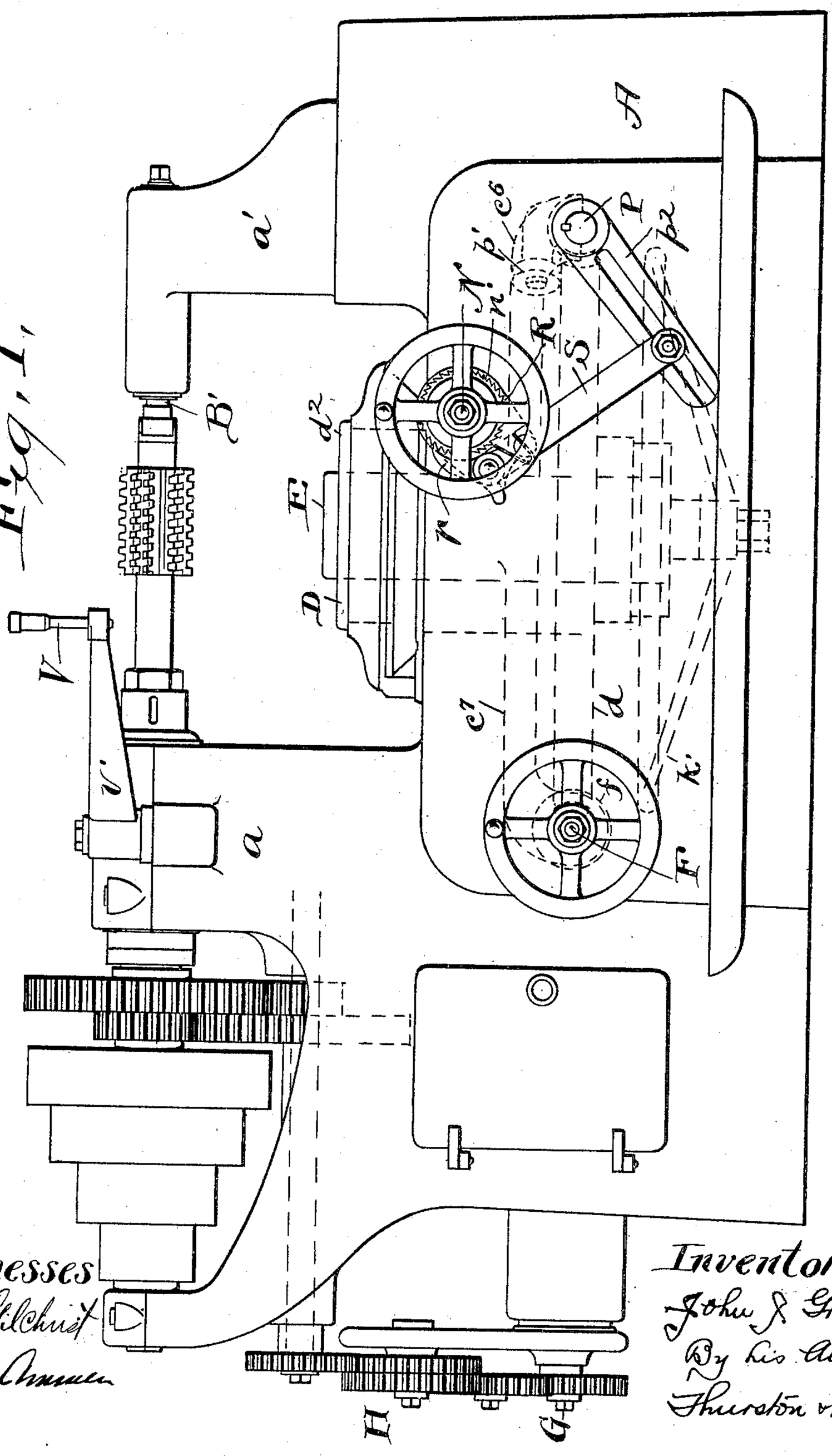
No. 684,634. Patented Oct. 15, 1901.

J. J. GRANT.

WORM WHEEL CUTTING MACHINE.

(Application filed Jan. 14, 1901.)

(No Model.) 4 Sheets—Sheet 1.



