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Moeller

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[54] **METHOD AND APPARATUS FOR FORMING A CABOCHON**

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[52] **U.S. Cl.** ..... **51/127,** 51/101 R, 51/229, 51/283

[51] **Int. Cl.** **B24b 7/00,** B24b 9/16, B24b 19/00

[58] **Field of Search** ..... 51/100, 101 R, 121, 127, 51/229, 283, 97

[56] **References Cited**

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Primary Examiner—Othell M. Simpson
Attorney, Agent, or Firm—Browne, Beveridge, DeGrandi & Kline

[57] **ABSTRACT**

A cabochon is formed by rotating a gemstone workpiece about a rotational axis while contacting it with an abrasive surface, moving the workpiece and the rotational axis in a radial path in response to its rotational movement to change the lateral position of the rotational axis in response to the angular displacement of the workpiece during its rotation, and swinging the rotational axis with respect to the abrasive surface, the swing axis lying normal both to the rotational axis and to the radial movement of the rotational axis.

11 Claims, 6 Drawing Figures

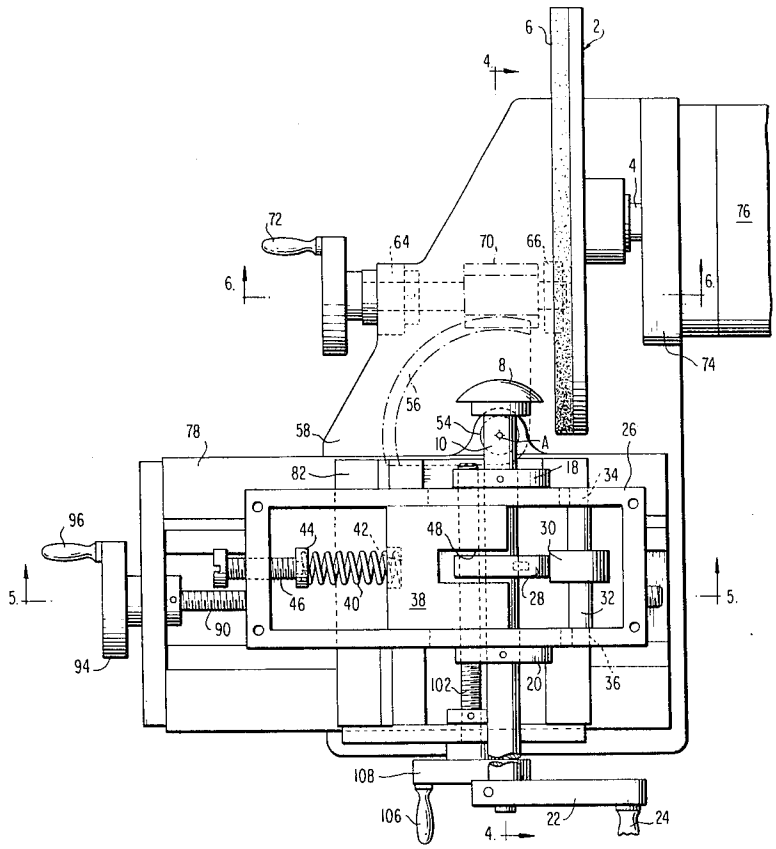


FIG. 1

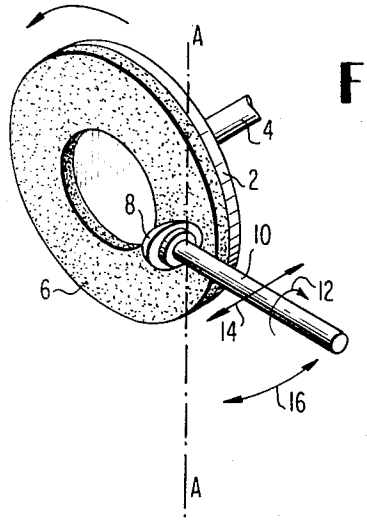


FIG. 2

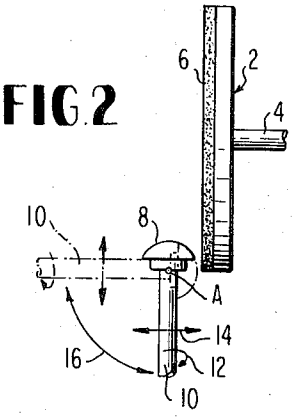


FIG. 3

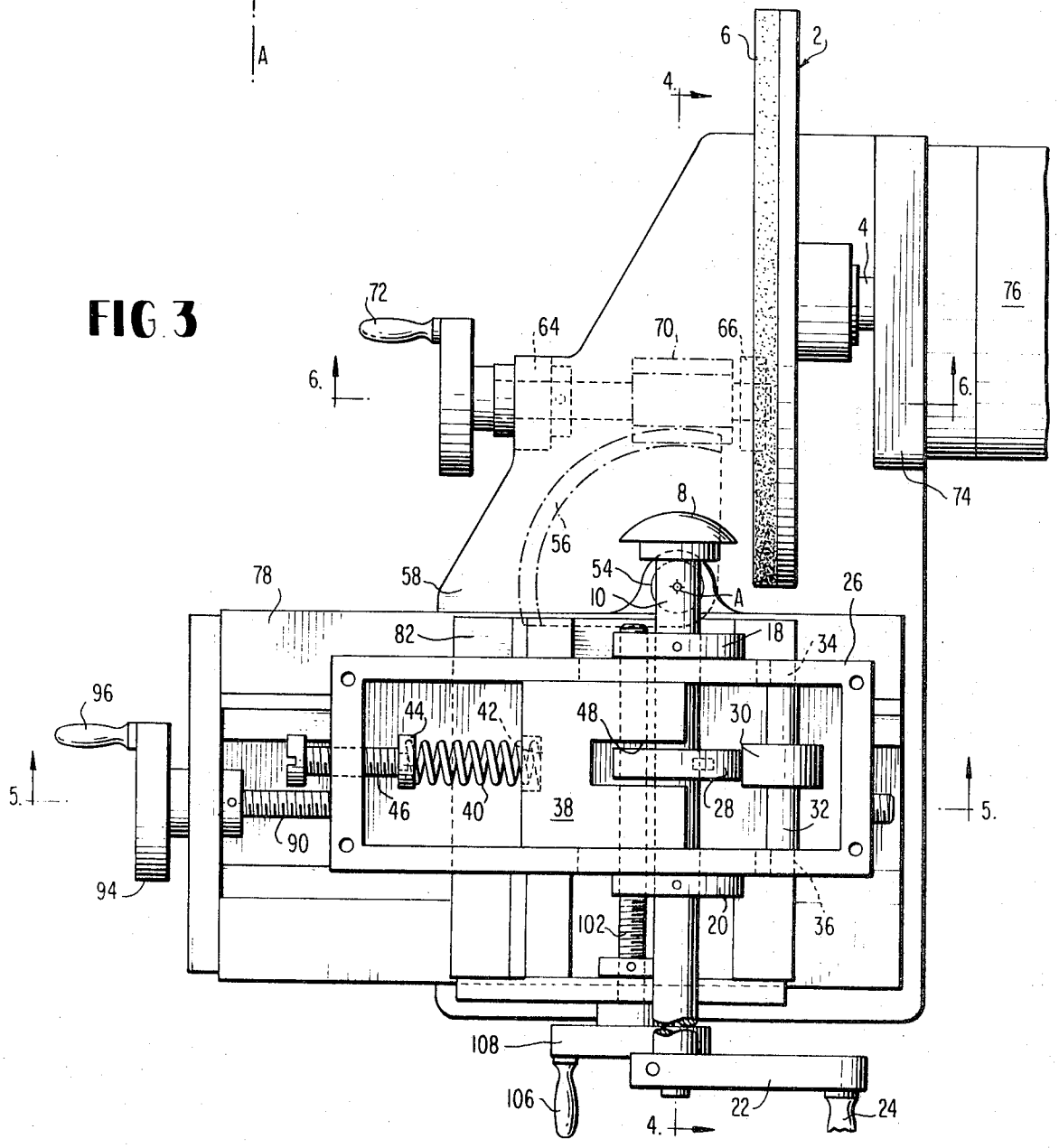


FIG. 4

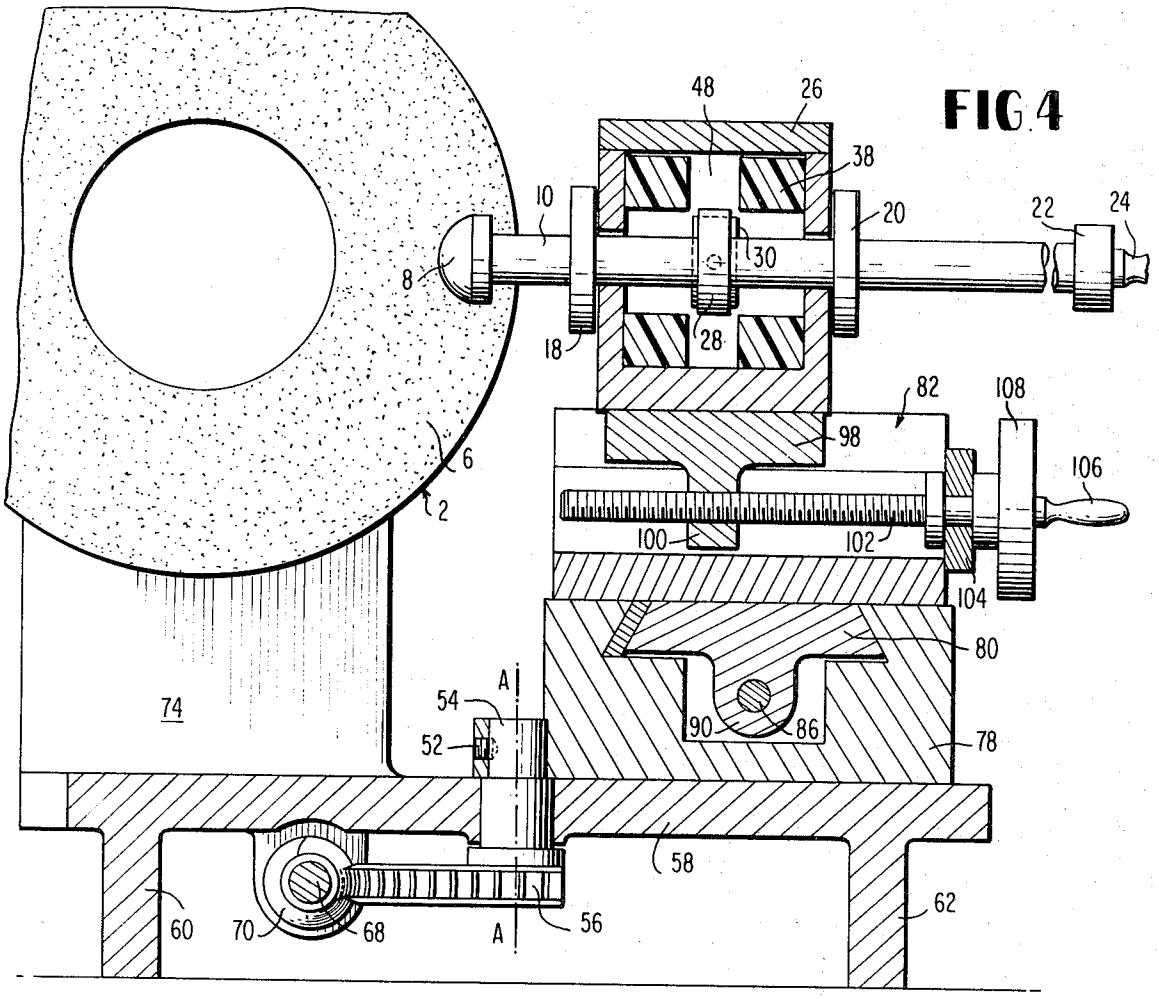
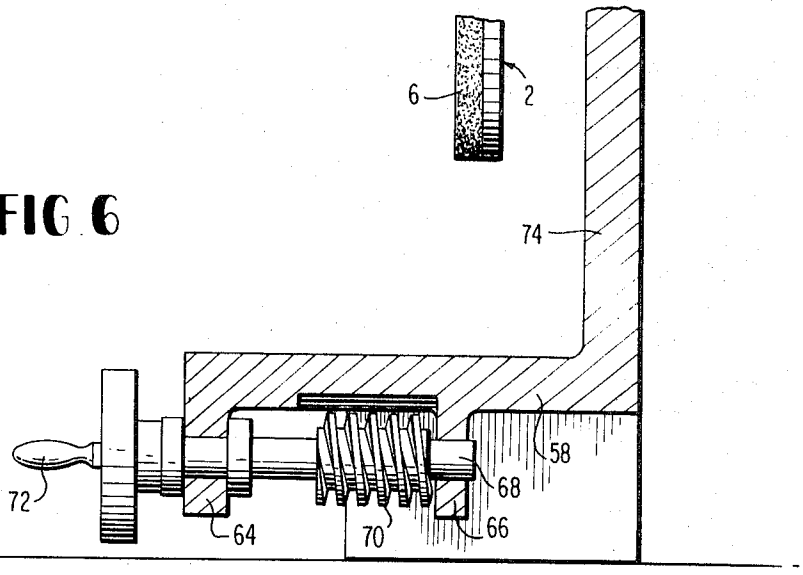

