

April 9, 1935.

L. S. CASTONGUAY

1,996,903

POLISHING MACHINE

Original Filed May 4, 1932 3 Sheets-Sheet 1

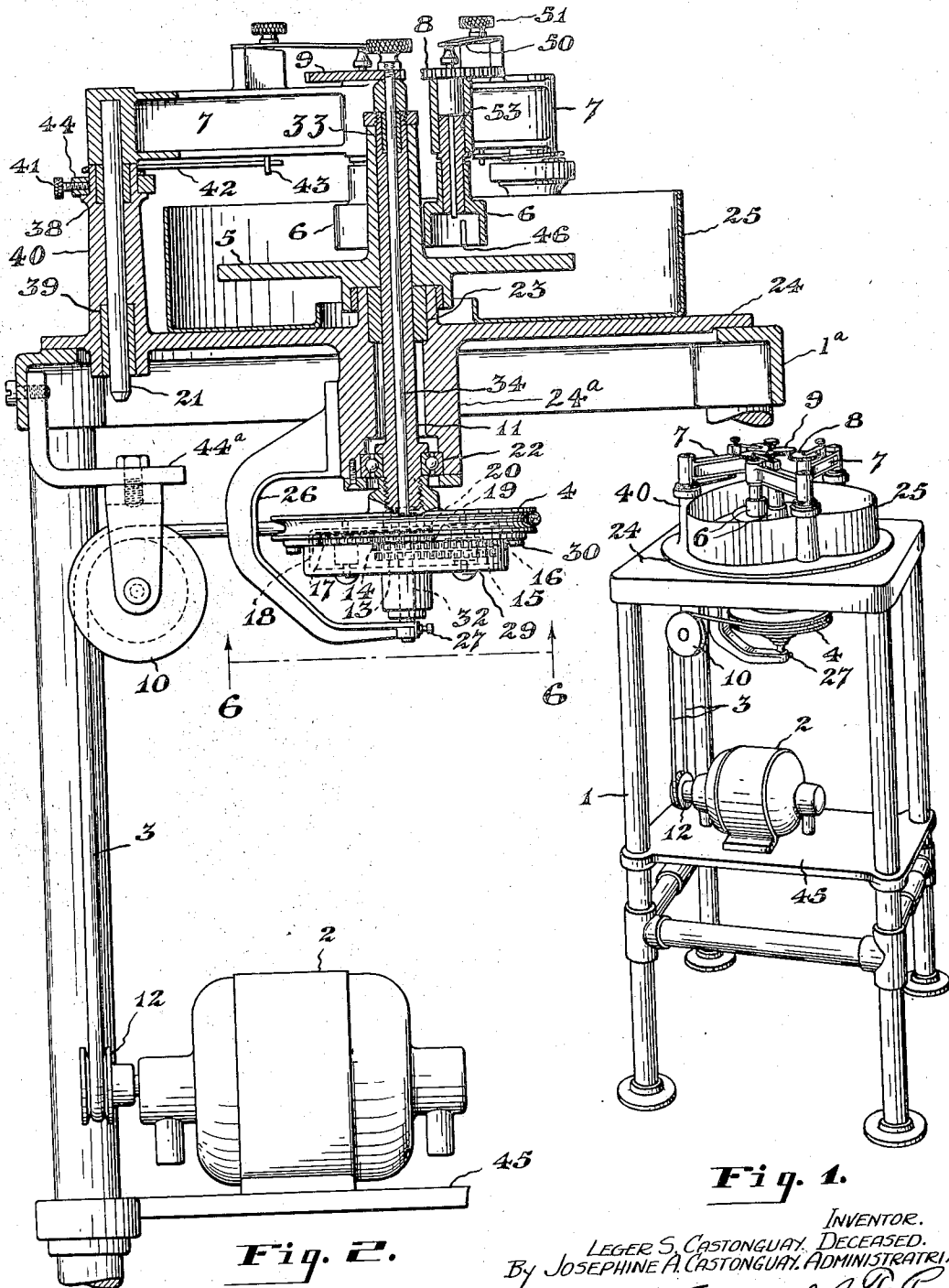


Fig. 1.

Fig. 2.

