(No Model.) 4 Sheets—Sheet 1.

# A. JOHNSTON.

## GRINDING DISK CUTTERS AND APPARATUS THEREFOR.

No. 504,386. Patented Sept. 5, 1893.

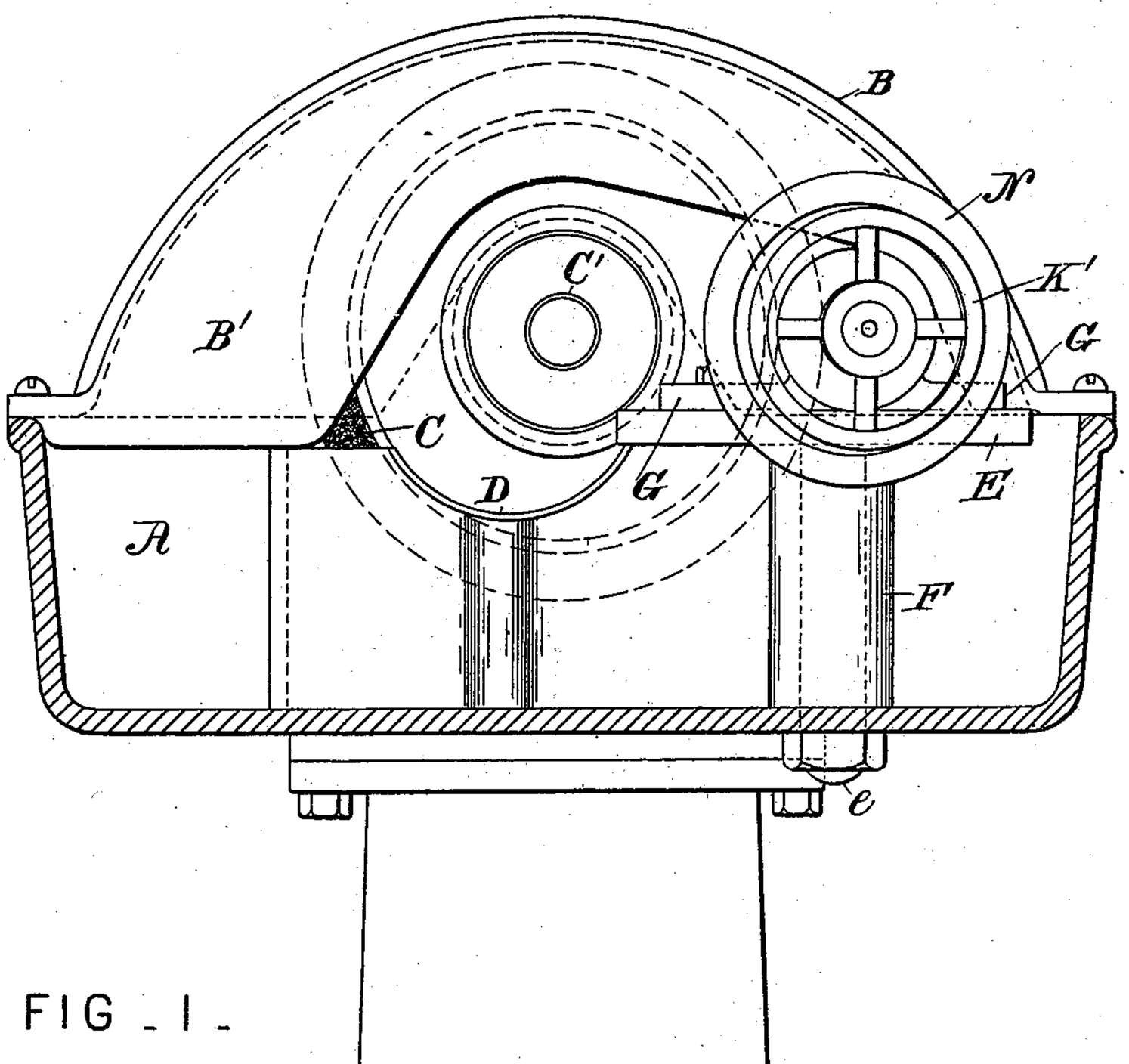



FIG. 1.

Attest:
Geo. T. Smallwood.
Geo. Lewes.

Inventor:
Allen Johnston.
by Foster & Freeman.
his attorneys

(No Model.)

