(No Model.) 3 Sheets—Sheet 1.

A. CAMPBELL.

GRINDING MACHINE.

No. 282,049. Patented July 31, 1883.

Fig. 1.

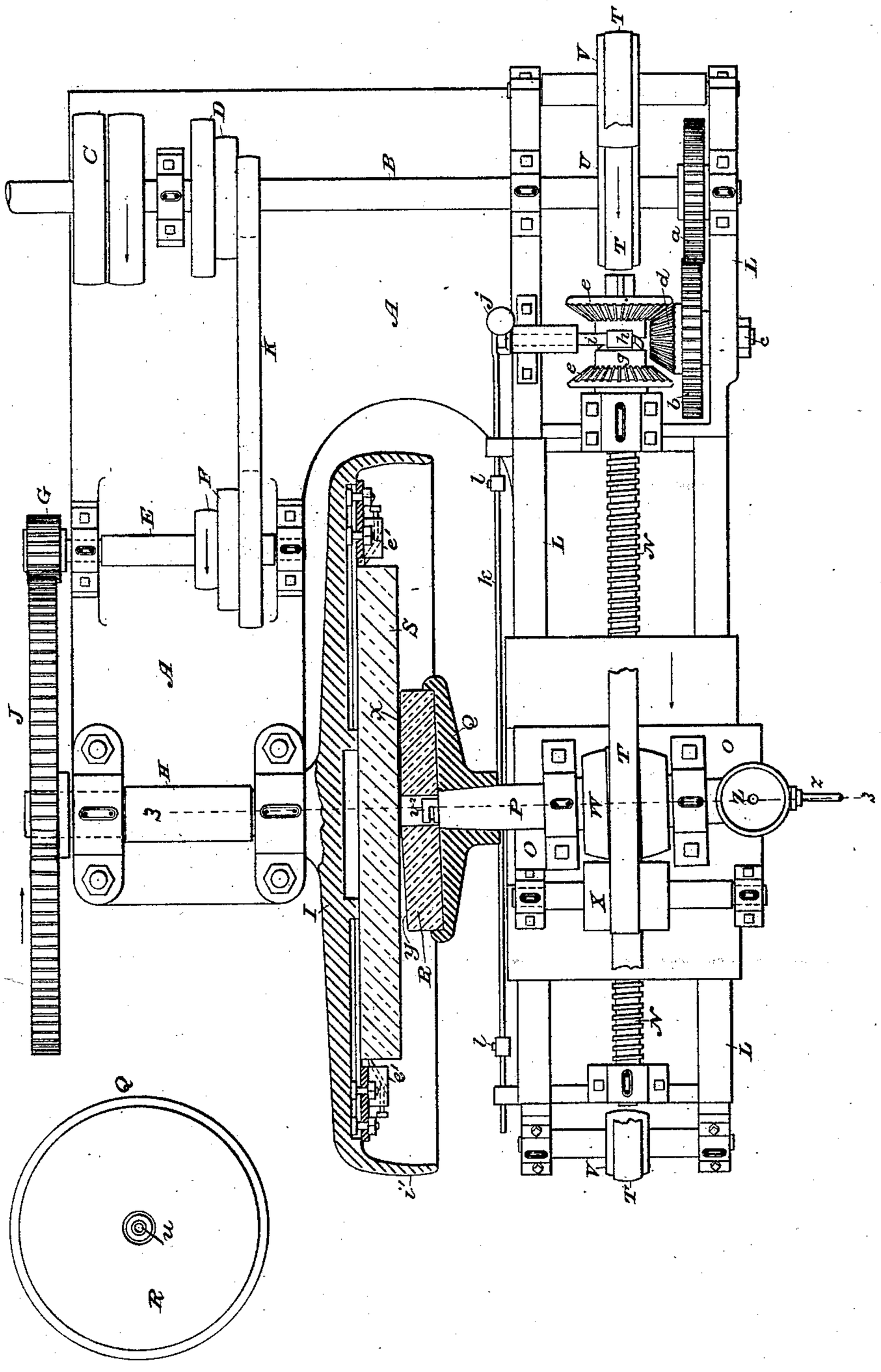

Fig. 5.

