S. D. OLSEN.

GRINDING MACHINE.

APPLICATION FILED SEPT. 1, 1910.

1,023,389.

Patented Apr. 16, 1912.

18 SHEETS—SHEET 1

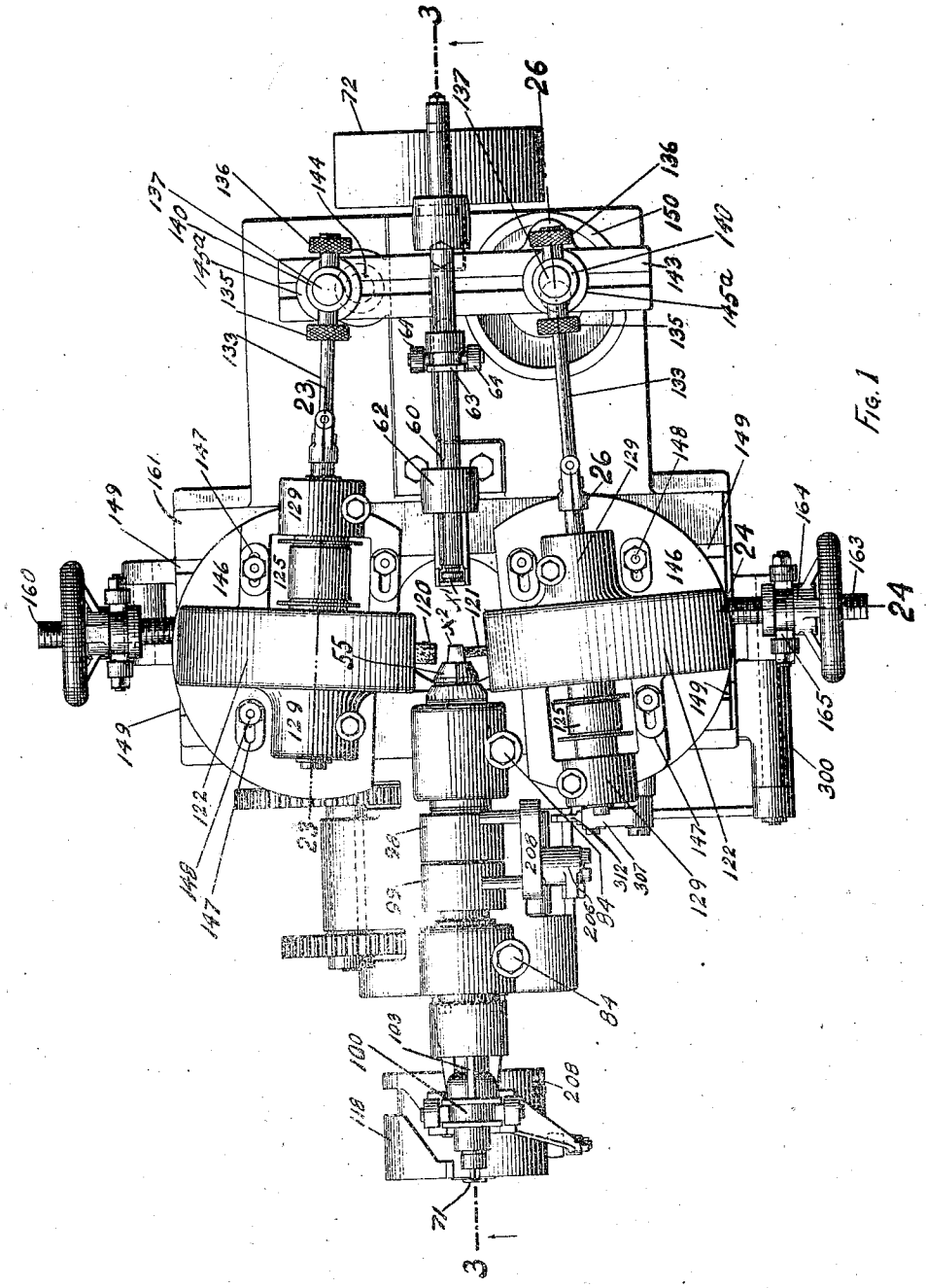


FIG. 1

Witnesses

F. E. Nares.

Edward L. Bleck

Inventor

Silvia Adolph Olsen

By his Attorney

Ernest L. Bleck

S. D. OLSEN.

GRINDING MACHINE.

APPLICATION FILED SEPT. 1, 1910.

Patented Apr. 16, 1912.

1,023,389.

18 SHEETS—SHEET 2.

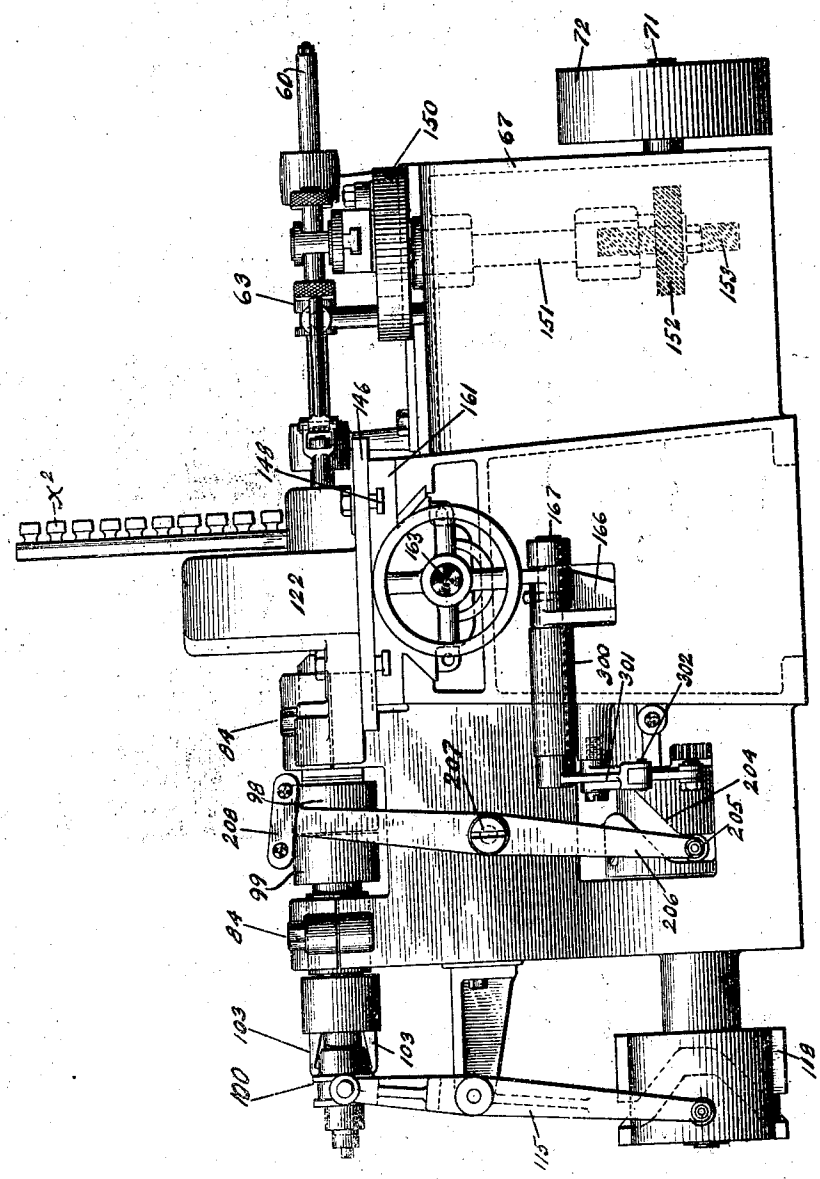


Fig. 2

Witnesses

F. E. Nave

Edward L. Reach

Inventor

Silvia Dopp Olsen

By his Attorneys

Edward L. Reach

S. D. OLSEN.

GRINDING MACHINE.

APPLICATION FILED SEPT. 1, 1910.

Patented Apr. 16, 1912.

1,023,389.

18 SHEETS—SHEET 3.

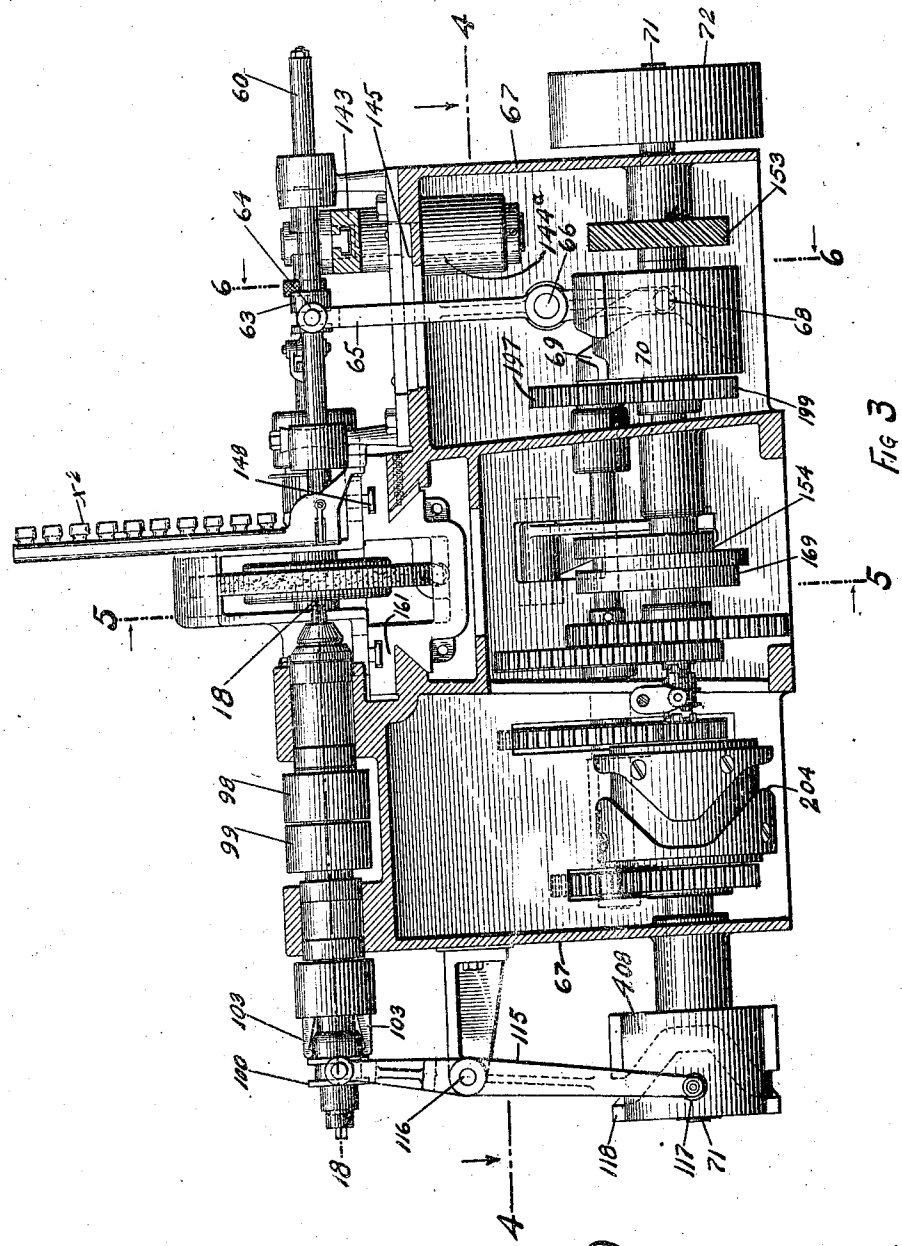


FIG 3

Witnesses:
F. L. Nares
Edward B. Black

Inventor
Sylvia D. Olsen
By his Attorneys
Edward B. Black

S. D. OLSEN.

GRINDING MACHINE.