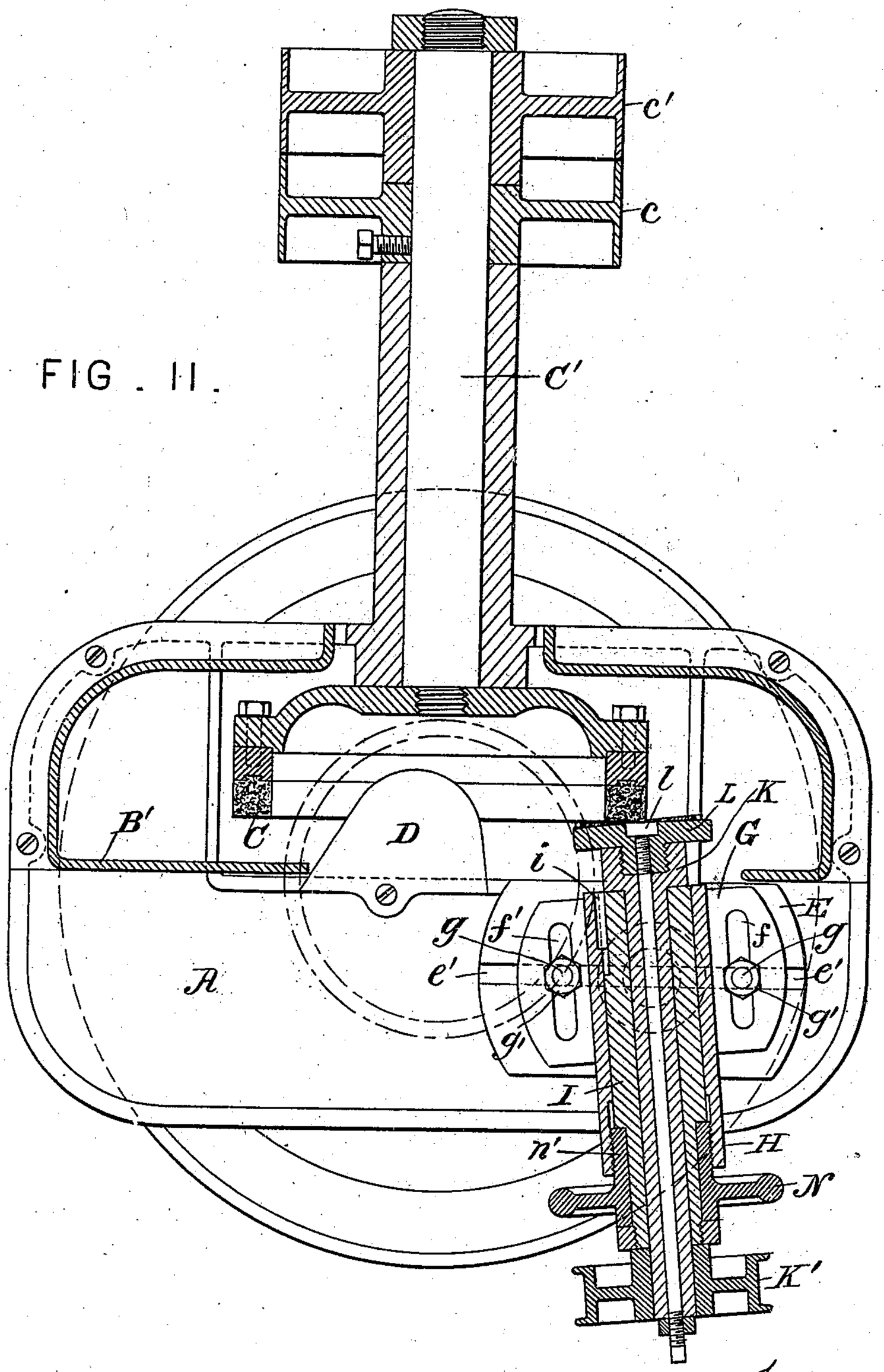
4 Sheets—Sheet 2.

# A. JOHNSTON.

## GRINDING DISK CUTTERS AND APPARATUS THEREFOR.

No. 504,386. Patented Sept. 5, 1893.

FIG. II.




Attest:
Geo. T. Smallwood.
Peter Lewis.

Inventor:
Allen Johnston
by Pollard & Mann.
his attorneys.

(No Model.) 4 Sheets—Sheet 3.

# A. JOHNSTON.

## GRINDING DISK CUTTERS AND APPARATUS THEREFOR.

No. 504,386. Patented Sept. 5, 1893.

FIG. III.

