Nov. 17, 1953

H. S. INDGE

HONING MACHINE

2,659,185

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3 Sheets-Sheet 1

Fig. 1

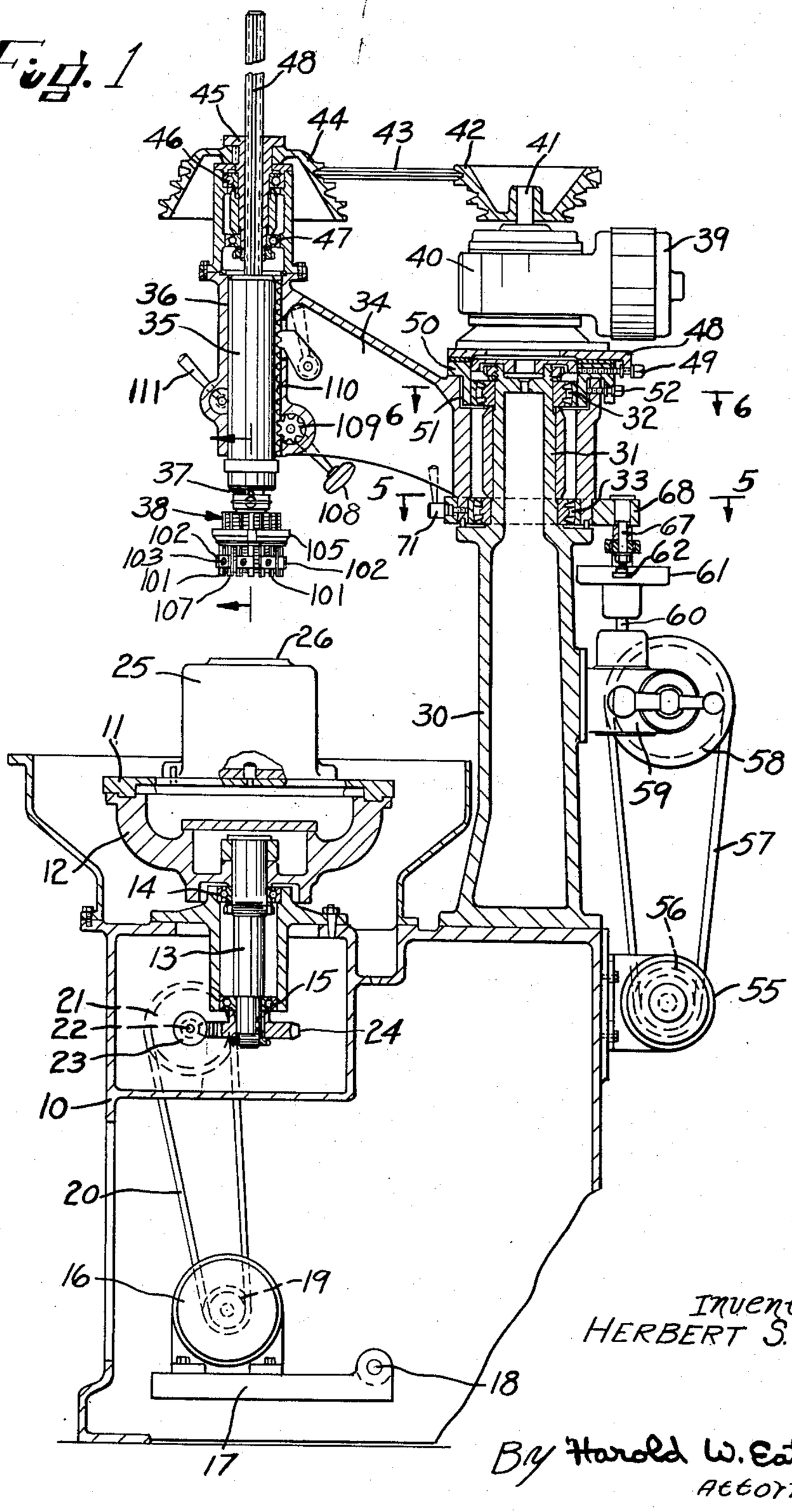

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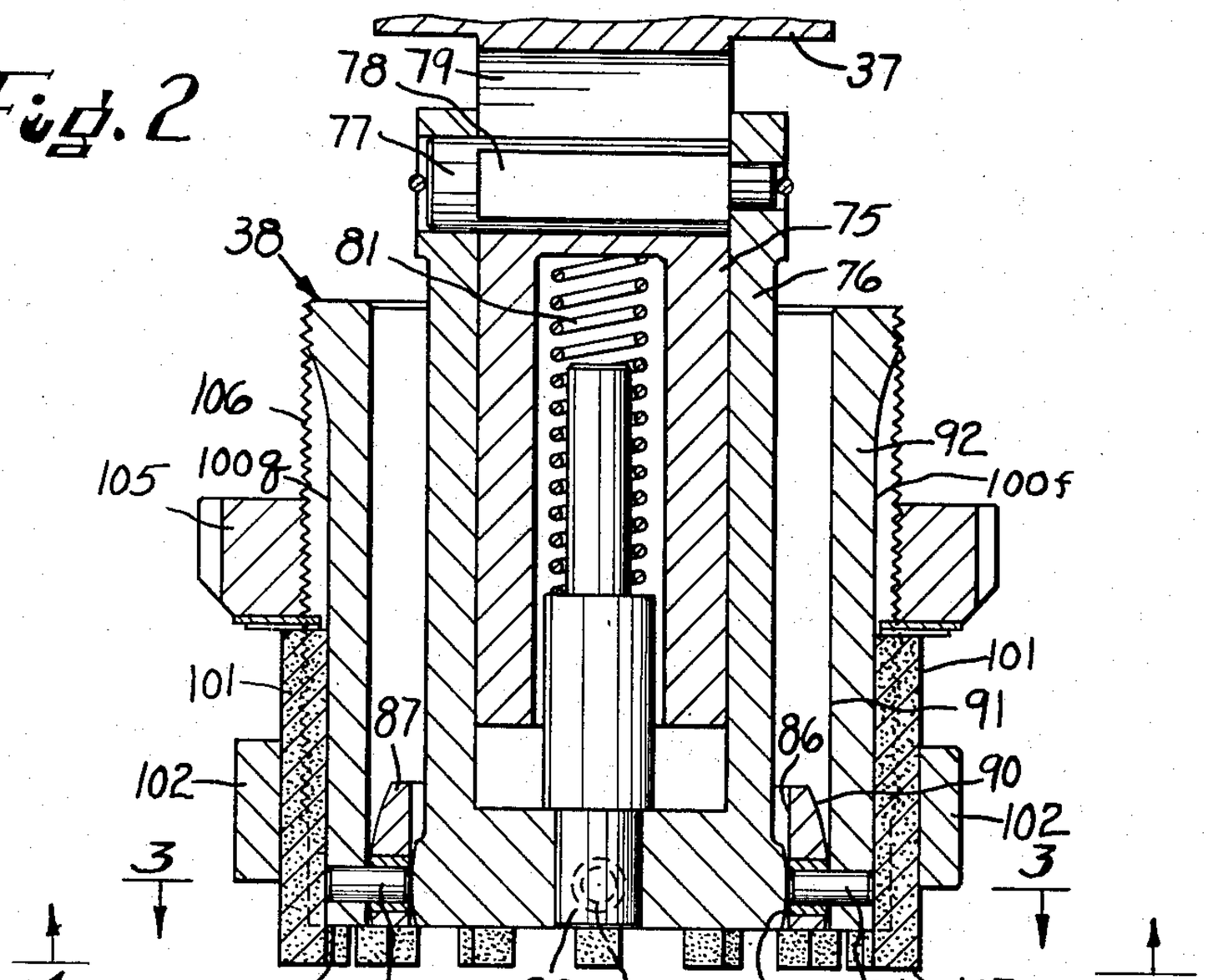
Fig. 2



