No. 607,369. Patented July 12, 1898.

G. H. HATHORN.

MACHINE FOR GRINDING AND POLISHING.

(Application filed Aug. 16, 1897.)

(No Model.) 2 Sheets—Sheet 1.

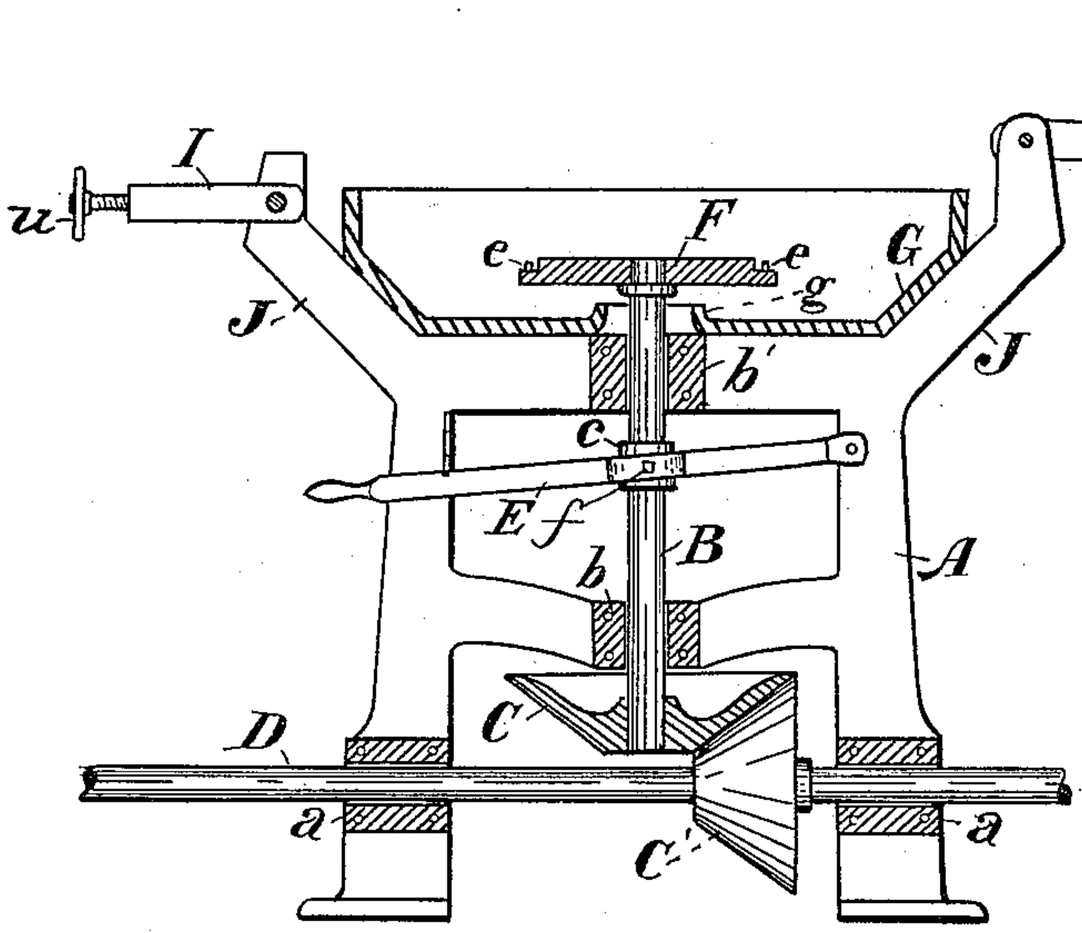