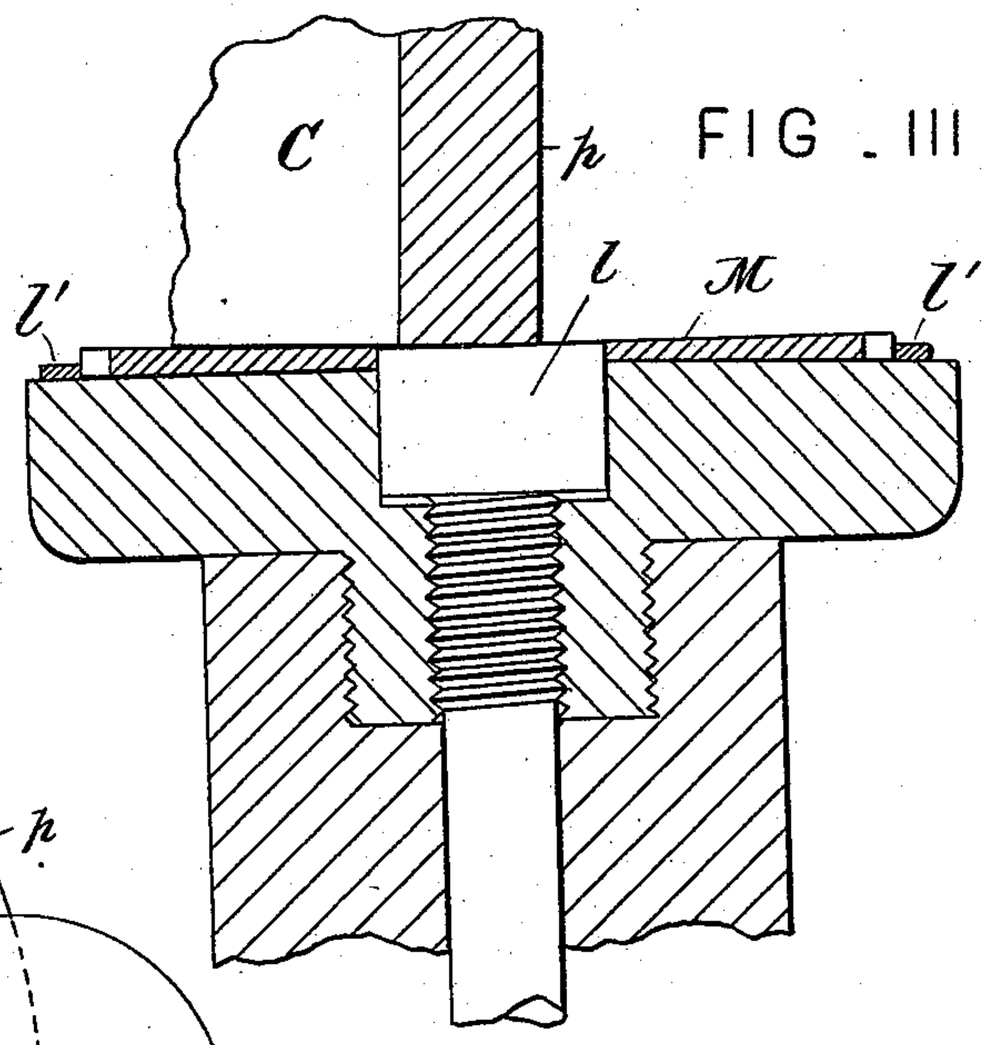



FIG. V.