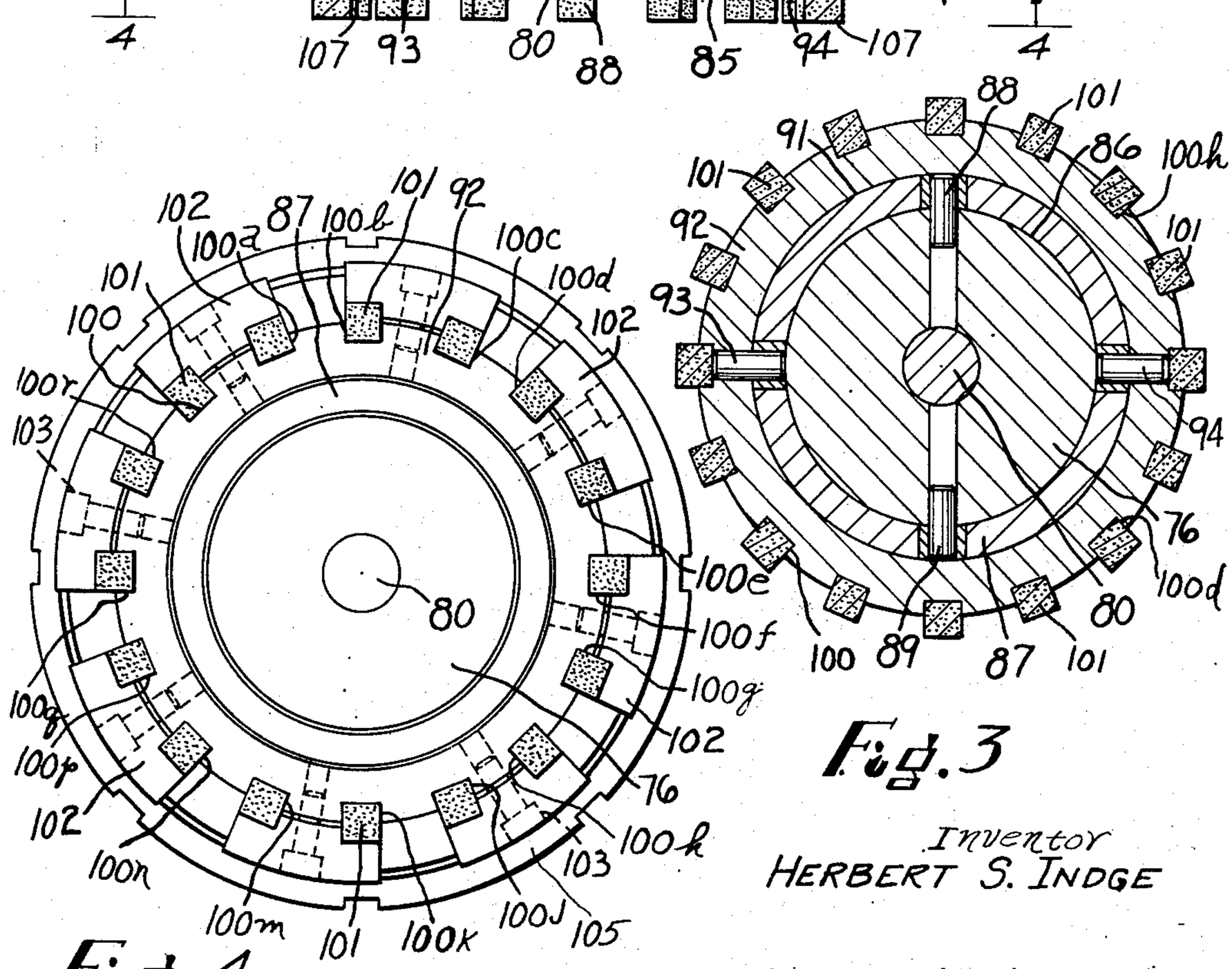


Fig. 3

Fig. 4

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Fig. 