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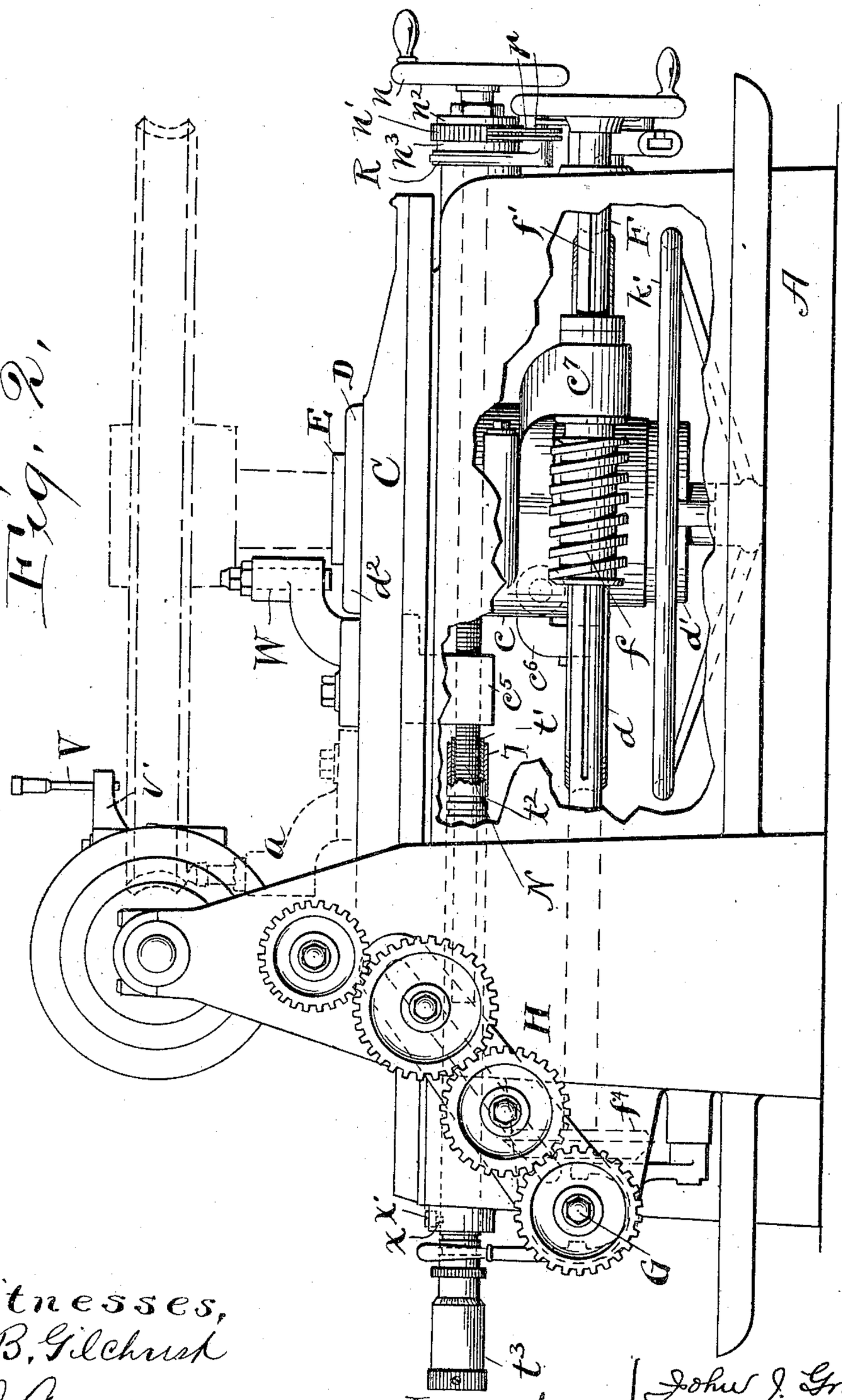
(No Model.) 4 Sheets—Sheet 2.

Fig. 2.



