(No Model.) 7 Sheets—Sheet 1.

U. & H. E. EBERHARDT.

GEAR CUTTING MACHINE.

No. 308,658. Patented Dec. 2, 1884.

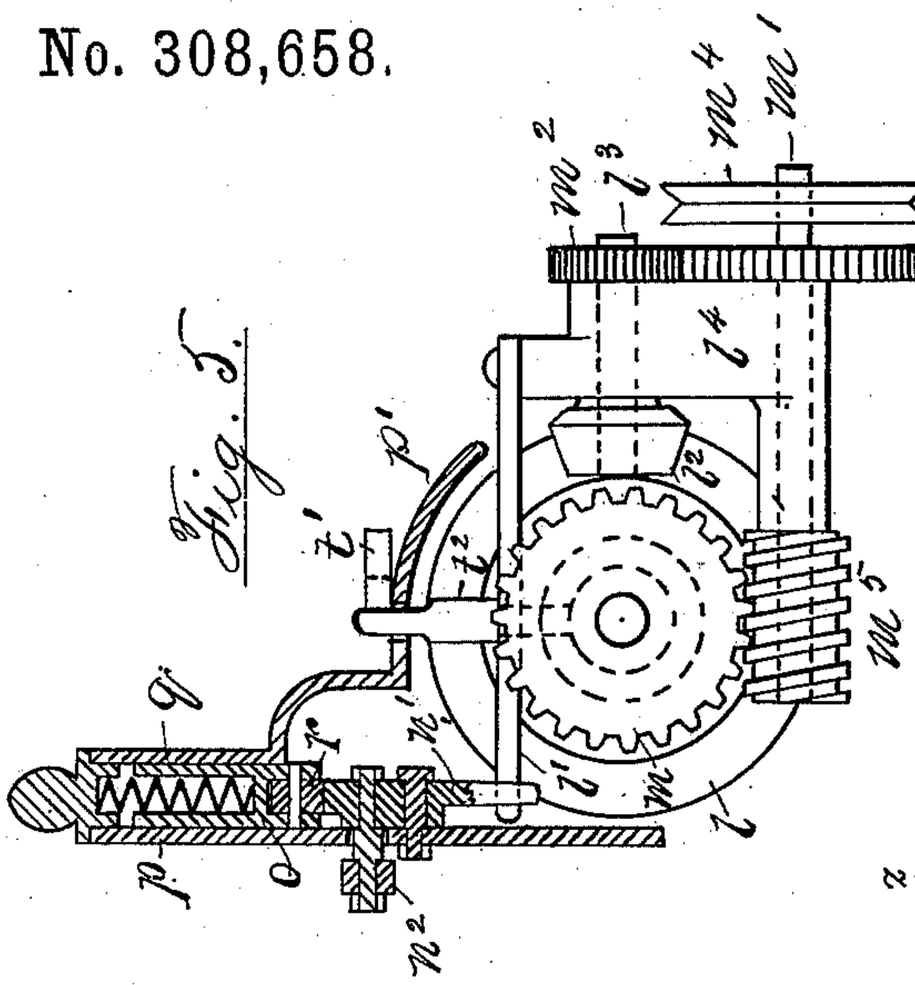

Fig. 2.

