(No Model.) 4 Sheets—Sheet 1.

U., H. E. & F. L. EBERHARDT.

GEAR CUTTING AND HOBBING MACHINE.

No. 510,122. Patented Dec. 5, 1893.

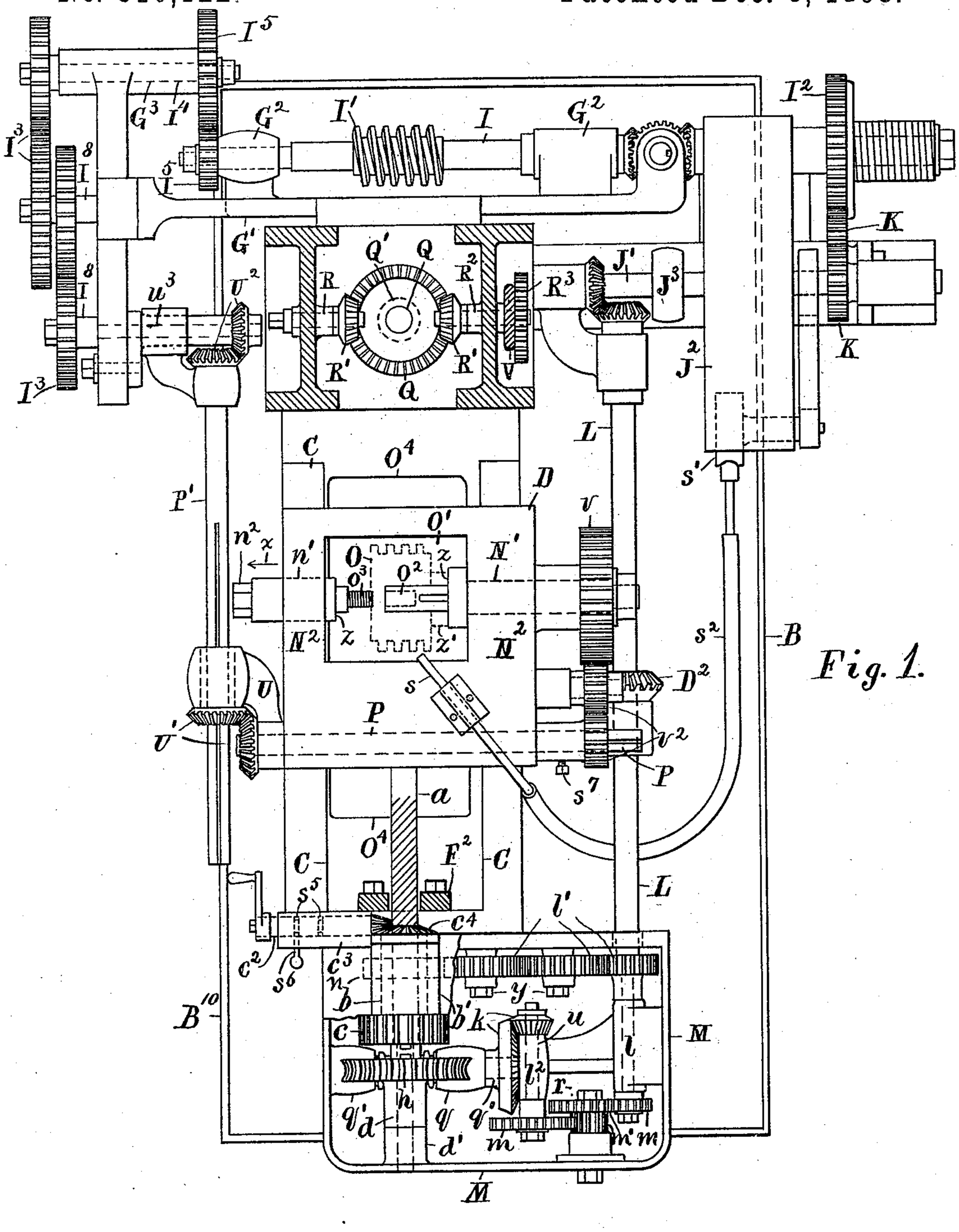

Fig. 1.

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GEAR CUTTING AND HOBBING MACHINE.

No. 510,122. Patented Dec. 5, 1893.