5

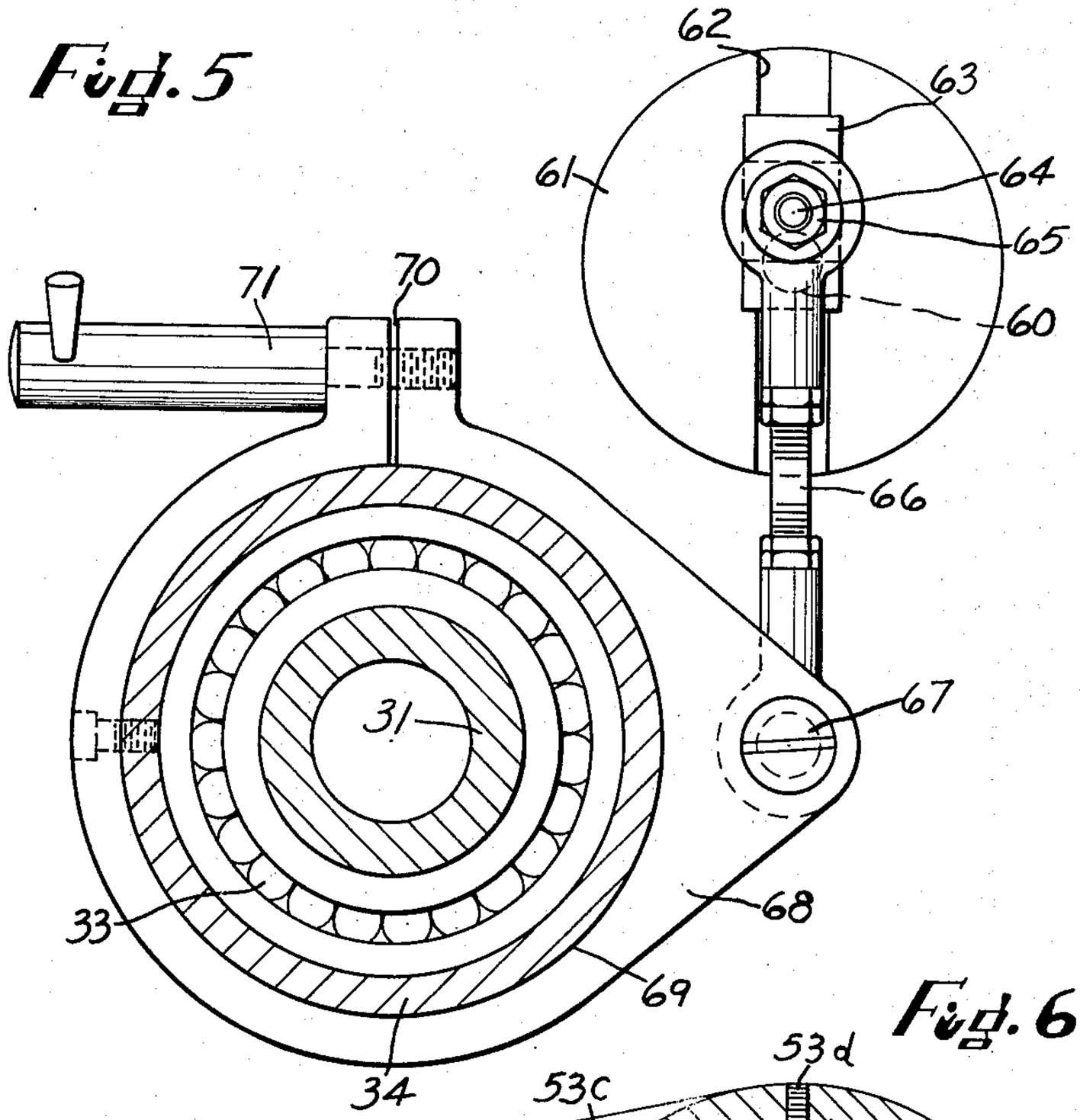
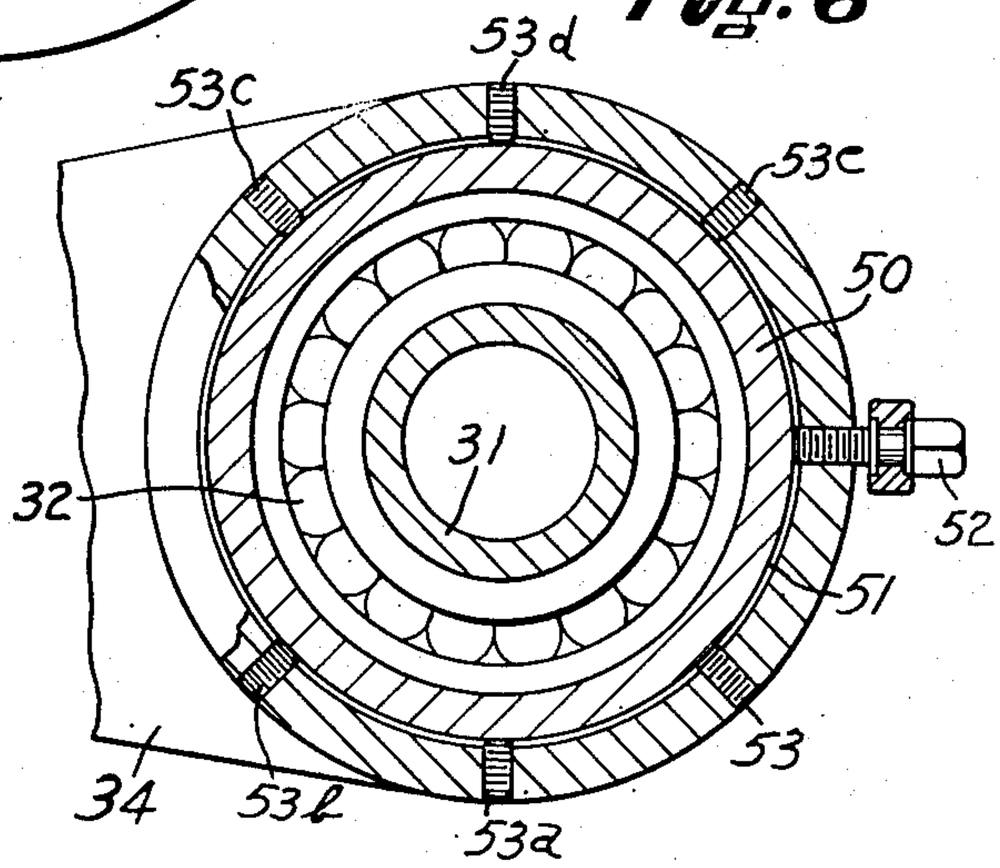