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Fig. 2.

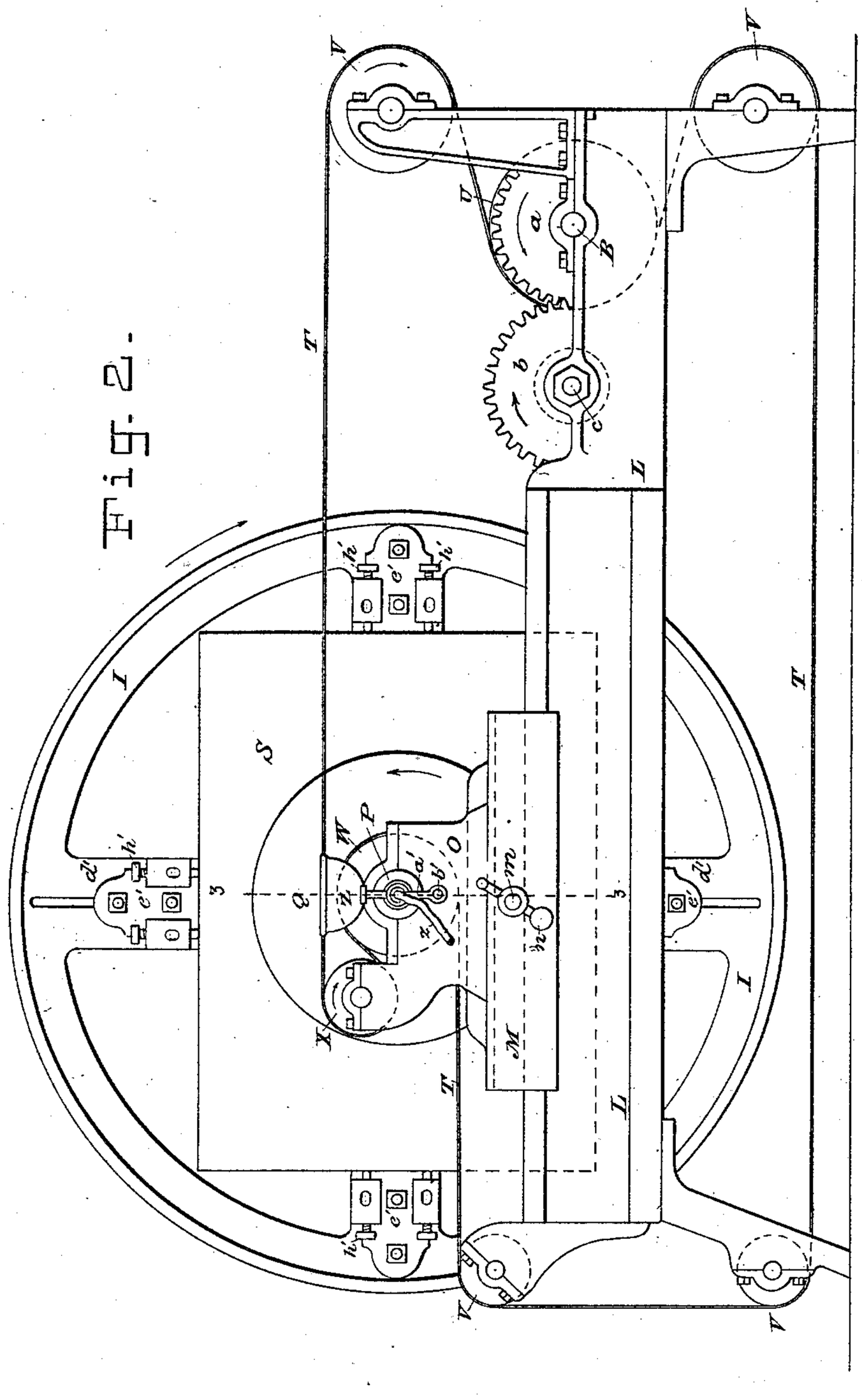

Fig. 4.