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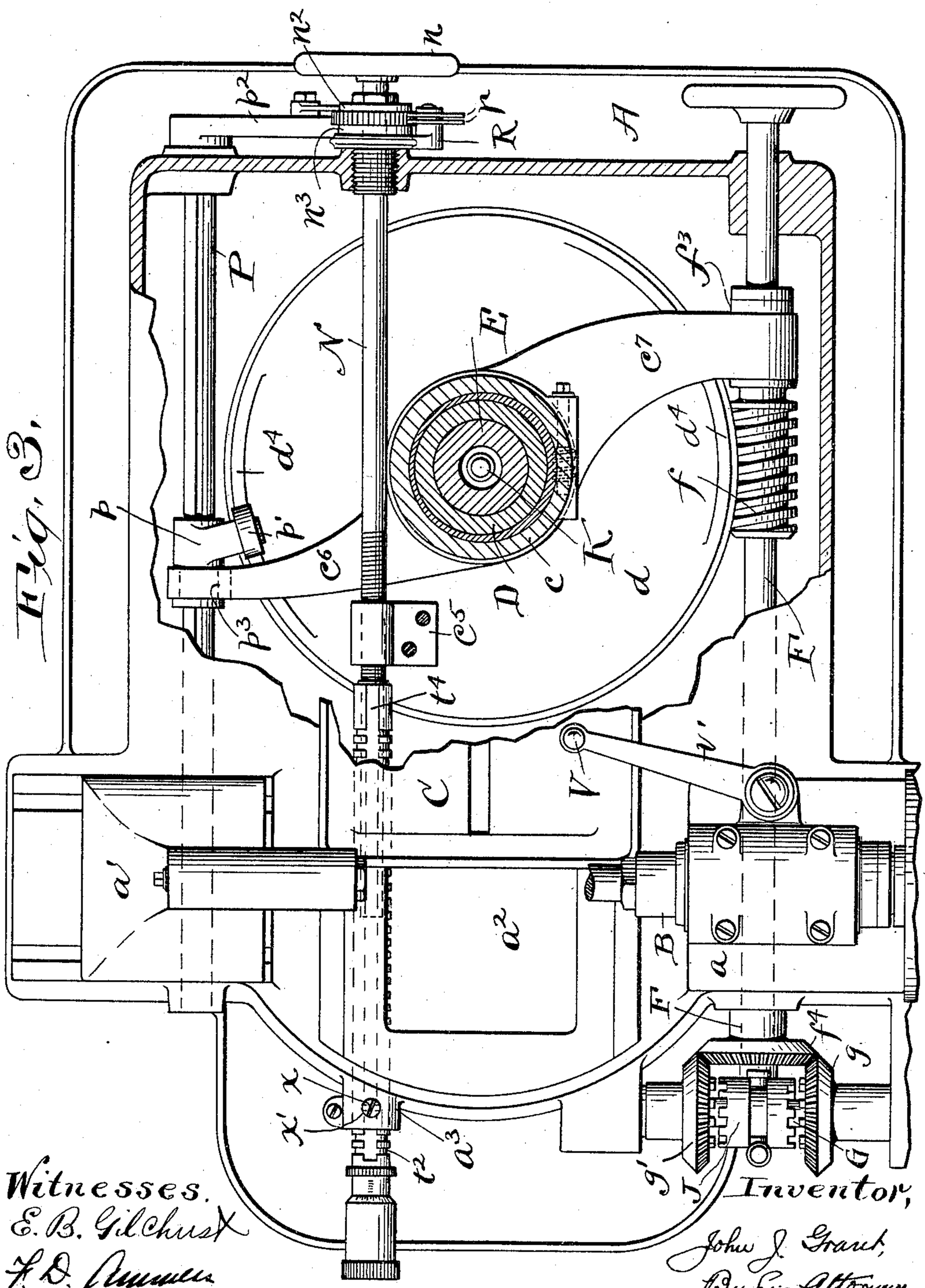
(No Model.) 4 Sheets—Sheet 3.

Fig. 3.



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4 Sheets—Sheet 4.

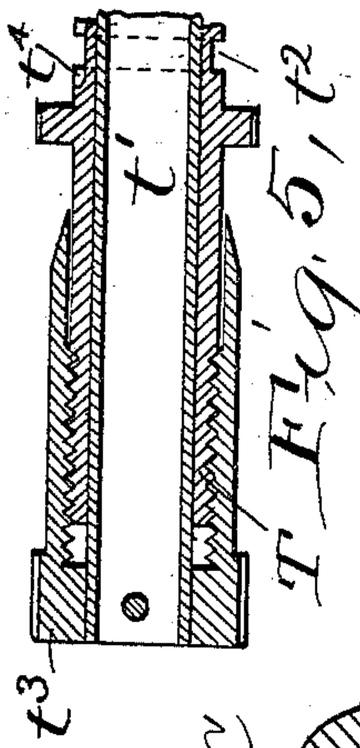

Fig. 5.

Fig. 4.

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UNITED STATES PATENT OFFICE.

JOHN J. GRANT, OF CLEVELAND, OHIO.

WORM-WHEEL-CUTTING MACHINE.

SPECIFICATION forming part of Letters Patent No. 684,634, dated October 15, 1901.

Application filed January 14, 1901. Serial No. 43,185. (No model.)

To all whom it may concern:

Be it known that I, JOHN J. GRANT, a citizen of the United States, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented a certain new and useful Improvement in Worm-Wheel-Cutting Machines, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings.

The object of the invention is to provide a machine which will rapidly and accurately cut the teeth of worm-wheels whatever be the diameter or thickness of the wheels (within the limits of the machine's capacity) or the number and pitch of the teeth.