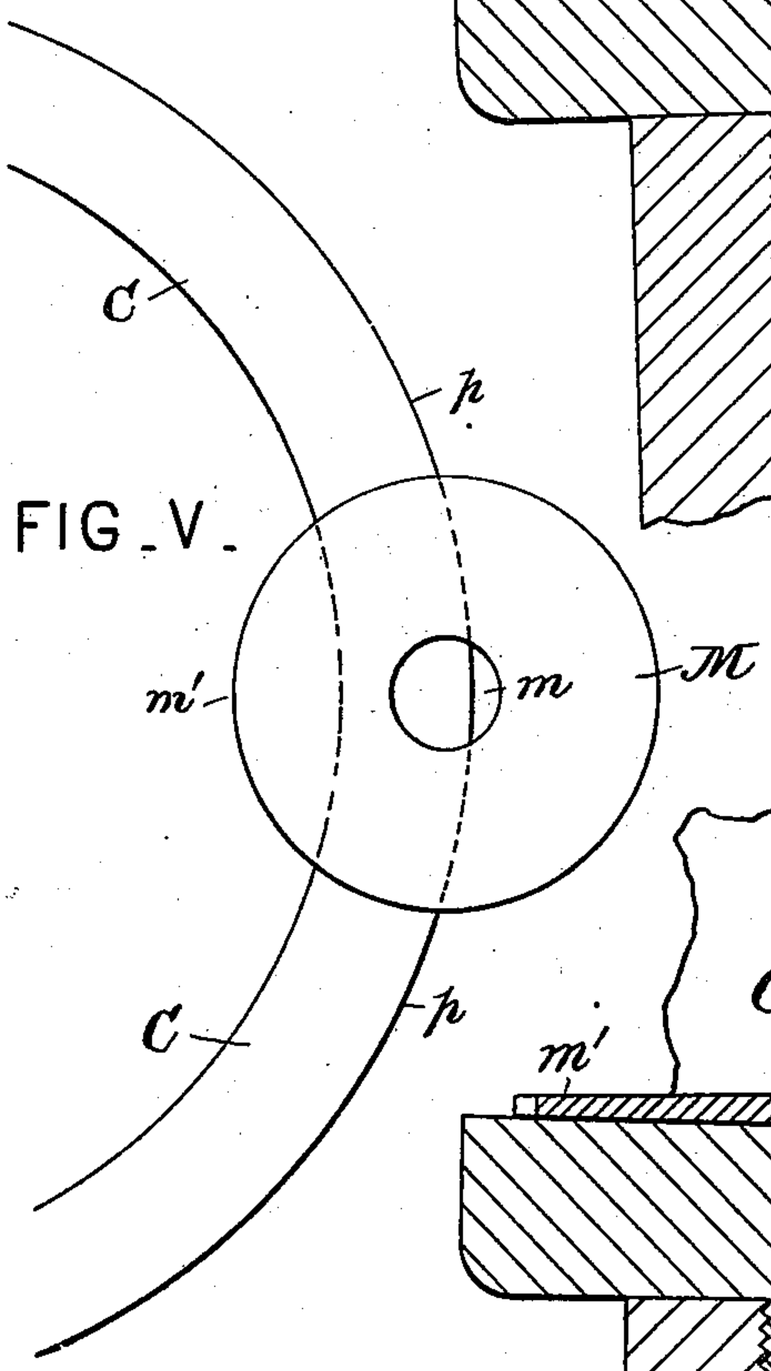
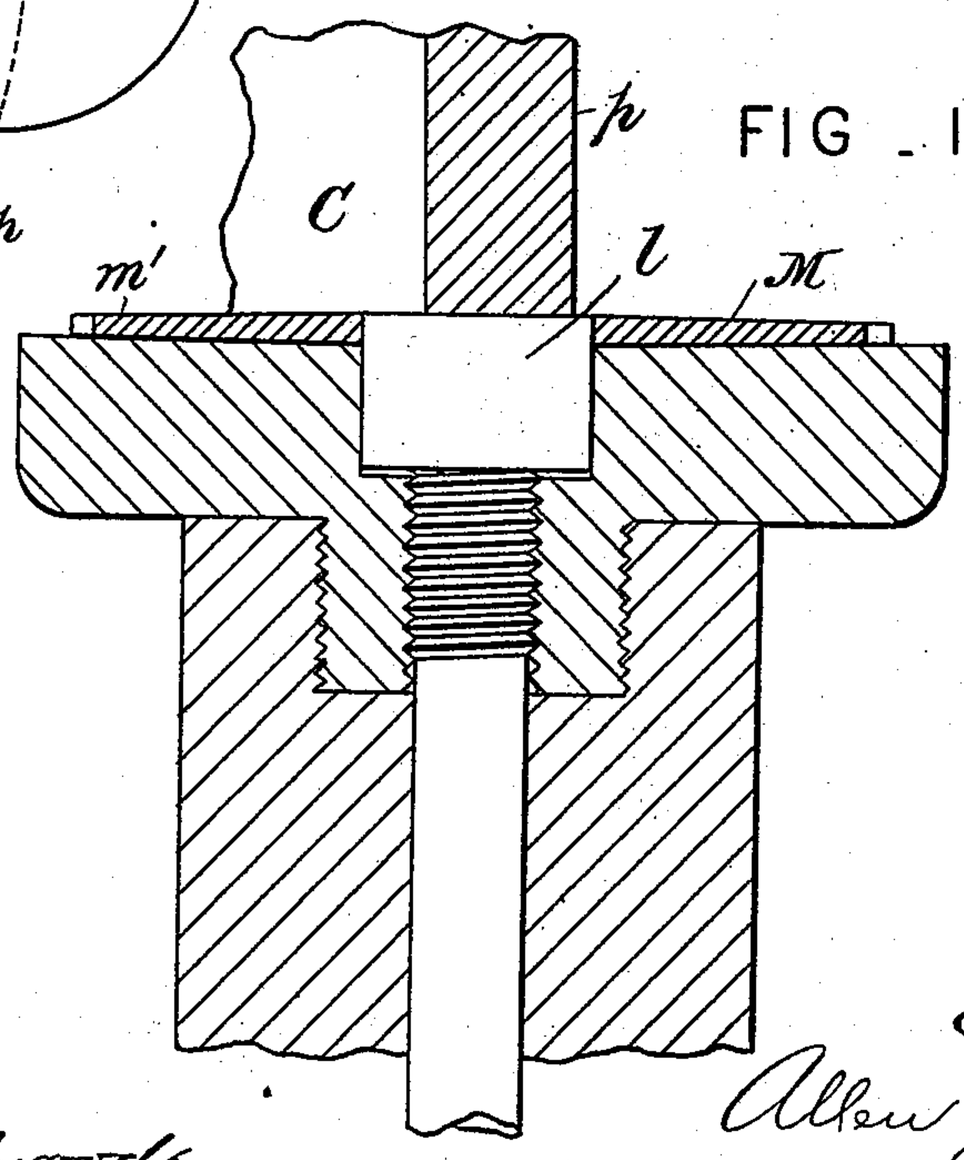



FIG. IV.




Attest:
Geo. T. Smallwood.
Reve Lewis.

Inventor;
Allen Johnston,
by Pollock & Mann.
his attorneys.

(No Model.) 4 Sheets—Sheet 4.

# A. JOHNSTON.

## GRINDING DISK CUTTERS AND APPARATUS THEREFOR.

No. 504,386. Patented Sept. 5, 1893.

FIG. VI.

