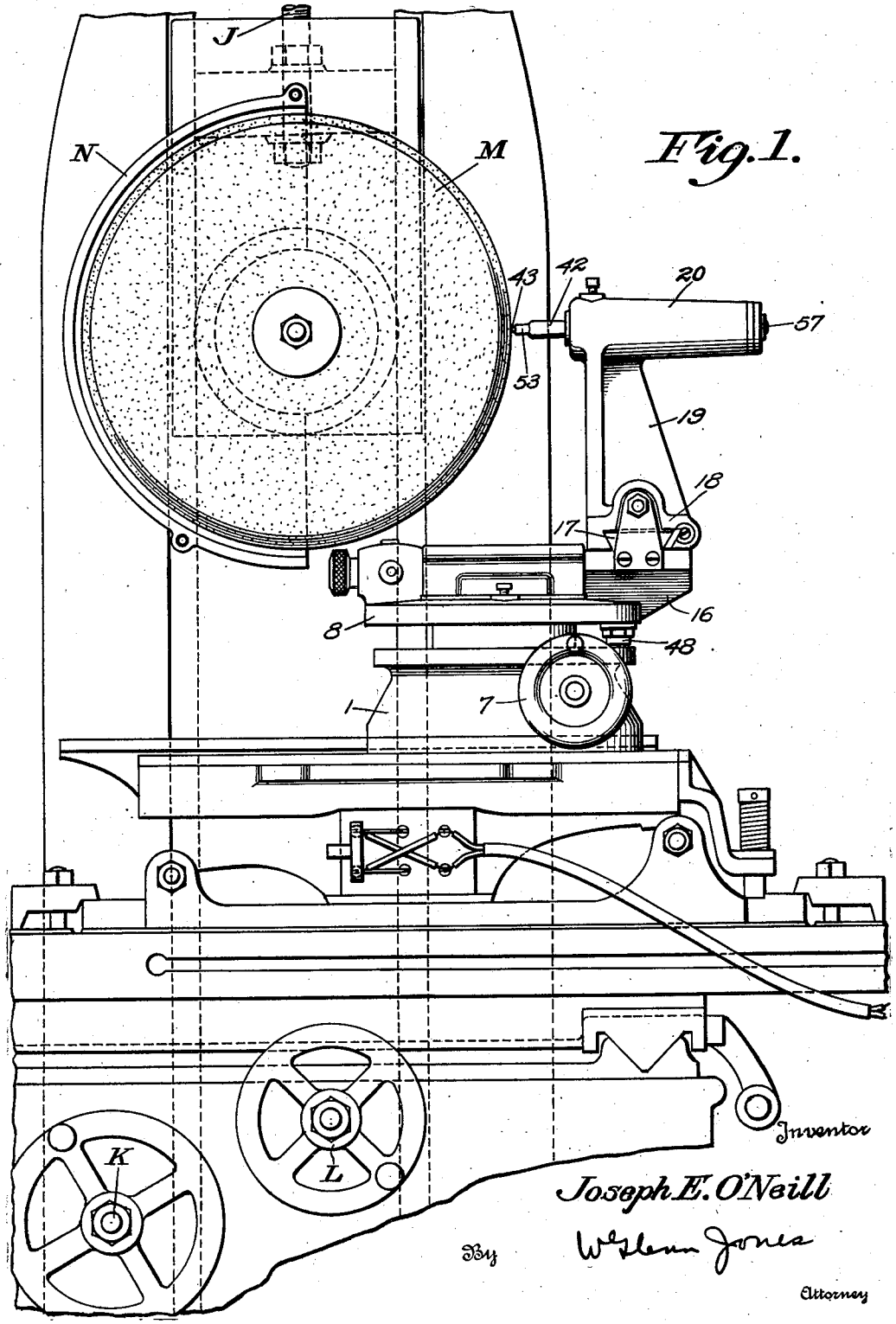

Fig. 1.

Inventor
Joseph E. O'Neill
By Wm Glenn Jones
Attorney

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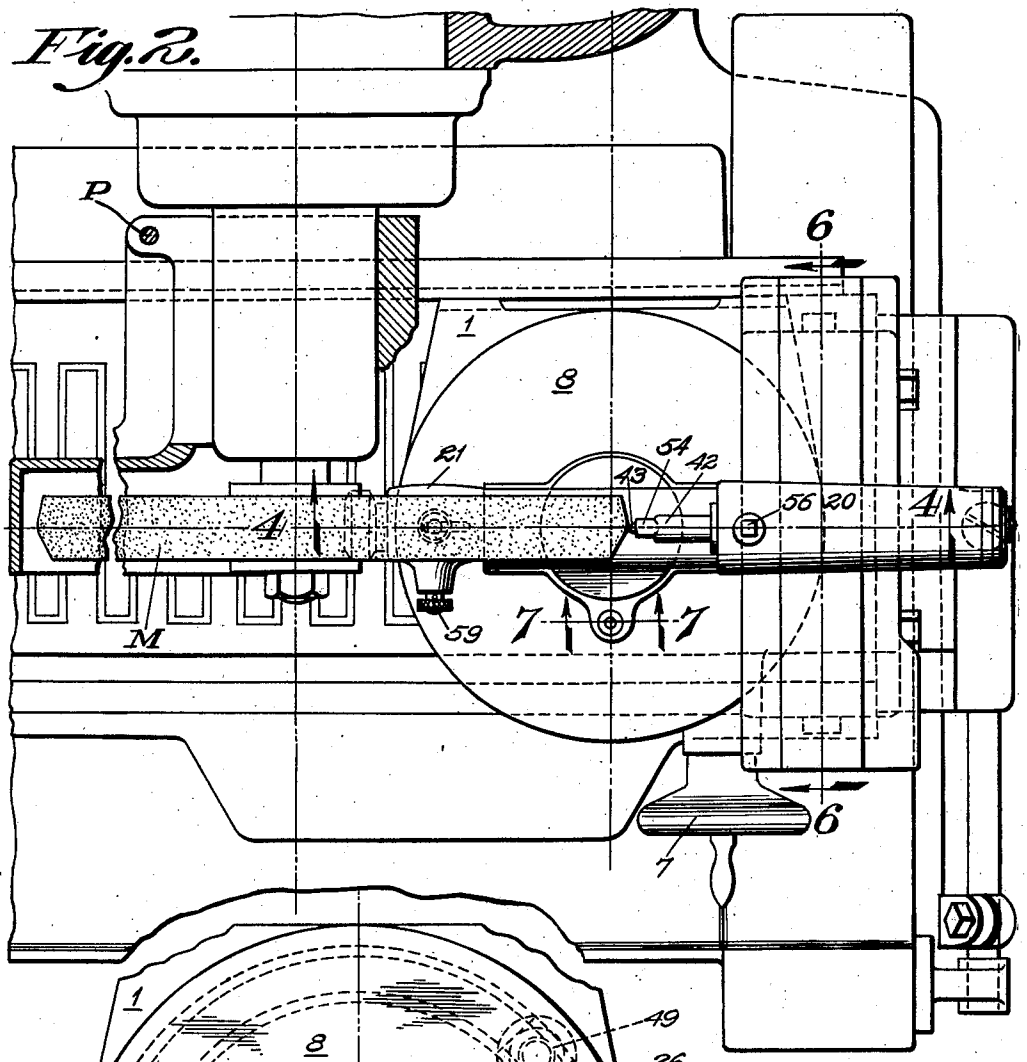
Fig. 2.