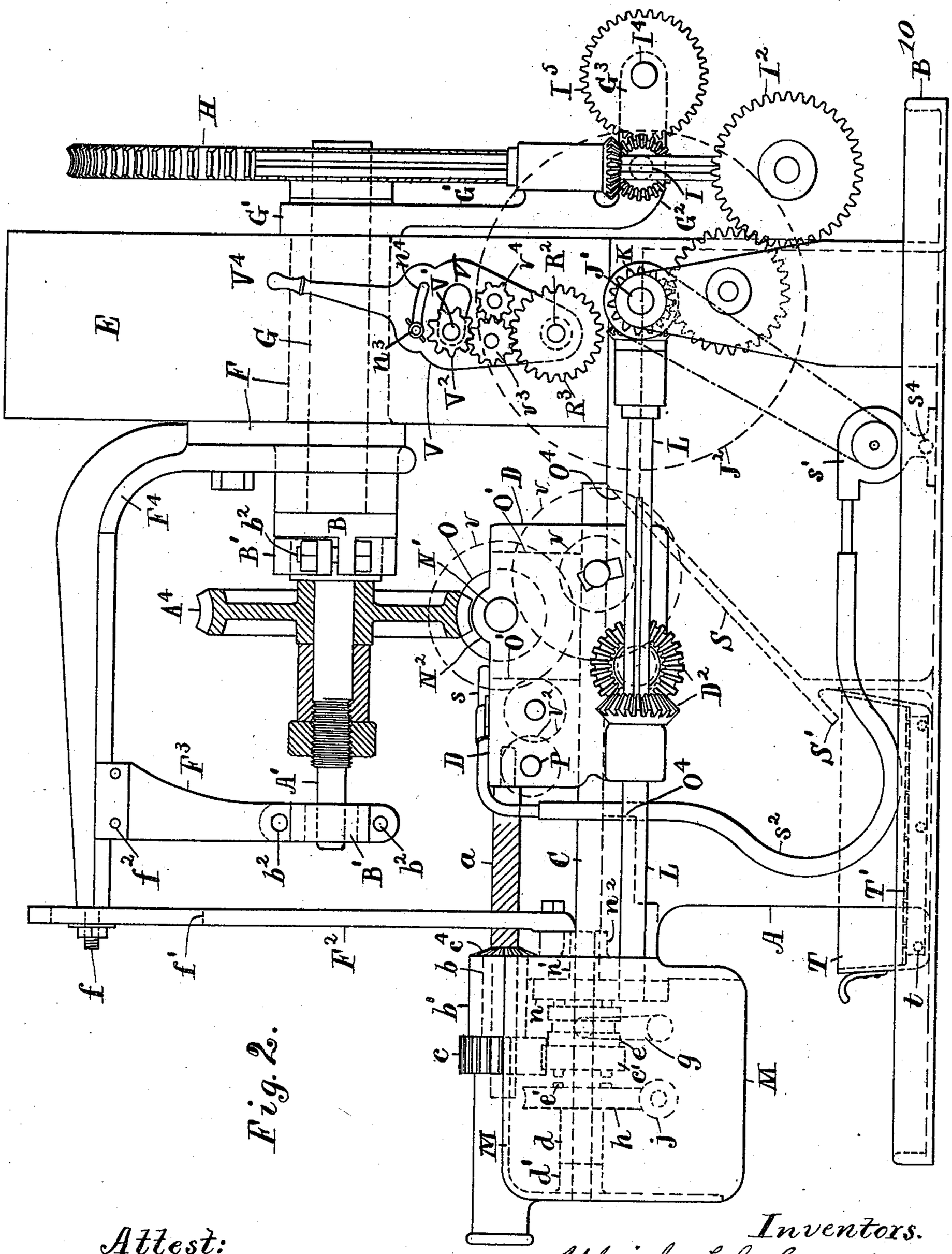

Fig. 2.

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GEAR CUTTING AND HOBBING MACHINE.

No. 510,122. Patented Dec. 5, 1893.

Fig. 7.

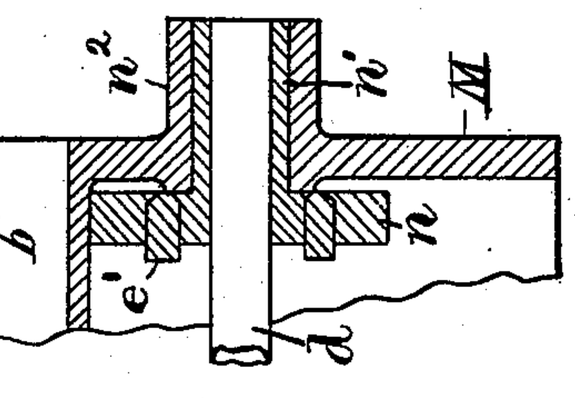


Fig. 4.

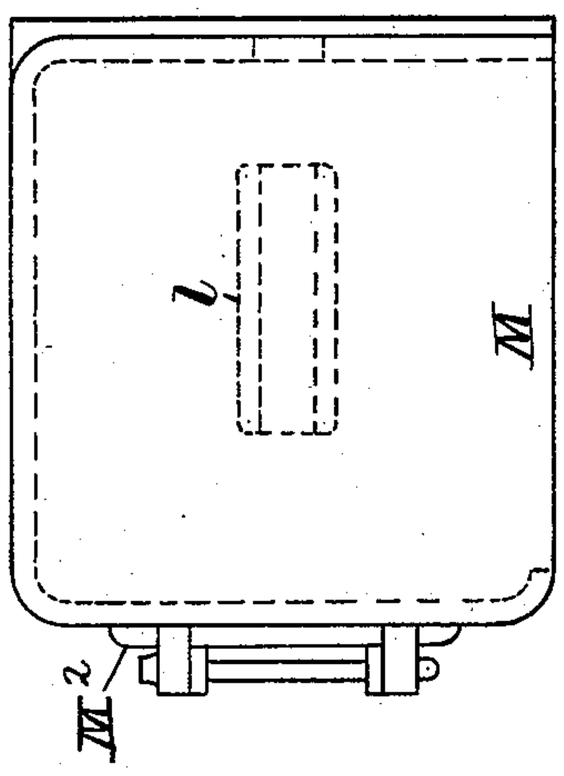


Fig. 6.