Fig. 1

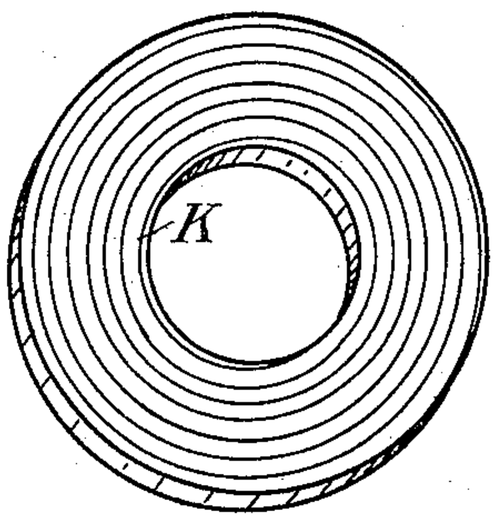

Fig. 2

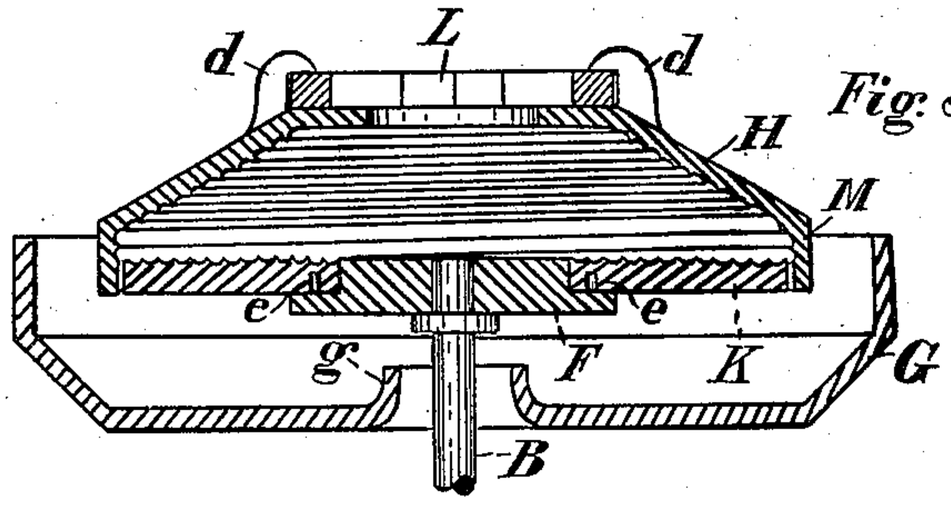

Fig. 3

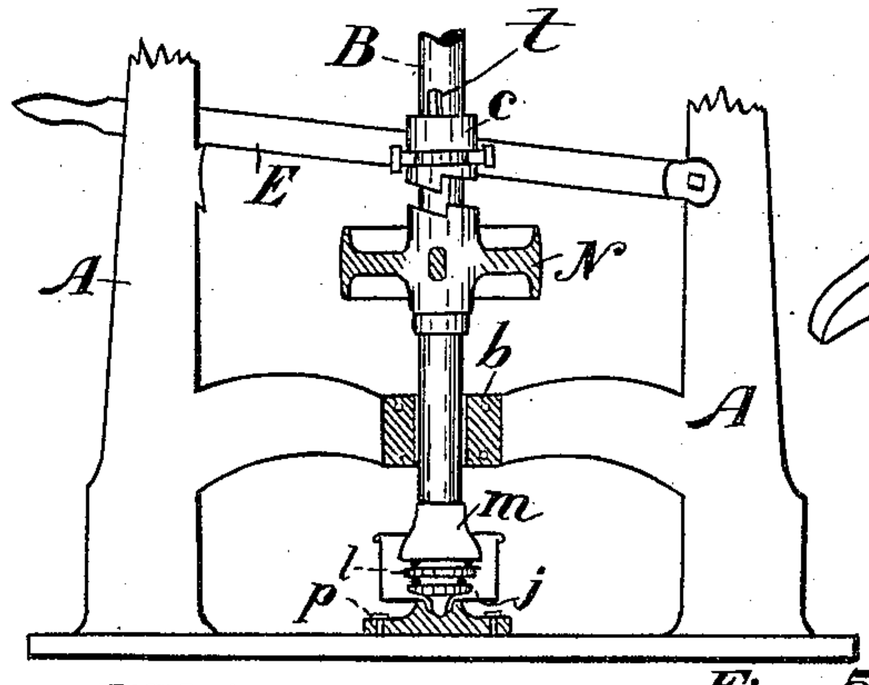

Fig. 5