APPLICATION FILED SEPT. 1, 1910.

1,023,389.

Patented Apr. 16, 1912.

18 SHEETS—SHEET 4.

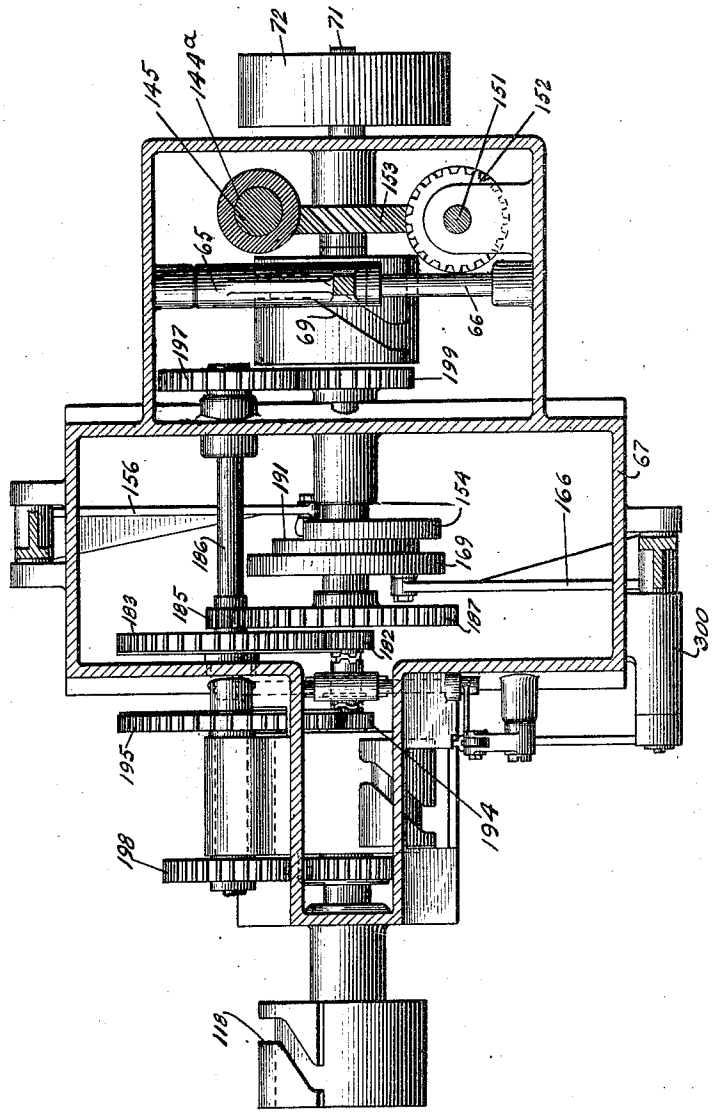


FIG. 4

Witnesses

F. E. Parer.

Edmund E. Black

Inventor

Sam Dolph D. Olsen

By Chas. N. Black.

S. D. OLSEN.

GRINDING MACHINE.

APPLICATION FILED SEPT. 1, 1910.

1,023,389.

Patented Apr. 16, 1912.

18 SHEETS—SHEET 5.

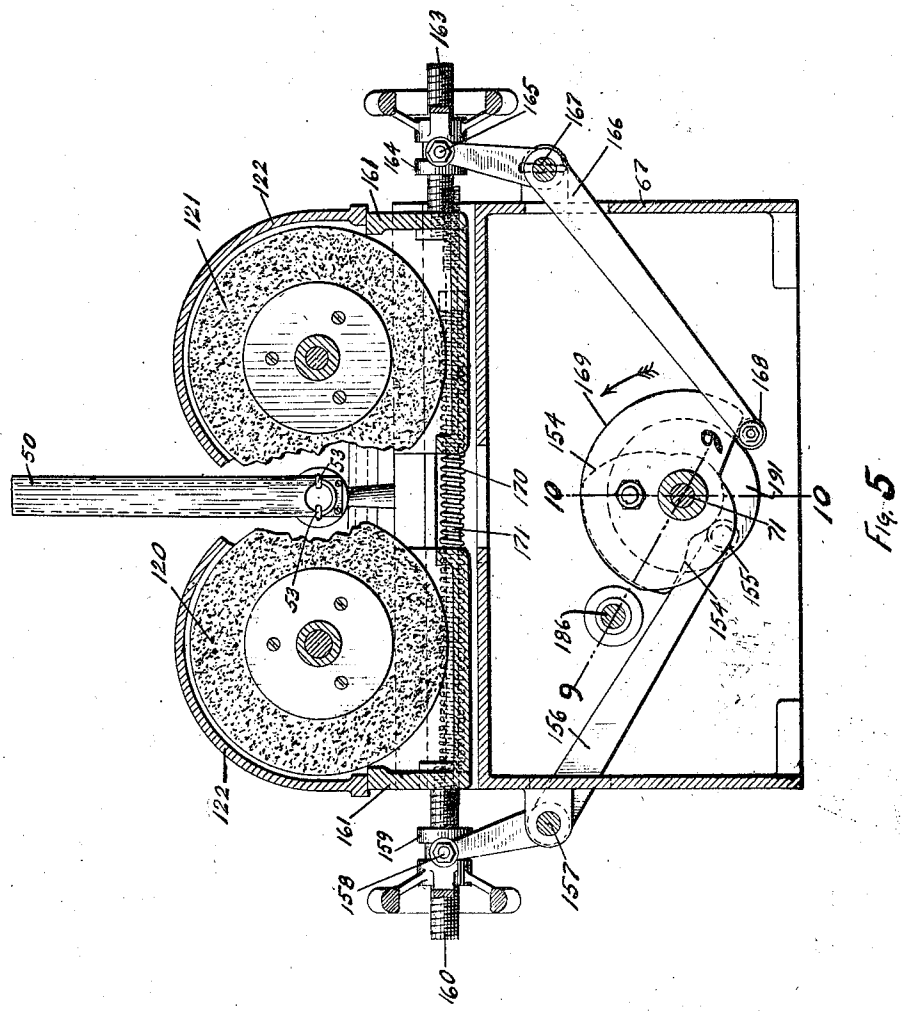


Fig. 5

Witnesses

F. E. Soper.

Edward E. Black

Inventor

By his Attorneys

Edwin F. Peach

S. D. OLSEN.

GRINDING MACHINE.

APPLICATION FILED SEPT. 1, 1910.

1,023,389.

Patented Apr. 16, 1912.

18 SHEETS—SHEET 6.

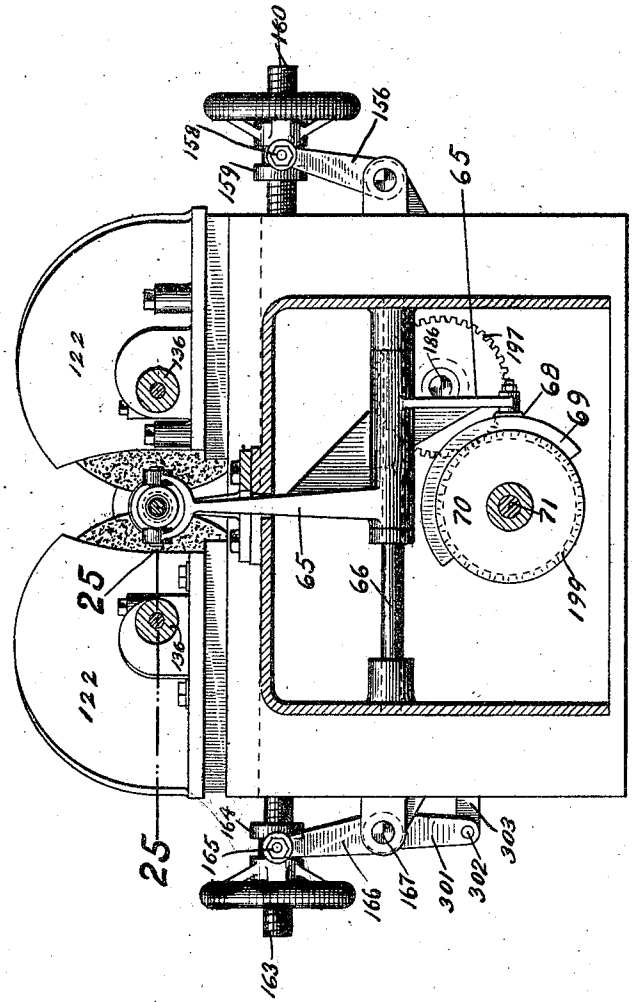


Fig. 6

Witnesses

F. E. Parry

Edward E. Bloch

Inventor

Sidney Dorr Olsen

By his Attorneys

Edmund S. Beach

S. D. OLSEN.

GRINDING MACHINE.

APPLICATION FILED SEPT. 1, 1910.

1,023,389.

Patented Apr. 16, 1912.

18 SHEETS—SHEET 7.

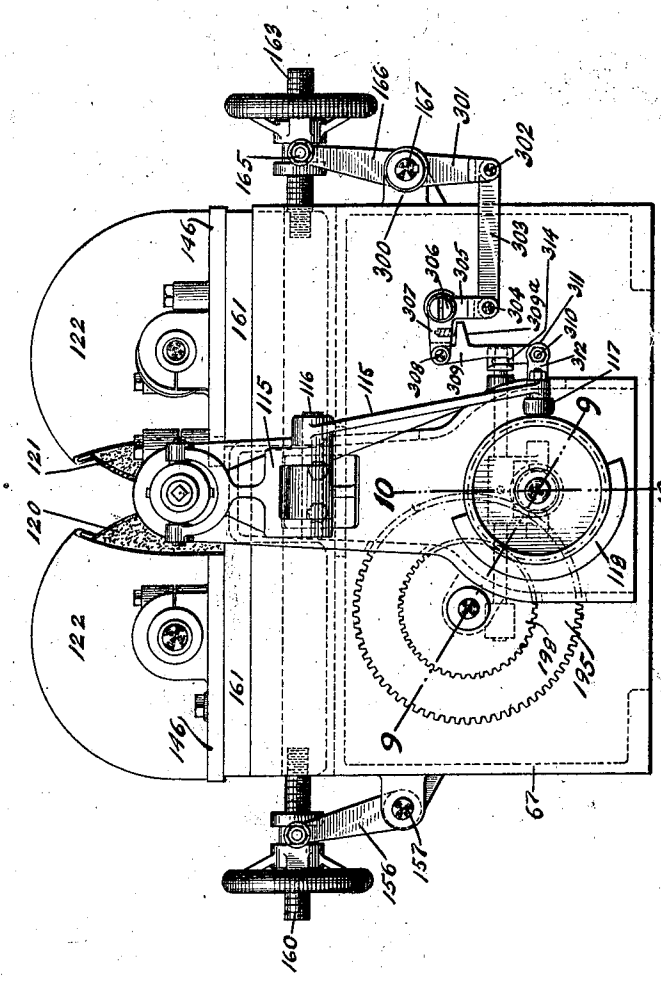


Fig. 7

Witnesses

J. E. Nazes

Edward A. Black

Inventor

Attorneys

S. D. OLSEN.

GRINDING MACHINE.