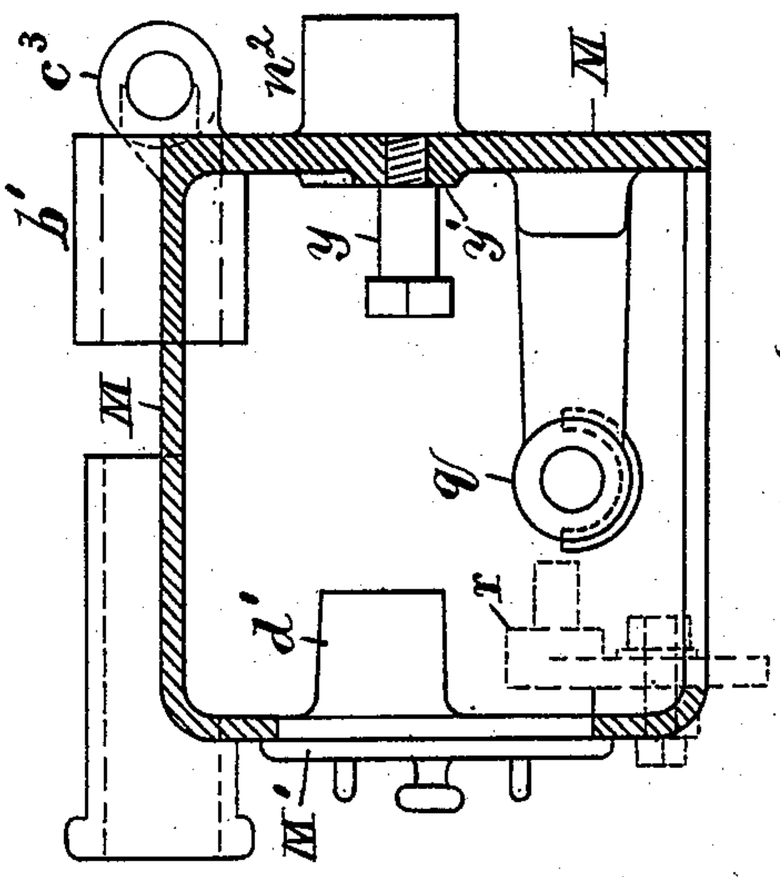


Fig. 3.

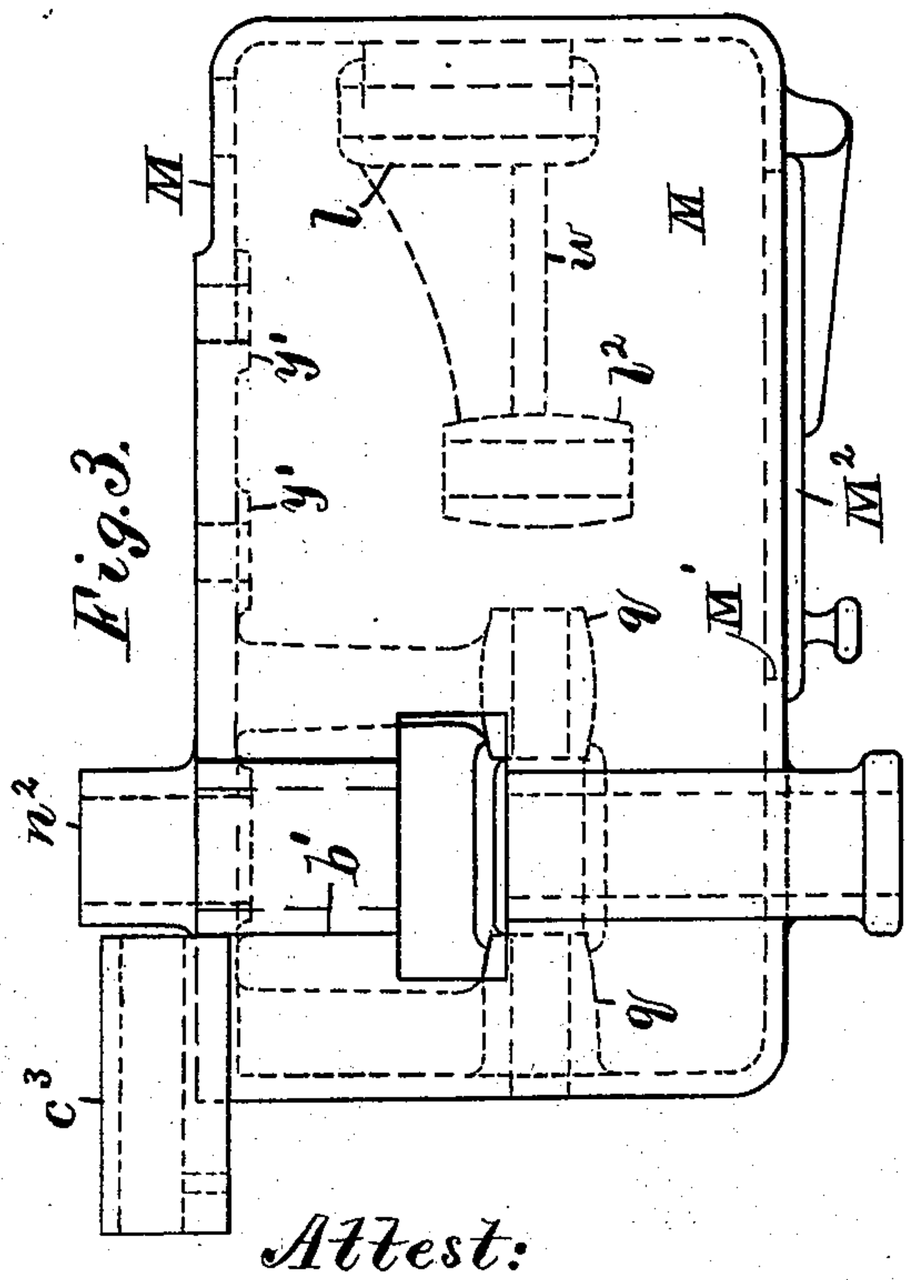
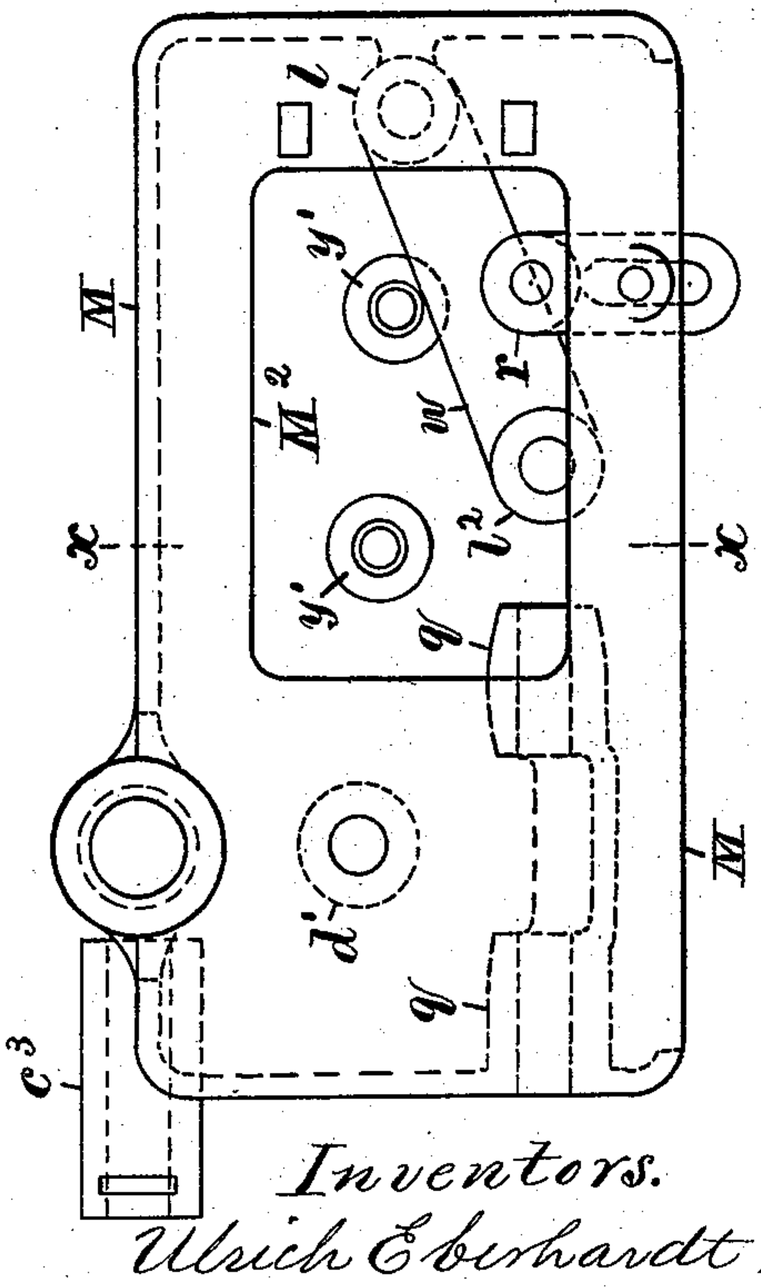