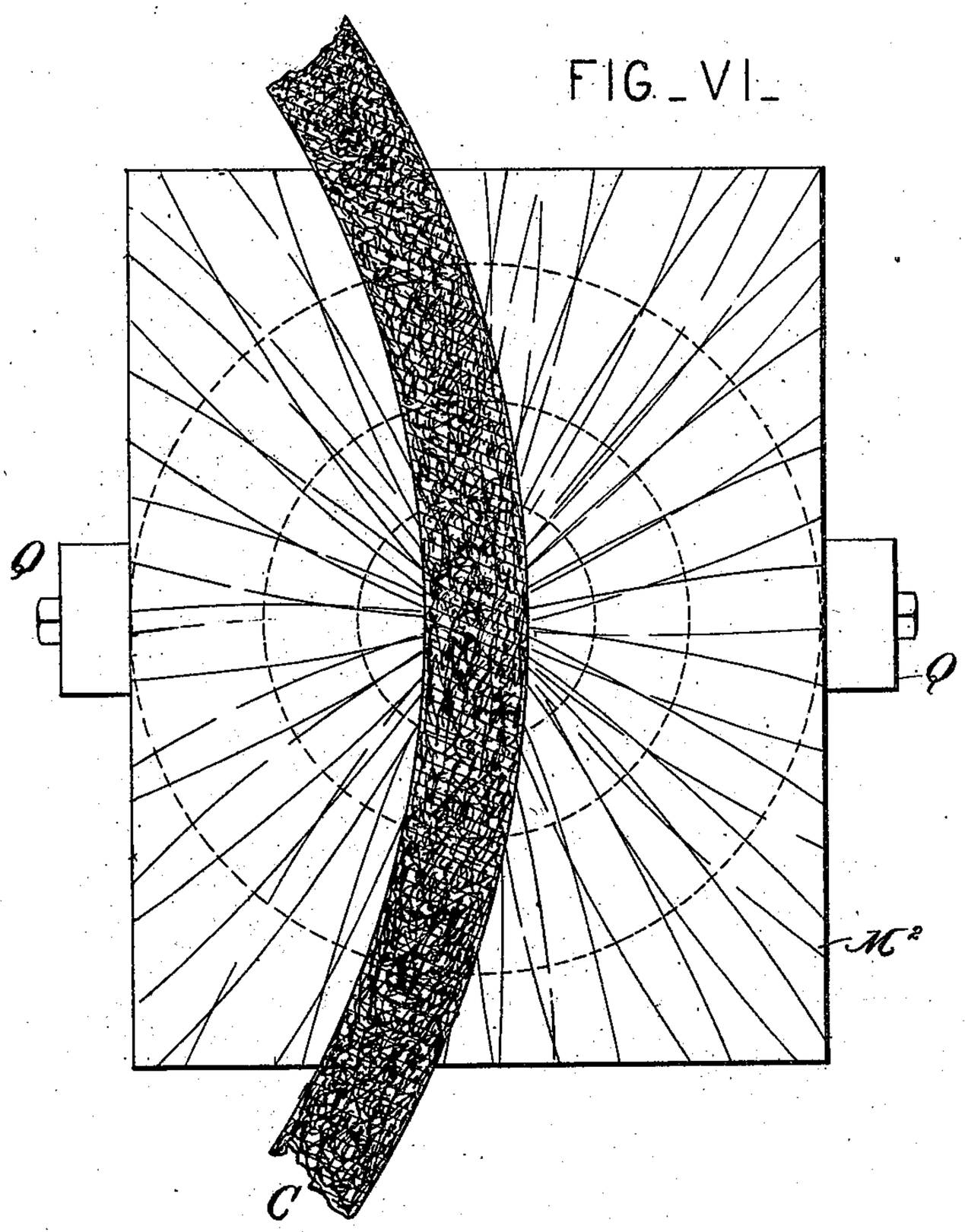
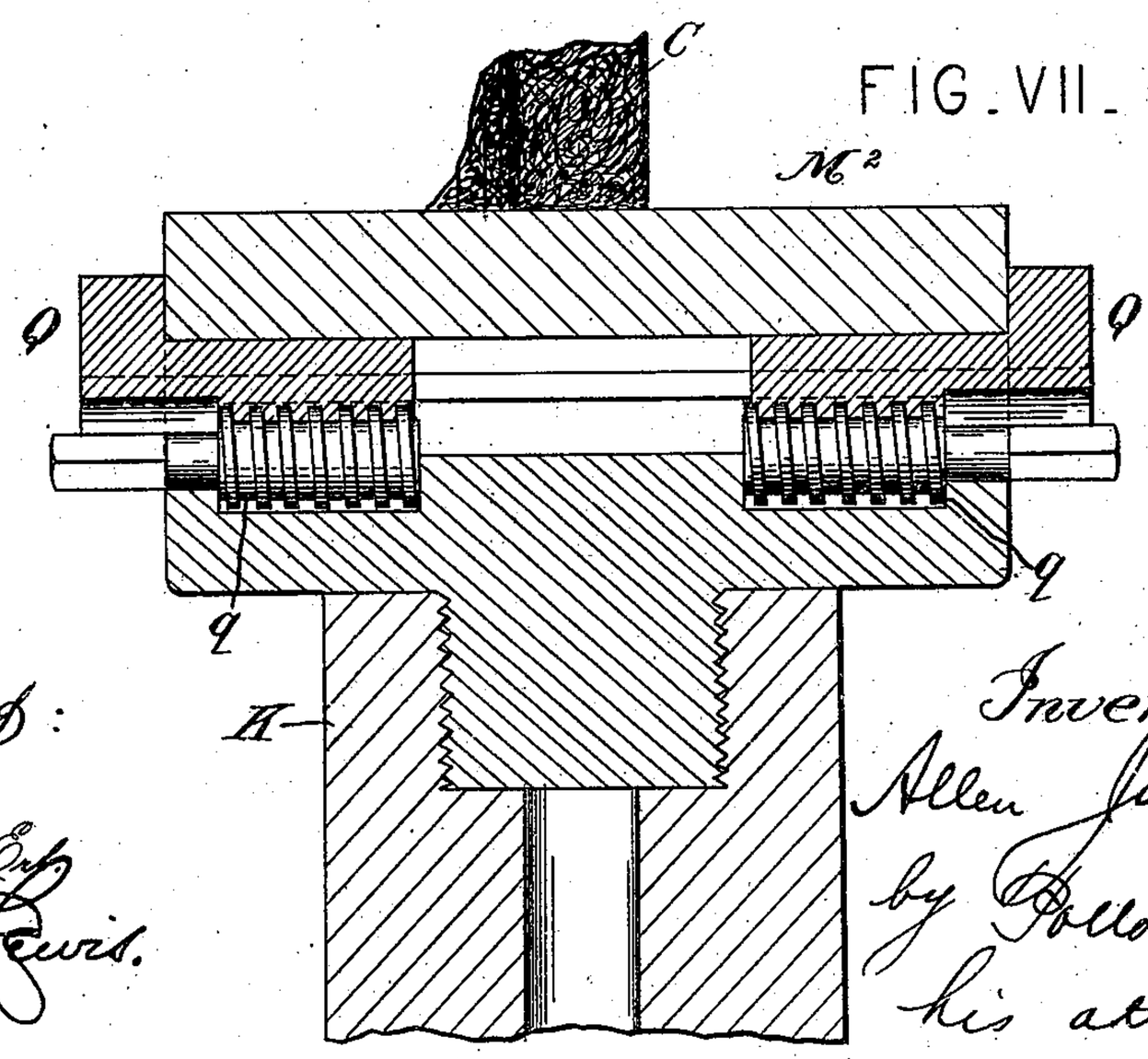



