United States Patent

Wylde

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[54] DEVICE FOR IMPARTING MOTION TO AN OPTICAL LENS

[72] Inventor: **Stephen Jack Wylde,** Croydon, England

[73] Assignee: **J. L. S. Limited,** Croydon, England

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[52] **U.S. Cl.** **51/160,** 51/120

[51] **Int. Cl.** **B24b 13/02**

[58] **Field of Search** 51/157, 160, 119, 120

[56] **References Cited**

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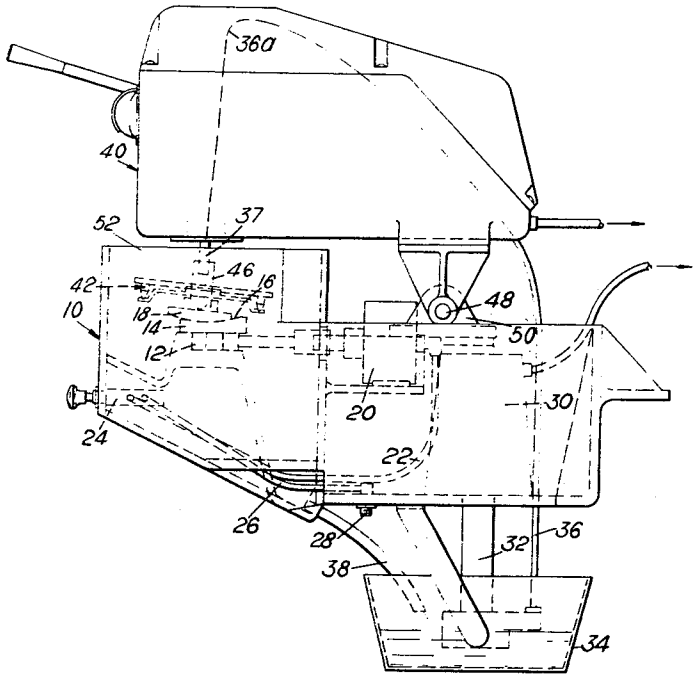
Primary Examiner—Othell M. Simpson

Attorney—Berman, Davidson and Berman

[57] **ABSTRACT**

A device for imparting motion to an optical lens while the latter is held in contact with the working surface of a lens-grinding, smoothing or polishing tool, comprising a lens-holder mounted on a shaft which, at spaced-apart points along its length, passes through or is connected to at least two driven eccentric bearing assemblies of which one is of adjustable eccentricity and the other has two eccentrics driven at two speeds which are in selected ratios to each other so that the shaft is given a substantially uniform but substantially non-repeating motion by the said eccentric bearing assemblies.

11 Claims, 7 Drawing Figures



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Fig. 1.