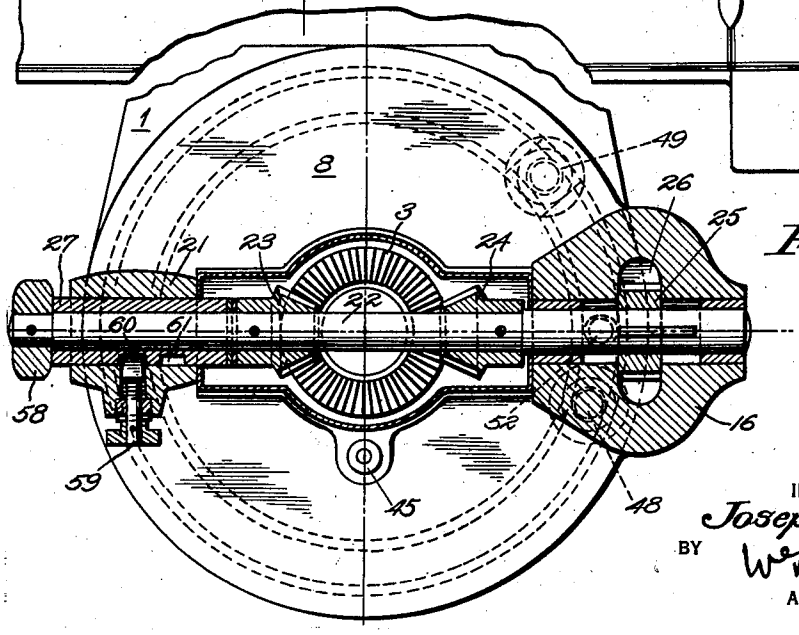


Fig. 5.

INVENTOR
Joseph E. O'Neill
BY
W. Glenn Jones
ATTORNEY

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GRINDING WHEEL DRESSING ATTACHMENT

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Fig. 3.