Fig. 5.



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GEAR CUTTING AND HOBBING MACHINE.

No. 510,122. Patented Dec. 5, 1893.

Fig. 8.

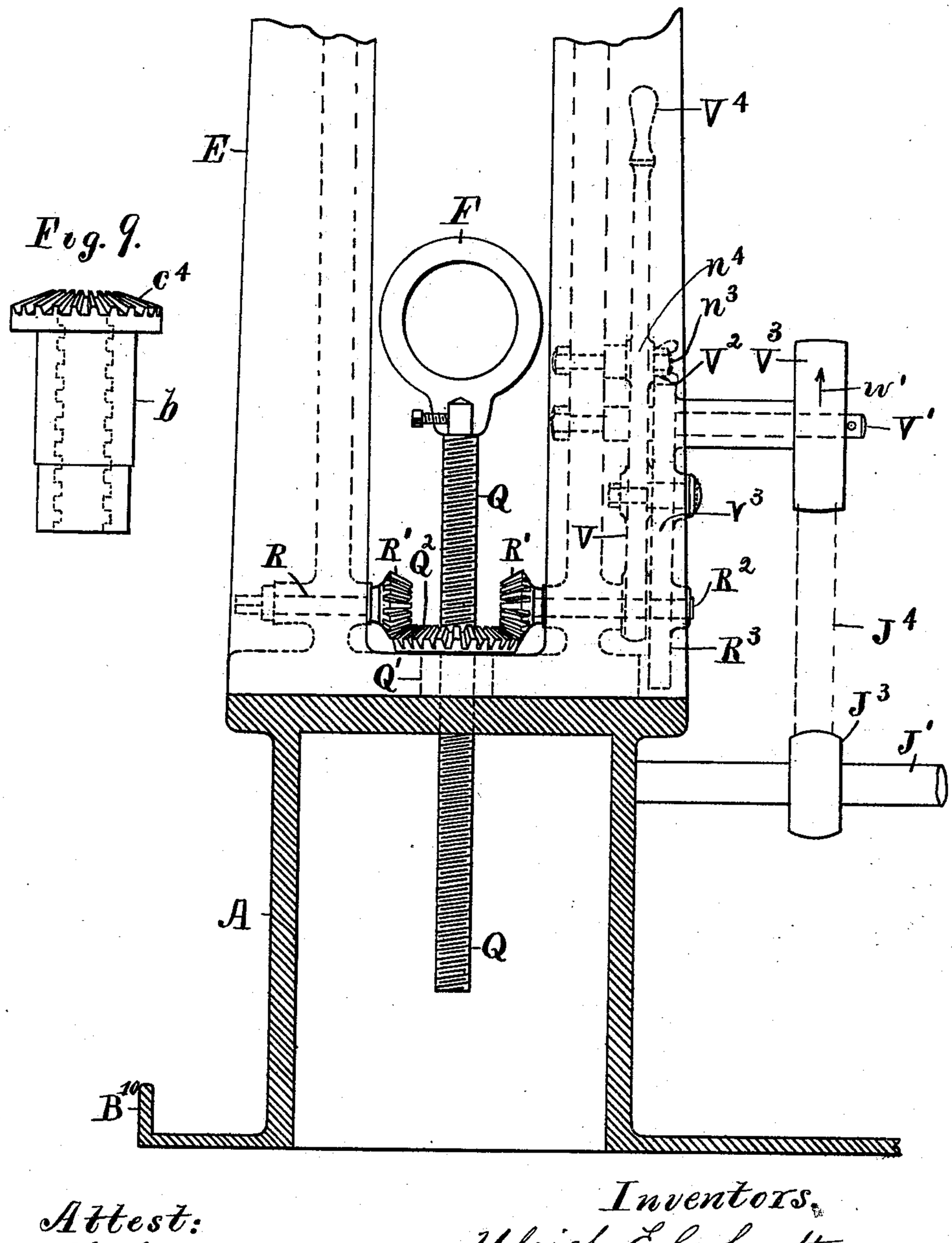

Fig. 9.