APPLICATION FILED SEPT. 1, 1910.

1,023,389.

Patented Apr. 16, 1912.

18 SHEETS—SHEET 8.

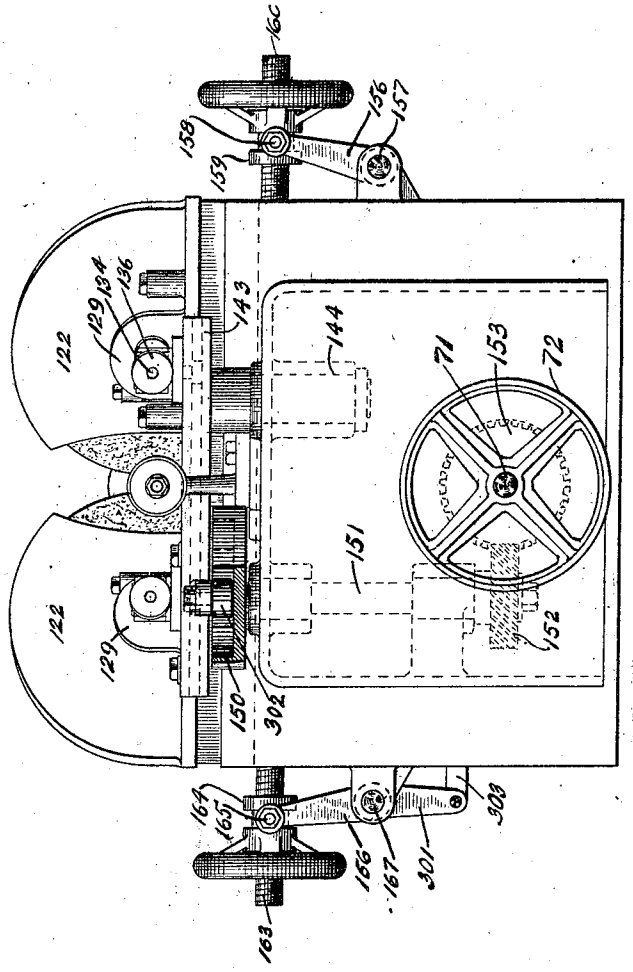


Fig. 8

Witnesses

J. E. Nagle.

Edward B. Black

Inventor

By Attorneys

S. D. OLSEN.

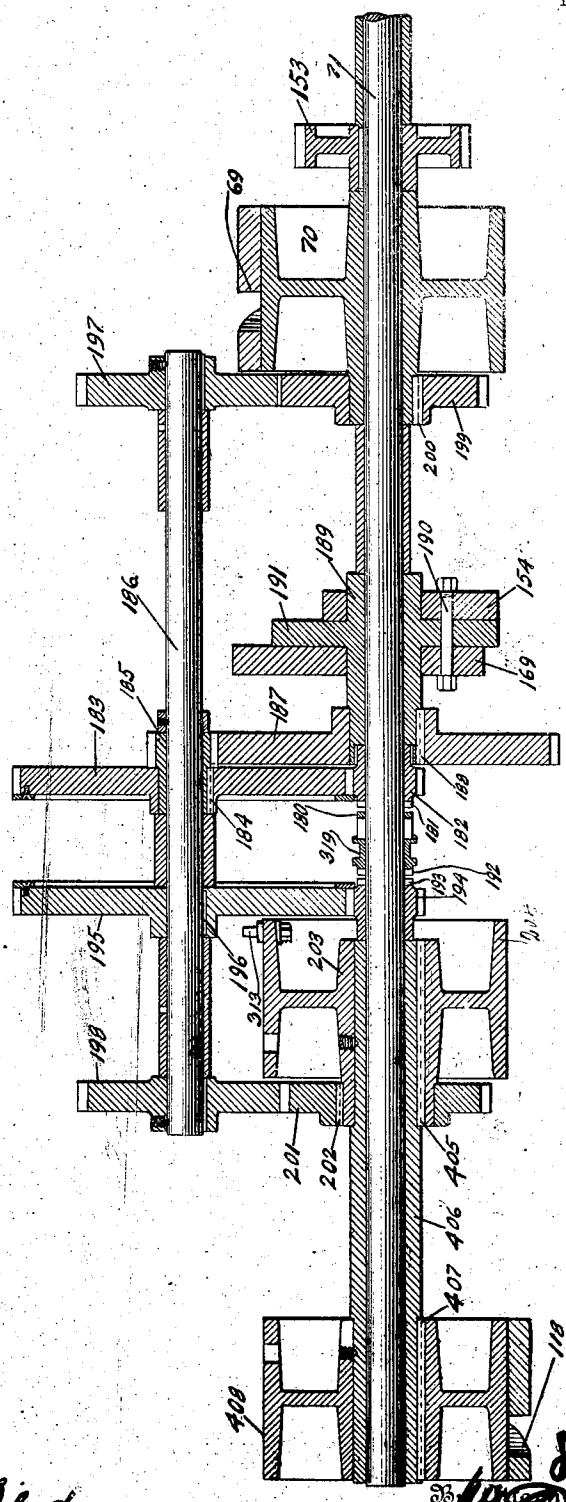
GRINDING MACHINE.

APPLICATION FILED SEPT. 1, 1910.

1,023,389.

Patented Apr. 16, 1912

18 SHEETS—SHEET 9.



Witnesses

F. E. Nave

Edward F. Read

Inventor

Svein Olsen Olsen

By Edward F. Read

S. D. OLSEN.

GRINDING MACHINE.

APPLICATION FILED SEPT. 1, 1910.

1,023,389.

Patented Apr. 16, 1912.

18 SHEETS—SHEET 10.

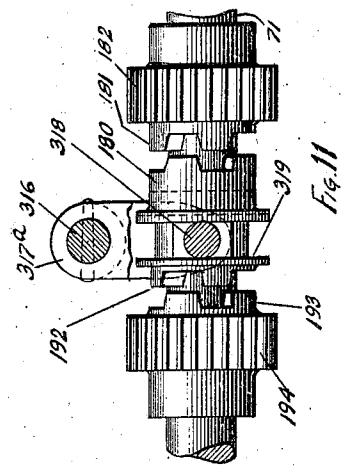


FIG. 11

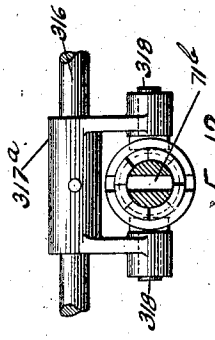


FIG. 12

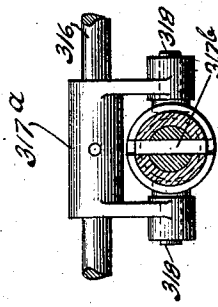


FIG. 13

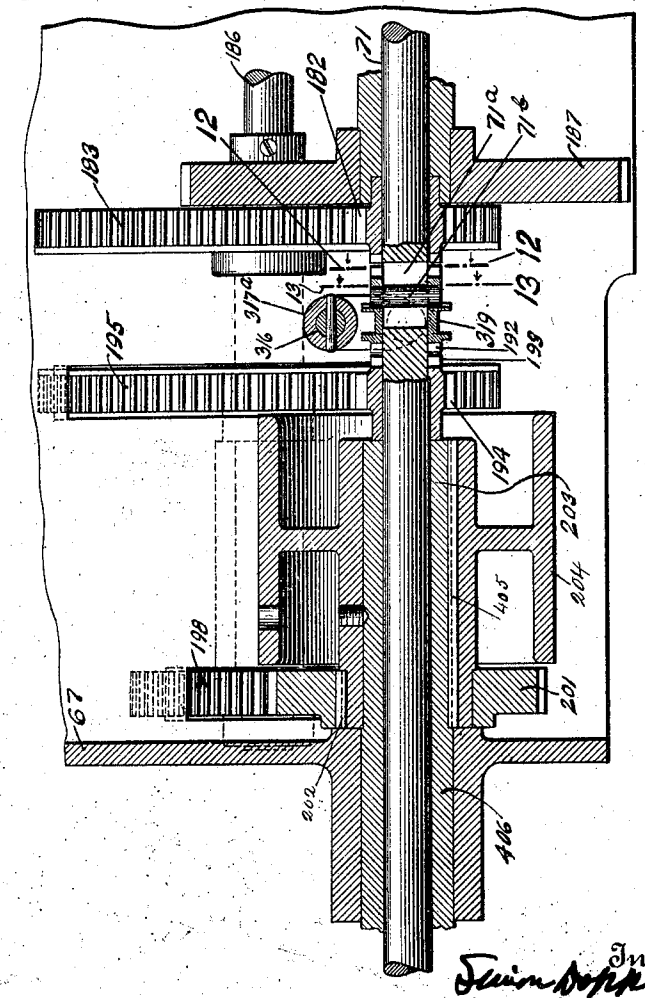


FIG. 10

Witnesses

F. E. Nazro

Edward C. Bloch

Inventor

Swin D. Olsen

By Attorneys

Edward C. Bloch

S. D. OLSEN.

GRINDING MACHINE.

APPLICATION FILED SEPT. 1, 1910.

1,023,389. Patented Apr. 16, 1912.

18 SHEETS—SHEET 11.

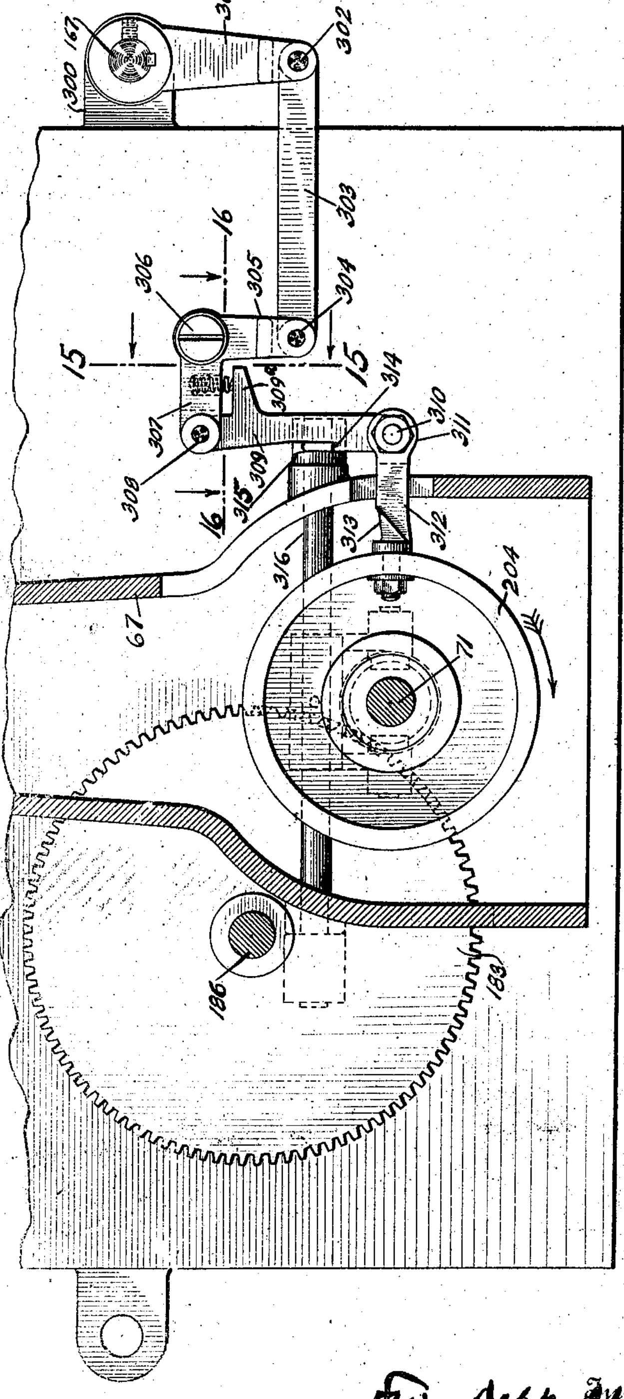


Fig 14

Witnesses

Inventor

By his Attorney

S. D. OLSEN.

GRINDING MACHINE.