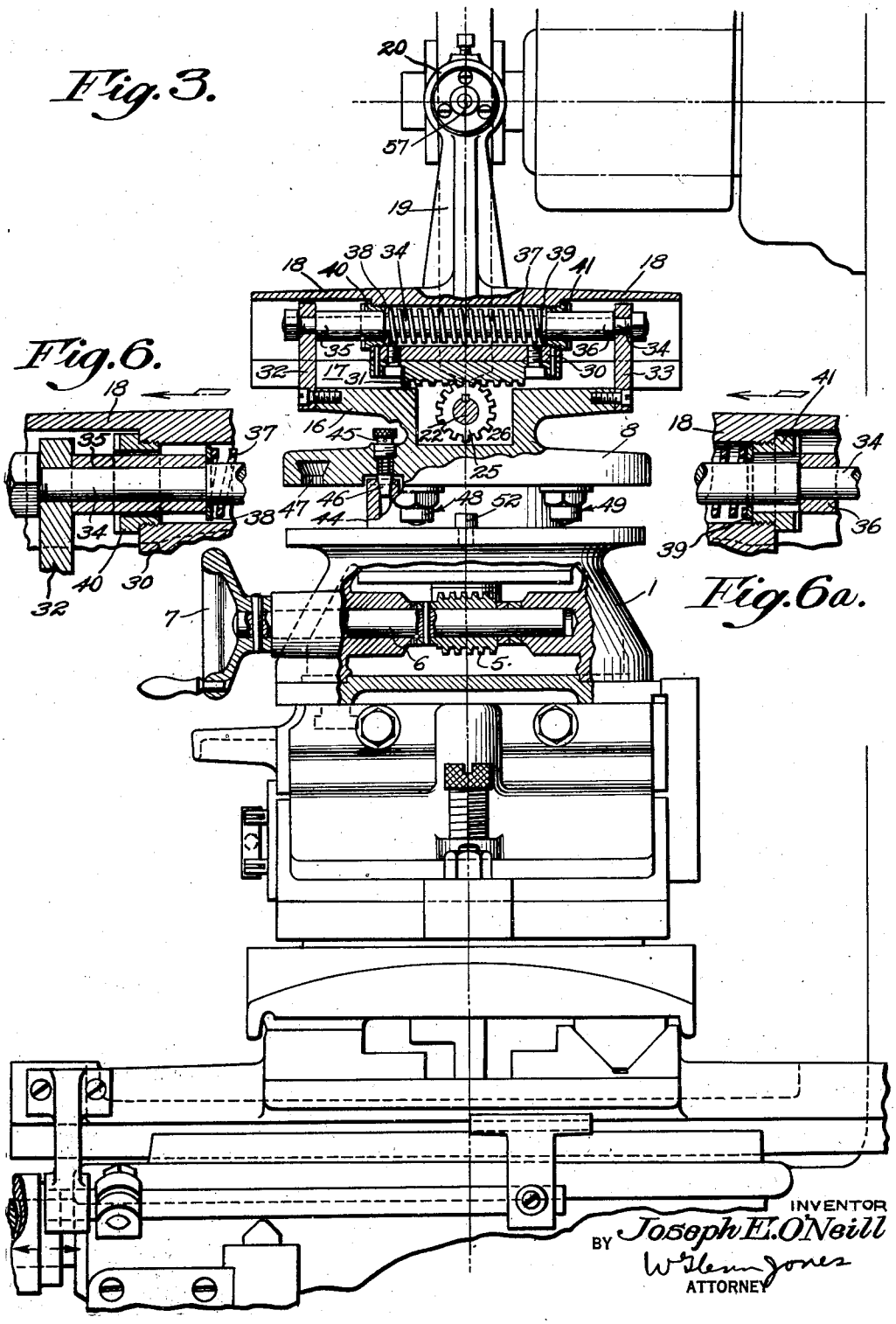

Fig. 6.

Fig. 6a.

INVENTOR
BY Joseph E. O'Neill
William Jones
ATTORNEY

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GRINDING WHEEL DRESSING ATTACHMENT

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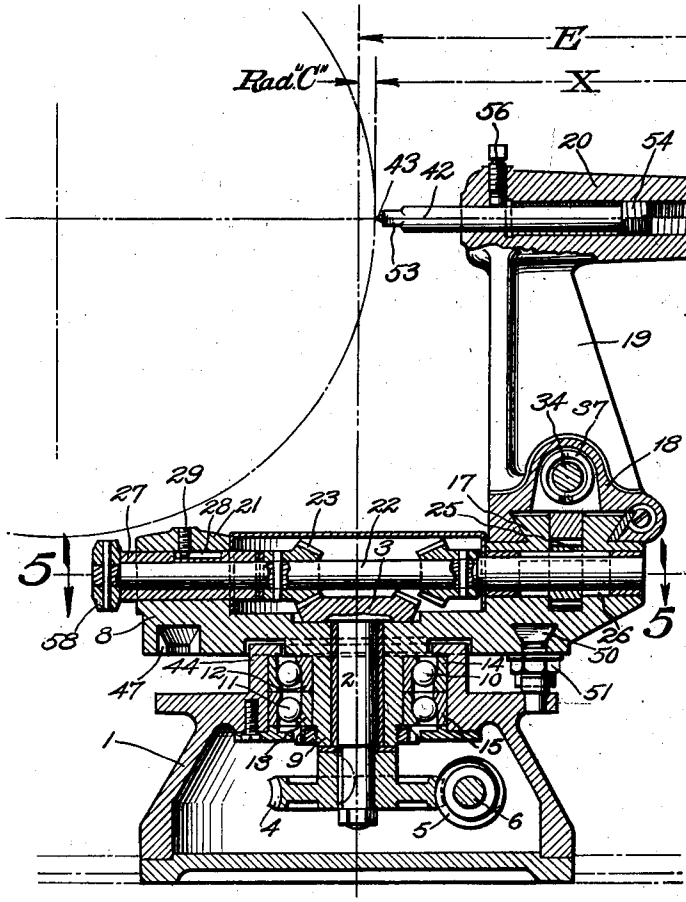


Fig. 4.

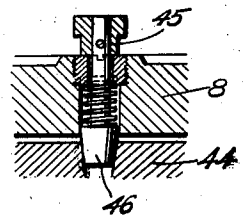
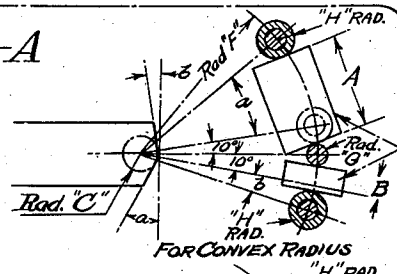


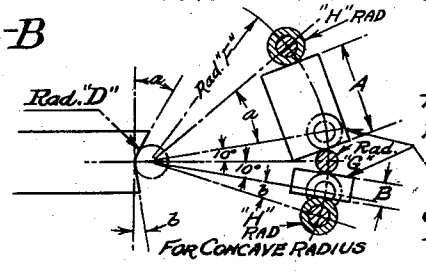
Fig. 7.

Fig. 8.

8-A



8-B



GAUGE BLOCKS

GAUGE BLOCKS

8-C FORMULAS:-

LENGTH OF GAUGE BLOCKS	
TO SET STOPS	$A = 2F \times \text{SINE}\left(\frac{a+10°}{2}\right) - (G+H)$
	$B = 2F \times \text{SINE}\left(\frac{b+10°}{2}\right) - (G+H)$

SETTING FOR DRESSING TOOL	
TO SET RADIUS	CONVEX RADIUS $X = E - C$ Rad.
	CONCAVE RADIUS $X = E + D$ Rad.

INVENTOR
Joseph E. O'Neill
BY
William Jones
ATTORNEY

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Fig. 9.