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Original Filed May 4, 1932 3 Sheets-Sheet 2

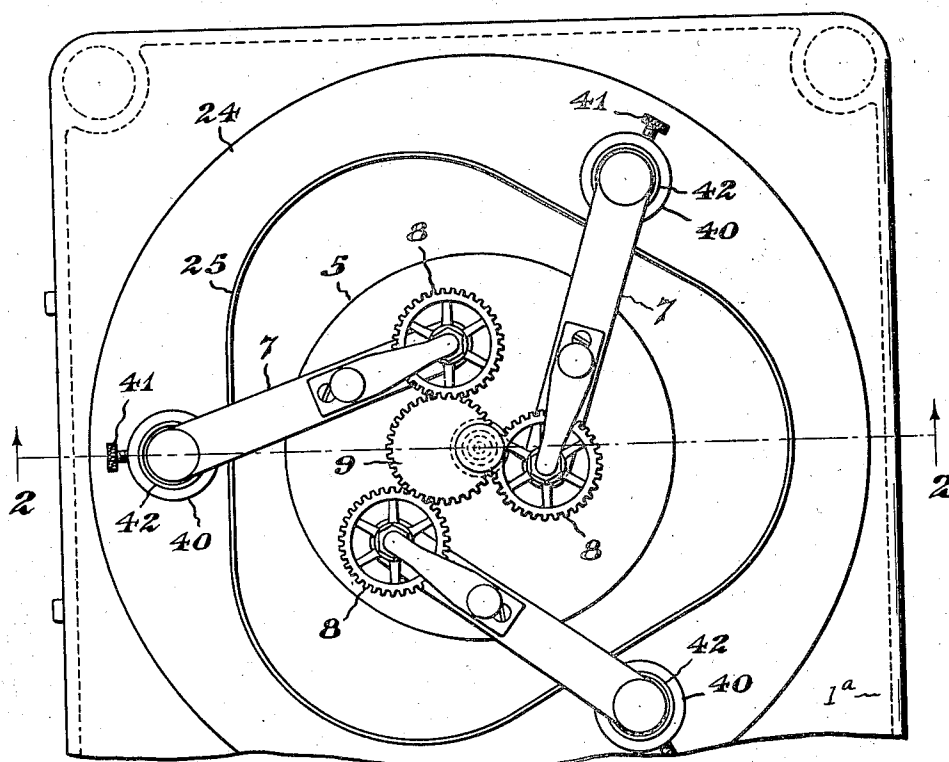


Fig. 3.

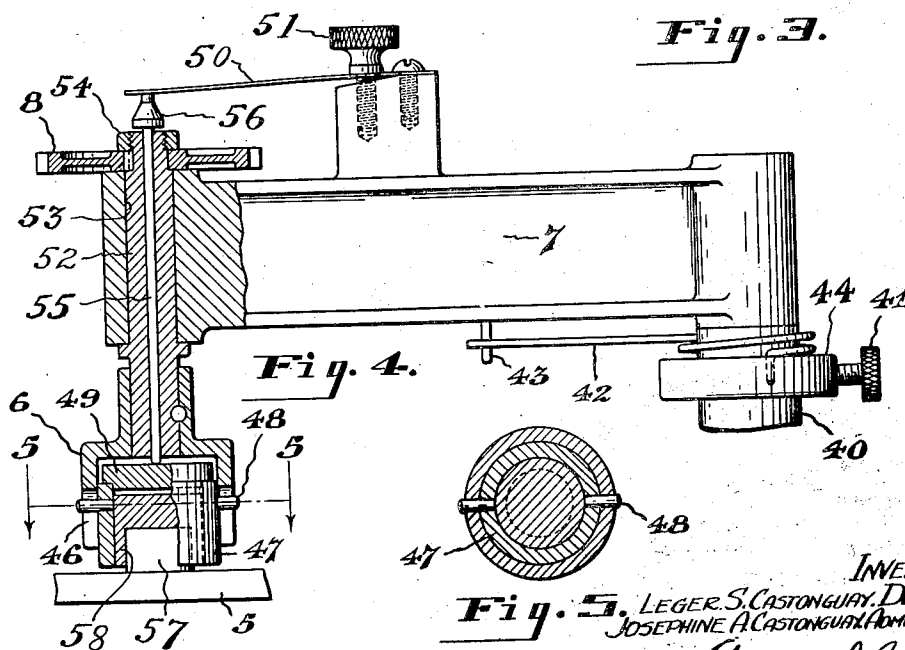


Fig.