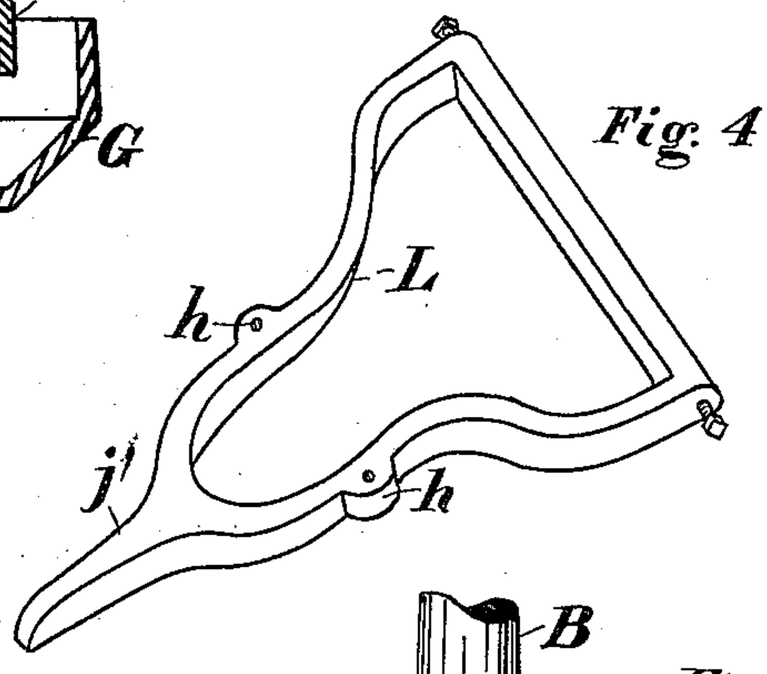

Fig. 4

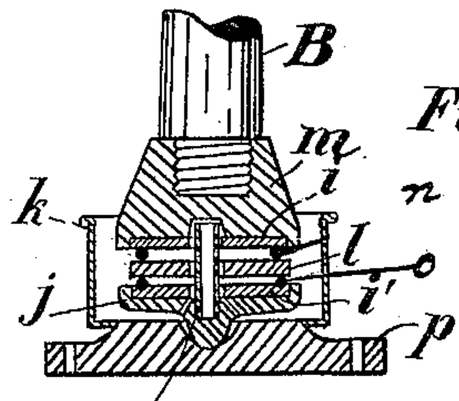

Fig. 6

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(No Model.) 2 Sheets—Sheet 2.

Fig. 7.