APPLICATION FILED SEPT. 1, 1910.

1,023,389.

Patented Apr. 16, 1912.

18 SHEETS—SHEET 12.

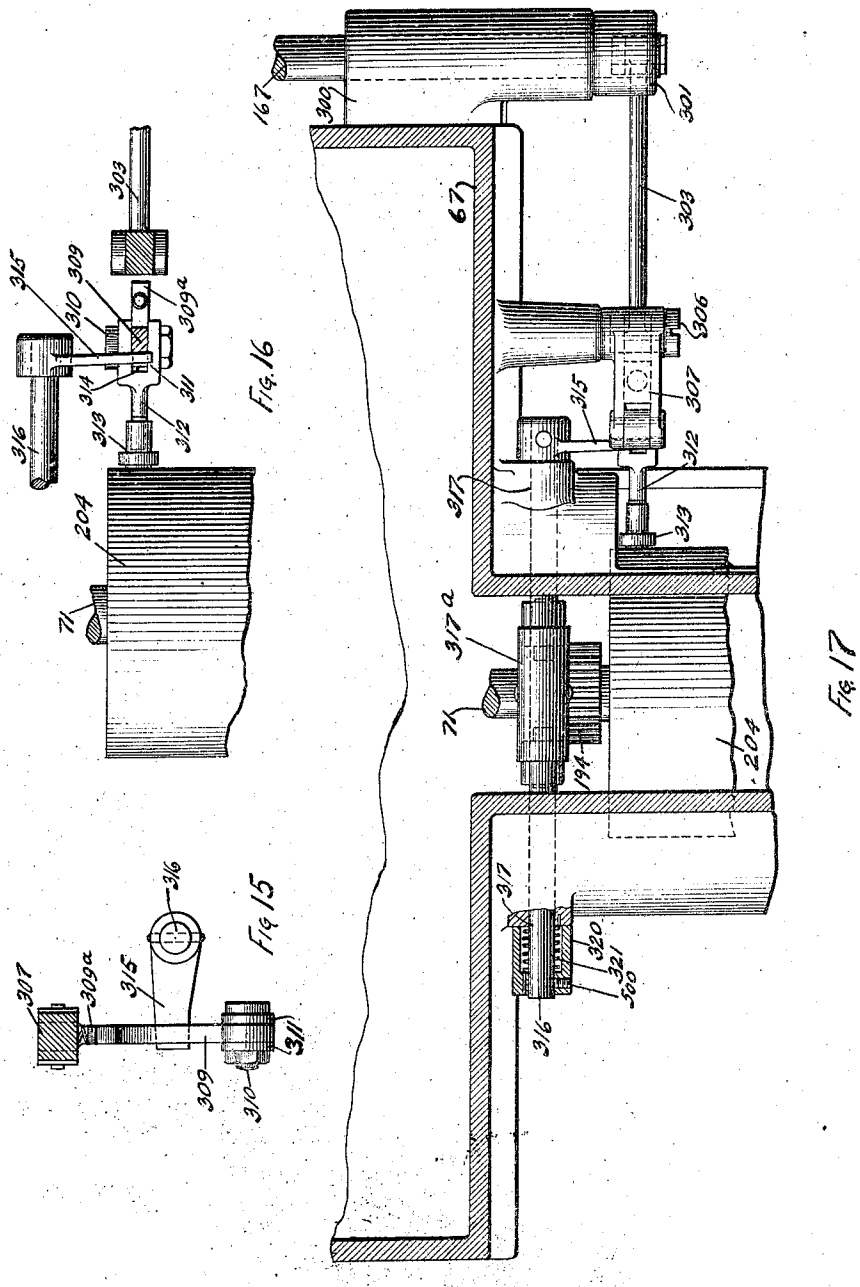


Fig. 16

Fig. 15

Fig. 17

Witnesses

F. E. Mann

Edward L. Reed

Inventor

Julius Doppke Olsen

By his Attorneys

Edward S. Roach

S. D. OLSEN.

GRINDING MACHINE.

APPLICATION FILED SEPT. 1, 1910.

1,023,389.

Patented Apr. 16, 1912.

18 SHEETS—SHEET 13.

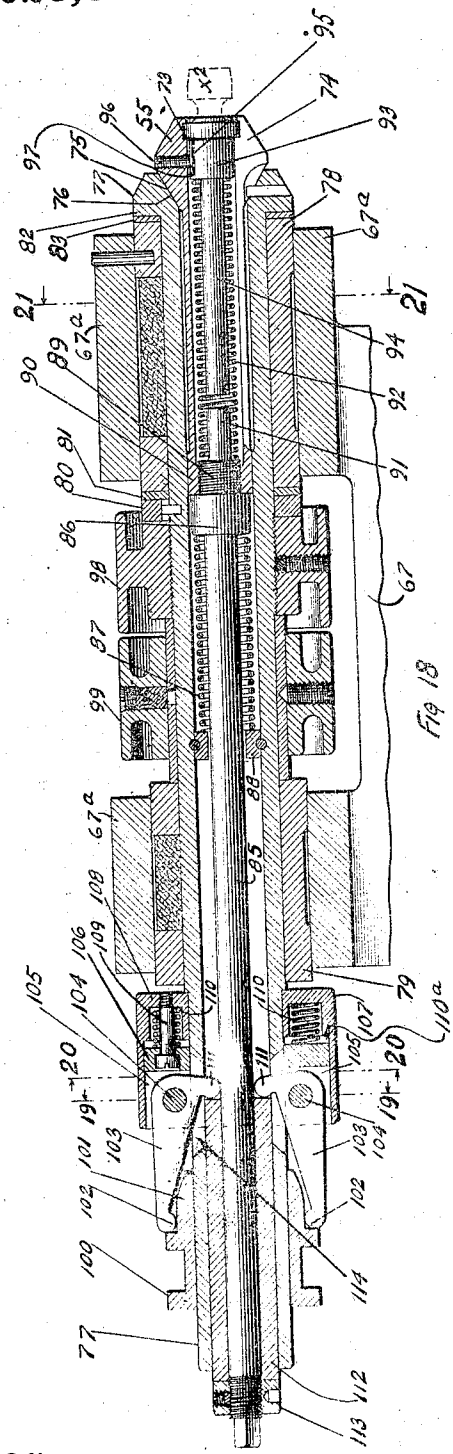


Fig 18

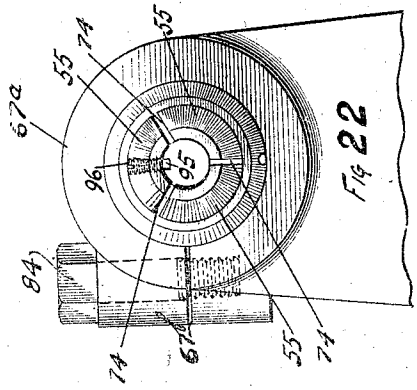


Fig 22

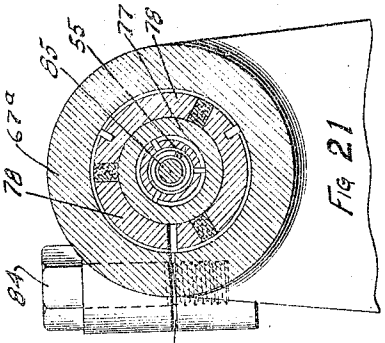


Fig 21

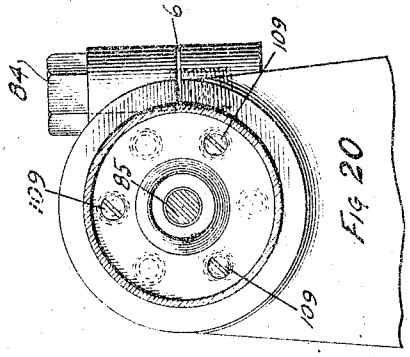


Fig 20

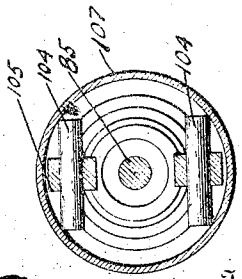


Fig 19

Witnesses

J. E. Nares

Edward C. Reach

Inventor

Louis Olsen

By Edward C. Reach

S. D. OLSEN.

GRINDING MACHINE.

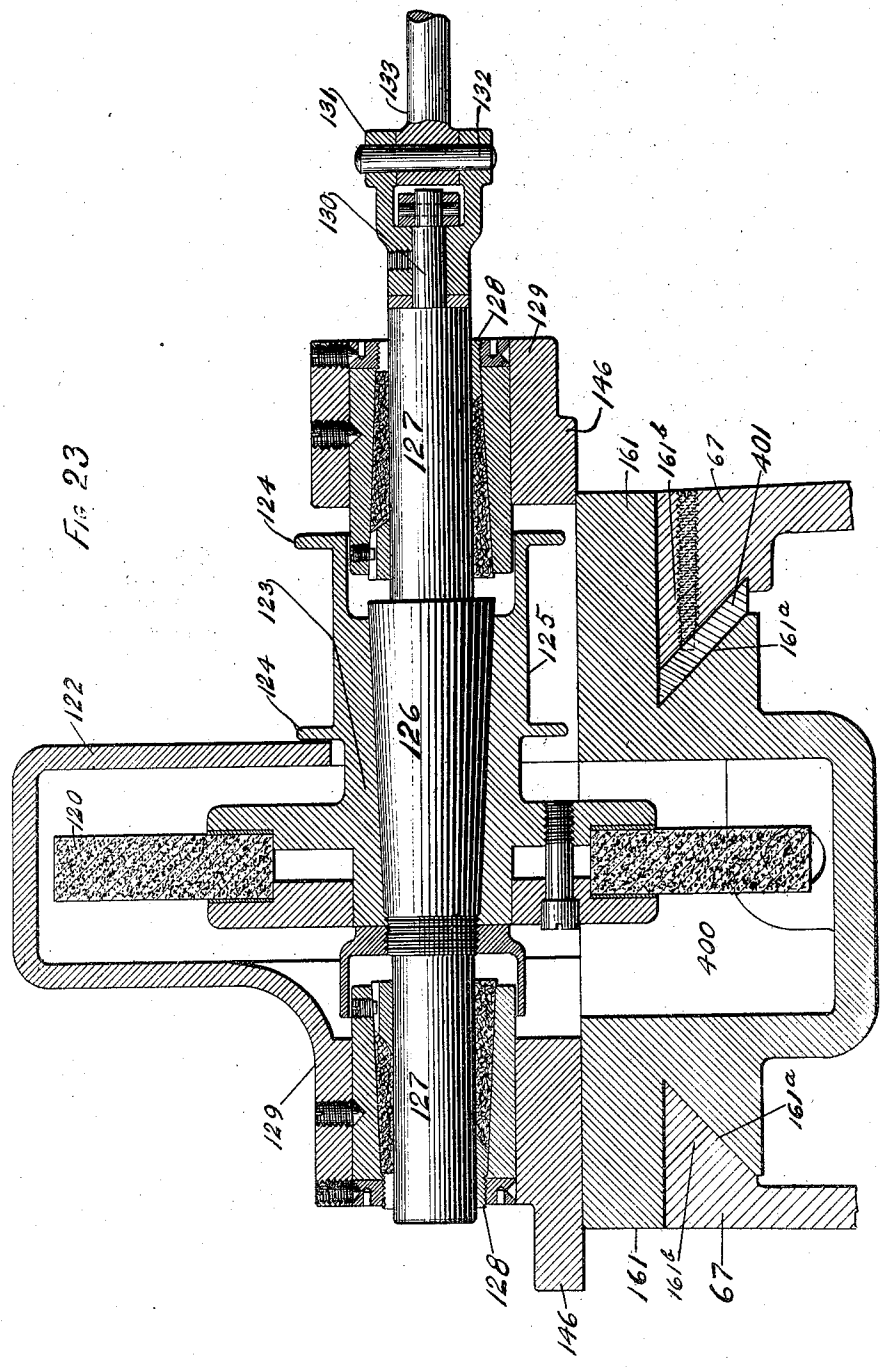
APPLICATION FILED SEPT. 1, 1910.