Fig. 6



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UNITED STATES PATENT OFFICE

2,659,185

HONING MACHINE

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Application June 29, 1951, Serial No. 234,285

3 Claims. (Cl. 51—55)

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The invention relates to honing machines and more particularly to a honing head for honing plane surfaces on a work piece.

One object of the invention is to provide a simple and thoroughly practical honing apparatus for precisely honing plane surfaces. Another object is to provide a yieldably mounted freely floating honing head. Another object is to provide a honing head which is provided with a universal driving connection having its pivotal axes lying in a plane located adjacent to the operative face of the hone so that pressure applied for the honing operation is uniformly distributed to the honing members. A further object is to provide a honing head having a plurality of spaced honing elements which are adjustably mounted on the head to facilitate compensation for wear so as to maintain the operative face of the hone in a predetermined relationship with respect to the axes of the universal driving connection. Other objects will be in part obvious or in part pointed out hereinafter.

One embodiment of the invention has been illustrated in the accompanying drawings, in which like reference numerals indicate like parts and wherein:

Fig. 1 is a vertical sectional view of a honing machine illustrating the improved floating honing head;

Fig. 2 is a vertical sectional view, on an enlarged scale, through the honing head;

Fig. 3 is a cross-sectional view, taken approximately on the line 3—3 of Fig. 2, through the honing head;

Fig. 4 is a bottom plan view, taken approximately on the line 4—4 of Fig. 2, of the honing head;

Fig. 5 is a fragmentary cross-sectional view, on an enlarged scale, taken approximately on the line 5—5 of Fig. 1, showing the mechanism for oscillating the honing head; and

Fig. 6 is a fragmentary cross-sectional view, on an enlarged scale, taken approximately on the line 6—6 of Fig. 1, through the adjusting mechanism for aligning the arm which supports the honing head.