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Original Filed May 4, 1932 3 Sheets-Sheet 3

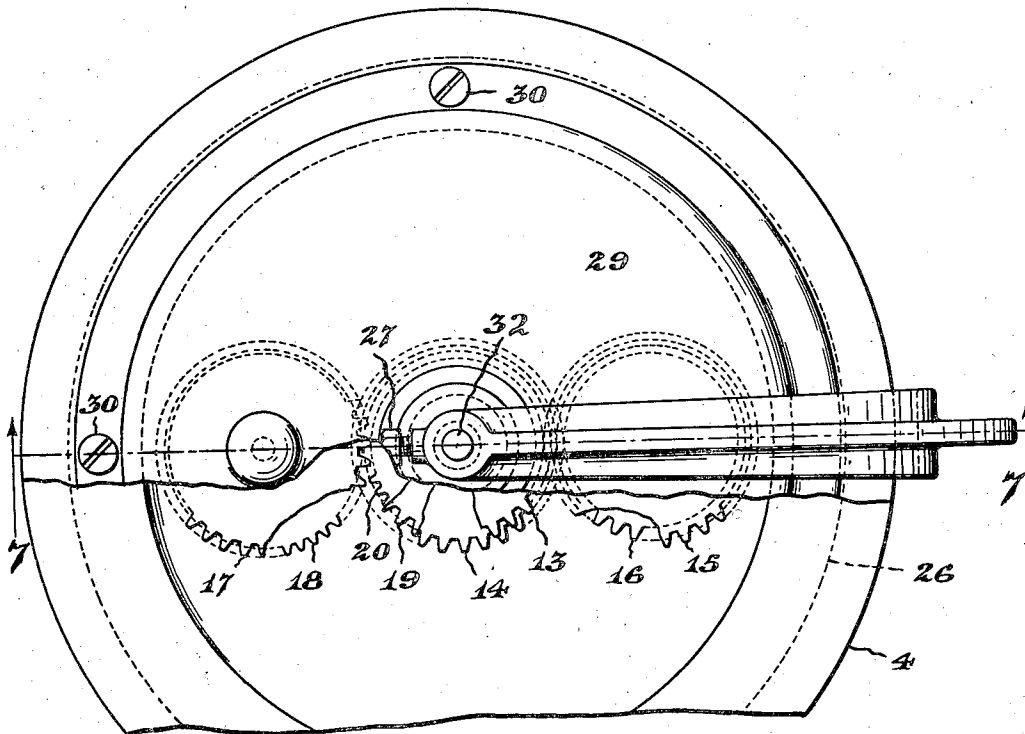


Fig. 6.

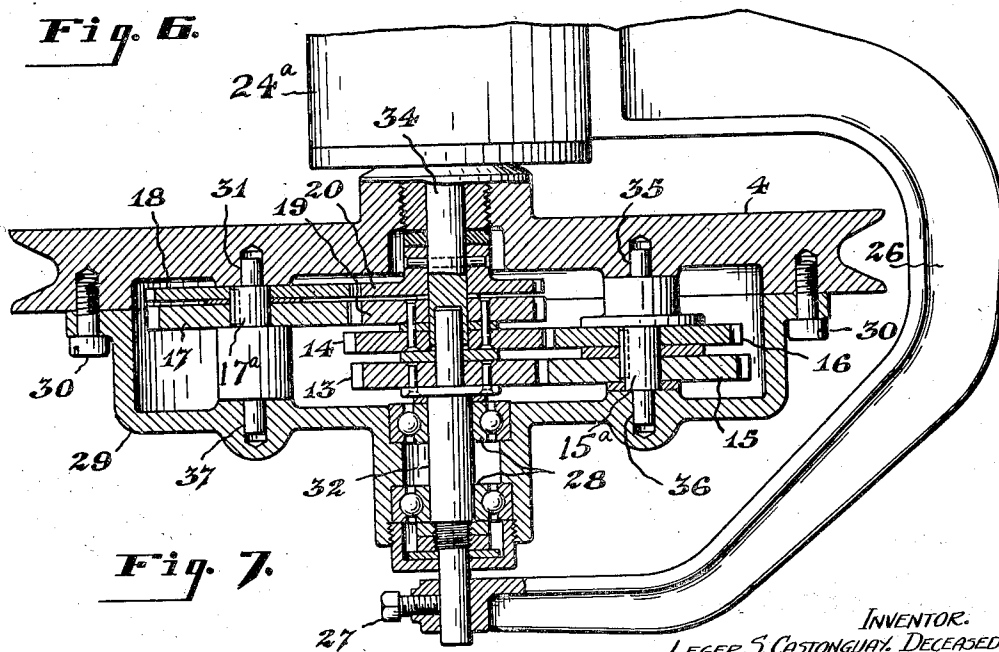


Fig. 7.