FIG. VII.




Attest:

Arthur A. Eby
Reeve Lewis.

Inventor:
Allen Johnston
by Pollock Macro,
his attorneys.

# UNITED STATES PATENT OFFICE.

ALLEN JOHNSTON, OF OTTUMWA, IOWA.

## GRINDING DISK-CUTTER AND APPARATUS THEREFOR.

SPECIFICATION forming part of Letters Patent No. 504,386, dated September 5, 1893.

Application filed June 15, 1892. Serial No. 436,854. (No model.)

*To all whom it may concern:*

Be it known that I, ALLEN JOHNSTON, of Ottumwa, in the county of Wapello and State of Iowa, have invented a new and useful Improvement in Grinding Disk-Cutters and Apparatus Therefor, which is fully set forth in the following specification.

This invention has reference to grinding convex, concave or straight metal surfaces, and has particular reference to the grinding of disk-shaped saws or cutters which are used for cutting slots—such as the nicks in screw-heads,—and for other purposes. These cutters are ground on their faces to a slight concavity, so that they are somewhat thicker at their outer toothed edges than at the center. Sometimes, for special work, the disks are ground convex on both faces, or concave on one side and convex on the other.

The invention has reference more generally to the grinding of steel disks from plane surfaces to a concave, convex or concavo-convex form. The operation of grinding these disks or cutters is a difficult and costly process, requiring skilled workmen, and is the chief item of expense in the manufacture of these articles. This may be most clearly indicated by stating that a disk-cutter, made, tempered, and in all respects finished to the point of grinding, is worth about ten cents, whereas, after its faces are ground to the desired form, it is worth eight or nine times that amount. The present practice is to hold the disk-cutter or blank by a chuck which engages in the central opening thereof, and present its face to the edge of a grinding wheel. The wheel and disk are rotated in planes substantially at right angles to each other. The disk must be fed across the edge of the grinder so that the latter may act on all points of the former's surface, and great care and skill must be exercised to secure a uniform bevel from the edge inward, and to remove just the right amount of metal. When one side is ground the disk is removed from the chuck, its position reversed, and the other side ground in the same manner. Not only is this method tedious, but considerable time is lost in chucking and unchucking the disks, so that the grinding of one disk an hour is a fair average for an ordinary workman.