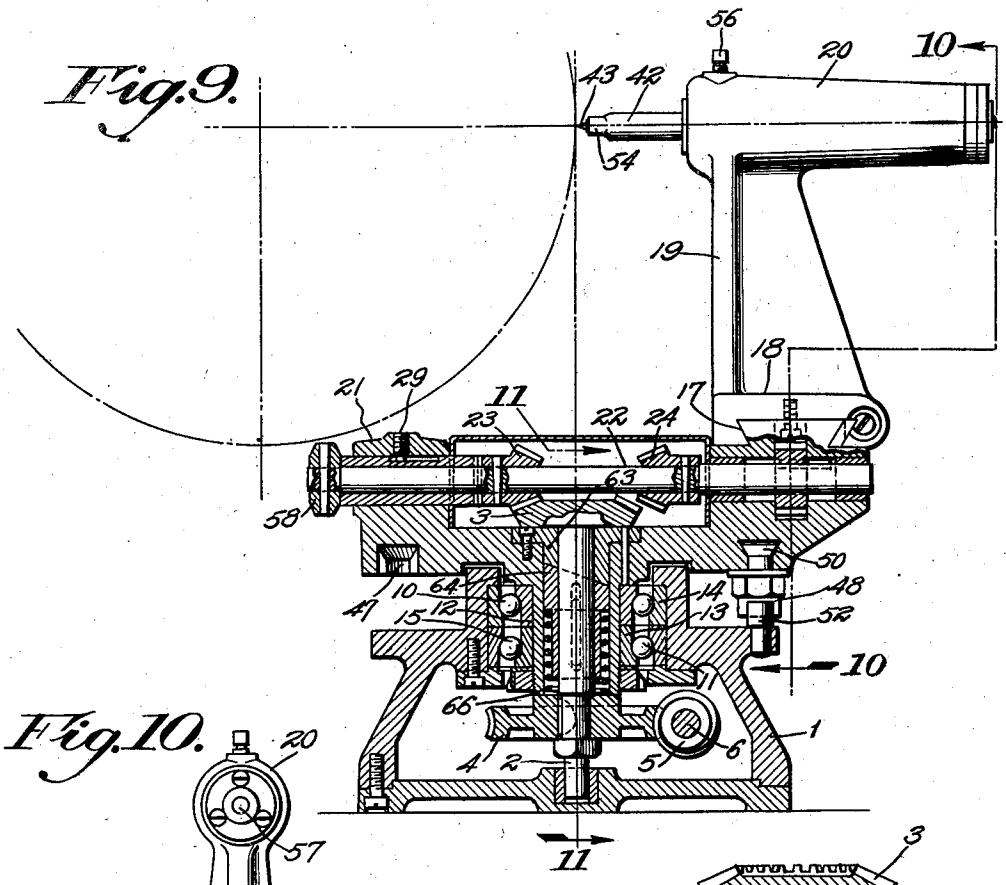


Fig. 10.

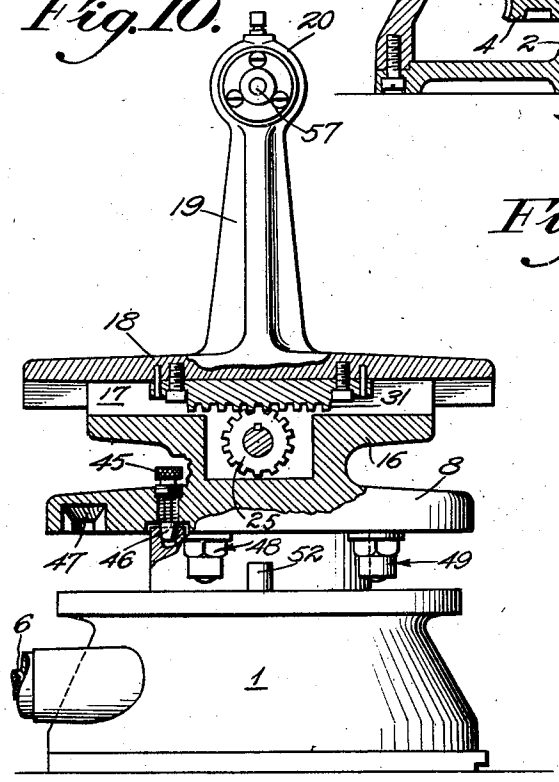
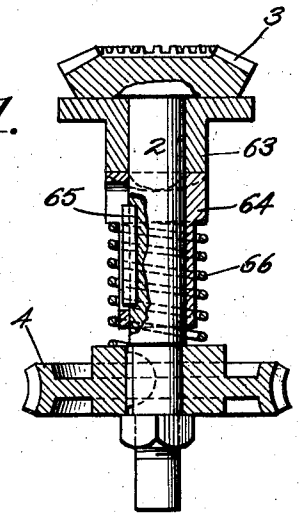


Fig. 11.



INVENTOR
Joseph E. O'Neill
BY
William Jones
ATTORNEY

Nov. 24, 1942. J. E. O'NEILL 2,302,712

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Fig. 12.