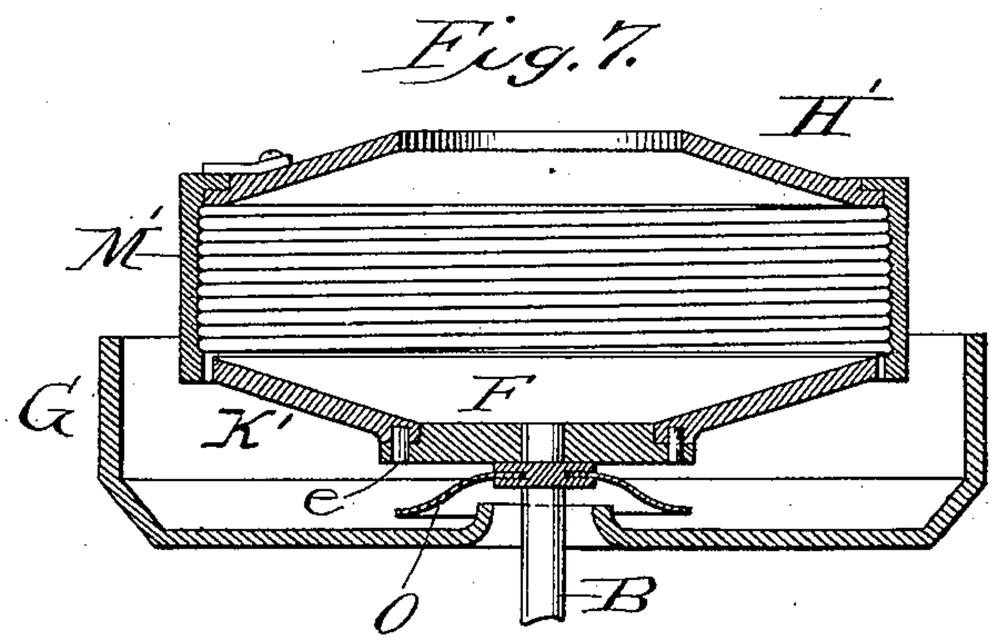
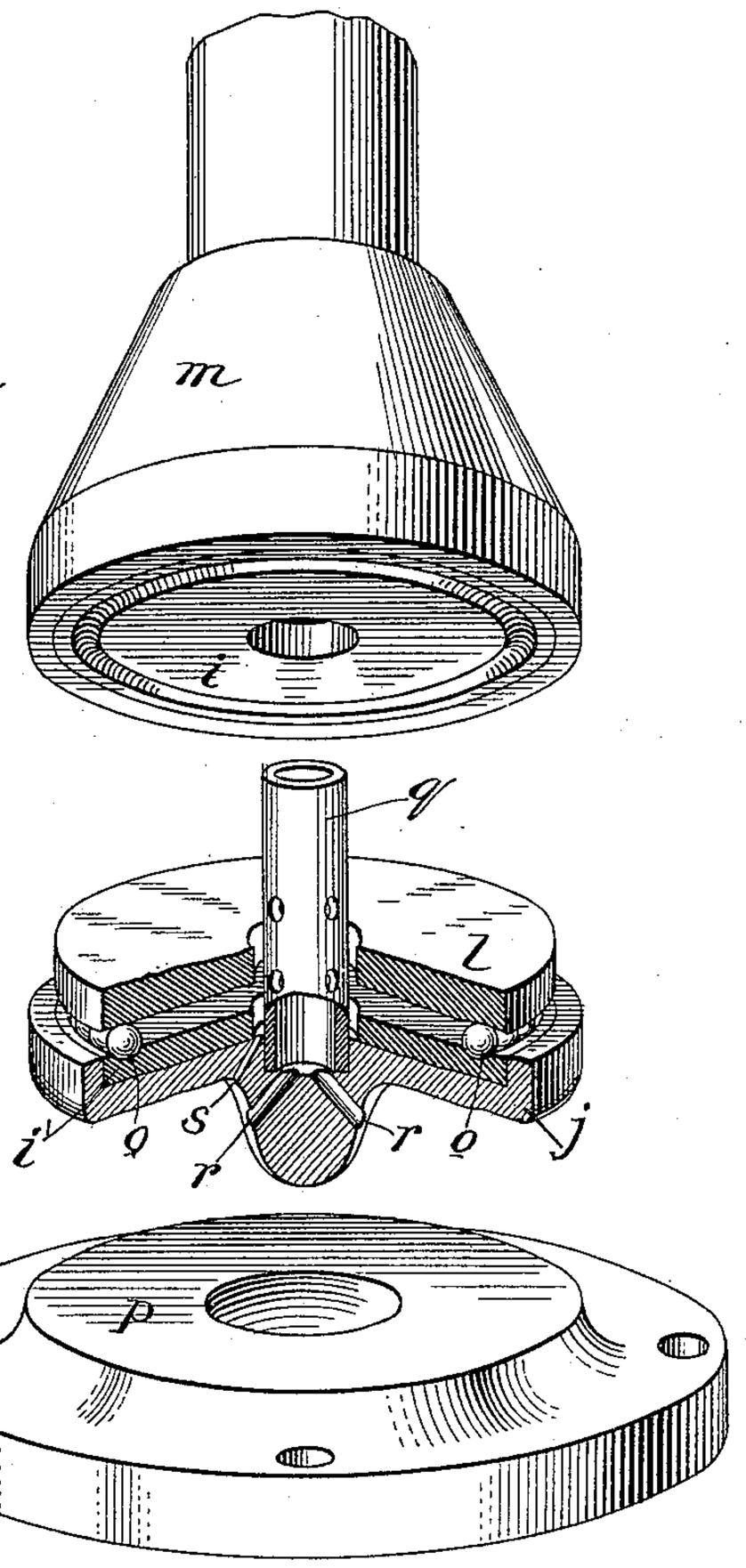


Fig. 8.



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UNITED STATES PATENT OFFICE.

GEORGE H. HATHORN, OF BANGOR, MAINE, ASSIGNOR TO THE DIRIGO BALL MANUFACTURING COMPANY, OF SAME PLACE.

MACHINE FOR GRINDING AND POLISHING.