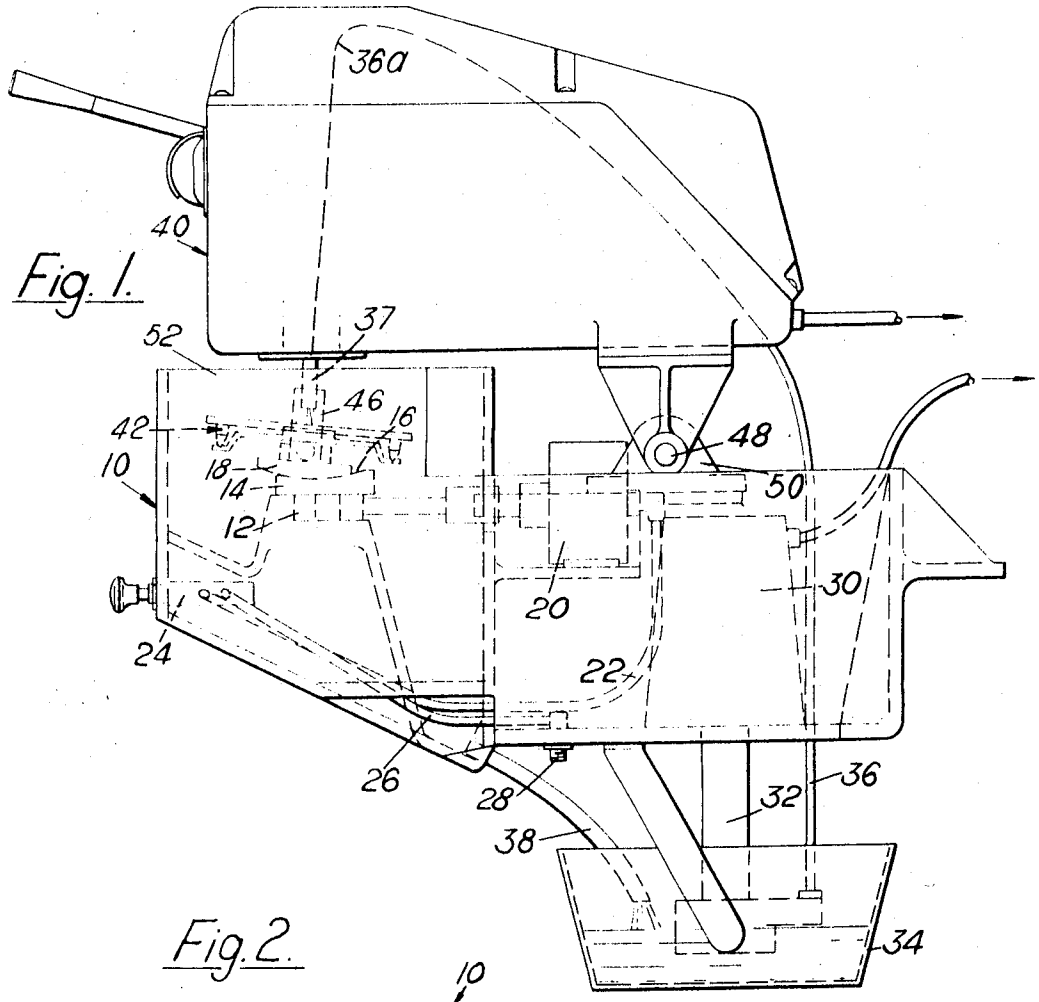
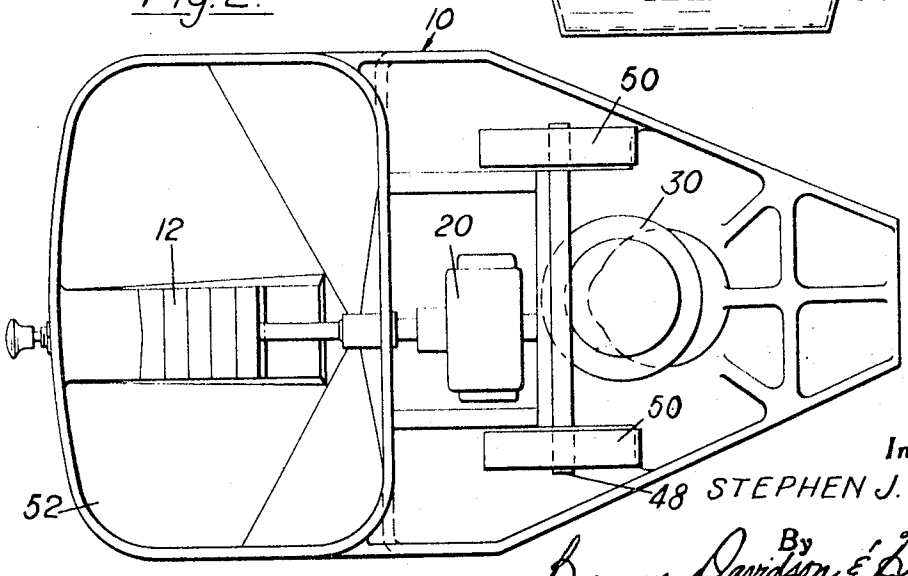