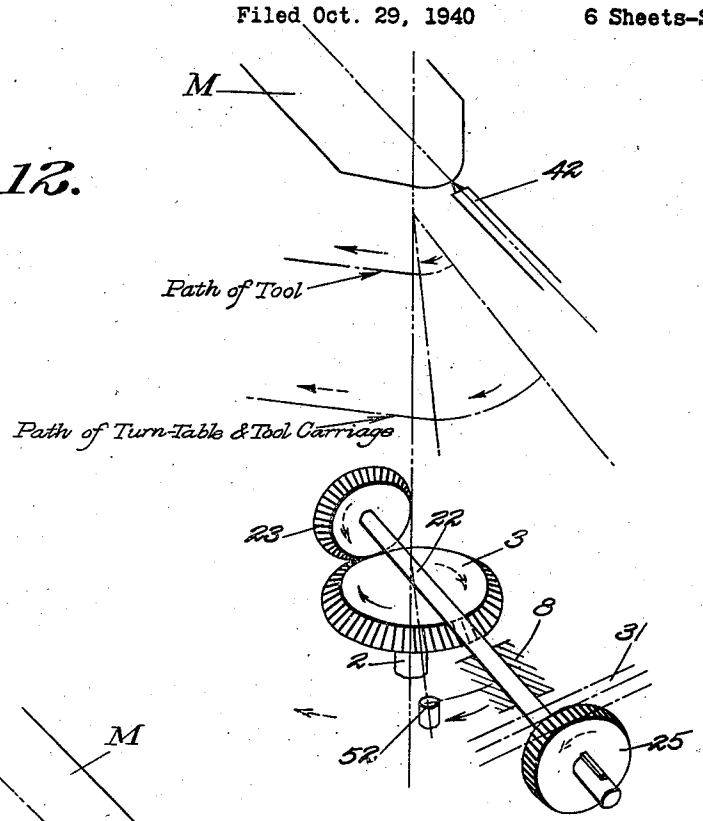
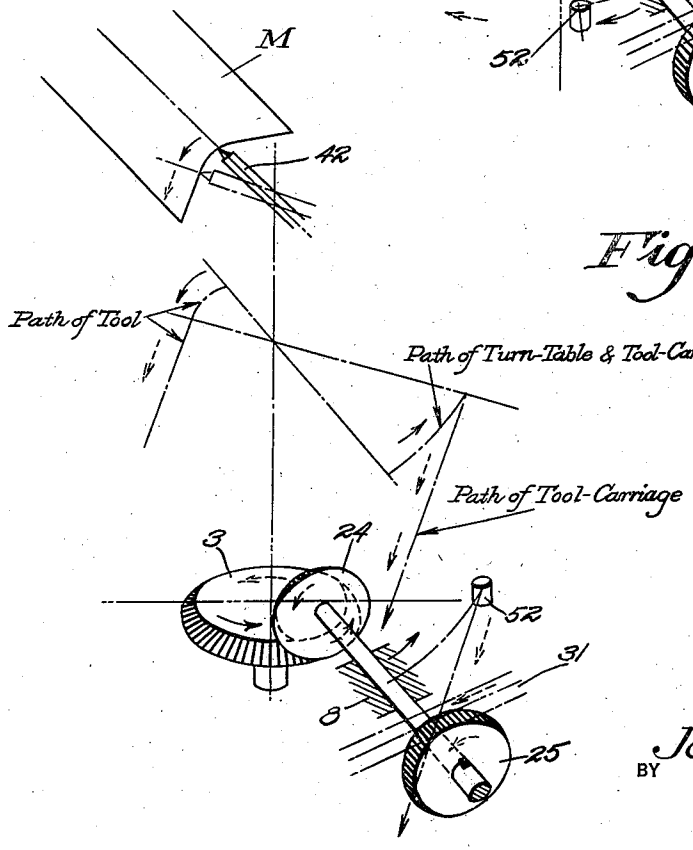


Fig. 13.



INVENTOR
Joseph E. O'Neill
BY
W. Glenn Jones
ATTORNEY

Patented Nov. 24, 1942 2,302,712

UNITED STATES PATENT OFFICE

2,302,712

GRINDING WHEEL DRESSING ATTACHMENT

Joseph E. O'Neill, Kenilworth, Md.

Application October 29, 1940, Serial No. 363,323

11 Claims. (Cl. 125—11)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

This invention relates to an attachment for use on grinding machines, for the purpose of dressing the grinding wheels thereof to a desired shape.

It is an object of this invention to provide a dressing attachment which may be quickly and easily adjustable to generate any desired profile on a grinding wheel.

It is another object of this invention to provide a dressing attachment which will generate convex and concave grinding wheel profiles with equal facility.

It is a further object of this invention to provide a dressing attachment which will generate in one continuous operation a grinding wheel profile composed of both straight and arcuate portions without any break in the profile outline.

Referring now to the drawings:

Fig. 1 is a front elevational view of a portion of a grinding machine showing an attachment conforming to one embodiment of the invention.

Fig. 2 is a plan view, somewhat enlarged, showing the attachment of Fig. 1 mounted before the grinding wheel and upon the magnetic chuck of the grinding machine, shown fragmentarily;

Fig. 3 is an end elevation of the attachment, looking from the right in Fig. 1, partly in section, shown mounted upon a fragment of the grinding machine;

Fig. 4 is a vertical, longitudinal, sectional view through the attachment taken along the line 4—4 of Fig. 2;

Fig. 5 is a horizontal, longitudinal, sectional view taken along the line 5—5 of Fig. 4;

Figs. 6 and 6—A are fragmentary, vertical, longitudinal, sectional views taken along the line 6—6 of Fig. 2, showing the details of the slide centering mechanism of Fig. 3;

Fig. 7 is an enlarged detail, vertical, sectional view taken along the line 7—7 of Fig. 2 showing the centering detent pin in engagement as required for setting-up adjustments to be considered later;

Fig. 8 shows diagrammatically and by legend the method of setting the rotary limit stops by use of the gauge block system;

Fig. 9 is a vertical longitudinal sectional view of a second embodiment of the dressing attachment utilizing a spring influenced cam arrangement in the manner of an overloading clutch;

Fig. 10 is a fragmentary sectional view taken along the line 10—10 of Fig. 9 showing the rack gear arrangement;

Fig. 11 is a vertical longitudinal sectional view along the line 11—11 of Fig. 9 showing enlarged details of the cam-clutch escapement;

Fig. 12 is a schematic diagram showing the arrangement and operation of the gearing and the paths of movement of the tool, the turntable, and the tool carriage for generating convex profiles; and,

Fig. 13 is a schematic diagram similar to that of Fig. 12 but with reference to the generation of concave profiles.

The embodiment of the device depicted in Figs. 1 to 7 comprises a hollow base 1 having centrally mounted thereon a turntable 8. The turntable 8 has a central depending portion 9 in the form of a hollow shaft, which is supported for rotation by a ball bearing assembly capable of taking thrust in either an upward or downward direction. This assembly is composed of two series of bearing balls 10 and 11 confined in parallel ball races formed in the outer faces of two abutting inner cones 12 and 13 and in the inner faces of two abutting outer cones 14 and 15. The areas of engagement of the raceways formed in cones 12 and 14 with the balls 10 are offset from the horizontal as shown in Fig. 4 so that downward movement of the turntable is prevented. The areas of engagement of the raceways formed in cones 13 and 15 with the balls 11 are offset in the opposite manner and thus prevent upward movement of the turntable.