A honing machine has been illustrated in the drawings comprising a base 10 which serves as a support for a rotatable work supporting platen 11. The platen 11 is supported by a spider 12 mounted on the upper end of a rotatable shaft 13. The shaft 13 is supported in anti-friction bearings 14 and 15 which are in turn supported in fixed relationship with the base 10.

A motor 16 is provided for imparting a rotary

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motion to the platen 11. The motor 16 is mounted on a motor supporting platen 17 which is pivotally mounted on a rock shaft 18 carried by the base 10. The motor 16 is provided with V-groove pulley 19 which is connected by a V-belt 20 with a V-groove pulley 21 which is mounted on the end of a rotatable shaft 22. The shaft 22 is provided with a worm 23 which meshes with a worm gear 24 mounted on the lower end of the shaft 13. It will be readily apparent from the foregoing disclosure that rotary motion of the pulley 19 will be imparted through the mechanism above described to impart a rotary motion to the platen 11 and to a work piece 25 mounted thereon, having a plane surface 26 to be honed.

The base 10 also serves as a support for a vertically arranged column 30 having a cylindrical portion 31 formed at its upper end. The cylindrical portion 31 serves as a support for a pair of spaced anti-friction bearings 32 and 33 which in turn support a horizontally extending arm 34.

The arm 34 supports a vertically arranged sleeve 35 which is slidably supported within a cylindrical aperture 36 formed in the arm 34. The sleeve 35 serves as a support for a rotatable spindle 37. The spindle 37 is preferably arranged with its axis of rotation parallel to the axis of rotation of the platen 11 and the work piece 25. A honing head 38, to be hereinafter described, is mounted on the lower end of the spindle 37.

A suitable driving mechanism is provided for the spindle 37 comprising an electric motor 39 which drives a conventional gear reducer unit 40. The gear reducer unit 40 is provided with a driven shaft 41 which supports a multiple V-groove pulley 42. The pulley 42 is connected by a V-belt 43 with a multiple V-groove pulley 44 mounted on a rotatable sleeve 45. The sleeve 45 is journalled in spaced anti-friction bearings 46 and 47. The bearings 46 and 47 are supported within a housing which is fixedly mounted on the arm 34. In order to facilitate tensioning the V-belt 43, the gear reducer unit 40 is mounted on a transversely arranged slide 48 which may be adjusted transversely relative to the column 30 by means of an adjusting screw 49. As illustrated in Fig. 1, the slide 48 is preferably supported on a flanged plate 50 carried by the bearing 32. In order to facilitate adjustment of the arm 34, a clearance is provided between the flanged plate and an internal cylindrical aperture 51 formed within the arm 34. An adjusting screw 52 is provided on the flanged plate 50 which serves to adjust the upper portion of the

arm **34** which is fulcrumed about the lower antifriction bearing **33** so that the honing supporting spindle **37** may be axially aligned with the axis of rotation of the work supporting platen **11**. A plurality of clamping screws **53**, **53***a*, **53***b*, **53***c*, **53***d*, **53***e* are provided to lock the arm **34** in the desired adjusted position.

In honing a plane surface such as surface **26** on a work piece **25**, it is desirable to provide not only a rotary motion of the hone **38** and the work platen **11** but also to provide an oscillation of the honing head **38** during the lapping operation. A suitable mechanism may be provided for oscillating the arm **34** which may comprise an electric motor **55** mounted on the base **10**. The motor **55** is provided with a V-groove pulley **56** which is connected by a V-belt **57** with a V-groove pulley **58** mounted on the drive shaft of a conventional gear reducer **59**. The gear reducer **59** is provided with a driven shaft **60** which supports a crank plate **61** having a diametrically arranged T-slot **62**. A slide block **63** is arranged to be adjusted transversely within the T-slot **62**. A clamping bolt **64** is provided to facilitate locking the slide block **63** in adjusted position by means of a nut **65**. The clamping bold **64** serves as a crankpin which is rotatably connected to one end of a connecting rod **66**. The other end of the connecting rod **66** is connected by a stud **67** with an arm **68**. The arm **68** is provided with an aperture **69** which mates with a correspondingly shaped surface on the arm **34**. The arm **68** is provided with a slot **70** and a binder screw **71** by means of which the arm **68** may be adjustably clamped to the arm **34**. It will be readily apparent from the foregoing disclosure that rotation of the pulley **56** caused by the motor **55** will be imparted to revolve the clamping bolt **64** to impart an oscillating motion to the arm **34**. The extent of oscillation may be varied by adjustment of the slide block **34** within the T-slot **62** of the crank plate **61**. If no oscillating motion of the arm **34** is desired, the slide block **63** may be adjusted so that the axis of the clamping bolt **64** is aligned with the axis of the shaft **60**. It will be readily apparent that the extent of oscillation of the arm **34** may be adjusted by shifting the slide block within the T-slot **62** to vary the eccentricity of the axis of the clamping bolt **64** relative to the shaft **60**.