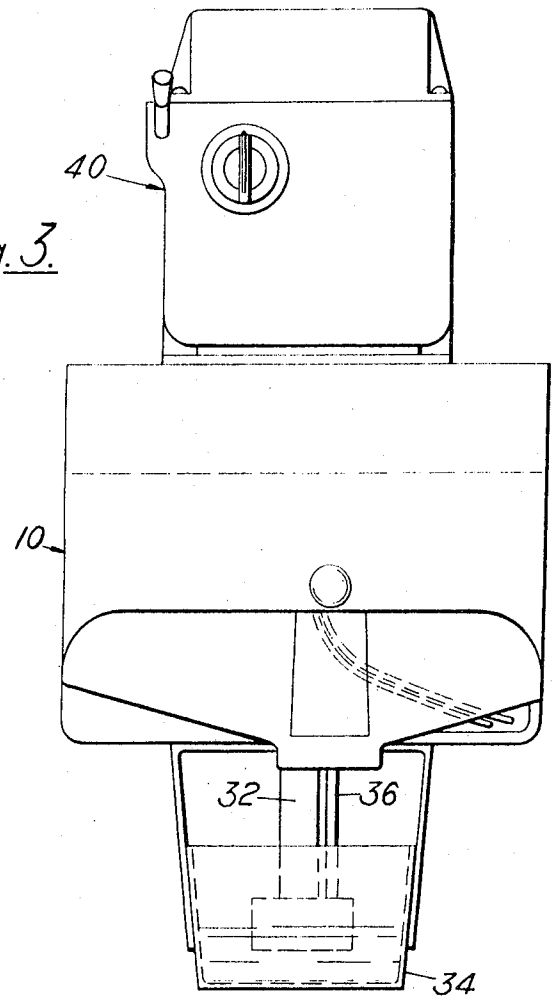
Fig. 2.



Inventor
STEPHEN J. WYLDE,

By
Berman, Davidson & Berman,
Attorneys.

Fig. 3.