1,023,389.

Patented Apr. 16, 1912.

18 SHEETS—SHEET 14.

Fig. 23



Witnesses

F. E. Nave

Edward E. Beach

Inventor

Swan D. Olsen

by his Attorneys

Edward E. Beach

S. D. OLSEN.

GRINDING MACHINE.

APPLICATION FILED SEPT. 1, 1910.

1,023,389.

Patented Apr. 16, 1912.

18 SHEETS—SHEET 15.

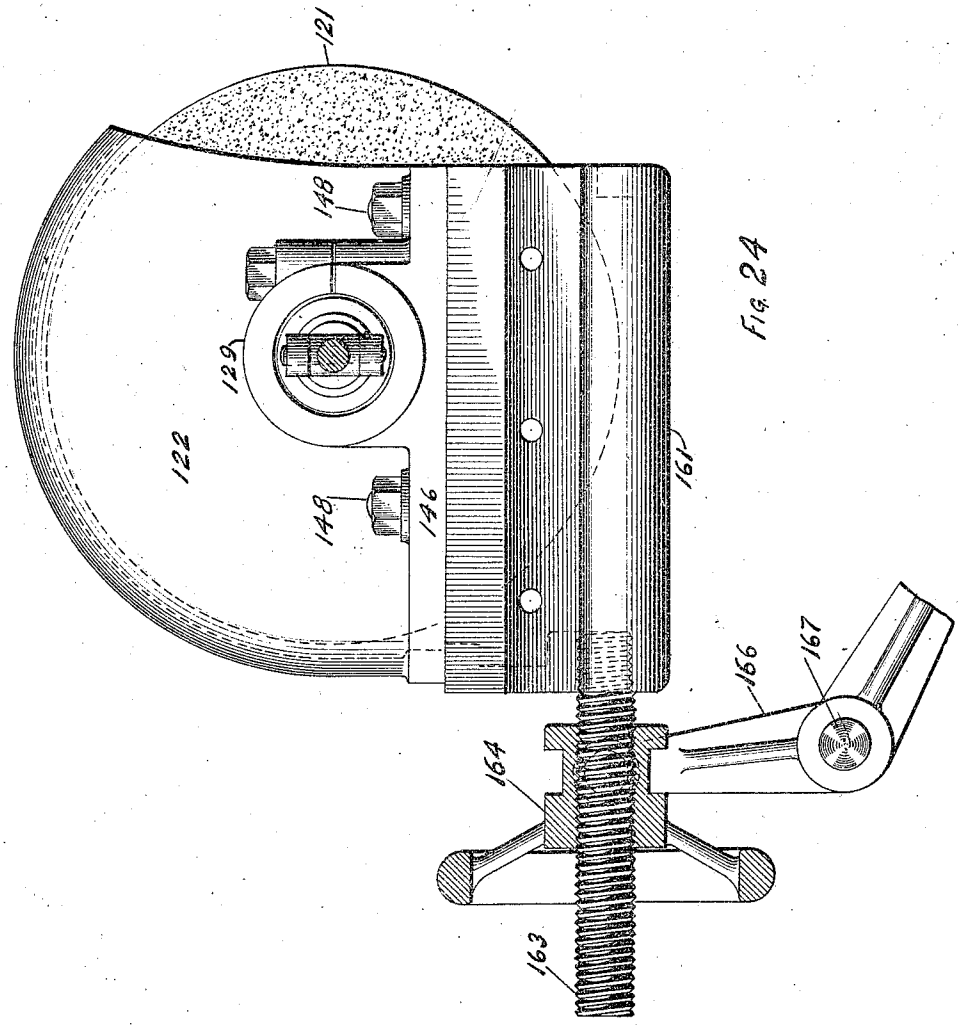


Fig. 24

Witnesses

F. E. Mary

Edward E. Black

Inventor

Elmer D. Olsen

By his Attorneys

Edward S. Beach

S. D. OLSEN.

GRINDING MACHINE.

APPLICATION FILED SEPT. 1, 1910.

1023,389. Patented Apr. 16, 1912.

18 SHEETS—SHEET 16.

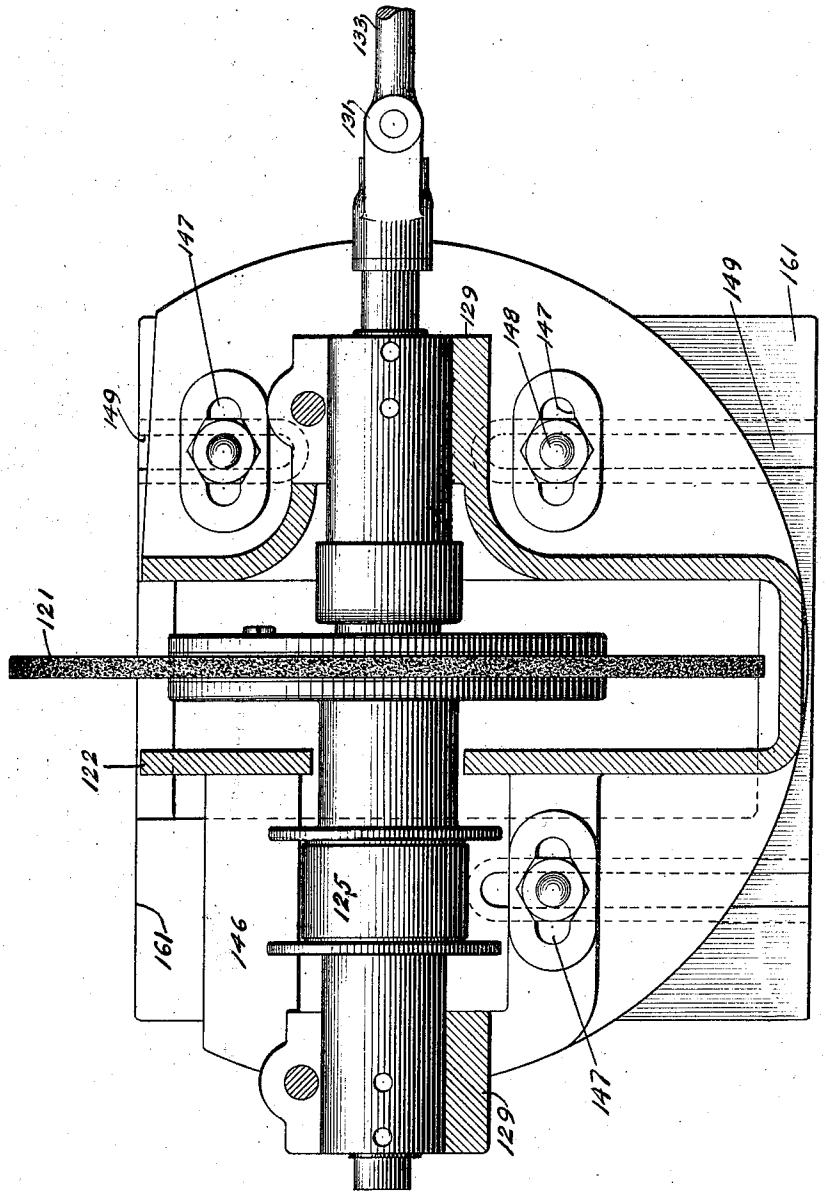


Fig. 25

Witnesses
F. E. Varez.
Edward E. Black

Inventor
Sluiz D. Olsen
By his Attorneys
Edmund S. Beach

S. D. OLSEN.

GRINDING MACHINE.

APPLICATION FILED SEPT. 1, 1910.

1,023,389.

Patented Apr. 16, 1912.