The general objects of the present invention are to expedite and cheapen the process of grinding these disks, to enable them to be ground with certainty to the exact shape desired and by unskilled workmen, and to dispense with the necessity of using a chuck and of feeding the disk laterally during the grinding operation. I accomplish these results in the following way: The disk is presented to the grinding wheel, not in a plane at right angles to the face of the wheel, as heretofore, but in a plane substantially parallel to the face of the wheel. If exactly parallel the work will be ground flat, but if slightly oblique it will be concave or convex, the amount of obliquity determining the arc of concavity or convexity to be given to the disk. If that edge of the disk which overlaps the wheel is inclined away from the latter, the disk will be ground concave; but if inclined toward it, the disk will be ground convex, the amount of concavity and convexity being proportional to the angle of inclination. If parallel it will be ground straight. Assuming the grinding to be concave, the corner of the grinder acts first on the inner edges of the annular disk, and the latter is fed forward (or the wheel may be advanced) as the grinding proceeds, until the grinder has hollowed out the entire face of the disk. The disk is not displaced laterally with respect to the axis of the wheel. By this process unskilled workmen are able to grind disks at an average of ten an hour, and over. Preferably the grinding is effected by means of a soft cup-shaped or hollow grinding wheel in conjunction with water, substantially as described in my Patent No. 465,376, dated December 15, 1891. To save time now lost in securing the disk by a chuck and releasing it therefrom, I provide a holder which consists essentially of a head which fits the finished disk (being either convex or concave) and a circular or ring shaped projection which loosely holds the disk and prevents its lateral displacement. This projection may be a boss adapted to fit into the central opening of the disk, or where the latter is very thin, it may be a ring which encircles the disk. These devices are regarded as the equivalent one of the other. When a plate or disk is ground flat a chuck may be employed.

The greatest advantages of the invention are realized when the face of the disk or plate

is to be ground to a curved surface; but the invention is also useful when grinding a straight or flat surface. When such surfaces are ground on the edge of the wheel, instead of on the face thereof, the plate or disk must be fed laterally across the grinding edge, there being only a single line of contact, and at first only a small portion of the surface being ground is in contact with the wheel, causing excessive grinding action at that part. Another consequence is that the piece being ground is heated and expanded unequally at different parts, more metal being removed at the heated and expanded places, so that when the piece cools and assumes its normal shape an uneven and untrue surface is the result. On the other hand when the piece is ground according to the present invention, that is, placing it against and overlapping the face of the grinder, and then revolving it in contact with said face, the necessity for lateral feeding is dispensed with, and every point of the surface of the metal piece is acted upon by the grinding wheel at each revolution of the former; whereby the difficulties above referred to are obviated, and a surface is ground more nearly true than could be obtained in any other way. It will be readily understood that the revolution of the disk while being ground distributes the heat, generated by the grinding, over the entire disk, and the action is at all times uniform; whereas, in the old method of grinding, the heat was localized at the part in contact with the wheel, the extent of contact being at first very small and constantly varying as the disk was fed across the edge of the wheel.

In order that the invention may be more fully understood, I will describe the same in connection with the accompanying drawings, which illustrate a machine designed to be used in grinding disks according to the invention.

Figure I, is a front elevation of the machine; Fig. II, a plan view thereof, partly in section. Figs. III and IV are enlarged details illustrating the grinding of a concave and of a convex disk respectively. Fig. V, is a detail in elevation illustrating the relative positions of the disk and grinding wheel, and Figs. VI and VII are respectively an elevation and a horizontal section showing a piece being ground to a straight surface.

In the drawings A is a trough adapted to contain water, and is supported upon a pedestal A′ and partly covered by a hood B.

C is the cup-shaped grinding wheel mounted on a horizontal arbor C′, having fast and loose pulleys *c*, *c*′. Wheel C is covered by hood B and is also partly protected in front by a vertical guard plate B′. Water is conducted to the interior of the wheel by a trough D and is spread by centrifugal force over the grinding surface of the wheel.

E is a horizontal table, supported by a bolt *e* which passes up through a sleeve F resting on the bottom of trough A. Table E can thus turn horizontally on its center. An adjustable plate G rests on table E, said plate having cross-slots *f f*′, which are intersected by a longitudinal slot *e*′ in said table. Through table E and through the points of intersection of the said slots, pass holding bolts *g*, and the plate G is secured to table E during the operation of grinding by means of the bolts and the nuts *g*′. Plate G carries a sleeve H, which is fast thereon, and within the sleeve H is another sleeve I, provided with a feather *i*, which lies in a groove in the outer sleeve, so that sleeve I can slide longitudinally but cannot rotate.

Sleeve I constitutes the bearing for a hollow spindle K, which carries at its outer end a driving pulley K′ and at its inner end a plate L, against which the disks are held while being ground. To prevent lateral displacement of the disk, the plate L has a projecting boss *l*, as shown in Figs. II, III, and IV which is adapted to fit in the central opening of the disk M. If the latter is very thin, or has no hole in it, I use instead of boss *l* a projecting ring *l*′, which encircles the disk. Whichever of these arrangements be used, it is evident that the operation of slipping a disk onto the holder, or removing it therefrom, may be very quickly performed. The sleeve I is encircled near its outer end by a hand-wheel N, whose hub *n*′ is screw-threaded externally and engages threads in the fixed sleeve H. By turning wheel N the sleeve I, and with it the work holder, may be moved lengthwise toward and from the grinding wheel C. It is obvious that devices of various kinds may be used to effect these adjustments.