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1,996,903

POLISHING MACHINE

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Application May 4, 1932, Serial No. 609,214

Renewed August 23, 1934

24 Claims. (Cl. 51—124)

This invention relates to automatic polishing machines and in particular polishing machines for the preparation of specimens of microscopic study.

5 It is the object of this invention to provide a polishing machine for the preparation of plane polished specimens for microscopic study which produces uniformly a high quality of product without requiring any peculiar skill or experience
10 on the part of the operator.

The machine consists essentially of a horizontal polishing disc mounted on a duraluminum casting which has been heat treated. This casting is attached rigidly to a cast iron table to prevent
15 any possibility of distortion. The polishing disc is belt driven by means of a one-fourth horse power motor and rotates at four hundred revolutions per minute.

Passing vertically through the shaft carrying
20 the polishing disc is a second spindle to which is attached an eccentric gear. This eccentric gear drives the specimen holders, of which there are three, in such a way that the specimen is slowly moved back and forth along the radius of the
25 rotating disc.

At the same time the specimen is slowly rotated so that the direction in which it is polished is continually changed. The gear reduction for the rotating of the specimen is accomplished by a
30 train of gears contained in a gear box located directly beneath the main drive pulley. The reduction ratio of the gearing is one hundred to one so that the specimen and its holder rotates at the rate of four revolutions per minute. This rotating
35 movement of the specimen prevents pitting and the formation of "comet tails" at inclusions of foreign materials in the specimen.

The specimen holders will accommodate specimens up to one inch in diameter and one inch
40 high. The ring in which the specimen is mounted fits into a sleeve mounted on an arm of the machine. A tension spring holds the gear of each arm in contact with the central eccentric gear. One, two, or three specimens can be polished at
45 the same time. The arms can also be disengaged while the machine is in operation.

The specimen holder containing the specimen is held positively in its sleeve with just enough
50 clearance so that the weight of the specimen will bring it in contact with the polishing disc. The tolerance, however, is so close that there is no appreciable play between the specimen holder and sleeve.

As a general rule, the weight of the mounted
55 specimen is sufficient to provide the necessary

pressure between the specimens and the polishing disc. If desired, additional pressure can be applied to the specimen by adjusting the thumb screw and thus increasing the tension of the flat
5 spring which is located on top of the specimen carrying arm. The additional pressure is transmitted to the specimen from the spring by means of a pin which extends through the shaft carrying
10 the specimen holder sleeve and which rests on a disc placed on top of the specimen ring.

With these and other objects in view, the invention consists in the novel construction, arrangement and combination of parts, hereinafter described, illustrated in some of its embodiments
15 in the accompanying drawings and particularly pointed out in the appended claims.

Referring to the drawings, Figure 1 is a perspective view of my improved polishing machine.

Figure 2 is a sectional view taken on line 2—2,
20 Figure 3.

Figure 3 is an enlarged plan view of the top of the machine.

Figure 4 is an enlarged side elevational view, partly in section, of one of the specimen holders
25 of the machine.

Figure 5 is a sectional view taken on line 5—5.
Figure 4.

Figure 6 is an enlarged plan view of the speed reducing gear train, taken on line 6—6, Figure 2, with certain of the parts broken away for convenience in illustrating the details of this part of
30 the mechanism.

Figure 7 is a sectional view, taken on line 7—7,
Figure 6.

This improved polishing machine comprises a
35 stand or frame 1, having a motor 2, carried on a platform 45, which is secured to the frame at a point intermediate its height. A belt 3, connects the motor pulley 12 in driving relation with a pulley 4, which is connected by a hollow
40 shaft 11 for rotation with the polishing disc 5. A pair of guide pulleys 10 are interposed between the pulleys 4 and 12. The guide pulleys 10 are carried by a supporting arm 44a which in turn
45 is secured to a top plate 1a.

Three specimen holders 6 are carried on pivotally mounted arms 7 above the disc 5. The arms 7 are provided with gears 8, which are connected in driving relation with the specimen
50 holders. The gears 8 engage an eccentrically secured gear 9, which is revolved by the motor 2 so that in the operation of the machine, the specimen carried by the specimen holder 6, is rotated and at the same time it is moved back and forth
55

across the face of the polishing disc 5 in a substantially radial direction.

The pulley 4 and the polishing disc 5 are rigidly secured to each other by means of a tubular shaft 11. The pulley 4 is somewhat larger than the motor pulley 12 and the disc 5 is thereby driven at a slower speed than that at which the motor 2 operates. The guide pulleys 10 are carried by a supporting arm 44a which in turn is secured to top plate 1a.