Inventor
STEPHEN J. WYLDE,

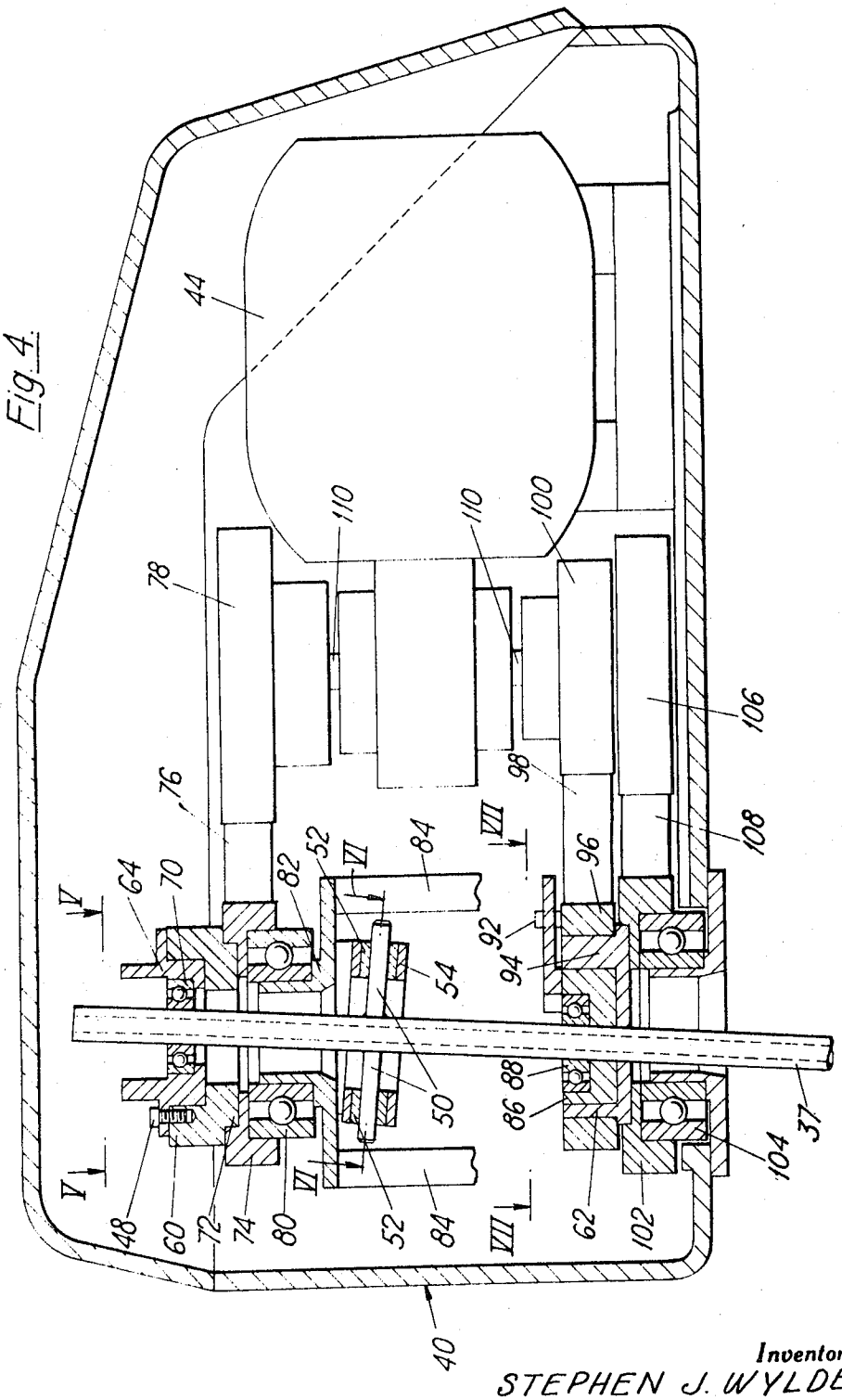
By
Berman, Davidson & Berman,
Attorneys.

Patented May 30, 1972

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Fig. 4.



Inventor
STEPHEN J. WYLDE,

By
Berman, Davidson & Berman,
Attorneys.

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Fig. 5

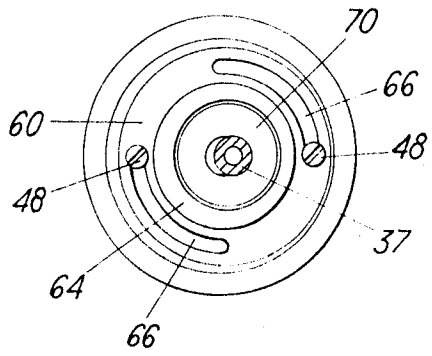


Fig. 6

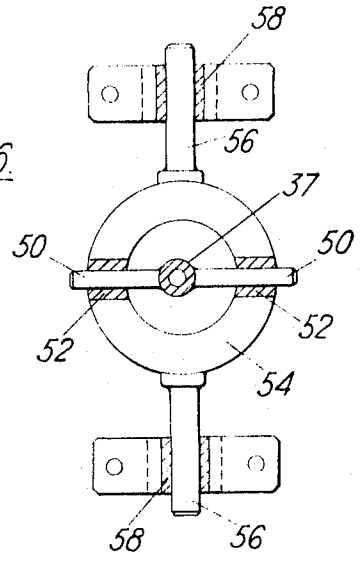
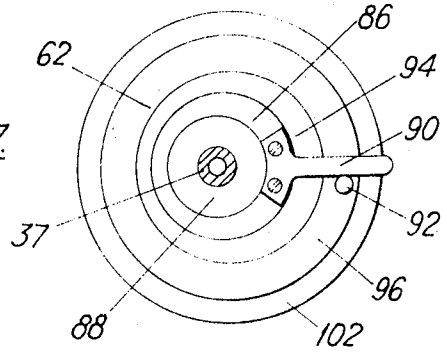


Fig. 7



Inventor
STEPHEN J. WYLDE,

By
Berman, Davidson & Berman,
Attorneys.