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UNITED STATES PATENT OFFICE.

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GEAR-CUTTING AND HOBBING MACHINE.

SPECIFICATION forming part of Letters Patent No. 510,122, dated December 5, 1893.

Application filed March 9, 1893. Serial No. 465,228. (No model.)

To all whom it may concern:

Be it known that we, ULRICH EBERHARDT, HENRY E. EBERHARDT, and FRED L. EBERHARDT, citizens of the United States, residing at Newark, Essex county, New Jersey, have invented certain new and useful Improvements in Gear-Cutting and Hobbing Machines, fully described and represented in the following specification and the accompanying drawings, forming a part of the same.

This invention relates to certain improvements in the mechanism for holding and driving the cutter, in the means for varying the speed of the worm which shifts the blank, in means for supporting the outer end of the mandrel which carries the blank, in means for raising and lowering the mandrel head by power, and in various other attachments hereinafter described.

In the drawings annexed, Figure 1 is a plan of a gear cutter provided with our improvements, the top of the casing over the feed gears being removed to exhibit the same, and the column being shown without the mandrel head or worm wheel. Fig. 2 is a side elevation of the same. Fig. 3 is a plan of the casing for the feed gears. Fig. 4 is an end view of the same. Fig. 5 is a front view of the same. Fig. 6 is a cross section of the same taken on line x, x, in Fig. 5. Fig. 7 is a section of part of the casing through the bearing n^2. Fig. 8 is an elevation of the bottom of the column E with the gearing to raise and lower the mandrel head; and Fig. 9 is a dotted view upon an enlarged scale of the rotary nut b.

The machine is constructed with a horizontal bed A surrounded at the base by a pan B^{10}, and a cutter head or carriage D is fitted to ways C upon the top of the bed.

The column E is mounted upon one end of the bed and provided with a mandrel head F carrying a shaft or arbor G having a worm wheel H upon its outer end. The head F is movable vertically by means of screw Q and suitable gearing.

A feed screw a is secured to the carriage D and projected through a rotary nut b mounted in bearing b' at the outer end of the bed, and provided with a feed gear c upon its outer end. The gear c is driven automatically in opposite directions by two trains of gearing connected with a feed shaft L, which is driven by a shaft J′ mounted at the rear end of the bed with a pulley J^3 thereon. The pulley is connected with a gear K by means of a friction driver, which actuates the worm I′ to rotate the blank and its mandrel intermittingly. Any form of friction driver may be used, the one in the drawings consisting in the continuously rotating gear I^2 which is fitted loosely upon its shaft and operates by friction upon a circular plate which is pressed toward the same by a spring. Such plate operates to rotate the shaft when the worm shaft I is released by the intermittent operation of the locking device, which is usually applied to the change wheels.

The shaft or arbor G is provided, upon its outer end, with a chuck B to hold the mandrel.

A frame G′ is fixed to the rear end of the bearing F to carry the bearings G^2 of the worm shaft I, and to support the studs I^8 for the primary change wheels I^3. Upon the frame G′ is fixed a bearing G^3 for an auxiliary shaft I^4, which is connected with the worm shaft I by secondary change wheels I^5.

An aperture O′ is formed in the cutter head with bearings N^2 at its opposite sides to sustain the cutter spindle, which is formed in two sections N′ and n'. The sections are connected by a threaded joint formed of a socket o^2 upon the section N′ and a threaded stud o^3 upon the section n'. The end of the section N′ extends only part way across the aperture O′, to permit the removal of the cutter between the end of such section and the outer bearing N^2. This is effected by unscrewing the sections at the threaded joint, which is done by applying a wrench to the head n^2 of the movable section, and withdrawing the same entirely out of its bearing, as indicated by the arrow x in Fig. 1. When the sections of the spindle are screwed together, the cutter is clamped between the shoulders z provided upon the same, with collars z' inserted to compensate for variations in the cutters. By such construction we are enabled to use bearings upon both sides of the cutter, and to

remove the cutter from the spindle N′ without taking the latter from its bearings. The section N′ is connected, upon the outer end, by change wheels *v* and bevel gears D^2 with the shaft L.

To rotate the worm I′ simultaneously with the cutter spindle N′, a shaft P is fixed transversely upon the carriage D in suitable bearings, and connected at one end with the gears *v* by cog-wheels v^2.

A swivel bracket U is journaled to the outer end of the shaft P and provided with bearings for bevel gears U′.

A spline shaft P′ is fitted movably to one of the bevel gears U′, and is connected at the opposite end by a swivel bearing, and bevel gears U^2 with one of the change wheels I^3. Such connection is formed by a shaft w^3, upon which the locking device would operate when cutting spur gears; but such locking device is not shown, as its operation is already well known, and the drawings, in Figs. 1 and 2, show merely the connections required for hobbing, with which the motion of the gears would be continuous. To this end a blank A^4, to form a worm wheel, is shown upon the mandrel A′, and it is evident that the cutter O must be rotated once for each tooth to be cut in the blank, and that the worm I′ must therefore rotate the worm wheel H and the mandrel A′ in a proportional degree. By means of the shafts P and P′ the cutter is connected directly with the primary change wheels I^3, which may be adjusted to produce such proportional movement. The secondary change wheels I^5 perform an entirely new function in such a connection, by affording the means to increase or diminish the effect of the ordinary change wheels I^3, as the change wheels I^5 may be removed from their respective shafts I and G^3 and others of suitable size substituted at any time.

In Figs. 1 and 2, the secondary change wheels I^5 are shown, one twice as large as the other, with the smaller wheel upon the worm shaft I, so that the effect of the ordinary change wheels I^3 upon the worm is doubled. Such effect may be varied in any degree by suitably changing the wheels I^5, thus securing a greater variety of speeds upon the worm, with the same set of change wheels I^3.

An aperture O^4 is formed in the top of the bed A coincident with the aperture O′ in the cutter head, and long enough to receive the chips discharged by the cutter as the head moves back and forth upon the ways C.