The invention consists in the construction and combination of parts hereinafter described, and pointed out definitely in the claims.

In the drawings, Figure 1 is a front elevation of the machine. Fig. 2 is a side elevation. Fig. 3 is a plan view partly sectional. Fig. 4 is a vertical transverse section through the work-carrying spindle, and Fig. 5 is a longitudinal sectional view of the outer end of the adjustable carriage-stop.

I will now describe the machine shown, which represents the best embodiment of the invention now known to me.

The frame A of the machine has near one side a head-stock a, in which the live-spindle B is mounted, and at the other side it has a tail-stock a' for the dead-spindle B'. In the bed-plate a^5 is an opening a^2, extending lengthwise of the machine, and at the sides of this opening are the dovetailed ways a^3, on which the sliding carriage C is mounted. This carriage has rigid with it a cylindrical barrel c, which extends vertically downward. In it the hollow spindle D is rotatably mounted. A worm-wheel d is keyed or otherwise fastened to the projecting lower end of this spindle, and a cap d' is screwed to said spindle below the worm-wheel. Said worm-wheel engages with the lower end of the barrel c, and an external flange d^2 on the upper end of the spindle rests upon the carriage, and thereby endwise movement of the spindle is prevented. Within said spindle a vertically-adjustable spindle E is fitted. It has an external longitudinal keyway e, in which a key d^3 on the spindle D engages. This compels the simultaneous rotation of the two spindles, but permits the vertical adjustment of the spindle E within the spindle D. It is to this spindle E that the wheel to be cut is secured. This spindle is adjusted vertically by means of a screw K, which passes through the cap d' and has a flange k, which rests upon said cap. It screws through a nut e', which is pinned or otherwise rigidly fastened to the spindle E. On the lower end of this screw a hand-wheel k' is secured, whereby it may be turned, with the result of moving spindle D up or down. The hub of this hand-wheel and the flange k, engaging with the cap d', prevent endwise movement of the screw. A shaft F, suitably mounted in the frame of the machine, carries a worm-sleeve f, which is so secured to it that it must rotate with it, but may move lengthwise upon it. This worm-sleeve has a longitudinal key f^2, which enters a groove f' in the said shaft. This shaft is connected with the live-spindle B by suitable mechanism which will compel the worm-wheel d and spindles D and E to rotate once while the live-spindle B is rotating as many times as there are to be teeth on the wheel which is being cut. The specific mechanism shown for effecting this result consists of a shaft G, change-gearing H, connecting it with the live-spindle, and the following mechanism for connecting the shaft G with the shaft F. Loosely mounted on this shaft G are two beveled gears g g', both of which engage at all times with a bevel-gear f^4 on the shaft F. Between the bevel-gears g g' is a clutch J, by which either gear g or g' may be connected with the shaft G, and thus provision is made for rotating the shaft F in either direction at the proper relative speed. An arm c^7, which is secured to the barrel c, engages in a circumferential groove f^3 in the worm-sleeve f, whereby as the said carriage is moved along this worm-sleeve will be also moved upon the shaft F and maintain its proper relation with the worm-wheel d. The feed of the carriage is effected by the means of feed-screw N, passing through a threaded bracket c^5 on the under side of the carriage. This feed-screw may be turned by means of the hand-wheel n, or it may be turned automatically by means of the following mechanism: A shaft P is mounted in the frame of the machine parallel with the feed-screw N.

An arm p embraces this shaft and is connected to it by a tongue-and-groove connection, which causes the arm and shaft to turn simultaneously, but permits the arm to slide along the shaft. In the hub of this arm is a circumferential groove p^3, which receives one end of an arm c^6, secured to the barrel c. This arm p extends over the worm-wheel d and carries a friction-roller p', which bears upon the top edge of said wheel d, which top edge has a cam or inclined surface d^4, by means of which the shaft P is periodically rocked. This shaft P has also a slotted arm p^2, which is connected by means of a link S with a pawl-carrier R, which is mounted upon the feed-shaft. This carrier carries two spring-pawls r r, which engage with a ratchet n', secured to said feed-screw. This ratchet is secured to the feed-screw by being clamped between two friction-disks n^2 n^3, which permits the said ratchet to slip upon said screw in case the movement of the carriage is positively stopped.

The wheel in which the teeth are to be cut will preferably be secured to a mandrel having a tapered end, which will be drawn into the tapered socket in the spindle D, as indicated by dotted lines in Fig. 2. They are not parts of the machine, and any other suitable means for connecting the work-wheel to the spindle D may be employed.