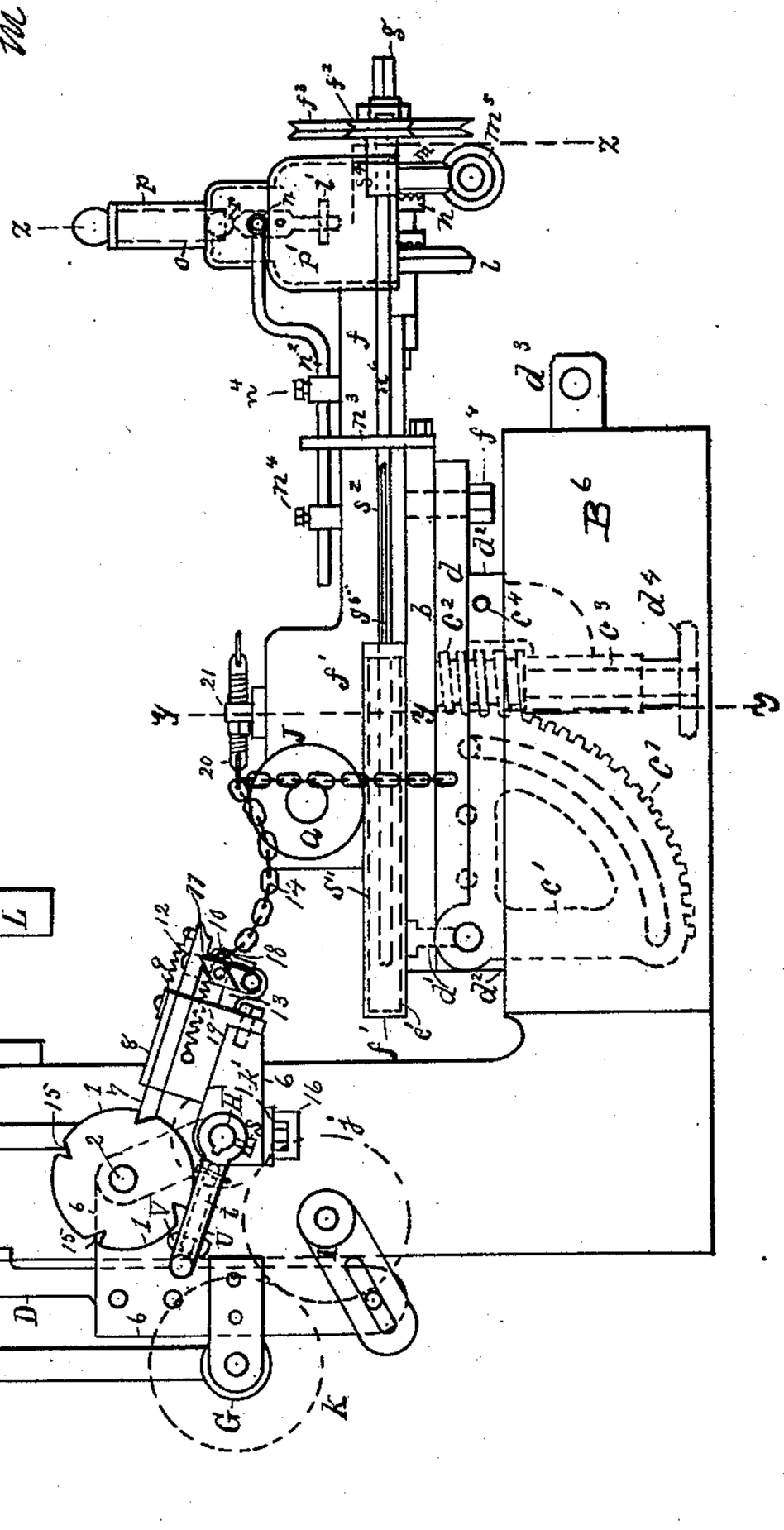

Fig. 1.

Attest.
W. F. D. Laue.
H. J. Theberath,

Inventor.
U. Eberhardt and H. E. Eberhardt per F. F. Laue atty.

(No Model.) 7 Sheets—Sheet 2.

U. & H. E. EBERHARDT.

GEAR CUTTING MACHINE.