18 SHEETS—SHEET 17.

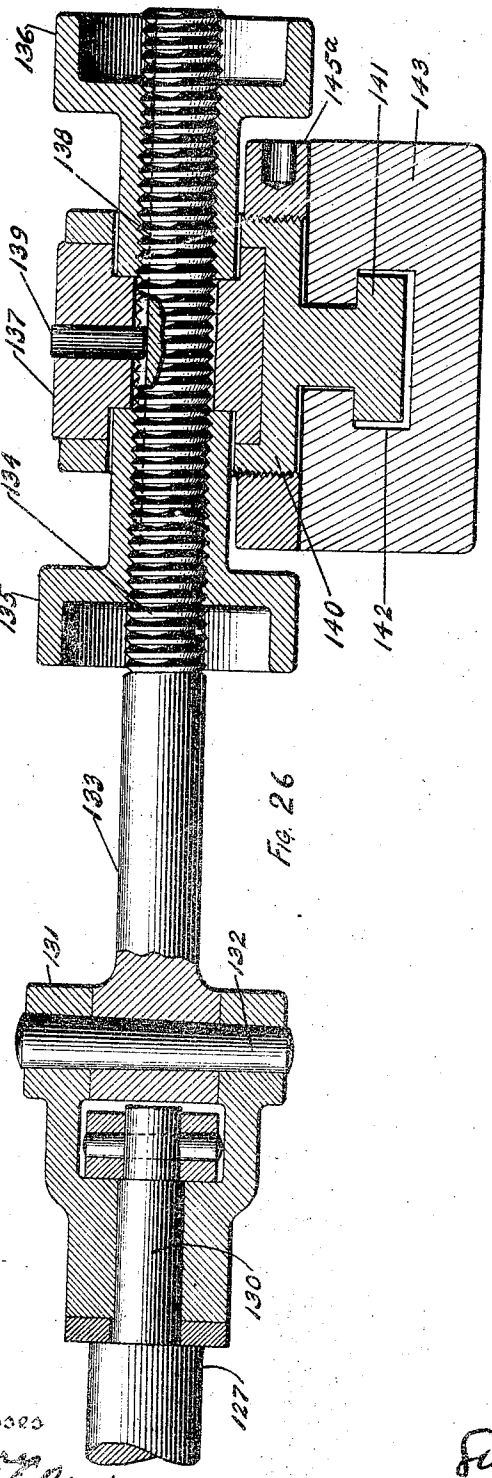


Fig. 26

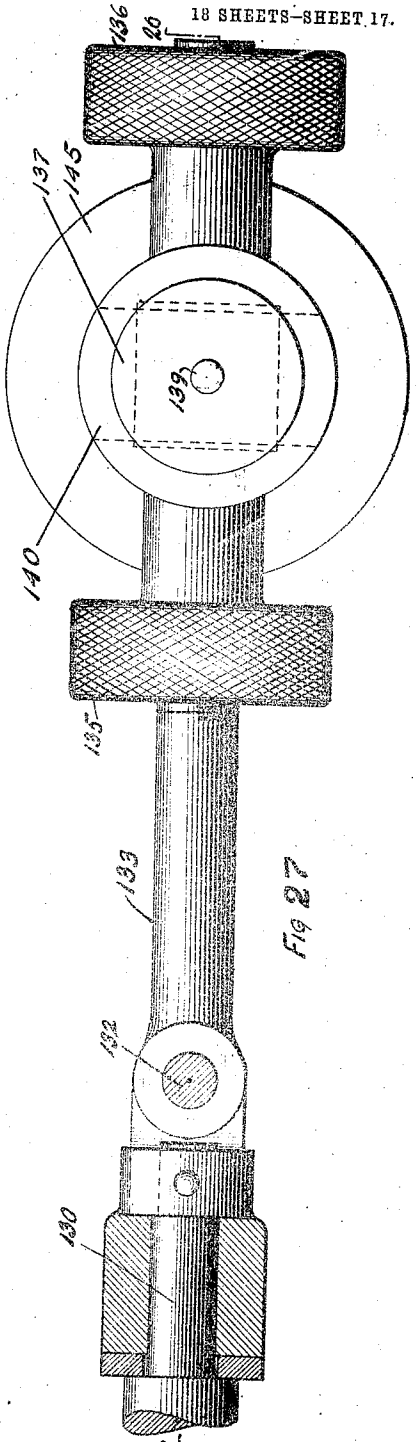


Fig 27

Witnesses
F. F. Narr
Edward C. Reed

Inventor
Selim D. Olsen
By Attorneys
Edward C. Reed

S. D. OLSEN.

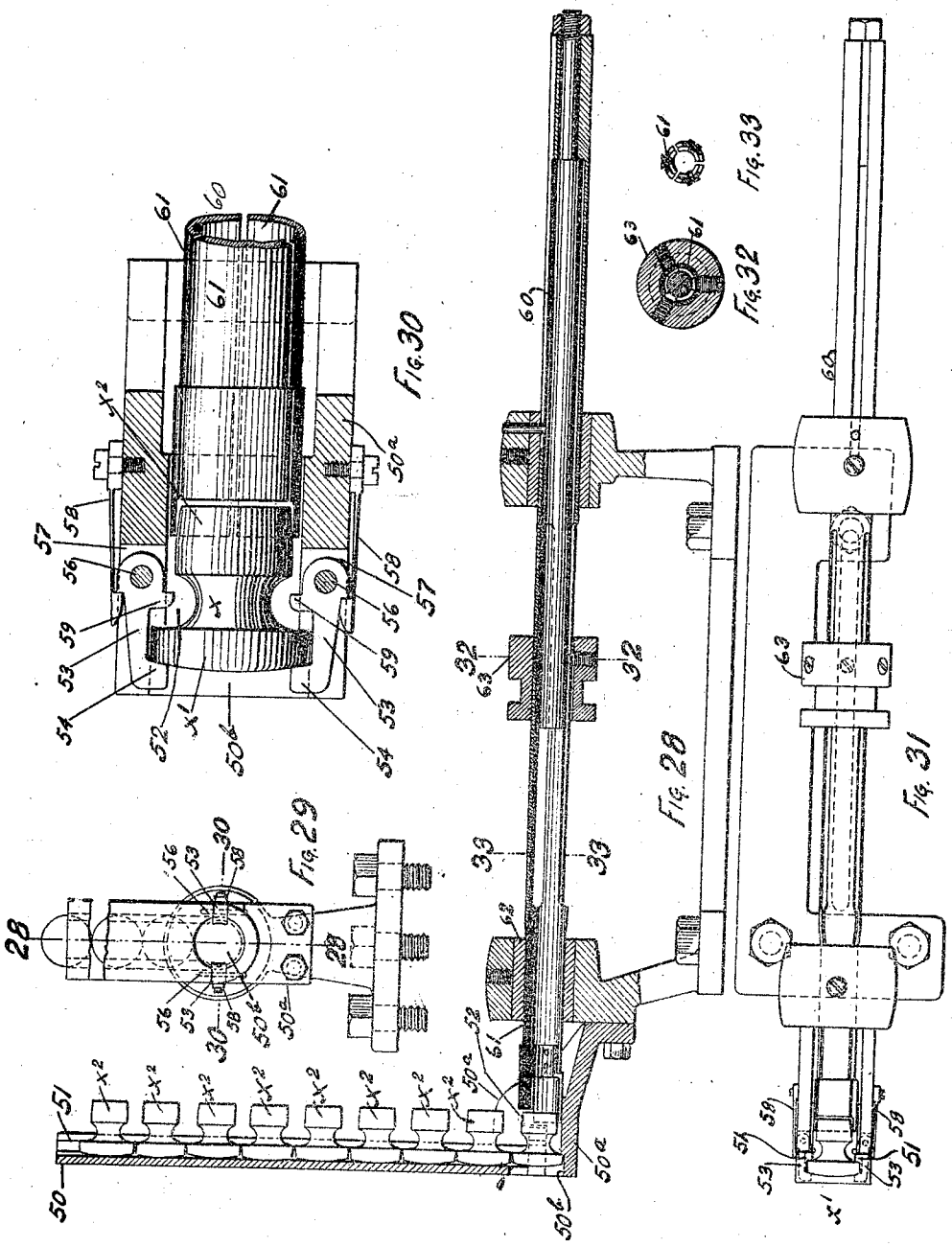
GRINDING MACHINE.

APPLICATION FILED SEPT. 1, 1910.

1,023,389.

Patented Apr. 16, 1912.

18 SHEETS—SHEET 18.



Witnesses:

F. E. Nare

Edmund E. Black

Inventor

Witnesses:

Edwin D. Beach

UNITED STATES PATENT OFFICE.

SIMON DOKK OLSEN, OF BROOKLYN, NEW YORK, ASSIGNOR TO PRECISION GLASS GRINDING MACHINE COMPANY, OF SIOUX FALLS, SOUTH DAKOTA, A CORPORATION OF SOUTH DAKOTA.

GRINDING-MACHINE.

1,023,389. Specification of Letters Patent. Patented Apr. 16, 1912.

Application filed September 1, 1910. Serial No. 580,063.

To all whom it may concern:

Be it known that I, SIMON DOKK OLSEN, a citizen of the United States, residing at Brooklyn, in the county of Kings and State of New York, have invented certain new and useful Improvements in Grinding-Machines, of which the following is a specification, reference being had therein to the accompanying drawing.

This invention relates to a machine for grinding glass and other stoppers, but particularly glass stoppers, in such wise that the stoppers may be interchangeably mated with the interiorly ground necks of glass or other receptacles, particularly glass receptacles.

In the accompanying drawings illustrating the principle of this invention in the best mode now known to the inventor of applying that principle, Figure 1 is a top plan view of one form of machine embodying the present invention. In this view, a vertical feed tube is shown with a glass stopper in position to be fed by a horizontally reciprocating stopper-carrier to a stopper-holding chuck which, however, is shown with a stopper in it; a finishing wheel, of carborundum or the like, being in contact with the surface of the stopper in the chuck. This view also shows a rough grinding wheel, of carborundum or the like, out of contact with the stopper. Fig. 2 is a front elevation of the machine. Fig. 3 is mainly a lengthwise sectional view of the machine on line 3—3 of Fig. 1, some of the parts, however, being shown in elevation. Fig. 4 is mainly a horizontal sectional view of the machine on line 4—4 of Fig. 3, looking down. Fig. 5 is a transverse sectional view, at line 5—5 of Fig 2, with the rough grinder and finishing grinder wheels in elevation. Fig. 6 is a cross-sectional view of the machine at line 6—6 of Fig. 3, some of the parts being shown in elevation. Fig. 7 is an end view of the machine taken from the left of Fig. 3. Fig. 8 is an end view of the machine taken from the right of Fig. 3. Fig. 9 is a view showing the main driving shaft and back gear shaft with certain cams and gears in section; the view being a development of the parts shown. This view may be considered also as a section on line 9—9 of Fig. 7. It illustrates, particularly, clutch mechanism for operating certain gears and the stopper-chucking cam, the belt-driving cam, the stopper-feeding cam, the stopper-roughening cam, the stopper-finishing cam, and at the right-hand end, a spiral gear for driving a rocker arm cam (not here shown) for laterally vibrating both grinders. Fig. 10 is an enlarged sectional detail, at a line corresponding to line 10—10 of Fig. 7, of a clutch mechanism with which the main driving shaft is provided, and whereby, when clutched at the right, the cams for actuating the rough and finishing grinders are operated through the back gear mechanism shown in Fig. 9; and when clutched at the left, the cam for the stopper carrying mechanism, the cam for the stopper chucking mechanism and the cam for the belt-shaft lever are operated through the said back gear mechanism. Fig. 11 is an enlarged view of the clutch mechanism shown in Fig. 10 and shows clutch pinions loosely mounted on the main driving shaft with a clutch in inoperative position between them. Fig. 12 is a cross-sectional detail of said clutch mechanism at line 12—12 of Fig. 10, parts being shown in elevation. Fig. 13 is a cross-sectional detail of the clutch mechanism at line 13—13 of Fig. 10, parts being shown in elevation. Fig. 14 is an elevational detail of automatic shifting mechanism for said clutch. Fig. 15 is in part an elevational and in part a sectional detail of a portion of said automatic shifting mechanism at line 15—15 of Fig. 14. Fig. 16 is a top plan view of said automatic shifting mechanism, partly in section at line 16—16 of Fig. 14, looking down. Fig. 17 is a partial top plan view of said automatic shifting mechanism looking down on the construction shown in Fig. 14, and more fully shows said shifting mechanism. Fig. 18 is a vertical central section of the stopper chuck spindle at right angles to the plane of the section indicated by line 18—18 of Fig. 3. Figs. 19, 20, and 21 are respectively cross-sectional elevations of said chuck spindle mechanism at lines

19—19, 20—20, and 21—21 of Fig. 18. Fig. 22 is an inner end elevation of said stopper chuck mechanism viewed from the right-hand end of Fig. 18. Fig. 23 is a lengthwise central section at line 23—23 of Fig. 1 of mechanism for rotating and laterally vibrating the rough grinder. Fig. 24 is an elevation mainly of the finishing wheel, its casing and support, but partly in section, on a line corresponding to line 24—24 of Fig. 1, the section showing a bell-crank and yoke connection for sliding said support toward and from a stopper. Fig. 25 is a top plan view of the finishing wheel and the frame which supports its driving shaft, the frame being adjustable on a slidable support to set the finishing wheel at different angles in relation to longitudinal axis of the machine. This view is partly in section at a line corresponding to a line 25—25 of Fig. 6. Fig. 26 is a vertical sectional detail, at a line corresponding to line 26—26 of Fig. 1, of the mechanism for adjusting the rod that vibrates the finishing wheel laterally during its rotation. Fig. 27 is a plan view of mechanism shown in Fig. 26. Fig. 28 is a vertical sectional view, at line 28—28 of Fig. 29, of the vertical feed tube and horizontal stopper carrier and other parts. Fig. 29 is a part elevation of the feed tube and stopper carrier mechanism. Fig. 30 is an enlarged horizontal sectional elevation, at line 30—30 of Fig. 29, of the front end, stopper-engaging mechanism of the stopper carrier. Fig. 31 is a top plan view of the stopper carrier mechanism, and Figs. 32 and 33 are respectively cross sections at line 32—32 and line 33—33 of Fig. 28. Fig. 32 shows how the carrier shifting collar is secured to the tubular carrier, and Fig. 33 illustrates the lengthwise slitting of the forward portion of the stopper carrier to form the spring jaws which seize the body of the stopper to convey the stopper head-first into the stopper chuck.