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102
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A
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52
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86
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70
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A
56
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FIG. 6


6
2
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72
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70
68
66

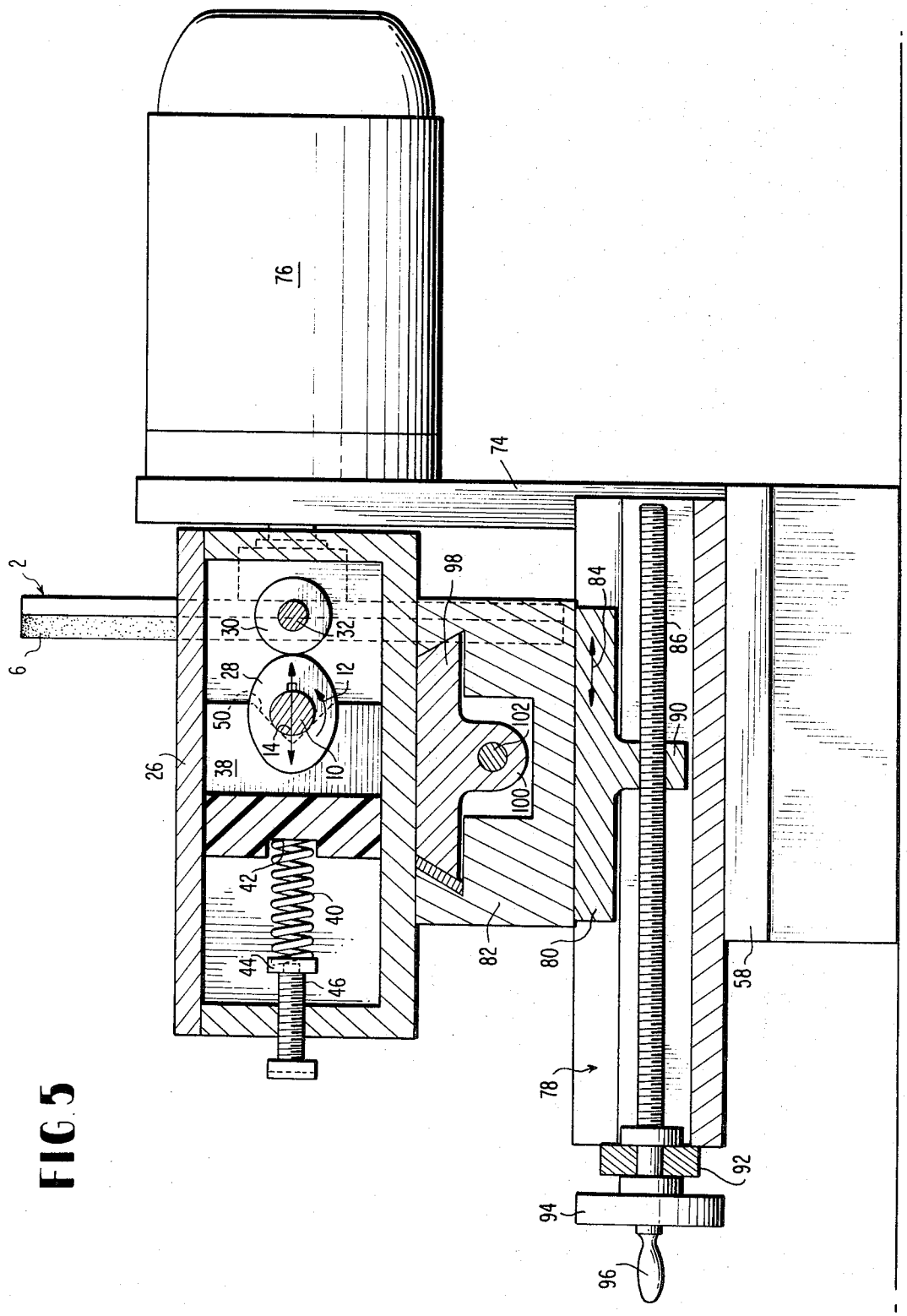

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FIG 5

METHOD AND APPARATUS FOR FORMING A CABOCHON

This invention relates to a method and apparatus for making a cabochon from a rough cut or uncut natural or synthetic stone. The resulting product is a cabochon gemstone provided with an unfaceted convex face.

Heretofore, cabochons have been made either manually or by specialized apparatus, typical examples of which in recent years are exemplified by U.S. Pat. Nos. 3,279,127, 3,568,369 and 3,673,742. The latter of these patents bears a number of similarities to the cabochon grinder disclosed herein, but it has severe limitations in that it requires a specially shaped abrasive surface which is incapable of making cabochons with varying degrees of curvature.

The present invention involves a relatively uncomplicated method and apparatus which is capable of making a variety of shapes and sizes of cabochons in an efficient and expeditious manner.

The invention is performed by the following steps and for means for performing these steps: supporting a workpiece for rotational movement about a rotational axis, moving the workpiece and the rotational axis in a radial path which lies radial to the rotational axis, the latter movement being in response to rotational movement so that the position of the rotational axis along the radial path is dependent upon the angular displacement of the workpiece, and providing relative swinging movement between the abrasive surface and the rotational axis, this swinging movement being about a swing axis which is normal both to the rotational axis and to the radial path.

Although the invention is capable of being performed by a wide variety of devices, a preferred form thereof is described herein for purposes of illustration.

Referring now, to the drawings, FIG. **1** is a diagrammatic perspective view which illustrates the various paths of movement of the shaft which supports the workpiece.

FIG. **2** is a plan view corresponding to FIG. **1**, also showing the extent of swinging movement of the workpiece-supporting shaft.

FIG. **3** is a plan view of a preferred form of apparatus embodying the concepts of the invention.