A pipe *s*, for discharging a cooling fluid upon the cutter, is shown in Figs. 1 and 2, connected by a flexible hose s^2 with a pump *s*′, which is set in the pan B^{10}.

The bed is shown cast in one piece, with closed sides, and hollow beneath the surface upon which the cutter head moves.

A passage with a sloping chute S is shown extending from the rear edge of the opening O^4 downward through the bed, toward the front end of the same, to direct the chips and fluid into a removable trough T.

An opening is formed in the front end of the bed to insert the trough, and a lip S′ is formed upon the end of the chute, above the bottom of the pan, under which lip the end of the trough may be inserted to collect the chips and fluid therefrom. The chute and its lip S′ are readily formed by casting within the bed and the chips and fluid are thus discharged into the trough instead of running down into the pan.

A perforated false bottom T′ is inserted within the trough T, and outlets *t* are formed below such false bottom to discharge the liquid which is strained from the chips into the pan B^{10}.

The pump *s*′ draws the liquid from the pan by inlet s^4, and is set at a considerable distance from the trough, to settle the impurities from the liquid as it flows from the trough to the pump. The pump thus supplies the cutter with the lubricant, over and over, in a purified condition.

A goose neck F^4 is projected horizontally from the mandrel head F, and a vertical brace F^2 is projected upward from the outer end of the bed and connected with the outer end of the goose neck to steady the same when the mandrel head is adjusted. A bolt *f* is inserted through a slot *f*′ into the end of the goose neck to form such connection, and is loosened when the mandrel head requires adjustment. An arm F^3 is fitted movably upon the goose neck, and is projected toward the mandrel A′ and provided at its lower end with an outboard bearing for the mandrel. The socket which retains the mandrel upon the end of the arm is provided with a cap B′ secured by removable bolts b^2, and the sleeve G is provided with a socket or chuck B having a similar cap, so that the mandrel may be removed laterally from its bearings. The arm F^3 is clamped adjustably upon the goose neck by screws f^2 and is thus adapted to support a mandrel of any length, while the bolt *f* adapts the brace F^2 to hold the goose neck at any height.

At the front end of the bed a casing M is shown inclosing the gearing for the nut *b* which actuates the feed screw *a*. A shaft *d* is mounted in bearings *d*′ within the casing and is provided with a clutch sleeve *e* having a gear *c*′ thereon, engaging with the wheel *c* upon the nut. At one end of the clutch sleeve a worm wheel *h* is fitted to the shaft, and at the opposite end a spur wheel *n*; both wheels being fitted to turn loosely upon the shaft *d* and provided with teeth *e*′ to engage similar teeth upon the clutch. The spur wheel *n* is provided with a sleeve *n*′ extended through the inner face of the casing and supported in a bearing n^2 upon its outer side; such bearing being recessed into the front end of the bed A. The casing is provided with a bearing *l* for the shaft L, which is con-

nected with the spur wheel n by intermediates l'. The intermediates turn upon bolts y secured in bosses y' upon the rear side of the casing. Shaft L is also connected with the worm wheel h by a worm j, bevel wheels k, and change wheels m.

Bearings q are provided to sustain the worm shaft q', and a bearing l^2 is attached by rib w to the bearing l, to support a shaft u which carries one of the bevel wheels k and one of the change wheels m.

An adjustable frog r is provided to sustain the intermediate wheels m' which are required to connect the change wheels m, when they are properly adjusted to produce the desired speed in the worm.

A clutch lever g, shown in Fig. 2, is provided to shift the clutch, which may be done automatically in the manner common in such constructions, as set forth in our application, Serial No. 442,075, filed August 3, 1892. When the clutch is engaged with the worm wheel h, a slow motion is imparted to the cog wheels c in a suitable direction to feed the cutter into the blank; but when the clutch is shifted to engage with the wheel n, the nut receives motion in an opposite direction, at a much higher rate of speed, through the wheels l', to retract the cutter quickly from the blank. The nut thus derives a slow motion from the feed shaft L by a train of gearing containing the change wheels m, by which the speed of the feed may be varied in any desired degree; while the wheels n and l' furnish a separate train for reversing the screw quickly at a uniform rate of speed.

The bearings for the shaft L, shaft u, shaft d, and shaft q', are cast integral with the casing M, as shown in Figs. 3 to 7 inclusive; which thus holds the parts firmly in the desired relations, and entirely prevents their derangement; while it protects the various cog wheels within the casing from obstruction by dirt, and protects the operator from contact with such wheels. An aperture M^2 is provided in the front of the casing in a suitable position to remove the change wheels m from the shafts L and u, and to adjust the frog carrying the intermediate gears m', and a door M′ is applied to the opening to exclude the dirt therefrom. The casing is shown open at the bottom, which affords access to the interior during the manufacture of the casing with its contained bearings.

A means for raising and lowering the mandrel head F by power is shown in Figs. 1, 2, and 7. A screw Q is projected downward from the head beneath the sleeve G, and is provided at the bottom with a rotary nut Q′ journaled at the bottom of the column having a bevel wheel Q^2 attached thereto. A shaft R is inserted through one side of the column and provided at the outer end with means to apply a wrench or crank. A shaft R^2 is projected through the opposite side of the column, and provided at its outer end with a spur wheel R^3. Both shafts are provided with bevel wheels R′ fitted to the wheel Q^2. A frog V is fitted to turn upon the shaft R^2 and limited in its movement by a bolt n^3 fitted to a slot n^4. A stud V′ is fixed to the column and projected through the frog V, and provided upon the outer end with a sleeve carrying a cog wheel V^2 and a pulley V^3. The pulley is omitted from Fig. 2. The frog is furnished with two intermediates, adapted, when one is used, to transmit the motion of the pulley V^3 in one direction to the nut Q′; and in the opposite direction when both intermediates are used. The principal intermediate v^3 is pivoted upon the frog between the wheels R^3 and V^2, and a wheel v^4 is pivoted adjacent to the wheel v^3 in such position as to mesh therewith, and also with the wheel V^2 when the frog is shifted.