The eccentric gear 9 is driven by the motor 2 at a relatively slow speed as compared with the speed of the disc 5. A planetary speed reduction gearing comprising the gears 13, 14, 15, 16, 17, 18, 19 and 20 is used to reduce the motor speed down to a suitable speed for driving the eccentric gear 9.

The planetary gears are inclosed within a two-piece housing which is formed in part by the pulley 4 and the casing 29. The pulley 4 and casing 29 are secured to each other by the cap screws 30. The upper end of the gear housing is journaled in anti-friction bearings 22 and at its lower end it is journaled in anti-friction bearings 28. The bearings 28 are carried on a fixed shaft 32 which is rigidly secured to a support arm 26 by means of the set screw 27. The arm 26 is rigid with the downwardly extending hub-part 24a of the bed plate 24. A bushing 23 is carried in the upper end of the hub-part to provide a bearing for the hollow shaft 11.

The gear 13 is fixedly secured to the shaft 32. The gears 15 and 16 are keyed to a shaft 15a which is journaled for rotation in the housing bearings 35 and 36. The larger of these two gears meshes with the stationary gear 13 while the smaller gear 16 meshes with the gear 14 which is secured in axial alignment to the gear 19.

The gears 14 and 19 are journaled for rotation on the lower end of the shaft 34. The pair of gears 17 and 18 are keyed to a shaft 17a, which is mounted for rotation in the housing bearings 31 and 37. The gear 17 meshes with the gear 19 and the gear 18 meshes with the gear 20, which is pinned to the shaft 34.

The specifications for the gears are as follows: Gear 13, twenty-four pitch, forty-eight teeth. Gear 14, thirty-two pitch, sixty-five teeth. Gear 15, twenty-four pitch, forty-eight teeth. Gear 16, thirty-two pitch, sixty-three teeth. Gear 17, thirty-two pitch, sixty-four teeth. Gear 18, forty-eight pitch, ninety-four teeth. Gear 20, forty-eight pitch, ninety-eight teeth.

From the foregoing, it is apparent that when the pulley 4 is rotated, the gears 15, 16, 17 and 18, roll around the gears 13, 14, 19 and 20, and that by the use of different size gears, the gear 20 and its shaft 34 are driven at a greatly reduced speed as compared with the speed of rotation of the gear housing or the disc 5 which rotates with it.

In the present case, the gear reduction is one hundred to one; that is for every hundred revolutions of the pulley 4, the shaft 34 makes one revolution. It will thus be seen that when the motor is started, the pulley 4 and the polishing disc 5 are directly driven by the motor 2 at a relatively high speed, while the shaft 34 and the eccentric gear 9 are driven at a relatively slow speed. The gear 9 is eccentric to its shaft and its engagement with the gears 8, which are carried by the arms 7, causes the rotation of these gears and the specimen holders 6 and at the same time moves the arms toward and away

from the center of the polishing disc with an oscillating motion.

The arms 7 are secured at their outer ends to shafts 21, which are journaled in the bushings 38 and 39. These bushings are carried in standards 40, which are integrally formed with the bed plate 24. The shafts 21 are so arranged that they may be readily removed from their bearings by simply raising the arm 7. The arms 7 and gears 8 are held against the eccentric gear 9 by the torsion springs 42. One end of the spring 42 engages a pin 43, carried by the arm 7, while the other end of the spring engages the adjustable collar 44 by means of which the tension of the spring may be adjusted. A thumb screw 41 is provided to hold the collar 44 in its adjusted position.

An important feature of my invention is the driving mechanism of the disc 5 and eccentric gear 9. As previously stated, the hollow shaft 11 is journaled in a lower anti-friction bearing 22 and an upper plain bearing 23. The shaft 34 is closely fitted within the hollow shaft 11, which at its upper end is provided with a bushing 33. The shaft 11 is fitted with the type of bearing shown so as to introduce a slight amount of friction at this point in order to take up the backlash of the reduction gears so that the arms 7 and the specimen holders 6 are operated smoothly and steadily.