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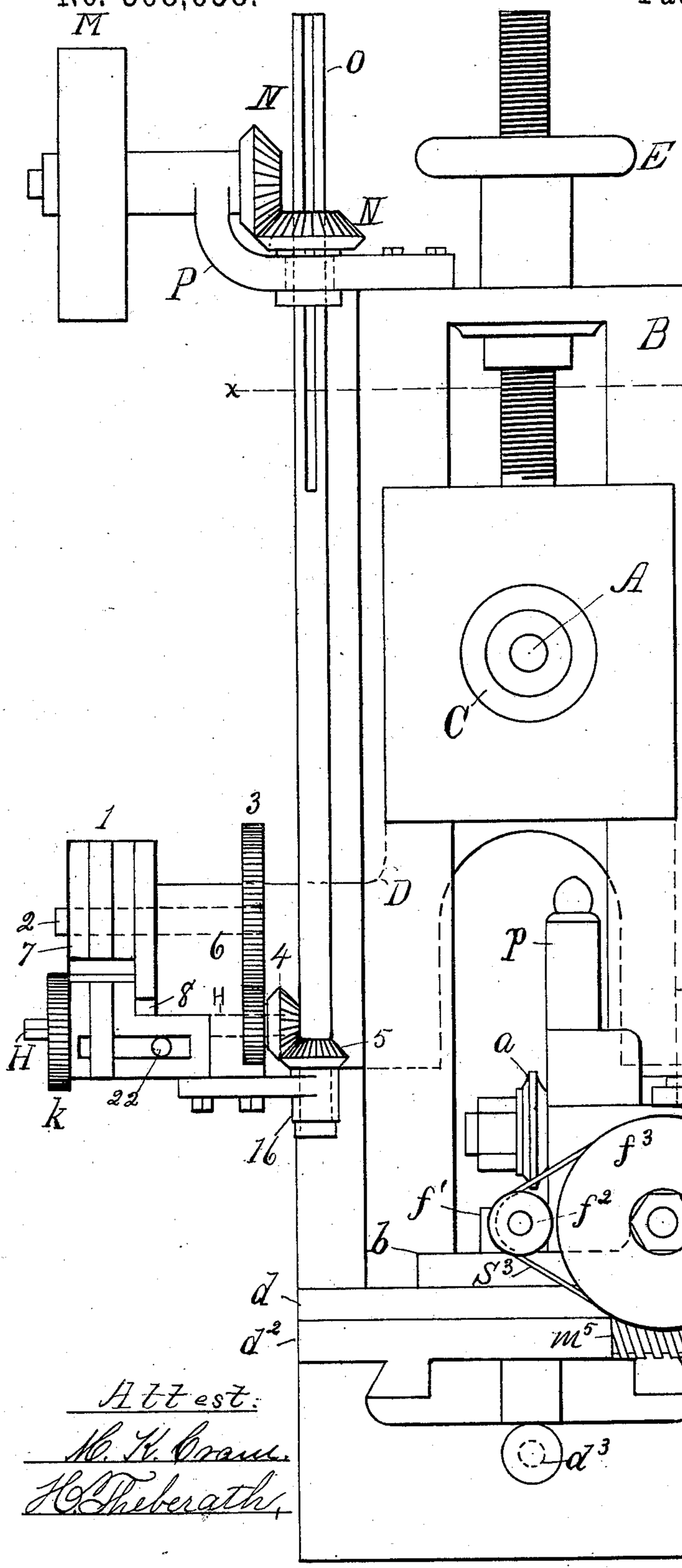

Fig. 2.

Attest:
H. K. Braun.
H. Theberath.

Inventors
U. Eberhardt
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per
J. S. Crane Atty

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(No Model.) 7 Sheets—Sheet 3.

U. & H. E. EBERHARDT.

GEAR CUTTING MACHINE.

No. 308,658. Patented Dec. 2, 1884.