In Fig. 2 the principal intermediate is shown connecting the pulley with the wheel R^3, which, when the pulley is rotated to the right, as per arrow w' in Fig. 8, operates to turn the nut Q′ to the right and thus to raise the mandrel head F. The frog is furnished with a handle V^4, and when shifted thereby may be secured by a nut upon the bolt n^3. When moved into a reversed position to that shown in Fig. 2, the intermediate v^3 would be disengaged from the wheel V^2, and the motion would be transmitted through both the intermediates v^4 and V^3 to the wheels R^3, thus reversing the motion as desired, and lowering the mandrel head F. The pulley V^3 is driven by belt connection with a pulley J^3 upon the shaft J′, and when it is desired to raise or lower the mandrel head through a considerable space the frog would be placed in the desired position to move the head upward or downward. When the head is set approximately in its required position, the motion of the nut may be stopped by shifting the frog to an intermediate position, in which case neither of the wheels v^3 or v^4 would engage the wheel V^2, and the pulley V^3 would therefore revolve without affecting the nut. A thumb nut upon the bolts n^3 operates to hold the frog in such inoperative position when required. The shaft R may then be actuated by a crank or wrench to adjust the head accurately. The hand-shaft R is also used in feeding the blank toward the cutters from time to time as may be required, by moving the mandrel head toward the bed A. The rotary nut b for the feed screw a is in like manner provided with a hand-shaft c^2 connected with the nut by bevel wheels c^4. The shaft is mounted in a bearing c^3 adjacent to the nut bearing b', and is arranged to shift longitudinally to disengage the wheels c^4 when the cutter head is actuated by the automatic devices. The shaft c^2 is furnished with two grooves s^5, and a sliding key s^6 is fitted to a slot in the bearing to engage either groove at pleasure, and to thus to hold the shaft in or out of gear with the wheel c^4. The shaft is

provided with a crank for turning it by hand, and when the gears c^4 are engaged the cutter head may be adjusted upon the bed into any desired position, and the worm wheel h then engaged with the gear c to feed the cutter automatically.

It will be fully understood that the machine described herein is intended and adapted for cutting spur gears as well as for hobbing worm wheels, in which case a suitable spur cutter would be placed upon the arbor of the spindle N′, and the hobbing shaft P would be disconnected from such cutter spindle by removing one of the gears v^2. The shaft P is shown of sufficient length adjacent to the gear v^2 to slide such gear outward, and thus disconnect the shaft without wholly removing the gear. A screw s^7 in the hub of such gear may be used to hold it in its operative or inoperative position. The pulley V^3 being mounted upon a stationary stud V′ may be driven from the shaft J′ by a chain or other suitable connection instead of the belt indicated in Fig. 8.

By the improvements above described, we greatly facilitate the use of the machine for a wide range of work and enable the operator to effect all the desired adjustments with great rapidity.

We have not claimed herein broadly the pan applied to the bed for receiving a cooling fluid, nor the use of chucks with laterally removable caps to sustain the mandrel A′, nor the means for supplying a cutter within the aperture O′ with a cooling fluid, as we have made such claims in another application, Serial No. 442,075, filed August 3, 1892, for improvement in gear cutting machines. We have however claimed herein the combination of the sockets with laterally removable caps in connection with a goose-neck affixed to the mandrel head.

Having thus set forth the nature of the invention, what is claimed herein is—

1. In a gear cutter having a worm wheel, a worm and worm shaft to rotate the blank, and primary change-wheels to regulate the intermittent movement of the blank, the combination, with the worm shaft, of an auxiliary shaft connected with the said change-wheels, and secondary change-wheels connecting the auxiliary shaft with the worm shaft, to vary the operation of the primary change-wheels upon the worm and the blank, substantially as herein set forth.

2. A gear cutting machine comprising the horizontal cast metal bed A having the pan B about the bottom, and having closed sides and an opening in its end, an aperture extending through the top of the bed, a sloping chute beneath the aperture extended toward the opening, the cutter head D carrying the cutter spindle and mounted movably upon the top of the bed and having an aperture in the bottom coincident with that leading to the sloping chute, and the vertical column E upon one end of the bed, with the mandrel head F adjustable vertically thereon, to carry the mandrel and the blank above the cutter head, substantially as herein set forth.

3. In a gear cutter, the combination, with a bed having a pan beneath the same, of a movable cutter head with a cutter spindle revolved thereon, the bed and cutter head having coincident openings to discharge the chips, a jet pipe for projecting a cooling fluid upon the cutter a sloping passage for conducting such chips and fluid into the pan, with a lip above the bottom of the pan, a removable trough fitted beneath such lip, the trough having a perforated false bottom and an outlet to discharge the fluid, and a pump to elevate the fluid to the cutter, substantially as herein set forth.

4. In a gear cutting machine having a cutter head with aperture in the same to admit the cutter, and spindle bearings N^2 upon opposite sides of the aperture, the combination, with the bearing N^2, of the spindle N′ with arbor projected partly across the aperture O′, the spindle section n' movable in the bearing, and a threaded connection between the sections, as and for the purpose set forth.

5. In a gear cutting machine having a horizontal bed A with cutter head D movable upon the top of the same, and a column E with mandrel head adjustable vertically thereon, the combination, with the mandrel and mandrel head, of a goose neck provided with an outboard bearing, and chucks with removable caps upon the mandrel bearing and upon the outboard bearing to hold the mandrel removably, substantially as herein set forth.

6. In a gear cutting machine having a horizontal bed A with cutter head D movable upon the top of the same, and a column E with mandrel and mandrel head adjustable vertically thereon, the combination, with the mandrel head, of a goose neck projected therefrom, an arm secured adjustably upon such goose neck, and an outboard bearing attached removably to the arm to support the outer end of the mandrel, substantially as herein set forth.