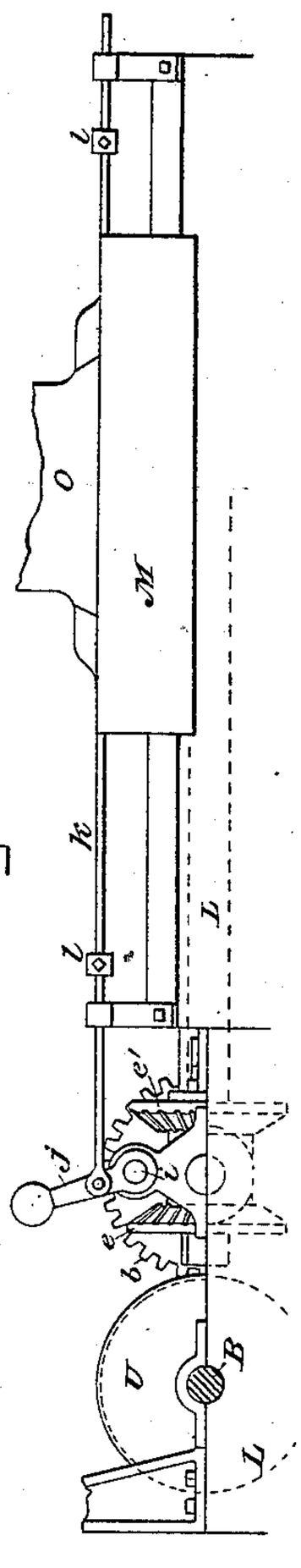

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Fig. 10.

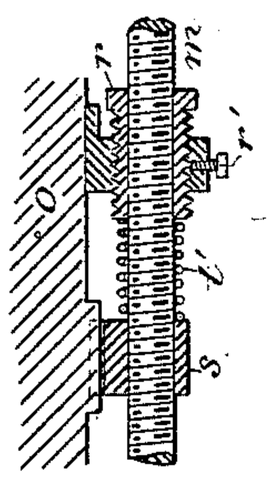


Fig. 11.

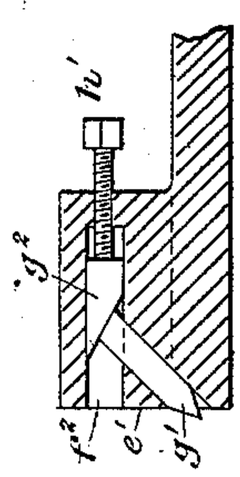


Fig. 9.

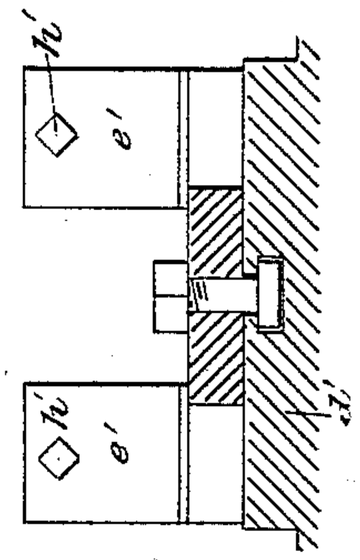


Fig. 3.