Referring to the drawings, the cycle of operations of the machine is: 1. A number of glass stoppers (the annularly reduced necks of which are marked x, the body portions forming the ground stopping part, x', and the heads x^2), such as in Fig. 1 (being mounted horizontally, one above another, in a vertical open slotted feed tube wherein they gravitate toward the foot of the tube), are successively gripped, and fed horizontally, by a stopper carrier into a stopper chuck. 2. The chuck grips the head of the stopper, leaving the body thereof projecting for, first, rough grinding, and then finishing grinding. 3. The stopper carrier then moves away from the stopper chuck. 4. The stopper chuck spindle rotates. 5. The rough grinder (wheel) is fed against the surface of the body portion x^2 of the stopper. 6. The rough grinder rotates and grinds. 7. The rough grinder is reciprocated laterally in contact with stopper surface being ground; the stopper surface and rough grinder preferably rotating in reverse directions. 8. The rough grinder is moved away from and out of contact with the bottle stopper (but continues to rotate). 9. The finishing grinder (wheel) is fed toward and into contact with the rough ground surface of the stopper. 10. The finishing grinder is rotated and grinds. 11. The finishing grinder is vibrated laterally during its grinding operation. 12. The finishing grinder is moved out of contact with the stopper but continues rotating, the rotation of the finishing wheel and stopper being preferably in reverse directions. 13. The stopper chuck is automatically arrested in its rotation. 14. The stopper chuck mechanism automatically releases the stoppers successively chucked, the stoppers when finished falling downwardly through a suitable space in the machine into a receptacle therefor, or onto the floor.

The pieces and parts of this machine will now be described in connection with its mode of operation.

The stoppers are located (Fig. 28) one above another in the feed tube 50 with their necks between the vertical walls 51 of a vertical passage of the feed tube, the foot-piece 50^a of which is provided with an enlarged recess 52 to permit the lowermost stopper in the stack of stoppers to gravitate between the diametrically opposite fingers 53 each having a hooked end 54. These ends 54 extend past opposite marginal portions of the stopper head x', and hold each stopper head as it falls into its lowermost position, at the foot of the feed tube, in horizontal alinement with the stopper chuck 55 (Fig. 1), the head of the stopper facing the open end of the chuck. Each finger 53 is pivotally attached at 56 to a slot wall 57 of the foot piece of the feed tube, and each finger is backed up by a spring 58, which springs keep the fingers normally closed over the stopper head. The inner vertical wall of the feed tube has a hole 50^b through which a stopper is carried to the chuck 55. On its inner side, each finger is provided with a lug 59 against which the front end of the endwise reciprocating stopper-carrier 60 strikes on its forward feeding movement during which the stopper is conveyed bodily from the foot-piece to the chuck, the carrier 60 seizing the body portion of the stopper and thrusting the stopper head into stopper chuck 55. The reciprocating carrier is formed of a tube split lengthwise at its inner end portion to form spring jaws 61 which, during the initial movement, encompass the inner end of the body x^2 of the

stopper; the spring jaws 61 being pressed together by their endwise passage through a cylindrical bushing 62. When carrier 60 has moved a little farther in the direction of chuck 55, the end of the carrier strikes against the lugs 59 to separate fingers 53, thereby carrying the stopper from between the fingers, through the hole 50^b, and at the end of the carrying movement of the carrier, thrusting the head of the stopper into the open jaws of the clutch 55.

Carrier 60 is provided with a grooved collar 63 which is engaged by yoke members 64 of lever 65 (Fig. 3) which is pivoted at 66 to main frame 67, pivot 66 being between the ends of the lever, and the lower arm of which is provided with a cam roll 68 that is engaged by a cam 69 fixed on the surface of a drum 70 which is loose on the main driving shaft 71 (provided with a driving pulley 72) that extends lengthwise of the machine. When cam 69 rotates, it vibrates the lower arm of lever 65 and thus vibrates the upper arm of the lever to give the stopper carrier 60 endwise reciprocation.

Stopper chuck 55 (Fig. 18) is made up of a lengthwise split sleeve having a recess 73 in its inner end for reception of a stopper head. The slits are indicated by 74 and by means of the spring jaws thus produced between slits 74 the stopper receiving end of the chuck member 55 is compressively clamped upon the stopper head after the same is thrust into the opening 73 by the final forward movement of stopper carrier 60. The stopper receiving end of chuck 55 is provided with a rearwardly slanting, annular shoulder 75, which, when in contact with a corresponding shoulder 76, of the rotatable cylindrical spindle 77, compresses the jaws of chuck member 55 on the head of the stopper. At the time when the stopper is inserted, the shoulder 75 must stand away from the shoulder 76 of the spindle to permit the spring jaws to move apart for reception of the stopper head in the recess 73. Thereafter, the chuck is moved in the opposite direction to compress the spring jaws on the stopper head as shown in Fig. 18.

Frame 67 of the machine is formed with cylindrical bushing-receiving openings in alinement one with another (as indicated in Fig. 18) in split brackets 67^a, and these receive bushings 78 and 79 in which the spindle 77 is rotatively mounted. Collar 80 and washer 81 on one side of bushing 78 and shoulder 82 of the spindle, and washer 83 on the other side of bushing 78 prevent endwise movement of bushing 78, the collar 80 being fixed to the spindle, as will be plain from Fig. 18. Bushings 78 and 79 are shown as ordinary split bushings mounted in the cylindrical openings of brackets 67^a, the slits 67^b whereof form ordinary bushing-clamping jaws held together by clamp screws 84.

Within the lengthwise bore of spindle 77, there is mounted an endwise reciprocable plunger 85, provided at its forward end with a head 86 which forms on its rearward side an abutment for the coiled spring 87, the rear end of which abuts against collar 88 fixed in the bore of the spindle. Spring 87 is mounted under compression. The forward end of the head 86 is provided with a threaded extension 89 on which the butt end 90 of the chuck 55 is threaded. Consequently the chuck and plunger 85 reciprocate endwise as one piece.

A spring centering pin 91 projects forwardly of the threaded extension 89 to help hold a coil spring 92, under tension, within the longitudinal chamber of the chuck 55 which, like spindle 77, is cylindrical and the foremost portion of the longitudinal chamber of which is provided with a sliding head 93 having a rearwardly extending centering pin 94 for spring 92. Head 93 is provided with a longitudinally-extending key-way 95 for reception of an inward key 96 from chuck 55, the inner end of the key impinging against the end wall 97 of the slot to keep the head 93 in place, and at the same time to permit a slight endwise movement of the head which serves as a buffer when the head of the stopper is thrust into the recess 73 of the chuck 55, the head 93 being then set back against spring 92 which is thereby compressed. When the stopper has been ground, the chuck is moved inwardly away from shoulder 76, the chuck jaws spring apart, and the spring 92 pushes the head 93 outwardly, thereby ejecting the finished stopper automatically from the chuck.

Spindle 77 is provided with a fixed driving pulley 98 and a loose pulley 99 for reception of a belt from overhead shafting. When a stopper head has been first inserted in chuck 55, the grooved collar 100, which is slidably mounted on the rear end of spindle 77, is moved in the direction of chuck 55, its cam collar 101 then riding under the free ends 102 of the diametrically opposite levers 103 which are pivoted at 104 in slots 105 of a collar 106 which is slidably mounted on the spindle within an annular casing 107 on spindle 77. Collar 106 is limited in its reciprocation within the casing by screws 109 which pass through the collar into the end wall 108 of the casing.

The heads of the screws are countersunk in holes in collar 106 and coil springs 110 are interposed, around the shanks of the screws 109, between the collar and the inner surface of the end wall of the casing in recesses in the casing. Collar 106 is free to slide over the screws 109 between the heads

of the screws and an interior shoulder 110ª of the casing, and is normally forced outwardly by the springs 110. The fulcra of levers 103 are therefore movable. Levers 103 are bell-crank levers, and have inner arms 111 which are adapted to abut against the inner end of a sleeve 112 which encircles the plunger 85 and is itself slidably mounted in the longitudinal chamber of spindle 77. Consequently when the cam collar 101 is forced in between the free ends 102 of levers 103, the lugs 111 of the levers 103 push on sleeve 112 and so force the plunger 85 rearwardly, the sleeve 112 being attached to the plunger by a collar 113.

Lugs 111 of the bell-crank levers play through slots 114 in spindle 77. Inasmuch as the plunger is moved rearwardly in mechanical connection with the moving or shifting fulcra 104 of the bell-crank levers 103, and when moving rearwardly pulls the shoulder 75 of the stopper chuck against the shoulder 76 of the spindle to close the chuck, it follows that this closing or chucking movement is of an elastic nature that will accommodate stopper heads of somewhat varying diameters without crushing them by the annular contraction of the spring jaws of the chuck; the springs 110 effecting what may be called elastic or variable closures of the spring jaws of the chuck. This is an important matter because of the almost inevitable variations in the dimensions of the heads of glass stoppers.

The grooved collar 100 is reciprocated on spindle 77 by a lever 115 (Figs. 3 and 7) fulcrumed to the frame of the machine at 116 and provided at its lower end with cam roll 117 adapted to be vibrated by cam 118 carried on main driving shaft 71 (Fig. 9). The next step in the cycle of operations is to feed the roughening wheel 120 against that surface of the stopper which is to be ground, for the purpose of reducing its circumference and grinding it approximately for the operation of the finishing wheel 121; each of these grinding wheels is best inclosed, as shown, in a suitable hood 122 as will be readily understood by those skilled in the art, and the wheels are preferably of carborundum although they may be of any suitable abrasive material of desired grade and bond.

The operating mechanism of each of the grinding wheels is identical and description of one will suffice for the description of the other. Each wheel is mounted on an interiorly tapered hub 123 (see Fig. 23). This hub is provided with annular flanges 124 to form a driving pulley 125 to which a belt from overhead shafting may be led. Hub 123 is mounted on a tapered portion 126 of a spindle 127, portions of which are mounted in preferably tapered bearings 128, one on one side of the wheel and the other on the other side of it. The interior of the chamber 122 is somewhat wider than the width of the wheel and the hub members, so that the abrasive wheel may be vibrated laterally within its hood 122. The spindle 127 is slidably mounted in its bearings 128 and the pulley-receiving-hub of the wheel is reciprocated between the bearing supports 129 which are parts of the hood.