DEVICE FOR IMPARTING MOTION TO AN OPTICAL LENS

This invention relates to machines for grinding, smoothing or polishing optical lenses. More specifically, it relates to a device for imparting motion to an optical lens while the latter is held in contact with the working surface of a lens-grinding, smoothing or polishing tool.

Various proposals have been made in the past for producing relative motion between an optical lens and the working surface of a lens-grinding, smoothing or polishing tool. In some arrangements, one or other of the two parts is held stationary, while the other one is moved in a reciprocating, circular or gyratory motion. In some other machines, both parts are moved so as to produce a compound motion between them. A disadvantage however of all these prior proposals is that they do not provide a sufficiently uniform, substantially non-repeating motion.

It is therefore an object of the present invention to provide an arrangement which gives rise to more uniform motion of a non-repeating nature than that given by the machines used hitherto.

To this end, the present invention is directed towards a device for imparting motion to an optical lens while the latter is held in contact with the working surface of a lens-grinding, smoothing or polishing tool, which device comprises a lens-holder mounted on a shaft which, at spaced-apart points along its length, passes through or is connected to at least two driven eccentric bearing assemblies of which one is of adjustable eccentricity and the other has two eccentrics driven at two speeds which are in selected ratios to each other so that the said bearing assemblies impart to the shaft a substantially uniform but substantially "non-repeating motion" as herein defined.

The term "non-repeating motion" as used herein is not to be interpreted too literally. For example, a motion which does not repeat itself more than once in 2,000 cycles is considered to be "non-repeating" as far as the present invention is concerned. Accordingly, the said term is to be understood as including any motion which does not repeat itself more than once in 500 cycles.

A lens-moving device of this construction can be used in various forms of machine, but it is especially applicable to a machine comprising a hollow main body containing a stationary holder for a lens-grinding, smoothing or polishing tool together with a motor for driving a pump which serves to deliver an abrasive slurry to the working surface of the tool, and a hollow work head containing another motor which drives a projecting lens-moving device adapted to move a lens in a desired motion while it is in contact with the working surface of the tool. The work head is pivotally mounted on the hollow main body so that it can be easily moved out of its working position in order to gain access to the tool and to the lens-moving device, the latter being arranged to extend into the hollow main body through an opening in the latter when the head is in its working position.

An example of a lens-moving device and a machine incorporating it in accordance with the invention is illustrated in the accompanying drawings, in which:

FIG. 1 is a side view of the machine;

FIG. 2 is a plan view of the machine shown in FIG. 1 with the work head removed;

FIG. 3 is a front view of the machine;

FIG. 4 is a vertical section of an enlarged scale through the work head of the machine; and

FIGS. 5–7 are sections taken on the lines V—V, VI—VI and VII—VII respectively in FIG. 4.

The machine shown in the drawings comprises a hollow main body **10** containing a stationary vice or other holder **12** for a lens-grinding, smoothing or polishing tool **14**. In this particular instance, the smoothing tool **14** has an upper concave surface **16** for polishing a convex surface on a lens **18**, but it could equally well be of mushroom shape so as to have an upper convex surface for polishing a concave surface on the lens. Usually the tool **14** will be provided with a wear-taking pad (not shown) on its upper surface **16**, the pad being attached to the surface **16** by an adhesive and comprising a layer of woven metal fabric, expanded metal foil or some such material.