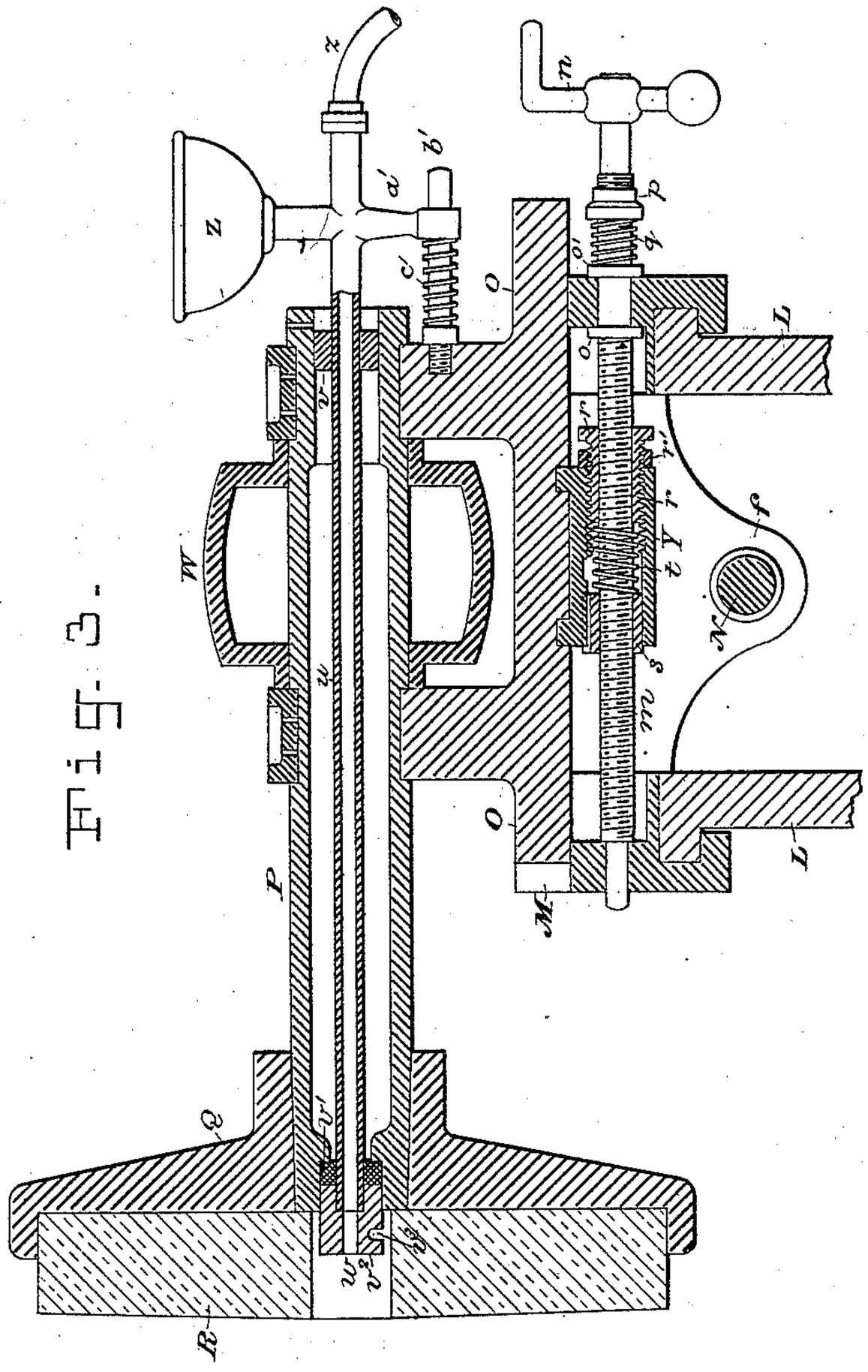
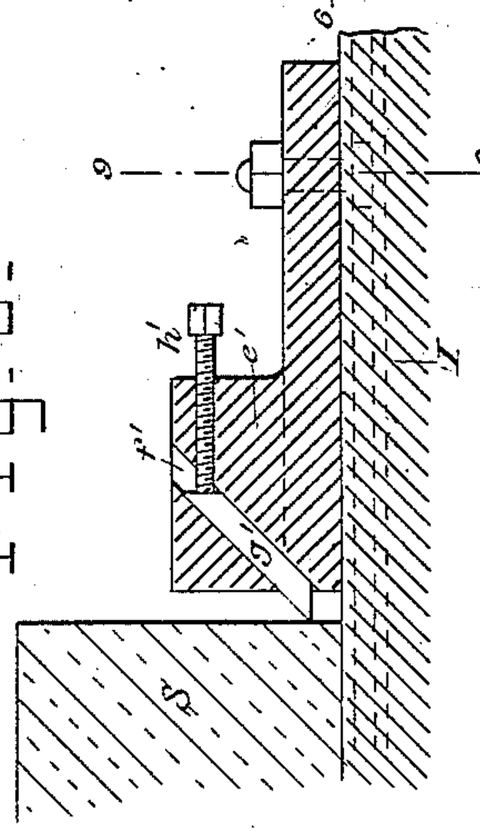