Concentrically and rotatably mounted in the depending portion 9 of turntable 8 is a vertical spindle 2 terminating at its upper end in a bevel gear 3 and having a worm gear 4 keyed on its lower end. The worm gear 4 is driven by a worm 5 keyed on a shaft 6 mounted horizontally in the base and rotated by a handwheel 7.

Formed above the upper surface of turntable 8 is a T-shaped post 16. Formed along its top is a dovetailed guide 17. Slidably mounted in the dovetailed guide is a slide 18 carrying a pedestal 19 which terminates in a tool-head 20.

Rising above the surface of the turntable diametrically opposite the post 16 is a support 21. Passing through both post 16 and support 21 is a shaft 22 having keyed thereto a pair of bevel pinions 23 and 24, either of which, by longitudinally moving said shaft, may be brought into meshing relationship to said gear 3. The shaft 22 carries a pinion 25 splined thereto and located in a slot 26 in post 16. Near the other end of the shaft a sleeve 27, mounted for rotation relative thereto but secured against endwise motion with respect thereto is provided with a longitudinal slot 28 into which extends a dogpoint set

screw 29, thus limiting the amount of endwise motion, with respect to table 8, allowed shaft 22.

The member 18 is arch-shaped in cross section and has extending downwardly from its upper inner surface, an extension 30 having secured to its lower edge a rack 31 which meshes with the pinion 25. Attached to the ends of the arms of the T-shaped post 16 are two supports 32, 33 as shown in Fig. 3. Secured between and passing through the upper ends of these supports is a bolt 34. The central portion of the bolt is of larger diameter than the end portions, as shown by Figs. 6 and 6a, and this portion of the bolt passes through a bore formed in extension 30. A pair of sleeves 35 and 36 fit over the reduced end portions thus increasing their diameter to a size greater than that of the central portion of the bolt. A spring 37 surrounds the central portion of the bolt and its ends abut washers 38 and 39 which are of larger diameter than abutting sleeves 35 and 36. A pair of threaded collars 40 and 41 are fitted into the ends of the bore in extension 30, their inner ends being flush with the inner ends of sleeves 35 and 36. The collars 40 and 41 are slidable over sleeves 35 and 36.

Figs. 6 and 6a illustrate what happens when relative movement between slide 18 and post 16 takes place. In Figs. 6 and 6a the slide 18 has been moved to the left with respect to post 16. It will be noted that the spring 37 has been compressed by the motion of collar 41 and washer 39 to the left, while washer 38 at the left end of the bolt is forced to remain in its initial position by sleeve 35.

The tool head 20 is formed with a horizontal bore in which is mounted a cylindrical diamond holder 42 carrying diamond 43 in its end.

In Figs. 1, 2, 3 and 4 the attachment is shown mounted upon the magnetic chuck of a conventional surface grinding machine. It may, however, be used with cylindrical grinding machines. Since the attachment has no means of its own for being adjusted before the grinding wheel use is made of the regular grinding wheel table and carriage adjustment handwheels and screws, marked J, K and L respectively of Fig. 1. These mechanisms are used just as one would use them for locating work with respect to the grinding wheel M. The diamond tool however, is located on the right of the grinding wheel, rather than below it, as is usually the case with the work, and it is therefore necessary to adjust the guard N around to the left, by turning screw P of Fig. 2 to loosen or tighten the clamp sleeve of the guard.

In order to generate grinding wheel profiles composed of arcs and straight lines tangent thereto, it is necessary that the turntable rotate about its axis for part of the time and then be arrested while straight line motion of the diamond continues. This is accomplished by the provision of stops as follows:

As best shown in Fig. 3, the base 1 has formed on its upper surface a collar 44, having a vertical bore therein, which is provided at its upper end with a tapered hole to take with a snug fit the tapered end 46 of a detent 45 which extends through turntable 8 and is spring pressed downwardly but may, by suitable turning in its bore, be held in a raised position out of engagement with collar 44. When the detent 45 is in engagement with the collar the tool head 20 is so positioned that the point of the diamond 43 will lie in the center plane of the grinding wheel, or the turntable may be said to be in its neutral or centered position. The under side of the turntable is provided with an annular groove 47 having tapered side walls, for the reception of a pair of adjustable stops 48 and 49 each having a dovetailed portion 50 which is carried by groove 47 and may be clamped in position by a nut 51. Coacting with the adjustable stops is a fixed stop 52 carried by the base 1 and located with its center line in the plane containing the axis of the turntable and passing through the center of the grinding wheel.

The diamond holder 42, as shown in Fig. 4, has a squared end 53 and a threaded head 54 which is threaded into bore 55 of tool head 20. A set screw 56 serves to hold the holder 42 in adjusted position. The opposite end of the head 20 is supplied with a hardened ball 57 which serves as an accurate starting point for measuring the distance E which remains constant and the variable distance X. The radius C of the generated arc may be found by subtracting the measured distance X from the known distance E.

The operation of the attachment is as follows: The position of the diamond must first be adjusted for a convex or concave profile. The position of the point of the diamond with respect to the axis of the turntable determines whether rotation of the turntable will produce a convex or a concave arc on the profile of the grinding wheel. If the point of the diamond is between the axis and the tool head 20 the arc will be convex; if the axis is between the diamond point and the tool-head the arc will be concave.

For generating convex profiles the pinion 23 must be in mesh with gear 3. This is accomplished by sliding shaft 22 to the right by means of knob 58 pinned to its left hand end as shown in Fig. 4. As shown in Fig. 5 a keeper pin 59 is carried by support 21 and when either of gears 23 and 24 is engaged with gear 3, is spring pressed into one of two recesses 60 and 61 formed in sleeve 27 which surrounds the left hand end of shaft 22, keeps pinion 23 or 24 in engagement and takes the thrust of pinions 23 and 24.