FIG. **4** is a sectional view of the apparatus as seen along the line **4—4** in FIG. **3.**

FIG. **5** is a sectional view of the apparatus as seen along the line **5—5** in FIG. **3.**

FIG. **6** is a sectional view showing the drive means for swinging the workpiece-supporting shaft as seen along the line **6—6** in FIG. **3.**

The basic concept of the invention is depicted in FIGS. **1** and **2** which illustrate an abrasive wheel **2** supported on a driven shaft **4** and provided with a flat abrasive surface **6** for grinding or polishing the material from which the cabochon is formed. The workpiece itself is a natural or synthetic stone **8** supported in a conventional manner on a dop shaft **10** and held in contact with the abrasive surface **6** of the wheel **2.** During the forming of the cabochon, the abrasive surface **6** of the wheel **2** stays in a same plane, and the dop shaft **10** is manipulated in a manner which will result in the formation of the cabochon-shaped surface on the final product.

There are several movements of the dop shaft **10** which are compounded to achieve the desired results.

The shaft **10** rotates about its own longitudinal axis as indicated by the arrow **12.** It also has a translatory movement in a path **14** which is radial with respect to the axis of dop shaft **10.** This radial movement is imparted to the shaft by a cam, described below, which moves the shaft in the direction of arrow **14** in response to shaft rotation so that the position of the longitudinal axis of the shaft changes with and is dependent upon its angular displacement during rotation.

The third aspect of movement is a swinging movement of the dop shaft **10** about the swing axis A—A, oriented normal to the longitudinal axis and the radial path of the dop shaft **10.** This latter movement is shown by the arrow **16,** and it may be accomplished by swinging the abrasive wheel **2** instead of the dop shaft **10.** The two extreme positions of the shaft during its swinging movement are seen in FIG. **2** where the swing axis appears as a point and is designated A.

In addition to the movements illustrated in FIGS. **1** and **2,** the preferred apparatus is provided with adjustment means which permits both longitudinal and transverse shifting of the dop shaft **10** with respect to the swing axis A—A. Such adjustments permit the operator to change the shape and curvature of the final product produced by performing the steps illustrated in FIGS. **1** and **2.**

A preferred apparatus for performing the invention is illustrated in FIGS. **3–6.** In these drawings, it will be seen that the rotational movement, identified by arrow **12** in FIG. **1,** is accomplished by rotationally supporting the dop shaft **10** by the elements in a housing **26.** The shaft may be turned manually by means of the crank arm **22** having a handle **24,** or it may be accomplished by a motor having suitable reduction gearing for rotating the shaft.

The dop shaft **10** projects from a housing **26** which encloses the means for rotationally supporting it and moving it along the path designated **14** in FIG. **1.** As best illustrated in FIG. **5,** the shaft **10** has an elliptical cam **28** affixed thereto for concurrent rotation by a set screw. The apparatus may be provided with a number of cams **28** having various sizes and shapes, which may be interchanged for making cabochons of different shapes. Dust seals **18** and **20** are attached to the dop shaft **10** and prevent abrasive particles and other foreign matter from entering the housing **26.**

The contoured face of the cam **28** is in engagement with a cam follower **30** which is rotatably mounted on a shaft **32** provided with reduced end portions **34** and **36** which seat within apertures on opposed walls of the housing. As the cam rotates, its contact with the cam follower **30** will cause it to reciprocate in the direction of the arrow **14.** The shaft **10** is held at a constant orientation with respect to the housing **26** and in continuous engagement with the cam follower **30** by means of the slider block **38** which is also positioned in the housing **26.** The slider block **38** is positively biased against spaced apart portions of the dop shaft **10** by a spring **40** which has one end received in a recess **42** in the slider block and its other end positioned in a retainer **44** at the end of an adjustment screw **46** which is threadedly mounted in the end wall of the housing **26.** Of course, rotation of the adjustment screw **46** will change the compression of the spring **40** and affect the force exerted by the spring **40** against the slider block **38** and ultimately on the shaft **10.** As seen in FIG. **3,** the slider block **38** has a groove **48** for accommodating the cam

28 without contacting it. On opposite sides of the groove, the slider block has V-shaped recesses 50 best shown in FIG. 5 for contacting the shaft and serving as bearing surfaces. The spaced relationship of the two V-shaped recesses 50 maintains the dop shaft 10 at a constant orientation with respect to the housing 26.