The vice is opened and closed so as to release and lock the tool **14** in position by an air cylinder **20**. This has an air-supply pipe **22** which is controlled by a hand-operated air valve **25** on the front portion of the main body **10**. A second pipe **26** leads from the valve **24** to an inlet orifice **28** in the lower surface of the main body **10** for connection to a suitable source of compressed air (not shown). The vice **12** and the air cylinder **20** are both arranged within the hollow main body **10** so as to be well enclosed. The main body **10** also contains a pump motor **30** which serves to drive a pump **32** provided with an inlet located in a sump or reservoir **34** removably supported below the hollow main body **10**. The pump has a delivery pipe **36** leading to a point **36***a* at the upper end of a hollow shaft **37** the lower end of which lies just above the tool **14** so that, in operation of the pump, the pipe **36** supplies an abrasive slurry through the hollow shaft **37** from the sump **34** to the working surface **16** of the tool **14**. The slurry thus washes over the working surface of the tool continuously during operation of the machine and is returned to the sump through the pipe **38**.

Mounted above the main hollow body **10** is a hollow work head **40** which contains an electric motor **44** (FIG. 4) arranged to drive a lens-moving device **42** (FIG. 1). The device **42** projects downwards from the forward lower surface of the work head **40** and is designed to move the lens **18** in a desired motion while the latter is held in contact with the working surface **16** of the tool **14**. In order that the head may be easily moved out of its working position (the position shown in FIG. **1**) so as to give access to the tool and to the lens-moving device, the head **40** is pivotally mounted at **48** on lugs **50** formed on the upper part of the hollow main body **10**. In this way the head can be swung upwards in a clockwise direction as the machine is shown in FIG. **1** about the horizontal axis provided by the pivotal mounting **48**. It will also be noted that the lens-moving device **42** is arranged to extend into the hollow main body **10** through an opening **52** in the latter when the head is in its working position. This has the advantage that slurry is not thrown out of the machine during the grinding, smoothing or polishing operations, and it also helps to keep the working parts of the machine in better condition.

As already indicated, one of the disadvantages of existing machines is that the means for producing relative movement between the lens and the tool doe not provide a sufficiently uniform, substantially non-repeating motion. To overcome this drawback, the machine of the present invention has a new form of lens-moving device **42** which is illustrated in detail in FIGS. **4–7** of the drawings.

As shown in FIG. **4**, the lens-moving device includes the hollow shaft **37**, which has already been referred to, as one of the means by which slurry is fed to the working surface of the tool. This shaft is in fact held against rotation about its axis by radial stubs **50** (see also FIG. **6**) which project from the middle portion of the shaft and which are arranged for sliding movement in sleeves **52**, the sleeves **52** being in turn located in a ring **54** having radial arms **56** which slide in fixed sleeves **58** and which project at right angles to the stubs **50**. In this way the shaft **27** is held against rotation while being free to gyrate or to follow some other motion not involving rotation about its axis.

Above and below the radial arms **50**, the shaft **37** passes through or is connected to eccentric bearing assemblies **60** and **62**. The upper assembly **60** comprises a driven eccentric **64** (see also FIG. **5**) which can be angularly adjusted by hand to an extent determined by the length of two slots **66** which each have a locking pin or screw **48** on the eccentric **64** projecting into them. As shown in FIG. **4**, a self-aligning ball bearing **70** is carried by the eccentric **64**, the upper end of the hollow shaft **37** passing through the bearing **70**. The eccentric bearing assembly **60** also includes a bush **72** to which is at-

tached a pulley **74** arranged to be driven by a belt **76** from a drive pulley **78**. The driven pulley **74** is mounted on a ball bearing **80** having a mounting **82** which is securely fixed to the casing of the work head by pillars **84**. It will also be seen from FIG. **4** that the assembly **50** . . . **58** illustrated in FIG. **6** for preventing rotation of the shaft **37** is secured to the underside of the bearing mounting **82**.