The adjustable limit stops 48 and 49 are positioned at the points where it is desired that arcuate motion of the diamond point cease and straight line motion begin. Now, when handwheel 7 is turned in one direction the spindle 2 driving through gear 3, bevel pinion 23 and pinion 25 will tend to move rack 31 in straight line motion. However, the spring 37 will resist such motion and will prevent pinion 23 from rotating. The result will be that pinion gear 23 will be swept around as spindle 2 turns and so will turntable 8, thus moving the diamond point in an arc. This will continue until one or the other of stops 48 or 49 contacts fixed stop 52. Then rotary motion of the turntable will cease and any further rotation of handwheel 7 will cause rack 31 to be moved relative to the turntable, thus compressing spring 37 and moving the diamond point in a straight line tangent to the previous arcuate motion. When spring 37 is fully compressed so that collar 40 or 41 hits support 32 or 33, further motion of the diamond point in that direction will cease. If the handwheel 7 is now turned in the opposite direction, the diamond point will retrace its straight line motion until the spring 37 is back to expanded position and the engaged stops are freed, then the arcuate motion will be retraced until the other limit stop engages with stop 52 whereupon straight line motion will again be commenced.

In order to generate concave profiles, the dia-

mond holder must be so adjusted that the point of the diamond projects past the axis of rotation of the turntable by an amount equal to the radius of the desired concave arc. The change gears must also be shifted until gear 24 meshes with gear 3. Now, looking at Fig. 4, a clockwise movement of worm 5 will result in arcuate movement of the tool head 20 into the paper, with a corresponding arcuate movement of the diamond point out from the plane of the paper, so long as the stops are not engaged. This movement is terminated by the engagement of stop 48 with fixed stop 52. Now continued motion of worm 5 in the same direction will cause straight line motion of the rack the tool head and the diamond point out from the plane of the paper—along a continuation of the direction of the arcuate motion as arcuate motion ceased. Reversing the direction of the rotation of hand-wheel 7 and worm 5 will complete the concave profile.

The setting of the limit stops may be accomplished by the use of gauge blocks or by the use of micrometer calipers. The diagrams of Fig. 8 illustrate the use of gauge blocks and show the formulas for deriving their length. The turntable is first placed in such a position as to allow detent 45 to enter the bore in collar 44. The tool is now in its neutral position as illustrated. The blocks are now placed and the stops brought into abutting relationship with them and secured in position.

A second embodiment of the invention is illustrated in Figs. 9, 10 and 11. In this embodiment the spring 37 has been omitted and movement of rack 31 in response to rotation of gear 25 is therefore unopposed. Surrounding spindle 2 is a two part sleeve. The upper part 63 is fixed to the turntable 8 and the lower part 64 is splined to the spindle 2 for limited longitudinal movement there along by means of a spline 65. The lower portion of the sleeve part 64 is reduced in diameter and a spring 66 surrounds the reduced portion. The abutting surfaces of the sleeve parts are cams and the action of the spring 66 will normally press the part 64 up against the part 63 until contact throughout the opposing cam faces is secured. The strength of spring 66 is such as normally to prevent relative movement between the cam faces and thus to cause a movement of spindle 2 to move turntable 8 around with it. However, when the stops halt movement of the turntable, continued movement of spindle 2 causes the cam faces to move relative to each other and thus allows movement of rack 31 relative to the turn table. This movement may continue until separation of the sleeve parts 63 and 64 due to relative motion between the cam faces, forces the lower end of part 64 down against the upper surface of worm wheel 4.

While the disclosure of the invention has been restricted to two embodiments thereof it should be understood that the invention is not limited thereto but only by the scope and limitations of the appended claims.

The principle of this invention is applicable to other kinds of machine tool work, such as profile grinding, profile milling and profile turning.

The invention described herein may be manufactured and/or used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

I claim:

1. In a grinding wheel dressing device, a rotary table, a slide mounted thereon and means guiding its movement in opposite directions along a line normal to the radius line of said table, a tool head carried by said slide, a wheel dressing tool carried by said tool head and radially movable with respect to said table in such a manner that its cutting edge may be positioned on either side of the center of said table, spring means tending to move said slide to a neutral position with regard to said radius line, a rack bar formed on the underside of said slide, a shaft mounted on said table and extending along said radius line, said shaft being mounted for limited axial movement, a gear splined to said shaft and meshing with said rack bar, a driving gear concentric with the axis of said table, a pair of pinions fixed on said shaft and so positioned that one of them will mesh with said driving gear when said shaft is positioned at either end of its allowed axial movement, means for rotating said driving gear, means for limiting the rotation of said table in each direction and means limiting the movement of said slide with respect to its guiding means.

2. In a grinding wheel dressing device, a rotary table, a slide mounted thereon, means guiding the movement of said slide in opposite directions along a line normal to a radius line of said table, a tool head carried by said slide, a wheel dressing tool carried by said tool head and radially movable with respect to said table in such a manner that its cutting edge may be positioned on either side of the center of said table, a shaft carried by said table and extending along said radius, said shaft being mounted for limited axial movement, a gear splined to said shaft, a rack carried by said slide and meshing with said gear, a driving gear located concentrically of said table, a pair of pinions fixed to said shaft and so positioned that one of them will mesh with said driving gear when said shaft is positioned at either end of its allowed axial movement, means for rotating said driving gear, means limiting the rotation of said table in each direction and means yieldably biasing said driving gear to a position such that said slide lies in a neutral position with respect to said radius.

3. In a grinding wheel dressing device, a rotary table, a slide mounted thereon, means guiding the movement of said slide in opposite directions along a line normal to a radius line of said table, a tool head carried by said slide, a shaft carried by said table and extending along said radius, said shaft being mounted for limited axial movement, a gear splined to said shaft, a rack carried by said slide and meshing with said gear, a driving gear located concentrically of said table, a pair of pinions fixed to said shaft and so positioned that one of them will mesh with said driving gear when said shaft is positioned at either end of its allowed axial movement, means for rotating said driving gear comprising a shaft upon which said gear is fixed, a two-part sleeve surrounding said shaft, the upper part of said sleeve being secured to said table, the lower part of said sleeve being splined to said shaft for limited motion therealong and spring pressed upwardly against said upper part, the adjacent faces of said parts being cam faces, and means limiting the rotary movement of said table.