SPECIFICATION forming part of Letters Patent No. 607,369, dated July 12, 1898.

Application filed August 16, 1897. Serial No. 648,441. (No model.)

To all whom it may concern:

Be it known that I, GEORGE H. HATHORN, a citizen of the United States, residing at Bangor, in the county of Penobscot and State of Maine, have invented certain new and useful Improvements in Machines for Grinding and Polishing, of which the following is a specification.

This invention relates to machines for grinding and polishing metal bodies to reduce them to true spherical form; and it consists in features, details, and combinations hereinafter recited.

The accompanying drawings illustrate the preferred form or embodiment of my invention, which will be explained in connection therewith.

Figure 1 is a sectional elevation of the improved machine with the cover or hood thrown back to afford access to the interior of the containing vessel and with the annular plate or disk removed; Fig. 2, a perspective view of said annular plate detached; Fig. 3, a sectional view of the main operative parts in working relation; Fig. 4, a perspective view of the lever or yoke by which the hood or cover is lifted; Fig. 5, an elevation, partly sectional, of the spindle, step, and clutch; Fig. 6, a sectional view of an antifriction-step; Fig. 7, a sectional view of the rotary disk and its hood or cover in slightly-modified form; Fig. 8, an enlarged perspective view of the antifriction-step, showing the parts separated and some of them in section.

In the drawings, A indicates a framework which may advantageously be formed of cast-iron, though wood or other materials may be used in whole or in part. The horizontal or cross members of this frame are provided with boxes or bearings *b b'*, as in Fig. 1, or with a step-bearing and guide-box *b*, as in Fig. 5, to carry a vertical shaft or spindle B.

In Fig. 1 the spindle or shaft B is represented as furnished with a beveled wheel C, which receives motion from a similar wheel C', carried by a horizontal shaft D.

The wheels C C' may be provided with teeth, or they may be friction-wheels, as preferred.

E indicates a lever provided with pins or studs *f*, which, entering a circumferential groove in a collar *c*, carried by the spindle B, serve to raise or lower the spindle as the lever is elevated or depressed, so that the wheels C C' may be carried into or out of contact and the machine be accordingly started or stopped at will.

Keyed, screwed upon, or otherwise secured to shaft or spindle D is a disk or plate F, the periphery of which is shouldered, as seen in Fig. 1, to afford a centering bearing and support for an annular plate or disk K, which rests thereon, as shown in Fig. 3, and is held in locking engagement therewith by pins *e e* or equivalent studs or projections extending from one of said parts into recesses in the other.

In Figs. 2 and 3 the disk or plate K is represented as a flat or horizontal plate, with a continuous spiral channel or groove in its face, and this is the preferred form; but it may be made dishing or with an upwardly-inclined face, as in Fig. 7, and channeled, as in Figs. 2 and 3, or smooth, as in Fig. 7. So, too, the spiral groove or channel may be provided or omitted when the plate is flat, and when provided will disappear in a comparatively short time through wear.

Above the disk or plate K or K' is a hood or cover H or H', the depending skirt M or M' of which encircles the periphery of said disk or plate, as shown in Figs. 3 and 7, the inner surface of said hood being formed with a spiral groove or channel, as shown in the drawings. The direction of the spiral of the groove should in all cases be such that when the disk or plate K or K' is rotated in its prescribed direction bodies lying upon the disk shall traverse said groove or channel and be thereby guided outward, or, in other words, the centrifugal force due to rapid rotation of the disk tends to throw the bodies outward and the spiral groove or channel of the plate operates to determine the rate of outward movement.

In moving outward the bodies roll over and over in the direction of the length of the groove or channel and are also caused by the outward pressure and movement and the movement of other bodies against and over them to change their axes of rotation, so that all sides are ground. In this way and in a