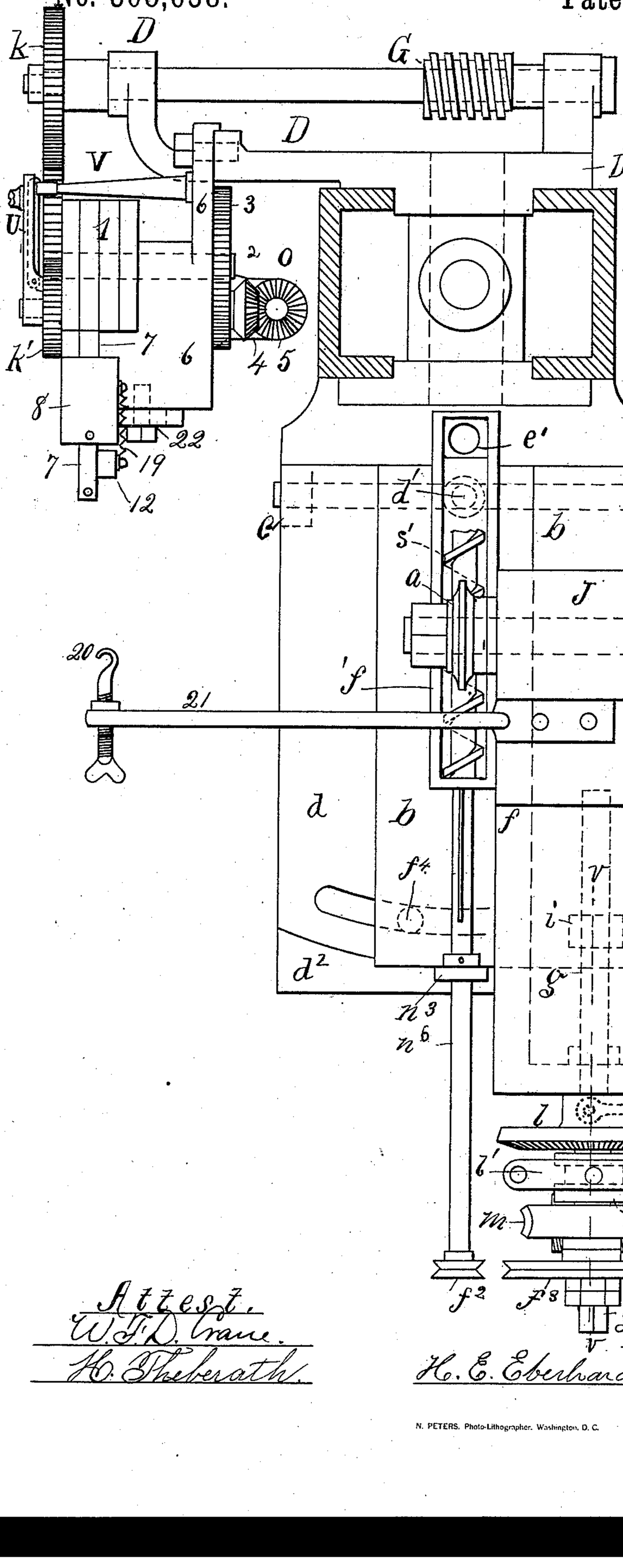

Fig. 3.

Attest.
W. F. D. Crane.
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(No Model.) 7 Sheets—Sheet 4.

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GEAR CUTTING MACHINE.

No. 308,658. Patented Dec. 2, 1884.

Fig. 6.