Fig. 8.

Fig. 7.

Fig. 6.



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UNITED STATES PATENT OFFICE.

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GRINDING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 282,049, dated July 31, 1883.

Application filed April 30, 1883. (No model.)

To all whom it may concern:

Be it known that I, ANDREW CAMPBELL, a citizen of the United States, residing at Brooklyn, Kings county, New York, have invented certain Improvements in Grinding-Machines, of which the following is a specification.

My invention relates to a machine designed, primarily, for grinding down and facing lithographic stones and bringing them to a uniform thicknes; but it may be employed for other analogous purposes—as for example, in truing up the faces of stones for other uses, and in grinding the faces of metal or glass plates. The stone or other thing to be ground is mounted on a revolving face-plate, and the rotating grinder is fed across its face and up to it by means of a cross-feed mechanism constructed similar to the cross-feed of an ordinary metal lathe. The grinder has a face in the form of a very flat cone, the angle of which need not exceed one degree, and the axis of the grinder, which is in the axis of the cone, is set at an angle with the axis of the face-plate which bears the stone or other thing being ground, this angle corresponding with the angle of the cone of the grinder. Thus the grinder presents to the surface to be ground a face that is nearly flat, and of course continuous, the effect being much the same as that produced with a broad grindstone of several hundred feet in diameter. Through the hollow axis of the grinder are introduced suitable abrading substances—as sand, glass, or emery—and water or other liquid. Novel means are provided for insuring a positive and accurate cross-feed, and for clamping the stone or other thing to be ground to the face-plate, all as will be hereinafter more fully described.

Another important feature of my invention is the grinding of the face of a lithographic stone by the application to its face of a rotary grinder, while the stone itself is made to rotate with the face to be ground arranged in a vertical or nearly vertical plane. Stones of this character must have perfectly plane faces, and I find this method of grinding especially well adapted for producing perfect results. I support the stone in a rotating holder or chuck, so that it stands up edgewise, whereby all tendency to sag in the center as it revolves is entirely avoided.

In the drawings, which serve to illustrate my invention, Figure 1 is a plan of my improved grinder, the face-plate and grinder being in horizontal mid-section. Fig. 2 is a side elevation. Fig. 3 is a cross-section, drawn to a scale double that of Figs. 1 and 2, through the axis of the grinder, substantially on lines 3 3 in Figs. 1 and 2. Fig. 4 is a view of the side of the machine opposite to that in Fig. 2. Fig. 5 is a front view of the conical-faced grinder. Figs. 6, 7, 8, and 9 are detached views on a large scale, designed to illustrate the clutch-jaw for holding the article to be ground. These will be referred to hereinafter. Figs. 10 and 11 illustrate modifications.

Referring to Figs. 1 and 2, A is a substantial bed-plate, upon which are mounted the main shaft B, bearing tight and loose pulleys C and cone-pulleys D, a counter-shaft, E, bearing cone-pulleys F, and a pinion, G, and a shaft, H, bearing the face-plate I, and a spur-wheel, J, which meshes with the pinion G. The counter-shaft is driven from the main shaft through the medium of a belt, K, which connects the two sets of cone-pulleys, as shown in Fig. 1.