very short time, comparatively speaking, bodies of irregular shape are rendered truly spherical. Owing to the fact that these bodies rest upon the plate or disk K or K′ they necessarily partake in a measure of its motion about its axis. Hence when they leave the periphery of the disk they tend to follow after it some distance, particularly as they make contact with the skirt M or M′ before losing contact with disk K or K′. If the disk K be flat, there will be no tendency of the bodies reaching its edge to rise unaided, though if the disk be dishing, as in Fig. 7, an upward direction will be imparted to them. To insure such upward movement, whether the disk be flat or dishing, and to prolong the grinding action, I preferably form in the inner face of the skirt M or M′ a spiral groove or channel running in such direction relatively to the direction of rotation of the disk that bodies entering said groove shall be caused to ascend the spiral by reason of the momentum acquired in moving with the disk. The action is a peculiar one, the bodies lying upon the disk partaking of its motion in considerable degree, but not moving at the same velocity, owing to the slipping or sliding of the disk beneath and relatively to the bodies thereon. The speed acquired by the bodies thus carried will vary with their nature, but in the present case may, it is thought, be reasonably assumed to be from a third to a half of that of the portion of the disk lying immediately beneath. Whatever the relation may be in fact, the velocity acquired by the bodies is sufficient to cause them to ascend the spiral channel or groove of the hood to a considerable height, varying with the character and the degree of finish of said bodies and the abrading or polishing materials carried with them.

If the skirt M or M′ be of considerable depth, the bodies may ascend only part way up the same and then fall back; but if it be shallower they may pass above the skirt and travel around the indrawn or converging walls of the hood a greater or less distance until their momentum is so far reduced that they will fall back to the disk K or K′.

Whatever be the character or extent of the action the bodies are repeatedly carried outward and then fall or roll inward, sometimes directed by the hood and sometimes rolling back over the accumulation at the circumference of the disk, but in all cases being subjected again and again to the action of the disk.

Extended use of the machine has demonstrated its great capacity and efficiency.

For convenience in applying and removing the hood or cover and for the purpose of maintaining it in proper working position I hinge or pivot between two upright arms J J of the frame A a lever L, provided with ears *h* and with a handhold *j′*, and I form the hood or cover with lugs or hooks *d* to engage over the ears *h*, as seen in Figs. 1 and 3. The ears are perforated or socketed, as seen in Fig. 4, to receive fastening screws or bolts should these be deemed necessary. At the side of frame A, opposite that at which the lever L is hinged, I pivot or hinge to another arm J of the main frame a bail I, carrying a screw and handwheel *u*. When the lever L is brought over the frame to lower the hood or cover to place, the bail I is swung up over its end or handhold *j′* and the screw is set down sufficiently to hold the lever rigidly in position, its lower side resting upon the arm J, which thus serves as a stop or gage to determine its position.

The foregoing description is based mainly upon the manner of mounting and actuating the shaft illustrated in Fig. 1. For the purpose of reducing friction and vibration I prefer to mount the shaft or spindle on an antifriction-step of the construction illustrated in Figs. 5, 6, and 8, also allowing to the spindle a limited amount of play in its guiding or supporting box *b* after the manner of the spindles of centrifugal separators or extractors. As shown in these figures, the spindle B has at its lower end an enlargement *m*, represented in the form of a block screwed thereon and having a central cavity or depression. The lower face of the enlargement *m* is also recessed to receive a hardened steel plate *i*, in which is formed a circular groove or track to receive antifriction balls or rollers *n*. Directly beneath the balls *n* and constituting a track or bearing therefor is a steel plate or disk *l*, which in turn is supported by a series of balls or rollers *o*, traversing a circular groove in a steel plate *i′*, seated in a disk or block *j*, having on its under side a rounded central projection which rests in a corresponding but larger depression in a step-plate *p*. This latter plate *p* is made fast to the frame A or to the floor on which it stands and is furnished with a cup *k*, which rises somewhat above the lower end of block *m*, as seen in Figs. 5 and 6. The cup serves to hold a supply of oil, which is preferably kept at a sufficiently high level to submerge the lower series of balls or rollers *o*, or it may rise to or above the second series.

Rising from the center of the disk or block *j* is a tube *q*, the sides of which are perforated and the lower end of which encircles or encompasses the upper ends of passages *r*, formed through the disk or block *j*. Other openings *s* through said disk *j* pass to the outside of the tube and to the space between it and the central opening of the plate *i′*, which, like that of the plates *i* and *l*, is somewhat larger in diameter than tube *q*. Under this construction of parts a constant circulation and distribution of oil is effected, the oil tending to rise by capillary attraction within tube *q* and between it and the encircling walls of the openings in the several plates, aided by the suction due to the outward movement of the oil over the several disks through centrifugal force and to the natural tendency of the oil to flow back to

the center and to rise to replace that thrown off. In moving outward over the disks the oil is supplied to both sets of balls or rollers and to the tracks which they traverse, and in this way perfect lubrication is effected and maintained.