The work-holder may be adjusted toward and from the axis of the grinder by means of slot *e*′, and may be turned more or less obliquely to the face of the grinder by means of the cross slots *f f*′. As shown in Fig. V, the outer corner *p* of the face of the grinder C intersects the central opening *m* of the disk or cutter M. Consequently the grinding takes place on both sides of this central opening. If the side *m*′ of the disk which is nearest the axis of the grinder, be inclined away from the latter, as shown in Figs. II and III, a concave face will be ground upon the disk. The grinding will begin at the edge of the central opening *m*, which at first is the only part that touches the face of the grinder, and will continue until the entire face of the disk is hollowed out. The degree of concavity will depend upon the angle of inclination of the disk M from the face of the grinder. When the work is to be ground concave, the bearing plate L of the work-holder is made convex to fit the shape of the finished disk, so as to furnish a perfect support therefor. The disk is placed upon its holder and advanced by wheel N into contact with the grinder, and the disk and grinder are then rotated, preferably in opposite directions. Since the disk has a flat face in contact with the convex bearing plate L, the former would have a tendency to spring,

as the grinding proceeds farther and farther from the center of the disk. To avoid this the disk after being partly ground on one face, is reversed and ground to the same extent on the other until the grinding is complete. Thus the disk is always supported by the bearing plate opposite or nearly opposite to the line of action of the grinder. If the side *m'* of the disk (Fig. V) be inclined toward the grinder (as in Fig. IV), the result will be a convex surface, the grinding beginning at the outer edge. In this case the bearing plate L should have a concave surface, as shown in Fig. IV. The method of reversing the disk at intervals is employed for the same reason as in the grinding of concave disks. The disk is fed in the direction of its axis of rotation as the grinding proceeds; but the feeding forward of the grinding wheel would be an equivalent operation.

When the work is to be ground flat it is presented parallel to the face of the grinder. This operation is indicated in Figs. VI and VII. The work $M^2$, which in this case is a rectangular plate, is held between the chuck-jaws Q carried by the spindle K, by which the work holder is rotated as in the other figures. The chuck jaws are adjusted by screws *q* in a well known manner. From these figures it will readily be seen that at each revolution of the plate $M^2$ every point of its surface will be acted upon by the grinder C, and that the pressure (which is the same whether a small or large surface of the work bears against the grinder), and also the heat generated by friction, are evenly distributed.

Having now fully described my invention, what I claim is—

1. The described method of grinding the face of a disk or plate, by presenting it in contact with the circular face of a grinder with the wheel overlapping and embracing about half the work, the rest of the surface of the latter projecting beyond the outline of the wheel, and rotating the work in such manner that at each revolution every point of its surface passes across the grinding face of the wheel, the relative positions of the axes of the work and grinder being maintained throughout the operation, substantially as described.

2. The method of grinding the face of a disk to a curved surface, by presenting the disk to the face of a grinding wheel at an angle slightly oblique to said face, and rotating the disk against the grinding face, substantially as described.

3. The method of grinding the face of a metal disk to a curved surface, by presenting the disk to the face of a grinding wheel so that about half the surface of the disk overlaps the face of the wheel, said disk being inclined at a slight angle with said face, rotating the disk, and feeding it in the line of its axis of rotation as the grinding proceeds, substantially as described.

4. The method of grinding a disk—such as a slot cutting tool—to a curved surface, which method consists in presenting the face of the disk to the face of a grinding wheel at a slight angle with said wheel, grinding a portion of the face of the disk against the corner of the wheel, then reversing and partly grinding the other face, and so proceeding until the grinding is complete on both sides, substantially as described.

5. In a machine for grinding metal disks to a concave, straight, or convex surface, the combination with the grinding wheel of a work-holder adapted to hold the disk against the face of the grinding wheel and mounted on a support which is adjustable to present the face of the work holder at different angles or parallel to the face of said wheel, means for rotating said work-holder on its axis, and means for moving it in line of its axis while the grinding proceeds, substantially as described.

6. The combination with the grinding wheel, of a rotatable work-holder adapted to present the work against the face of the grinding wheel, and comprising a bearing plate and a circular projection adapted to engage the edge of the work, a support for said work-holder adjustable on an axis transverse to the axis of the grinder, means for rotating the work-holder, and means for moving it toward and from the face of the grinding wheel, substantially as described.

7. The combination with the grinding wheel, of a table for supporting the work-holding devices, a plate adjustable axially and also adjustable transversely with respect to the face of the grinding wheel, a rotatable bearing-plate adjustable in its support in the line of its axis, and a holding projection on the face of said plate, substantially as described.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

ALLEN JOHNSTON.

Witnesses:
A. G. HARROW,
J. T. HACKWORTH.