L represents the bearing-frame, upon which is mounted a slide or carriage, M. This slide is operated automatically by means of a gear-wheel, *a*, on the main shaft, which meshes with another gear-wheel, *b*, mounted rotatively on a stud, *c*, in the frame L. Secured to wheel *b* is a miter-wheel, *d*, which meshes with one or the other of the miter-wheels *e* and *e*, connected together and splined on the end of the feed-screw N, which engages a nut, *f*, (shown only in Fig. 3,) on the carriage M. Rotation of the main shaft B imparts slow rotary motion to the face-plate I, and a reciprocating motion to the slide or carriage M on the bearings or shears L. This reciprocating movement is produced by means of mechanism I will now describe with reference to Figs. 1 and 4. As before stated, the miter-wheels *e* and *e* are connected together by a circumferentially-grooved sleeve,

g, and are splined on the screw N. By sliding them on the screw either may be made to engage the wheel *d*, and thus the rotary motion of the screw be reversed. In order to effect this reversal automatically, I provide a fork, *h*, to engage the groove in the sleeve *g*, and secure this to a shaft, *i*, mounted to oscillate in a suitable bearing on L. To the outer end of this shaft I secure a weighted arm, *j*, and this I couple to a shifting-rod, *k*, on which are adjustably fixed collars *l l* in the path of the carriage M. Thus when the carriage reaches the end of its movement it strikes the collar, and through rod *k* shifts the gears *e e*. This is a well-known shifting device, and I make no specific claim to it. Other well-known devices may be employed in lieu of this, or the shifting may be effected by hand.

O is a carriage or slide mounted in guides or keepers on the slide M, and adapted to be moved on the same transversely of the slide M and at right angles to the axis of the feed-screw N—that is to say, in a plane parallel to the axis of the shaft H, which bears the face-plate I. On the carriage O is rotatively mounted a hollow shaft, P, which bears the grinding-head. This latter comprises a chuck or holder, Q, and the conical grinder R. This grinder may be of stone, emery, or any suitable abrading or polishing material adapted to the purpose. I make its face conical, as shown in Figs. 1 and 3, preferably employing an angle of only one or two degrees with the base, or eighty-eight to eighty-nine degrees with the axis of the cone. In order to bring the face of the cone on one side (*x* in Fig. 1) parallel to the face of the stone or other article, S, being ground, I mount the shaft P obliquely with the axis of shaft H as respects the vertical plane; but the two are aligned in the horizontal plane. This gives a clearance on the opposite side, (*y* in Fig. 1,) as clearly shown. The coned grinder is thus made to present practically a nearly flat face to the stone S, and a continuous surface moving always in one direction. As the stone S moves slowly on its axis and the rotating grinder R plays back and forth across its surface, every part of the surface of the stone will be subjected to the same abrading action. In order to impart at once a reciprocating and a rotary movement to the grinder, I provide the mechanism I will now describe, with reference particularly to Fig. 2.

T is an endless belt, which passes over a pulley, U, on the main shaft B, guide-pulleys V V on the frame of the machine, a pulley, W, on the grinder-shaft P, and a guide-pulley, X, on the carriage O. This arrangement permits, as will be understood without further explanation, the driving of shaft P from the main shaft without slackening belt T, in whatever position the carriages M and O may stand.