The swinging movement of the dop shaft about the axis A—A is achieved by mounting the housing 26 on a support structure which is swingably mounted with respect to the abrasive surface. As seen in FIG. 4, the support structure is affixed by a set screw 52 to a shaft 54 which has on its lower end a gear segment 56. The shaft 54 pivots in a bore in the center of the platform 58 of the apparatus. The platform 58 is held above the supporting surface by spaced apart leg flanges 60 and 62. On the underside of the platform 58, there are a pair of depending support brackets 64 and 66 which, as shown in FIG. 6, support the shaft 68 of a lead screw 70 which meshes with the gear segment 56 to rotate the dop shaft assembly. The shaft 68 may be rotated manually by a handle 72, but it preferably is operated by a motor having suitable reducing gearing for slowly swinging the dop shaft assembly about the axis A—A.

The drive motor 76 for the abrasive wheel 2 is supported on the platform 58 by the motor support bracket 74. As seen in FIG. 3, the motor shaft 4 extends through the bracket 74 and connects to the rear face of the abrasive wheel 2. It is desirable to mount the abrasive wheel 2 on the shaft 4 in a manner which permits adjustment in the spacing between the abrasive surface 6 and the axis A—A, such adjustment providing the desired initial positioning of the abrasive surface with respect to the axis of the dop shaft 10. This movement may also be provided by mounting the motor support bracket 74 for adjustable movement or by moving the axis A—A toward the abrasive surface 6.

A number of factors will affect the shape of the cabochon produced according to the invention. The shape of the cam 28 is determinative of the shape of the peripheral outline of the cabochon which will be geometrically similar thereto. Another factor will be the longitudinal position of the dop shaft 10 with respect to the swing axis A—A, inasmuch as the curvature of the convex face of the cabochon will be greater if it is positioned closer to the axis A—A. Further, the position of the swing axis A—A with respect to the translatory movement of the dop shaft 10 will affect its shape and will require adjustment, especially on occasions when the shaft-moving cam 28 is replaced with a cam of a different size. In order to permit these adjustments, a pair of slide carriages are interposed between the housing 26 and the pivot shaft 54 for the dop shaft assembly.

The swinging base member 78, best seen in FIGS. 4 and 5, rests on the upper surface of the platform 58 and, as previously described, is swingable with respect thereto. The swinging base 78 has a dovetail slide track open to its upper surface for slidably receiving a dovetail slide 80 which is attached to a sliding carriage 82. Movement of the dovetail slide 80 in the swinging base 78 is in the direction indicated by the arrow 84 in FIG. 5. Such movement is produced by a lead screw 86 which is engaged in a threaded aperture in a depending projection 90 of the dovetail slide 80. The lead screw 86 is rotationally mounted and longitudinally affixed to the swinging base 78 by means of a bearing assembly 92. Rotation of the lead screw 86 is produced by turning the adjustment wheel 94 by means of the crank handle 96.

Adjustable movement of the dop shaft 10 in a direction parallel to its longitudinal axis is made possible by mounting the housing 26 on a dovetail slide 98 so that the housing 26 serves as an upper carriage. This dovetail slide 98 is received by a dovetail groove in the lower carriage 82, the slide 98 having a depending flange 100 which has a threaded aperture for receiving the threaded adjustment shaft 102 best shown in FIG. 4. The shaft 102 is attached to the lower sliding carriage 82 by a bearing assembly 104 which permits the shaft 102 to rotate but prevents if from moving along its own longitudinal axis. The lead screw shaft 102 may be manually rotated by a crank handle 106 on the adjustment wheel 108. Of course, such rotation will result in longitudinal movement of the dop shaft so as to change the distance between the surface of the workpiece and the swing axis A—A. As this distance increases, the radius of the arc of curvature of the cabochon will be increased.