From the foregoing description it is apparent that the work-wheel which is being cut will be positively rotated at exactly the proper rate relatively to the live-spindle D, to which the hob for cutting said teeth is secured. It will not be merely dragged along by the hob, as has been the common practice heretofore. It is also apparent that the carriage will be fed slowly and automatically toward said hob, whereby the cuts in the periphery of said work-wheel will be deepened progressively. It is desirable that the interdental spaces or grooves on the periphery of said worm-wheel shall be of exactly the proper depth. An adjustable stop for the carriage is provided for accurately effecting this result. In the construction shown this stop consists of a sliding sleeve T, movable endwise in a suitable bearing a^4 in the framework of the machine. This sleeve has external circumferential grooves t^2, placed, say, an inch apart, into which a locking-finger x projects to prevent further endwise movement. This finger is the lower end of a screw x'. This sleeve T has also an external longitudinal groove t^4, which when said sleeve has been turned to the proper position will receive the end of said finger x and allow the sleeve to be moved endwise. Within this sleeve T is another sleeve t', which may slide therein, and this sleeve t' has attached to its outer end a micrometer-nut t^3, which embraces the sleeve T. The feed-screw N enters the sleeve t' and the bracket c^5 will engage with the end of said sleeve, and thereby the advance of the carriage will be stopped quickly and accurately.

To adjust the position of the end of the sleeve t', which serves, as stated, as the stop for the carriage, the sleeve T is turned until it may be moved endwise—that is to say, until the longitudinal groove t^4 is in line with the finger x. Said sleeve is then moved until said sleeve is in proper position, which is shown by graduation-marks on its projecting surface, and the sleeve is then turned so that said finger will prevent further longitudinal movement. Then the micrometer-nut is turned until the end of the sleeve t' is in the desired position, which will be indicated by the reading of said sleeve. In order to accurately adjust the spindle E vertically to bring the horizontal plane of the tool-axis midway between the top and bottom surfaces of the work-wheel, whatever be its thickness, a micrometer-screw V is provided. It is mounted in an arm v', which is pivoted to the headstock on a vertical pivot, whereby it may be swung so as to bring the screw over the edge of the work-wheel whatever be its diameter. The screw is graduated and marked, so as to read in figures corresponding with the thickness of the work-wheel. For example, if the rim of the wheel be three inches thick the reading of the screw will be "3" when the work-wheel is properly centered. Underneath the rim of the wheel adjacent to the hob is a vertically-adjustable support W, which prevents said work-wheel from being sprung downward by the tool while the cutting is in progress.

Having described my invention, I claim—

1. In a worm-wheel-cutting machine, the combination of a live-spindle, a sliding carriage movable toward and from said spindle, a vertical sleeve rotatably mounted in said carriage, mechanism for positively rotating said sleeve and the live-spindle at the desired relative speeds, a vertically-adjustable spindle in said sleeve, and tongue-and-groove connections between said sleeve and spindle, substantially as specified.

2. In a worm-wheel-cutting machine, the combination of a live-spindle, a sliding carriage movable toward and from said spindle, a vertical sleeve rotatably mounted in said carriage, a spindle in said sleeve, tongue-and-groove connections between said sleeve and spindle, a cap and a worm-wheel secured to the lower end of said sleeve, a screw mounted in said cap and screwing into a piece which is rigid with said spindle, a collar fast to the screw above the cap, an operating-wheel fast to the screw below the cap, and mechanism intermediate of the live-spindle and worm-wheel whereby they are rotated at the desired relative speeds.

3. In a worm-wheel-cutting machine, the combination of a live-spindle, a sliding carriage, a vertical spindle rotatably mounted thereon, mechanism whereby said spindles are positively driven at the desired relative speeds, a cam-faced wheel secured to said vertical spindle, a rock-shaft, an arm slidable

upon said shaft and connected therewith by a tongue and groove, which arm is adapted to engage with the cam-face of said wheel, a feed-screw engaging with the carriage, a ratchet-wheel secured to said feed-screw, a pawl-carrier mounted axially with respect to said feed-screw, and mechanism intermediate of said pawl-carrier and rock-shaft, substantially as specified.

4. In a machine of the character specified, the herein-described stop for limiting the advance of the carriage, which consists of a sliding sleeve having circumferential grooves and a longitudinal groove, a finger adapted to project into said grooves, a second sleeve, slidable within the first, with its inner end in line of travel of some part of the carriage, and a micrometer-nut secured to the outer end of this inner sleeve and screwing on the outer end of the outer sleeve, substantially as specified.

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

JOHN J. GRANT.

Witnesses:
ALBERT H. BATES,
E. B. GILCHRIST.