It is important that the cross-feed mechanism, whereby the carriage O is moved, and whereby the grinder R is fed up to the stone S, shall be very positive in its action and sensitive to the slightest movement of the cross-feed screw. To accomplish this I provide the said screw with appliances clearly shown in Fig. 3, wherein *m* is the cross-feed screw, mounted in the carriage M, and provided with a suitable crank, *n*. To prevent any end-play in its bearings, due to wear, this screw is provided with a fixed collar, *o*, inside of the bearing, a loose collar, *o'*, outside the bearing, an adjusting-nut, *p*, and a spring, *q*. The spring must have strength sufficient to overcome the resistance offered by the carriage O. This device provides against lost motion in the screw-bearings. To guard against lost motion in the nut on the carriage O the following described device is employed: Y is a tubular shell secured to the under side of the carriage O, and *r* is a nut, internally and externally threaded, which screws into the end of Y, and also screws onto the feed-screw *m*. This nut is provided with a set-nut, *r'*. In the other end of the shell Y is splined a tubular nut, *s*, which also screws onto the feed-screw *m*, and between the nuts *r* and *s* is arranged a spiral spring, *t*. This spring may be adjusted to any tension required by screwing in the nut *r*. This tension must be sufficient to resist any opposition due to the inertia of the carriage O. The tubular shell need not extend over the spring *t* and nut *s*, except in so far as to provide a splined attachment for the nut *s* to carriage O to prevent it from turning with the screw; but as constructed the springs and nuts are housed and protected from dirt. A set-screw might be substituted for the nut *r'*. Fig. 10 illustrates this construction.

Fig. 3 illustrates the means for supplying the grinder R with sand and water or other grit and liquid. Through the hollow of shaft P extends a tube, *u*, which has bearings at *v v'* in shaft P, and opens into a central cavity, *w*, in the grinder. This tube *u* does not rotate with shaft P, and is provided with a receiver or holder, Z, for the grit, and a hose or pipe, *z*, to lead the water or other liquid from the supply to the tube *u*. From the rear end of tube *u* depends a branch, *a'*, with an eye which engages a stud, *b'*, on the carriage O. Behind this arm is a spring, *c'*. This permits the pipe *u* to be moved longitudinally on its bearings, so that the bearing *v'*, which is in the nature of a rawhide-piston, may be got at for oiling. This tight-fitting piston prevents water and grit from getting into the shaft P and at the bearings. Spring *c'* retracts the parts. On the end of pipe *u* is a species of head or nozzle, v^2, with a recess at v^3, in its lower lip to prevent the water and grit from working back into the bearing. This is not very important; but the recess or groove at the lower side of the lip, where the gritty liquid is apt to collect, serves in some degree as a barrier to prevent the liquid from being carried back by capillary attraction to the bearing in the shaft P.

I will now describe my improved chuck or

clamp which I employ herein for holding the stone S in place in the face-plate I. This device is shown in position in Figs. 1 and 2, and is illustrated on a larger scale, detached, in Figs. 6, 7, 8, and 9. I show each jaw of the chuck constructed double—that is, with two gripping-teeth; but this is not essential. On the face-plate I are formed two diametrically-arranged raised seats, *d'*, which are slotted and undercut, as shown, to receive the heads of the clamp-bolts, in the manner of an ordinary clamping-chuck. The clamping-jaw *e'* of the chuck is penetrated by an aperture or cylindrical bore, *f'*, arranged obliquely and opening out at the top and face of the jaw, as shown in Fig. 6, which is a vertical section on line 6 6 in the plan, Fig. 7. This bore *f'* receives a tooth or dog, *g'*, (shown detached in Fig. 8,) which has its ends beveled, as indicated. A screw, *h'*, screws through the jaws *e'* from the back and impinges upon the beveled upper end of the tooth *g'*, which is presented to it at right angles. The lower sharp end of the tooth projects from the face of the jaw adjacent to the stone S and bites into the same when *h'* is brought to bear against its upper end. The pressure on the stone being oblique, it will be seen that the stone will be pressed up firmly to its bearings *d'* on the face-plate, as well as held between the converging jaws of the clutch. I prefer to make the teeth *g'* from a cylindrical bar of steel; but they may be made from square or polygonal bars as well.

Fig. 9 is a cross-section on line 9 9 in Figs. 6 and 7, showing the slot in *d'*.