7. In a gear cutting machine having a horizontal bed A with a cutter head D movable upon the top of the same, of a column E upon the inner end of the bed with mandrel and mandrel head adjustable vertically thereon, the combination, with the mandrel head, of a goose neck projected therefrom, an arm secured adjustably upon the goose neck and provided with an outboard bearing for the mandrel, and a vertical brace secured upon the outer end of the bed and having a slotted connection to the end of the goose neck, as herein set forth.

8. In a gear cutting machine having a bed with cutter head movable upon the top of the same, and a column with mandrel and mandrel head adjustable vertically thereon, the combination, with the cutter head D, of a screw a fixed thereto, and provided with a rotary

nut *b*, a bearing *b'* upon the bed to sustain the said nut, a cog-wheel *c* upon the nut, with suitable gearing to rotate the same automatically, a laterally projecting shaft c^2 and bearing c^3 adjacent to the said nut, gears c^4 connecting the nut and the shaft c^2, and means for turning the shaft by hand to adjust the screw and cutter head, substantially as herein set forth.

9. In a gear cutting machine having a bed with cutter head movable upon the top of the same, and a column with mandrel and mandrel head adjustable vertically thereon, the combination, with the cutter head, of a screw fixed thereto, a rotary nut mounted upon the outer end of the bed, a feed shaft with a train of gearing connecting the shaft and nut by change wheels, and a separate train of gearing for reversing the movement of the nut, a clutch to engage the separate trains alternately with the nut, and the casing M inclosing such clutch and trains of gearing, and having the bearings therefor cast upon such casing, as set forth.

10. In a gear cutting machine having a bed with cutter head movable upon the top of the same, and a column with mandrel and mandrel head adjustable vertically thereon, the combination, with the cutter head, of a screw fixed thereto, a rotary nut mounted upon the outer end of the bed, a feed shaft with a train of gearing connecting the shaft and nut by change wheels and a separate train of gearing for reversing the movement of the nut, a clutch to engage the separate trains alternately with the nut, the casing M inclosing such clutch and trains of gearing and having the bearings therefor cast upon such casing, and an aperture with door in the front of such casing to insert and remove the change wheels, substantially as herein set forth.

11. The means for rotating the cutter spindle in unison with the mandrel in a gear cutting machine, consisting in a bed with cutter head movable upon the top of the same and a column with mandrel head provided with a worm wheel, a worm, and change wheels for rotating the same mounted adjustably upon the column, a driving shaft with gearing to rotate the cutter spindle, a hobbing shaft supported in bearings transversely upon the cutter head, spur gears connecting the same at one end with the cutter spindle, and gearing connecting the hobbing shaft with the cutter spindle and with the worm through its change wheels, as herein set forth.

12. The means for rotating the cutter spindle in unison with the mandrel consisting in a gear cutting machine having a bed with cutter head movable upon the top of the same, and a column with mandrel head provided with a worm wheel, a worm, and change wheels for rotating the same mounted adjustably upon the column, a driving shaft with gearing to rotate the cutter spindle, a hobbing shaft supported in bearings transversely upon the cutter head, spur gears connecting the same at one end with the cutter spindle, a swivel bearing upon the opposite end of the hobbing shaft, and a spline shaft with bevel gears for connecting the hobbing shaft with the worm through its change wheels, substantially as herein set forth.

13. In a gear cutting machine having a bed with cutter head movable upon the top of the same, and a column with mandrel bearing adjustable vertically thereon, the combination, with the mandrel bearing, of a nut journaled in one end of the column, a screw projected from the mandrel bearing through such nut, a bevel gear with shaft projected laterally through the column, a spur wheel and frog upon the outer end of such shaft, a stud with gear and pulley adjacent to such shaft, and intermediate gears upon the frog adapted to transmit the motion of the pulley, reversibly to the spur wheel, substantially as set forth.

14. In a gear cutting machine having a bed with cutter head movable upon the top of the same, and a column with mandrel bearing adjustable vertically thereon, the combination, with the mandrel bearing, of a nut journaled in one end of the column, a screw projected from the mandrel bearing through such nut, a bevel gear with shaft projected laterally through the column to rotate the nut, a spur wheel and frog upon the outer end of such shaft, a stud with gear and pulley adjacent to such shaft, intermediate gears upon the frog adapted to transmit the motion of the pulley reversibly to the spur wheel, and a hand-shaft with bevel wheel to rotate the nut independently, substantially as herein set forth.

15. In a gear cutting machine having a bed with cutter head movable upon the top of the same, and a column with mandrel bearing adjustable vertically thereon, the combination, with the bed, of a single driving pulley J^2 having a shaft *J'* mounted in fixed bearings thereon, separate trains of gearing connected with such shaft for rotating the blank, the cutter, and the feeding devices, a nut journaled in one end of the vertical column, a screw projected from the mandrel bearing through such nut, a bevel gear with shaft projected laterally through the column to rotate the nut, a pulley V^3 with reversible gearing connected to such shaft, a pulley J^3 upon the shaft *J'* with belt or other suitable connection to the pulley V^3, the whole arranged and operated substantially as herein set forth.

16. A gear cutter having a bed with cutter head movable upon the top of the same, a column upon the bed with mandrel head adjustable vertically thereon, a cutter spindle mounted upon the cutter head with a feed screw to actuate the same, a driving shaft mounted in fixed bearings with a driving

pulley thereon, a train of gearing connecting such fixed pulley shaft with the movable cutter head, a separate train of gearing connecting the fixed pulley shaft with the feed screw, to feed the cutter through the blanks, and a separate train of gearing for reversing the feed screw to retract the cutter, substantially as herein set forth.

In testimony whereof we have hereunto set our hands in the presence of two subscribing witnesses.

ULRICH EBERHARDT.
HENRY E. EBERHARDT.
FRED L. EBERHARDT.

Witnesses:
EDWARD F. KINSEY,
THOMAS S. CRANE.