When the stepped spindle is employed, I provide it with a loose band-wheel N, having its hub provided with clutch-teeth to engage with similar teeth of collar *c*, which under this arrangement of parts is free to move a limited distance vertically, but is caused to rotate with the shaft by a connecting spline or feather *t*. The lever E serves under this arrangement to raise and lower only the collar *c*, and thus to uncouple or to couple the band wheel and shaft to stop or start the machine.

The lever E may be retained in its different positions by any usual form of rack or holding device.

To collect the oil and abrading materials used in the machine and thrown off at the periphery of the disk through centrifugal force, I provide a pan G, the outer walls of which rise above the lower edge of skirt M or M′ of the hood or cover. The central opening through which the shaft or spindle passes also has an upturned flange or wall to prevent escape of oil at that point. Finally, to prevent oil, &c., following down the under face of disk K or K′ and the shaft or spindle B a disk O is applied to the latter below disk K or K′ and preferably of the form indicated in Fig. 7. Whether the speed be sufficient to throw off the oil by centrifugal force or it drip from the disk by gravity, it will fall beyond the flange or wall *g* and be received and retained within the pan G.

In the foregoing description I have spoken of the enlargement *m* as made separate from and secured to the spindle B, and I have also described the plates *i* and *i′* as being made separate and removable; but these features while considered desirable are not essential.

As the skirt M or M′ requires to be redressed somewhat frequently and wears away much more rapidly than the top of the cover I prefer to make it separate from the top and to form the parts with interlocking shoulders, as in Fig. 7. Obviously any equivalent means of connection may be provided.

The interposition of the disk F between the disk or plate K or K′ and the spindle B permits the ready removal of the disk for redressing or for the substitution of another disk, and this provision is quite desirable; but it is obvious that the machine will operate satisfactorily without this special construction.

It is of course understood that the parts H′, K′, and M′ are the mechanical equivalents of the parts H, K, and M, and the claims are to be read and understood accordingly.

Having thus described my invention, I claim—

1. In a machine for grinding and polishing, the combination of a disk or plate rotatable about a vertical axis; and a fixed encircling skirt or body having a spiral groove or channel rising from the disk in the direction of rotation of the latter.

2. In a machine for grinding and polishing, the combination of a disk having in its face a spiral groove adapted to receive and guide the bodies to be ground or polished; and means for imparting to the disk a high speed of rotation; an open or unobstructed space being left above the disk to permit the free rise and fall of the articles placed thereon, and to enable them to freely change their axes of rotation.

3. In combination with a spirally grooved or channeled disk and with means for imparting rotation thereto; a fixed encircling wall to arrest bodies thrown off from the disk and to return them thereto.

4. In a machine for grinding and polishing, the combination of a spindle; a disk or plate carried thereby and having a spiral groove or channel formed in its face; means for rotating said spindle and disk; and a hood or cover having its skirt arranged to encircle the disk and provided with a spiral groove or channel rising in the direction of rotation of the disk.

5. In combination with spindle B and disk F secured thereto; detachable annular disk or plate K carried by disk F; and hood or cover H encircling and covering the disk F, substantially as described and shown.

6. In combination with shaft or spindle B, and step-plate *p*, the antifriction-bearing, consisting of block or enlargement *m* and plates or disks *l* and *j* with balls or rollers interposed between proximate faces, substantially as and for the purpose set forth.

7. In combination with spindle B and parts *i*, *l* and *j*, the latter provided with perforations; tube *q* communicating with said perforations; and cup *k* encircling said parts, substantially as and for the purpose explained.

8. In a machine for grinding and polishing, the combination of a horizontal disk; means for rotating said disk; and a hood covering and encircling the disk and having a spirally-grooved skirt detachable from the top, substantially as and for the purpose explained.

In witness whereof I hereunto set my hand in the presence of two witnesses.

GEORGE H. HATHORN.

Witnesses:
W. E. BROWN,
GEO. W. E. BARROWS.