Fig. 11 illustrates a modification of my improved clamping-jaw. In this construction screw *h'* does not impinge directly upon the end of tooth *g'*, but upon a follower, g^2, which plays in a bore, f^2, and which has a beveled extremity that impinges on the beveled upper end of *g'*. The construction and operation will be obvious from inspection of Fig. 11.

I do not limit myself to the precise arrangement of the parts herein shown—for example, the shafts H and P may stand vertical or inclined instead of horizontal, as shown, in facing off metals or other surfaces where perfect accuracy is not required. For grinding the faces of lithographic stones, however, the stone should stand with the face to be ground in a vertical or nearly vertical plane. The shaft P might also be mounted on its carriage O, with its axis parallel to the path in which said carriage moves transversely across M, and the said carriage O be mounted to stand and move obliquely on the carriage M. This would give the shaft P its proper obliquity.

The grinder R may be constructed of the proper shape and then set in the holder Q by screws or cement, or it may be made from some suitable composition, as emery, sand, and hydraulic cement, and molded directly in the holder. The grinder need not be fed past the center of the stone S; indeed I prefer it should not, as in that case the two would move in the same direction, which is objectionable. The arrows in Figs. 1 and 2 illustrate the direction in which the rotating parts move.

I provide the face-plate I with a raised cup-like flange, *i'*, as shown in Fig. 1, to act as a guard and prevent the gritty liquid from being thrown off and among the machinery. Instead of being mounted to rotate, this face-plate might be arranged to reciprocate, or it might be stationary and the grinder be arranged to move over its entire surface.

Having thus described my invention, I claim—

1. A grinding-machine comprising a suitable face-plate or chuck to hold the object to be ground, a grinder having a slightly-conical face mounted rotatively on an oblique axis, substantially as shown, and a feeding mechanism, substantially as described, for feeding said cone-faced grinder over the face of the object to be ground, substantially as set forth.

2. The combination, in a grinding-machine, of a face-plate to hold the object to be ground, mounted rotatively, a conical-faced grinder mounted rotatively on an axis oblique to the axis of the face-plate, and mechanism, substantially as described, for imparting a rotary motion to said face-plate and grinder, and for feeding the grinder up to and across the face of the object to be ground, substantially as and for the purposes set forth.

3. The combination, in a grinding-machine, of the face-plate I and its shaft H, the carriage M, mounted to slide on the frame or shears L, parallel with the face of the face-plate I, the carriage O, mounted to slide on the carriage M, and transversely thereof, the grinder R, with a conical face, mounted in a holder, Q, and the grinder-shaft P, mounted obliquely on the carriage O to a degree that will bring the face *x* of the grinder into a plane parallel to the face of the face-plate I, substantially as set forth.

4. The cross-feed screw *m*, provided with a fixed collar, *o*, a loose collar, *o'*, an adjusting-nut, *p*, and spring *q*, substantially as set forth.

5. The combination, with the carriage O and screw *m*, of the shell Y, secured to carriage O, the nuts *r* and *s*, and the spring *t*, arranged between them, substantially as and for the purposes set forth.

6. The combination, with the carriage O, of the screw *m*, provided with the tight and loose collars *o o'*, the nut *p*, and spring *q*, and the shell Y, nuts *r* and *s*, and the spring *t*, all arranged substantially as set forth.

7. The combination of the hollow grinder-shaft and the grinder, the tube *u*, provided with bearings in the hollow of the grinder-shaft, the holder or hopper Z for the grit, and the pipe *z*, supplying water or other liquid, substantially as set forth.

8. As a clamp for holding the object to be ground, a block or socket-piece provided with

an oblique bore, f', to receive the tooth, the said tooth g' and the screw h' for setting the tooth, substantially as set forth.

9. A machine for grinding the faces of lithographic stones, comprising means for holding the stone to be ground with its face to be ground in a substantially vertical plane, and means for rotating said stone while it is being ground, all constructed and arranged to operate substantially as set forth.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

ANDREW CAMPBELL.

Witnesses:
HENRY CONNETT,
ARTHUR C. FRASER.