Another important feature of this invention is that of providing suitable mechanism for retaining the specimen at all times in proper relation with respect to the polishing disc 5. In accomplishing this object, the specimen holding cup 6 of the device, is rigidly secured to a hollow shaft 52, which is journaled in a sleeve 53, formed in the inner end of the arm 7. The gear 8 is keyed to the shaft 52 and securely held thereon, by means of the nut 54. A pin 55 extends through the hollow shaft 52 and at its upper end it terminates at a point above the gear 8, and at its lower end it terminates at a point just inside of the cup 6. The pin 55 is engaged by a flat spring 50, which is carried by the arm 7. The tension the spring 50 exerts on the pin 55 may be adjusted from zero to maximum by means of a thumb screw 51. A collar 56 is carried on the pin 55 at a point adjacent to its upper end for the purpose of limiting its downward movement.

The cup 6 is vertically slotted at 46 for receiving the pins 48 of the hollow cylinder or ring 47, in which a specimen 57 is mounted by means of wax or any other suitable medium 58. The top of the ring 47 is fitted with a cover plate 49, which is engaged by the pin 55 for the purpose of holding the specimen 57 in contact with the polishing disc 5.

The cylinder 47 is very closely, yet freely fitted in the cup 6, so that it may be easily moved to take up the wear of the specimen and at the same time hold the surface of the specimen in the plane of the polishing disc. A guard 25 is provided to catch the abrasive and polishing materials which are thrown off of the disc 5 during the operation of the machine.

The use of tools is not necessary in setting up my machine for operation, or in changing specimens. This operation is readily accomplished by simply removing the arms 7 whereupon the cylinders 47 and the specimens which they hold can be easily inserted or removed. The speed of grinding or polishing can be readily changed by adjusting the tension on the springs 50. In many cases, the weight of elements supported by speci-

mens, provides sufficient pressure between the disc and the specimen.

In most cases, the initial work is performed on the specimen with a certain amount of spring tension and during the finishing polishing operation, the weight of the specimen and its holder is used to provide the contact pressure between the specimen and the plate 5.

These operations can be carried out without any attention on the part of the operator. The specimen is set in its holder so that at the start of the operation, there is a slight amount of clearance between the collar 56 and the top of the hollow shaft 52. This clearance determines the amount of material which is ground off the specimen at high speed by reason of the tension of the spring 50. When the collar engages the shaft 52 the tension of the spring no longer affects the specimen and the finishing pressure is reduced to the weight of the specimen of its holder. In this manner the specimens are quickly ground and polished to plane and highly polished surface without any particular attention or skill on the part of the operator.

Furthermore, it is to be understood that the particular forms of apparatus shown and described, and the particular procedure set forth, are presented for purposes of explanation and illustration and that various modifications of said apparatus and procedure can be made without departing from this invention as defined in the appended claims.

Having thus described this invention, what is claimed is:

1. In a grinding and polishing machine, in combination, a support, a disc mounted for rotation in said support, a specimen holder pivotally mounted on said support in operative relation with said disc a gear casing, a tubular shaft connecting said gear casing with said disc, means for rotating said gear casing, a second shaft in said tubular shaft, means connecting said specimen holder and second shaft in driving relation, and means in said gear casing for driving said second shaft.

2. In a grinding and polishing machine, in combination, a support, a disc mounted for rotation in said support, a specimen holder pivotally mounted on said support in operative relation with said disc, a gear casing, a tubular shaft connecting said gear casing with said disc, means for rotating said gear casing, a second shaft in said tubular shaft, means connecting said specimen holder and second shaft in driving relation, and means in said gear casing for driving said second shaft at a different speed than that of said casing and tubular shaft.

3. In a grinding and polishing machine, in combination, a support, a disc mounted for rotation in said support, a specimen holder pivotally mounted on said support in operative relation with said disc, a gear casing, a tubular shaft connecting said gear casing with said disc, means for rotating said gear casing, a second shaft in said tubular shaft, means connecting said specimen holder and second shaft in driving relation, and means in said gear casing for driving said second shaft at a slower speed than that of said tubular shaft.

4. In a grinding and polishing machine, in combination, a support, a disc mounted for rotation in said support, a specimen holder pivotally mounted on said support in operative relation with said disc, a gear casing, a tubular shaft

connecting said gear casing with said disc, means for rotating said gear casing, a second shaft in said tubular shaft, means connecting said specimen holder and second shaft in driving relation, and speed reducing gearing in said casing for driving said second shaft at a slower speed than that of said tubular shaft.

5. In a grinding and polishing machine, in combination a support, a disc mounted for rotation in said support, a specimen holder pivotally mounted on said support in operative relation with said disc, a gear casing, a tubular shaft connecting said gear casing with said disc, means for rotating said gear casing, a second shaft in said tubular shaft, means connecting said specimen holder and second shaft in driving relation, and planetary gearing in said casing for driving said second shaft at a slower speed than that of said tubular shaft.