4. In a grinding wheel dressing device, a rotary table, a slide mounted thereon, means guiding the movement of the slide in opposite directions along a line normal to a radius line of said table, a tool head carried by said slide, a cutting tool carried by said tool head and having a cutting

edge extensible along a line passing through said axis, means to adjust said tool so that its cutting edge may lie either on the same or opposite side of said axis with respect to said tool head, means operable to move said slide along said guiding means, means normally biasing said slide to a neutral position with respect to said radius, said biasing means being strong enough to prevent movement of said slide along said guiding means as long as said table is free to rotate, and said biasing means and said slide moving means being so arranged as to apply the force of said slide moving means to said table in a manner to rotate said table, means limiting the rotary movement of said table and means for selectively applying the force of said slide moving means to move said slide in either of its two possible directions of movement, upon the termination of the rotation of said table in a given direction due to the action of said limiting means.

5. In a grinding wheel dressing device, a rotary table, a slide mounted thereon, means guiding said slide in opposite directions along a path normal to a radius line of said table, a tool head mounted on said slide, a tool carried by said tool head and having a cutting edge extensible along a line passing through said axis, with said cutting edge so positioned that said axis lies between it and said tool head, means operable to rotate said table in either direction means limiting said rotation and means operable by said limiting means, to apply the force of said rotating means to said slide, to move it in a direction opposite the direction of movement in which said slide was moving, due to the rotation of said table, at the cessation of the rotation of said table.

6. In a grinding wheel dressing device, a rotary table, a slide mounted thereon, means guiding said slide in opposite directions along a path normal to a radius line of said table, a tool head mounted on said slide, a tool carried by said tool head and having a cutting edge extensible along a line passing through said axis and adjustable on either the same or the opposite side of said axis as said tool head, means operable to rotate said table in either direction within fixed limits and means operable when said table has reached either of said limits to selectively apply the force of said rotating means to said slide to move it in a direction either opposite to or the same as the direction of movement in which said slide was moving, due to the rotation of said table at the cessation of the rotation of said table.

7. Means for causing a particular element of a mechanism to follow a continuous path composed of either a convex or a concave arc and a straight line tangent to an end of said arc, comprising a base, a support mounted on said base for pivotal movement about an axis passing through said support, a member mounted on said support, guiding means constraining said member to move in a path normal to a radius of said supporting means, means holding said element said holding means being mounted on said member for movement therewith and being adjustable to move said element along a line passing through said axis to a position either on the some or on the opposite side of said axis as said holding means, driving means comprising a driving element rotatable about said axis, means to apply the force generated by said driving element to said member in a direction tending to move it along its path, means yieldingly restraining movement of said member and transferring said force to said support in a direction to rotate said support, means limiting the extent of the rotation of said support, and means for shifting the direction of application to said member of the force generated by the movement of said driving element in a given direction, whereby said member may be moved in either of its two possible directions of movement by the movement of said driving element in one direction, which direction may be either of the directions of movement possible to said driving element.

8. In a grinding wheel dressing device, a support rotatable about an axis, a tool head mounted upon said support and offset from said axis, a tool held by said head, said tool having a working edge and being extensible along a line extending radially with respect to said axis in a manner to position said working edge on either side of said axis, said tool head having formed thereon a hardened accurately formed reference surface intersecting said line and lying normal thereto at the point of intersection, said surface facing in a direction opposite to said axis and being so positioned that for all positions which said working edge may occupy on the same side of said axis as said surface, said surface will be farther from said axis than said edge, whereby the distance of said edge from said axis may be accurately determined by measuring the distance of said working edge from said surface and comparing it with the known distance of said surface from said axis, substracting the larger of said distances from the smaller.

9. In a grinding wheel dressing device, a support rotatable about an axis, a tool head mounted upon said support and offset from said axis, a tool held by said head, said tool having a working edge and being extensible along a line extending radially with respect to said axis, and a hardened ball immovably held by said tool head, said ball being so held that its center lies along said line, said tool lying nearer said axis than said ball, the surface of said ball farthest from said axis being available as a reference surface for determining the distance of said cutting edge from said axis.

10. Means for causing a particular element of a mechanism to follow a continuous path composed of a concave arc and a straight line tangent to an end of said arc, said means comprising a support mounted for pivotal movement about an axis passing therethrough, a member mounted on said support, guiding means constraining said member to move in a path normal to a radius of said axis, means mounting said element on said member in such a manner that it is positioned on the opposite side of said axis from said member, a driving means comprising a rotating portion concentric with said axis, means transmitting the force generated by said driving means to urge said member along said path, yieldable means normally restraining said member from motion in response to said urging, said transmitting means being so constructed as to thereupon apply said force to said support in such a direction as to rotate said support about said axis in a direction opposite to that along which said member was urged, and means limiting the rotation of said support, whereby when said rotation is stopped by said limiting means said force will overcome said restraining means and said member will be moved along said path in response to said urging.

11. Means for causing a particular element of a mechanism to follow a continuous path composed of concave arc and a straight line tangent

to an end of said arc, said means comprising a support mounted for pivotal movement about an axis passing therethrough, a member mounted on said support, guiding means constraining said member to move with respect to said circuit in a path normal to a radius of said axis, means mounting said element on said member in such a manner that it is positioned on the opposite side of said axis from said member, a driving means comprising a gear wheel concentric with said axis, a shaft mounted on said support and extending radially with respect to said axis, a rack formed on said member, a pair of pinions secured to said shaft, one of said pinions meshing with said rack and the other meshing with said gear wheel and lying between said axis and said member, whereby rotation of said gear wheel will urge said member along said path, means restraining the movement of said member in response to said urging, whereby the force generated by said rotation will rotate said other pinion and move said support in a direction opposite to the direction in which said member was urged, and means limiting the movement of said support, whereby when said movement has been stopped by said limiting means, said member will be moved along said path in response to said urging.

JOSEPH E. O'NEILL.