The operation of the disclosed apparatus will be evident from the foregoing description. A workpiece is mounted on the dop shaft 10 and the abrasive surface 6 is brought into contact with the cabochon. The abrasive surface is rotated and the dop shaft is rotated, the latter rotation serving also to move the dop shaft in a radial path 14 under the influence of the attached cam 28 which operates against the stationary cam follower 30. Concurrently, and at a slow rate, the entire dop shaft assembly swings about the axis A—A until the dop shaft is at a position normal to the abrasive surface as is illustrated in broken lines in FIG. 2. At this point, the cabochon will be complete, having been made in a relatively short period of time and without imperfections.

Those skilled in the art will realize that there are a great number of ways which the invention may be performed, and that the disclosed apparatus is merely exemplary of these. Therefore, it is emphasized that the invention is not limited only to the single embodiment disclosed hereinabove, but extends to encompass the modifications and variations thereto which fall within the spirit of the following claims.

I claim:

1. Lapidary apparatus for use in shaping a gemstone workpiece into a cabochon, comprising,

a shaft for supporting a workpiece,

said shaft being rotatable about its longitudinal axis,

means for moving the shaft in a radial path in response to its rotation so that the position of its longitudinal axis changes with and is dependent upon its angular displacement during rotation,

abrasive means having an abrasive surface for contacting a workpiece supported on the shaft, and

means for providing about a swing axis relative swinging movement between the longitudinal axis and the abrasive surface of the abrasive means, said swing axis lying normal both to the longitudinal axis and to the radial path of the shaft.

2. The apparatus of claim 1 having means for adjusting the location of the shaft to vary the position of the workpiece with respect to the swing axis.

3. The apparatus of claim 2 wherein the means for adjusting the location of the shaft includes a pair of car-

riages slidable in mutually perpendicular directions which lie perpendicular to the swing axis.

4. The apparatus of claim **1** wherein the means for moving the shaft in a radial path includes a cam connected to and rotatable with the shaft, and cam follower means engaged against the cam to move the cam and the shaft radially upon rotation of the shaft.

5. The apparatus of claim **1** wherein said swing axis is substantially perpendicular to the radial path and to the longitudinal axis of the shaft.

6. The apparatus of claim **5** having means for adjusting the location of the shaft to vary the position of the workpiece with respect to the swing axis.

7. The apparatus of claim **6** wherein the means for adjusting the location of the shaft includes a pair of carriages slidable in mutually perpendicular directions which lie perpendicular to the swing axis.

8. The apparatus of claim **6** wherein the means for moving the shaft in a radial path includes a cam connected to and rotatable with the shaft, and cam follower means engaged against the cam to move the cam and the shaft radially upon rotation of the shaft.

9. The apparatus of claim **8** wherein the means for adjusting the location of the shaft includes a pair of carriages slidable in mutually perpendicular directions which lie perpendicular to the swing axis.

10. Apparatus for making a cabochon, comprising, an abrasive surface,

means for supporting a workpiece for rotational movement about a rotational axis,

means for moving the workpiece and the rotational axis in a path lying radial to the rotational axis in response to said rotational movement so that the position of the rotational axis along said path is dependent upon the angular displacement of the workpiece,

means providing for relative swinging movement between the abrasive surface and the rotational axis, said relative swinging movement being about a swing axis which is normal both to the rotational axis and to said path.

11. A method of making a cabochon, comprising the steps of contacting a workpiece with an abrasive surface while simultaneously doing the following:

rotating the workpiece about a rotational axis,

moving the rotational axis in a path lying radial to the rotational axis, said movement being in response to rotation of the workpiece so that the lateral position of the rotational axis along said path is dependent upon the angular displacement of the workpiece,

relatively swinging the abrasive surface and the rotational axis, said swinging occurring about a swing axis which is normal both to the rotational axis and to said path.

* * * * *