The honing head **38** is preferably formed with a plurality of spaced honing elements in order to produce a highly efficient honing action upon the work surface **26** to be honed. The lower end of the spindle **37** is provided with a cylindrical portion **75** which slidably supports a cup-shaped sleeve **76**. A stud **77** having parallel slabbed off surfaces **78** is supported by the sleeve **76** and passes through an elongated slot **79** formed in the cylindrical portion **75** of the spindle **37**. The elongated slot **79** serves to facilitate motion of the honing head in an axial direction relative to the spindle **37**. The cup-shaped sleeve **76** is provided with a centrally located vertical stud **80** which supports the lower end of a compression spring **81**. The compression spring **81** serves to facilitate applying a predetermined honing pressure as will be hereinafter described.

It is desirable to provide a universal driving connection between the spindle **37** and the honing elements to be hereinafter described and to locate the universal driving connection as close to the operative face of the hone as practicable in order that the hone may be freely floating and that pressure applied thereto may be uniformly distributed to the entire operative honing face. The cup-shaped sleeve **76** is provided with a partial spherical surface **85** which fits within an internal cylindrical surface **86** formed in an annular ring **87**. The annular ring **87** is pivotally connected to the cup-shaped sleeve **76** by a pair of diametrically opposed studs **88** and **89** (Fig. 3). Similarly the annular ring **87** is provided with a partial spherical surface **90** which fits within an internal cylindrical surface **91** formed within a sleeve **92** which is concentric with but spaced from the sleeve **76**. The sleeve **92** is pivotally connected with the annular ring **87** by means of a pair of diametrically opposed pivot studs **93** and **94** which are arranged at 90° to the pivot studs **88** and **89**. It will be readily apparent that the pivot studs **88**—**89** and **93**—**94** are located in close proximity to the operative face of the honing elements to be hereinafter described and serve as a universal connection to allow the sleeve **92** to freely float relative to the spindle **37**.

The sleeve **92** is provided with a plurality of grooves **100**, **100***a*, **100***b*, **100***c*, **100***d*, **100***e*, **100***f*, **100***g*, **100***h*, **100***j*, **100***k*, **100***m*, **100***n*, **100***p*, **100***q* and **100***r* formed in the outer periphery thereof and arranged parallel to the axis of rotation of the spindle **37**. A plurality of elongated honing sticks **101** are mounted within the grooves **100**. Adjacent pairs of honing sticks **101** are clamped to the sleeve **92** by means of a clamping block **102** and a clamping screw **103** which is screw threaded into the sleeve **92**.

It is desirable to provide a suitable longitudinal adjustment for the honing sticks **101** to compensate for wear thereof during honing so as to maintain the operative honing face in close proximity to the pivotal axes of the universal driving connection. This mechanism may comprise a collar **105** which is threaded onto a threaded portion **106** formed on the outer periphery of the sleeve **92**. The collar **105** serves as an end thrust member for all of the honing sticks **101**. When it is desired to adjust the honing sticks **101**, the clamping screws **103** may be loosened and the collar **105** rotated to cause an endwise motion of the honing sticks **101** after which the clamping screws **103** may be tightened to clamp the honing sticks **101** in adjusted position. The lower faces **107** of the honing sticks **101** are arranged to lie in the same plane to form an operative honing surface.