The lower eccentric bearing assembly **62** differs from the bearing **60** in that it has two driven eccentrics **86** and **94** one arranged within the other. A ball bearing **88** transmits the motions of these two eccentrics to the shaft **37** which passes through the bearing **88**. As shown in FIGS. **4** and **7**, the inner eccentric **86** has a radial arm **90** which extends over and beyond the outer eccentric **94** and is driven by a stud **92** on a drive pulley **96**, the pulley **96** being driven through a belt **98** from a drive pulley **100**. The outer eccentric **94** is driven by a further pulley **102** attached to the underside of the eccentric **94** and of larger diameter than the pulley **96**, the pulley **102** being rotatably mounted on a ball bearing **104** and being driven by a further drive pulley **106** through a belt **108**. In this way it is ensured that the eccentricity of the bearing assembly **62** is changed constantly during rotation of the two eccentrics **86** and **94**.

The drive pulleys **78**, **100** and **106** are mounted on a common shaft **110** (or on two co-axial shafts), the shaft **110** being driven by the electric motor **44**.

By means of the lens-moving device **42** described above, the shaft **37** can be made to gyrate or follow other compound rotary movements without rotating about its own longitudinal axis. The actual motion can be varied over a very wide range by virtue of the fact that the eccentricity of the bearing assembly **60** can be adjusted by hand as desired while the eccentricity of the other bearing assembly **62** is varied automatically during operation. As a result, the shaft **37** has an adjustable, substantially uniform, non-repeating motion which is not given by existing machines. Needless to say, this motion can be varied further by changing the sizes of the pulleys which are provided on the shaft **110** to impart rotary motion to the eccentrics of the eccentric bearing assemblies.

I claim:

1. A device for imparting motion to an optical lens while the latter is held in contact with the working surface of a tool, the said device comprising a lens-holder adapted to hold a lens in contact with a tool, a shaft on which the lens-holder is mounted, a first driven eccentric bearing assembly in driving connection with the shaft at one point along the length thereof, a second driven bearing assembly in driving connection with the shaft at a second point along the length thereof, said first driven bearing assembly having an eccentric of adjustable eccentricity, and said second driven bearing assembly having two eccentrics arranged to be driven at different speeds in selected ratios to each other whereby the said bearing assemblies impart to the shaft a substantially uniform but substantially "non-repeating motion" as herein defined.

2. A device according to claim **1**, in which means are provided for holding the shaft against rotation about the longitudinal axis thereof while leaving the shaft free to gyrate.

3. A device according to claim **2**, in which the means for holding the shaft against rotation about the longitudinal axis thereof comprise radial stubs which project from the shaft and are arranged for sliding movement in a ring which is similarly provided with radial arms arranged for sliding movement and projecting at right angles to the radial stubs.

4. A device according to which the claim **1**, in which the eccentric of the first bearing assembly is arranged to be angularly adjusted to vary the eccentricity of the bearing assembly and to be releasably locked in a selected position of adjustment.

5. A device according to claim **4**, in which the first bearing assembly comprises a single driven pulley by means of which the eccentric is rotated.

6. A device according to claim **4**, in which the first bearing assembly comprises a single driven pulley by means of which the eccentric is rotated, the said driven pulley being rotatably supported on a fixed mounting to which means for holding the shaft against rotation about the longitudinal axis thereof are also secured.

7. A device according to claim **1**, in which the two eccentrics of the second bearing assembly are arranged one within the other.

8. A device according to claim **1**, in which the second bearing assembly includes two independently driven pulleys, one for rotating one eccentric of the said bearing assembly and the other for rotating the other eccentric of the said bearing assembly.

9. A device according to claim **7**, in which the inner eccentric of the second bearing assembly has a radial arm which extends over and beyond the outer eccentric and is driven by a stud on a driven pulley associated with the said inner eccentric.

10. A device according to claim **1**, in which the two eccentric bearing assemblies are driven by three drive pulleys mounted on a common shaft.

11. A device according to claim **1**, in which the shaft passes through two self-aligning ball bearings carried by the two eccentric bearing assemblies.

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