6. In a grinding and polishing machine, in combination, a support, a disc mounted for rotation in said support, an arm pivotally mounted on said support for movement about a vertical axis, specimen holder journaled for rotation about a vertical axis in said arm, a gear casing, a tubular shaft connecting said gear casing with said disc, means for rotating said gear casing, a second shaft in said tubular shaft, means connecting said specimen holder and said second shaft in driving relation, and means in said gear casing for driving said second shaft.

7. In a grinding and polishing machine, in combination, a support, a disc mounted for rotation in said support, an arm pivotally mounted on said support for movement about a vertical axis, specimen holder journaled for rotation about a vertical axis in said arm, a gear casing, a tubular shaft connecting said gear casing with said disc, means for rotating said gear casing, a second shaft in said tubular shaft, means connecting said specimen holder and said second shaft in driving relation, and means in said gear casing for driving said second shaft at a slower speed than that of said tubular shaft.

8. In a grinding and polishing machine, in combination, a support, a disc mounted for rotation in said support, an arm pivotally mounted on said support for movement about a vertical axis, specimen holder journaled for rotation about a vertical axis in said arm, a gear casing, a tubular shaft connecting said gear casing with said disc, means for rotating said gear casing, a second shaft in said tubular shaft, means connecting said specimen holder and said second shaft in driving relation, and planetary gearing in said casing for driving said second shaft at a slower speed than that of said tubular shaft.

9. In a grinding and polishing machine, in combination, a support, a disc mounted for rotation in said support, an arm pivotally mounted on said support for movement about a vertical axis, specimen holder journaled for rotation about a vertical axis in said arm, a gear casing, a tubular shaft connecting said gear casing with said disc, means for rotating said gear casing, a second shaft in said tubular shaft, an eccentrically located gear secured to said second shaft, a gear secured for rotation with said specimen holder meshing with said eccentrically located gear, means connecting said specimen holder and said second shaft in driving relation, and means in said gear casing for driving said second shaft.

10. In a grinding and polishing machine, in combination, a support, a disc mounted for rotation in said support, an arm pivotally mounted

on said support for movement about a vertical axis, specimen holder journaled for rotation about a vertical axis in said arm, a gear casing, a tubular shaft connecting said gear casing, a
5 second shaft in said tubular shaft, an eccentrically located gear secured to said second shaft, a gear secured for rotation with said specimen holder meshing with said eccentrically located gear, means connecting said specimen holder and
10 said second shaft in driving relation, and means in said gear casing for driving said second shaft at a slower speed than that of said tubular shaft.

11. In a grinding and polishing machine, in combination, a support, a disc mounted for rotation in said support, an arm pivotally mounted on said support for movement about a vertical axis, specimen holder journaled for rotation about a vertical axis in said arm, a gear casing, a tubular shaft connecting said gear casing with said disc, a second shaft in said tubular shaft, means for rotating said gear casing, an eccentrically located gear secured to said second shaft, a gear secured for rotation with said specimen holder meshing with said eccentrically located gear, means connecting said specimen holder and said second shaft in driving relation, and means in said gear casing for driving said second shaft.

12. In a grinding and polishing machine, in combination, a support, a disc mounted for rotation in said support, an arm pivotally mounted on said support for movement about a vertical axis, a specimen holder journaled for rotation about a vertical axis in said arm for holding a specimen in contact with said disc, a gear casing, a tubular shaft connecting said gear casing with said disc, a second shaft in said tubular shaft, means connecting the second shaft and specimen holder in driving relation, means for automatically decreasing the pressure of contact between the specimen and said disc after a certain amount of material has been ground off the specimen, and means in said gear casing for driving said second shaft.

13. In a grinding and polishing machine, in combination, a support, a disc mounted for rotation in said support, an arm pivotally mounted on said support for movement about a vertical axis, a specimen holder journaled for rotation about a vertical axis in said arm for holding a specimen in contact with said disc, a gear casing, a tubular shaft connecting said gear casing with said disc, means for rotating said gear casing, a second shaft in said tubular shaft, means connecting the second shaft and specimen holder in driving relation, adjustable means for varying the pressure of contact between the specimen and said disc, and means in said gear casing for driving said second shaft at a slower speed than that of said tubular shaft.