The inner end 130 of spindle 127 is provided with a coupling member 131 to which is loosely pinned, at 132, the rod 133 which is threaded at 134 to receive a pair of adjusting nuts 135 and 136 that are spaced apart, with their inner ends impinging against the outside of a cylindrical turn-block 137, which is transversely bored for passage of the threaded portion 134 of rod 133. The threaded portion 134 of rod 133 is provided with a lengthwise extending keyway 138 in which rides a pin 139 fastened in turn-block 137. Block 137 is loosely mounted in an adjustable block 140 having a T-shaped bottom flange 141 that slides in the corresponding T-shaped slot 142 formed in the upper side of the horizontal rocker arm 143 that is fixed at 144 near its rear end, to a vertical rocker shaft 145 mounted in a vertical bearing 144ª formed in the main frame (Figs. 1 and 3).

As stated, each rod 133 is connected with rocker arm 143 through described parts. Each adjustable block 140 is adjustably clamped by clamp collar 145ª to rocker arm 143, the collar being threaded on block 140 and adapted to be turned into and out of contact with the rocker arm 143.

By loosening either clamp collar 145ª, either adjustable block 140 may be loosened in the rocker arm 143 and consequently either or both blocks may be adjusted on the rocker arm to vary the amplitude of the lateral vibration of the grinding wheels. By adjustment of screw sleeves 135 and 136, the grinders may be positioned with their peripheries in desired lateral relation to the stopper surface to be ground.

Each casing 122 has a flat horizontal bottom flange 146 that is cross-slotted at 147 for reception of bolts 148, the heads of the bolts being mounted in T-slots 149, as shown in Fig. 3 (see Fig. 23), of the transverse slide 161 formed on its opposite sides with parallel V-grooves 161ª that receive and thus form ways for the corresponding V-ribs 161ᵇ of frame 67. These grooves and ribs extend transversely of the machine frame from front to rear thereof. The slots 147 are elongated in the general direction of the length of the machine and the casing flanges 146 are sidewise adjustable. Each slide 161 has between its V-ribs a dependent chamber 400 which is complementary to the

chamber of a casing 122 and receives the lower portion of the wheel (Fig. 23). By loosening the nuts of bolts 148, and also sliding the bolts 148 in slots 149 each casing may be adjusted in reference to its supporting slide 161 in order to vary the angular relation of the grinding wheel periphery (or the circumferential plane of the grinding wheel) to the longitudinal axis of the stopper chuck 55. Each casing 122 carries the bearings 128 and their supports 129, which are integral with the casing. This angular adjustment of the grinding wheels is essential in order to bring the grinding peripheries of the wheels into proper grinding relation to stoppers having body portions the circumferential walls of which are at varying angles to the longitudinal axes of the stoppers. Each slide is adapted to be reciprocated in its ways from and toward the stopper while it is in the chuck.

The rocker arm 143, which is horizontal, is (see Figs. 1, 2 and 8) vibrated laterally by means of a cam 150 on a vertical shaft 151 journaled in the frame and provided at its lower portion with a spiral gear 152 that meshes with a spiral gear 153 on the main driving shaft 71. A cam roll 302 on the under side of rocker arm 143 works in the groove-cam 150. Consequently each grinding wheel is laterally vibrated while it is in use and rotating.

The rough grinder 120 is fed up to the stopper and performs its rough or preliminary grinding operation before the finer finishing wheel 121 is thrown into operation. The feed of the rough grinder is effected by the roughing cam 154 (Figs. 3, 5, and 9) on driving shaft 71. This roughing cam 154 works on a cam roller 155 on the bell-crank lever 156 which is pivoted to the frame at 157 and provided with a yoke 158 that engages the annularly-grooved hub 159 conveniently formed with a hand wheel as shown. This hub 159 is threaded on a threaded stud 160 which is a rigid rearward projection of rearward slide 161. The front slide 161, which supports the casing for the finishing wheel 121, is provided with a forwardly extending threaded stud 163 that is similarly provided with an annularly-grooved hub 164 formed with a hand-wheel as shown, the hub working with the yoke members 165 of a bell-crank lever 166 that is fast to work-shaft 167 journaled in the main frame. The lower arm of this bell crank is provided with a cam roller 168 which is operated by the finishing cam 169 carried by the main driving shaft. The construction of the two casings, bearings, and slides, is the same for each grinder.

Whenever either the rough grinder or finishing grinder is moved up to its work, it is moved against the stress of a spiral spring 170 kept in place by a horizontal rod 171, the spring being interposed between the transverse slides 161, 161 that support the grinding wheels so that the spring is always compressed by a feed movement of either slide.

The finishing wheel mechanism is thrown into operation as soon as the rough grinder has ceased operation and has moved away from the stopper. During the successive operative rotations of the roughening cam 154 and finishing cam 169, which rotations are coincident, the right-hand clutch teeth 180 (Figs. 9, 10, and 11) mesh with the clutch member 181 on the hub of pinion 182 which is loose on driving shaft 71. This pinion is in constant mesh with back gear 183 which is keyed at 184 to the back gear pinion 185 which is loose on back gear shaft 186. Pinion 185 meshes with a gear 187 which is splined at 188 to a hub 189 on which the roughening cam 154 and finishing cam 169 are fixed by a transverse bolt 190 through both cams and the intermediate flange 191 of hub 189. Shaft 71 has a lengthwise extending slot 71^a for key 71^b which permits the double clutch 319 to move laterally and at the same time compels it to rotate with the shaft. Whenever, on the other hand, the clutch teeth 192 engage with the clutch member 193 of the pinion 194 which is loose on the main driving shaft, said pinion 194 meshes with the back gear 195 which is keyed to back gear shaft at 196, and the back gear shaft 186 is rotated; and the two gears 197 and 198, each fixed to the back gear shaft, are simultaneously rotated. Gear 197 meshes with gear 199 splined at 200 to the hub of drum 70 of the stopper feeding cam 69, thereby actuating the stopper feeding cam. Simultaneously, gear 198 meshes with gear 201 which is splined at 202 to the hub 203 of the belt shifting cam drum formed with a cam groove 204. (Compare Fig. 9 with Fig. 3.) The latter cam vibrates a cam roller 205 on the end of lever 206 pivoted at 207 to the frame of the machine. The upper end of this lever carries a belt shifting device 208, whereby a belt on pulley 98 is automatically shifted to the loose pulley 99, or vice versa. The chuck 55 speedily stops after the belt is shifted to loose pulley 99.

The hub 203 of the belt shifting cam 204 is keyed at 405 to a sleeve 406 which is loosely mounted on the main driving shaft and its sleeve 406 is splined at 407 to the stopper chucking cam hub 408 which carries exteriorly the stopper chucking cam 118, the operation of which has been described.

To shift the clutch mechanism the rocker shaft 167 of lever 166 is laterally (see Fig. 2) extended through a bracket 300 of the frame, its outer end being provided with a

fixed rocker arm 301, the lower end of which is loosely pinned at 302 to a link 303, the other end of which is loosely pinned at 304 to one arm 305 of a bell crank which is pivoted at 306 to the frame of the machine. Arm 307 of the bell crank is loosely pinned at 308 to a lever 309 which is clamped at 310 to the forked end 311 of a tripping lever 312, which lever extends into the path of a tripping pin 313 on the drum 204 of the belt shifting cam. The lever 309 has a horizontal shoulder 314 which engages with a rocker arm 315 of a horizontal rocker shaft 316 mounted in suitable bearings 317 in the frame. This rocker shaft is provided, between its ends, with a yoked clutch shifter 317ª, provided with an inwardly projecting clutch shifting pin 318 which engages the annular groove of clutch 319.

The outer end of rocker shaft 316 is provided with an adjustable cap 320 within which a coiled spring 321 under tension is mounted, one end of this spring being fixed to the frame and the other end to the cap, and the cap is held in place by a set-screw 500. The tension of the spring is such as to tend to rock the shaft 316, clockwise when the shaft is viewed from its left-hand end (Fig. 17). Consequently, the spring normally tends to turn the rocker shaft 316 so as to move the clutch 180 into contact with clutch 181, whereby the two grinding cams 169 and 154 are simultaneously operated through pinion 182, back gear 183, back gear pinion 185, and gear 187. Each grinder therefore successively operates on a given stopper during a single rotation of gear 187 and of the roughing cam 154 and finishing cam 169, the surfaces of which are shaped to effect the successive grinding operations of the two grinders (see Fig. 5). These parts constitute what may be called an automatic tripping mechanism for shifting clutch 319 either to the right (for driving the grinding cams) or to the left (for driving the belt shifting cam 204, the stopper feeding cam 69 and the stopper chucking cam 118). When the grinding cams have made nearly one revolution, the finishing wheel is moved away from the stopper. In this movement, bell-crank lever 166 is rocked so that lever 409 is raised vertically, lifting the free end of lever 315 and thereby rocking the shaft 316 (Figs. 14–17) against the tension of spring 321, thereby throwing clutch 319 to the left and thereby starting up the belt-shifting, stopper-feeding, and stopper-chucking cams. These parts remain in operation until the tripping pin 313 on the belt shifting cam hub strikes tripping lever 312, thus pushing shoulder 314 out from under the lever 315 and permitting the tension of spring 321 to rock shaft 316 in the reverse direction whereby the clutch shifter 317ª is moved to first disengage clutch 319 from its left-hand working position into its right-hand working position in which position the grinding cams are operated as already stated.

In operation, driving shaft pulley 72, fixed pulley 98 of the chuck spindle and the two grinding-wheel driving-pulleys 125, are driven simultaneously from suitable shafting, and when once rotating, with the feed tube supplied, all the operations of the machine are automatically successive, the chuck being automatically stopped at the end of each grinding operation for the automatic discharge of the ground stopper. In the above-stated cycle of operations the fact is not noted that the two grinders are coincidently rotated and vibrated.

The described machine is designed for high-speed operation and the production of a maximum output in a minimum time, and such are its advantages.

What is claimed is:

1. The combination of a feed-tube mechanism; an automatic work-carrying mechanism operating to seize articles to be ground, successively at the feed-tube, and successively convey them to and thrust them into an automatic rotary work-holding and work-ejecting chuck; a work-chuck; and automatically fed and retracted grinding mechanism, said grinding mechanism comprising a pair of grinding wheels, one of coarser abrasive material than the other.

2. In a grinding machine, the combination of a work-chuck and reciprocating work-carrier adapted to convey articles to be ground to the chuck and thrust them successively into it; with a pair of grinding wheels one mounted at one side of the work-chuck and the other mounted at the other side thereof; means for continuously rotating both grinding wheels; and means for simultaneously vibrating them laterally while they are rotating.

3. In a grinding machine, the combination of an automatic chucking and work-ejecting mechanism; a work-carrying mechanism adapted to deliver articles to be ground successively to the chuck; a pair of grinding wheels each rotatively mounted one at one side and the other at the other side of the chuck; means for rotating the wheels simultaneously; an automatic mechanism common to both grinding wheels and adapted to vibrate them laterally during their simultaneous rotation; means for automatically feeding the grinding wheels one after the other to the work to be ground; automatic mechanism for successively moving the grinding wheels away from the work; automatic mechanism for arresting the rotation of the chuck; and automatic mechanism for reciprocating the carrier; said

chuck mechanism comprising a fixed and loose power-transmitting device, and each grinding wheel being provided with a power transmitting device; a main shaft provided with a power-transmitting device; and operative automatic connections between the shaft and said automatic means for vibrating the grinding wheels; operative automatic connections between the shaft and the fixed and loose pulley power-transmitting device; and operative connections between said shaft and said automatic chucking mechanism.

In testimony whereof I affix my signature in presence of two witnesses.

SIMON DOKK OLSEN.

Witnesses:
EDWARD S. BEACH,
EDWARD E. BLACK.