The operation of this improved honing apparatus will be readily apparent from the foregoing disclosure. A work piece **25** having a surface **26** to be honed is mounted on the platen **11**, the electric motors **16**, **39** and **55** are then started, the sleeve **35** may then be lowered by means of a manually operable lever **108** which rotates a gear **109** meshing with a rack bar **110** to cause a downward motion of the sleeve **35** to move the honing surface **107** into operative engagement with the surface **26** to be honed. The work piece is rotated, the hone **38** rotated and the arm **34** oscillating through a stroke determined by the position of the clamping bolt **64** as above described. The downward movement of the sleeve **35** is continued until the spring **81** is compressed to give the desired honing pressure after which the sleeve **35** is locked in adjusted position by a binder bolt **111**. Due to the universal driving connection located adjacent to the honing faces **107**, a uniform honing pressure will be applied to the entire operative face of the hone **38**.

It will thus be seen that there has been provided by this invention apparatus in which the

various objects hereinabove set forth together with many thoroughly practical advantages are successfully achieved. As many possible embodiments may be made of the above invention and as many changes might be made in the embodiment above set forth, it is to be understood that all matter hereinbefore set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

I claim:

1. In a honing machine having a rotatable spindle and a honing head thereon including a slidably mounted sleeve on said spindle, driving connections between the spindle and sleeve including an elongated slot in said spindle and a drive pin on said sleeve passing through said slot, an outer sleeve surrounding said first sleeve which is concentric with and spaced therefrom, a plurality of spaced grooves formed in the outer periphery of the outer sleeve, a honing element adjustably clamped in each of said grooves, the ends of said elements forming a plane honing face, yieldable means interposed between the spindle and inner sleeve to facilitate an axial yielding movement of the sleeve and honing head, and a universal driving connection between the lower ends of said sleeves to facilitate equalizing the pressure applied to said honing face.

2. In a honing machine having a rotatable spindle and a honing head thereon comprising a slidably mounted sleeve on said spindle, an outer sleeve surrounding said first sleeve which is concentric with and spaced therefrom, a plurality of spaced honing elements adjustably clamped on the outer periphery of said outer sleeve, the ends of said elements forming a plane honing face, a universal driving connection between the lower ends of said sleeves to facilitate equalizing pressure applied to said honing face, and an adjustable collar threaded onto the outer periphery of said outer sleeve which serves as an end thrust member for said honing elements and also to facilitate endwise adjustment thereof to compensate for wear so as to maintain the honing elements in a predetermined relationship with the pivots of said universal driving connections.

3. In a honing machine having a rotatable spindle and a honing head thereon including a slidably mounted sleeve on said spindle, yieldable connections between said spindle and sleeve to facilitate an axial yielding movement of said sleeve an outer sleeve surrounding said first sleeve which is concentric with and spaced therefrom, a plurality of spaced honing elements adjustably clamped on the outer periphery of the outer sleeve, the ends of the said elements form a plane honing surface and universal driving connections between the lower ends of the said sleeves comprising an annular ring interposed between the lower ends of the said sleeves, a partial spherical surface formed on the lower end of the inner sleeve which fits within an internal cylindrical surface within said ring, a pair of diametrically opposed aligned studs interposed between the lower ends of the said inner sleeve and said ring, a partial spherical surface on the outer periphery of said ring which mates with an internal cylindrical surface formed within said member, and a pair of diametrically opposed aligned studs arranged at right angles to said first studs and interposed between said ring and the lower end of said outer sleeve to facilitate self-alignment of the honing face.

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References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
344,919	Otis	July 6, 1886
1,180,260	Grice	Apr. 18, 1916
1,520,662	Maynard et al.	Dec. 23, 1924
1,955,362	Floss	Apr. 7, 1934
2,136,036	Avery	Nov. 8, 1938
2,160,494	Floss	May 30, 1939
2,195,065	Wallace	Mar. 26, 1940
2,272,974	Indge	Feb. 10, 1942
2,284,056	Indge	May 26, 1942
2,307,632	Meyer	Jan. 5, 1943
2,331,523	Wacker	Oct. 12, 1943