60 14. In a grinding and polishing machine, in
combination, a support, a disc mounted for rota-
tion in said support, an arm pivotally mounted on
said support for movement about a vertical axis,
a specimen holder journaled for rotation about
65 a vertical axis in said arm for holding a spec-
imen in contact with said disc, a gear casing, a
tubular shaft connecting said gear casing with
said disc, means for rotating said gear casing, a
second shaft in said tubular shaft, means connect-
70 ing the second shaft and specimen holder in
driving relation, adjustable means for varying the
pressure of contact between the specimen and
said disc, and planetary gearing in said casing
for driving said second shaft at a slower speed
75 than that of said tubular shaft.

15. In a grinding and polishing machine, in combination, a support, a disc mounted for rotation in said support, an arm removably and pivotally mounted on said support for movement about a vertical axis, a specimen holder journaled for rotation about a vertical axis in said arm, a gear casing, a tubular shaft connecting said gear casing with said disc, means for rotating said gear casing, a second shaft in said tubular shaft, means connecting said specimen holder and said second shaft in driving relation, and means in said gear casing for driving said second shaft.

16. In a grinding and polishing machine, in combination, a support, a disc mounted for rotation in said support, an arm removably and pivotally mounted on said support for movement about a vertical axis, a specimen holder journaled for rotation about a vertical axis in said arm, a gear casing, a tubular shaft connecting said gear casing with said disc, means for rotating said gear casing, a second shaft in said tubular shaft, means connecting said specimen holder and said second shaft in driving relation, and means in said gear casing for driving said second shaft at a slower speed than that of said tubular shaft.

17. In a grinding and polishing machine, in combination, a support, a disc mounted for rotation in said support, an arm removably and pivotally mounted on said support for movement about a vertical axis, a specimen holder journaled for rotation about a vertical axis in said arm, a gear casing, a tubular shaft connecting said gear casing with said disc, means for rotating said gear casing, a second shaft in said tubular shaft, means connecting said specimen holder and said second shaft in driving relation, and planetary gearing in said casing for driving said second shaft at a slower speed than that of said tubular shaft.

18. In a grinding and polishing machine, in combination, a support, a disc mounted for rotation in said support, an arm removably and pivotally mounted on said support for movement about a vertical axis, a specimen holder journaled for rotation about a vertical axis in said arm, means for mounting a specimen removably fitted in said specimen holder, a gear casing, a tubular shaft connecting said gear casing with said disc, means for rotating said gear casing, a second shaft in said tubular shaft, means connecting said specimen holder and said second shaft in driving relation, and means in said gear casing for driving said second shaft.

19. In a grinding and polishing machine, in combination, a support, a disc mounted for rotation in said support; an arm removably and pivotally mounted on said support for movement about a vertical axis, a specimen holder journaled for rotation about a vertical axis in said arm, means for mounting a specimen removably fitted in said specimen holder, a gear casing, a tubular shaft connecting said gear casing with said disc, means for rotating said gear casing, a second shaft in said tubular shaft, means connecting said specimen holder and said second shaft in driving relation, and means in said gear casing for driving said second shaft at a slower speed than that of said tubular shaft.

20. In a grinding and polishing machine, in combination, a support, a disc mounted for rotation in said support, an arm removably and pivotally mounted on said support for movement about a vertical axis, a specimen holder jour-

naled for rotation about a vertical axis in said arm, means for mounting a specimen removably fitted in said specimen holder, a gear casing, a tubular shaft connecting said gear casing with
 5 said disc, means for rotating said gear casing, a second shaft in said tubular shaft, means connecting said specimen holder and said second shaft in driving relation, and planetary gearing in said casing for driving said second shaft at
 10 a slower speed than that of said tubular shaft.

21. A sample support including an arm, a shaft rotatably mounted thereon, a holder slidably connected with said shaft, a spring element rigid with the arm and extending over the end of the
 15 shaft, and means to transmit the force of the spring to the holder to urge it in one direction axially of the shaft while the same is in motion.

22. A device as in claim 21, and means to adjust the tension of the spring.

23. A sample support including an arm, a hollow shaft rotatably mounted thereon, a holder slidably connected with said shaft, a spring device secured to the arm and overlying the end
 5 of the shaft, a pin slidable in the shaft and abutting the holder and the spring whereby to transmit the force of the spring to the holder.

24. A sample support including an arm, a shaft rotatably mounted therein, a holder slidably connected with said shaft, a tension element mounted
 10 at one end of said arm, means connecting the other end of said tension element with said holder, and an adjustable fulcrum for varying the tension of said element on said connecting element.
 15

JOSEPHINE A. CASTONGUAY,
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