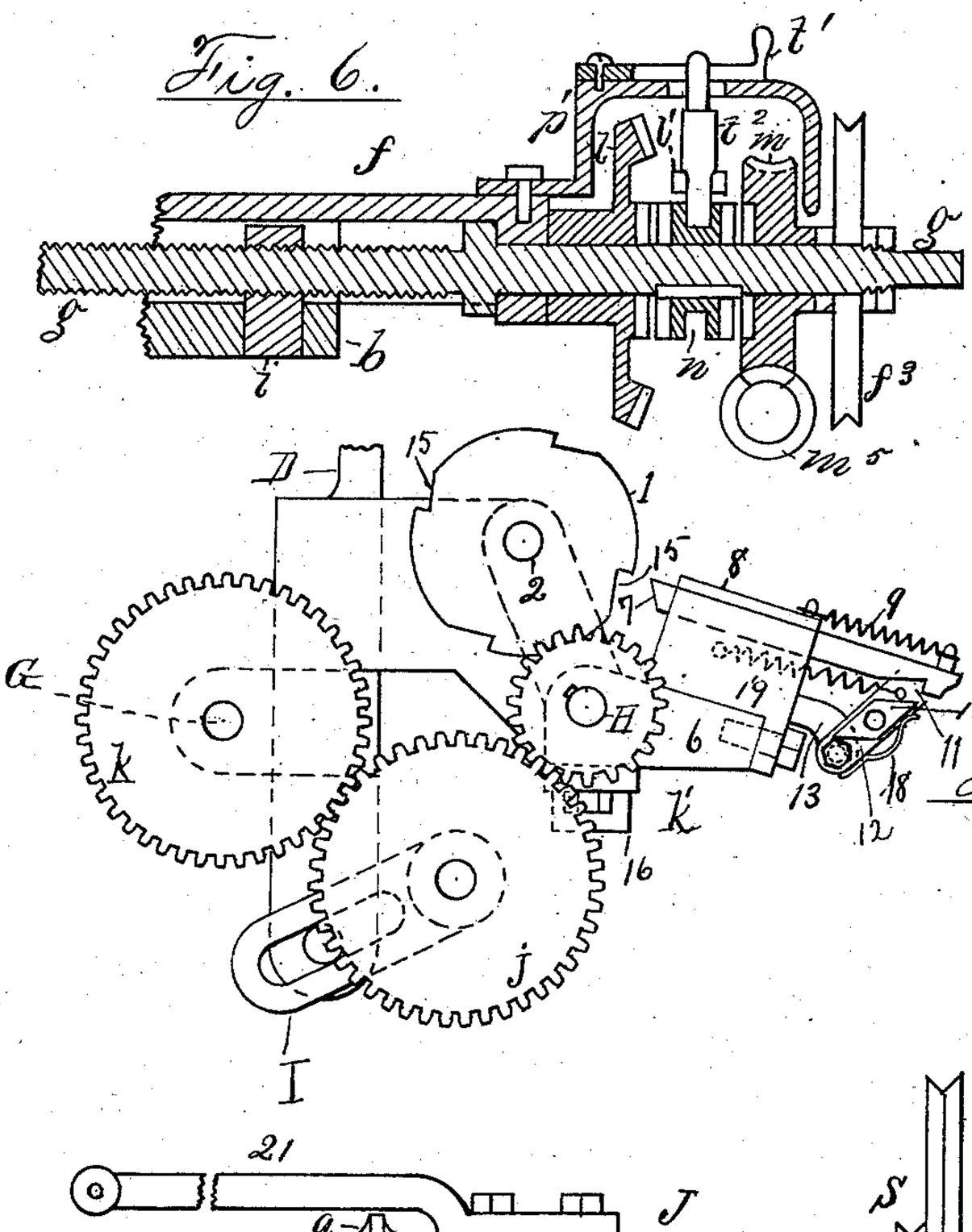
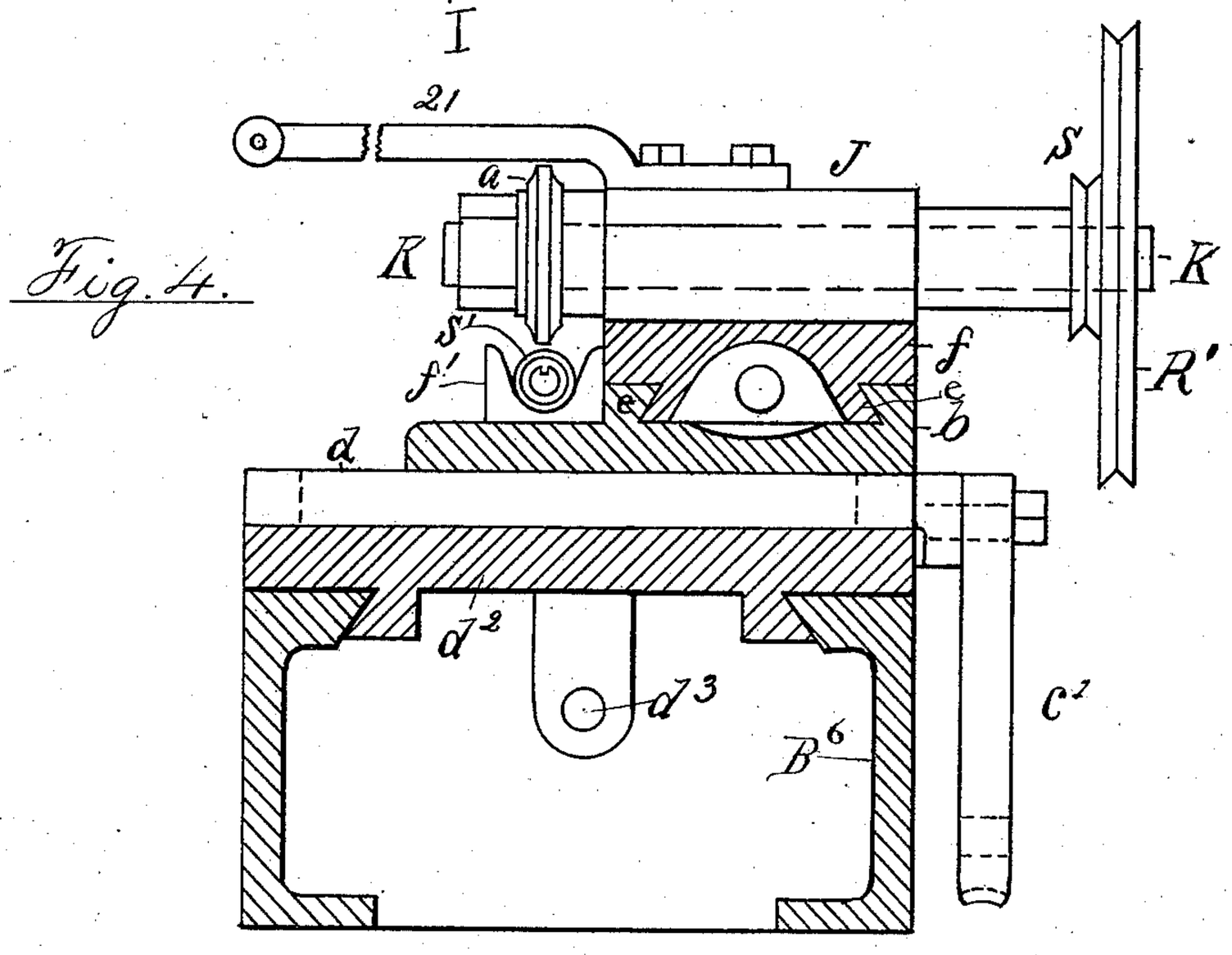


Fig. 7.

Fig. 4.



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(No Model.)

7 Sheets—Sheet 5.

U. & H. E. EBERHARDT.

GEAR CUTTING MACHINE.

No. 308,658. Patented Dec. 2, 1884.

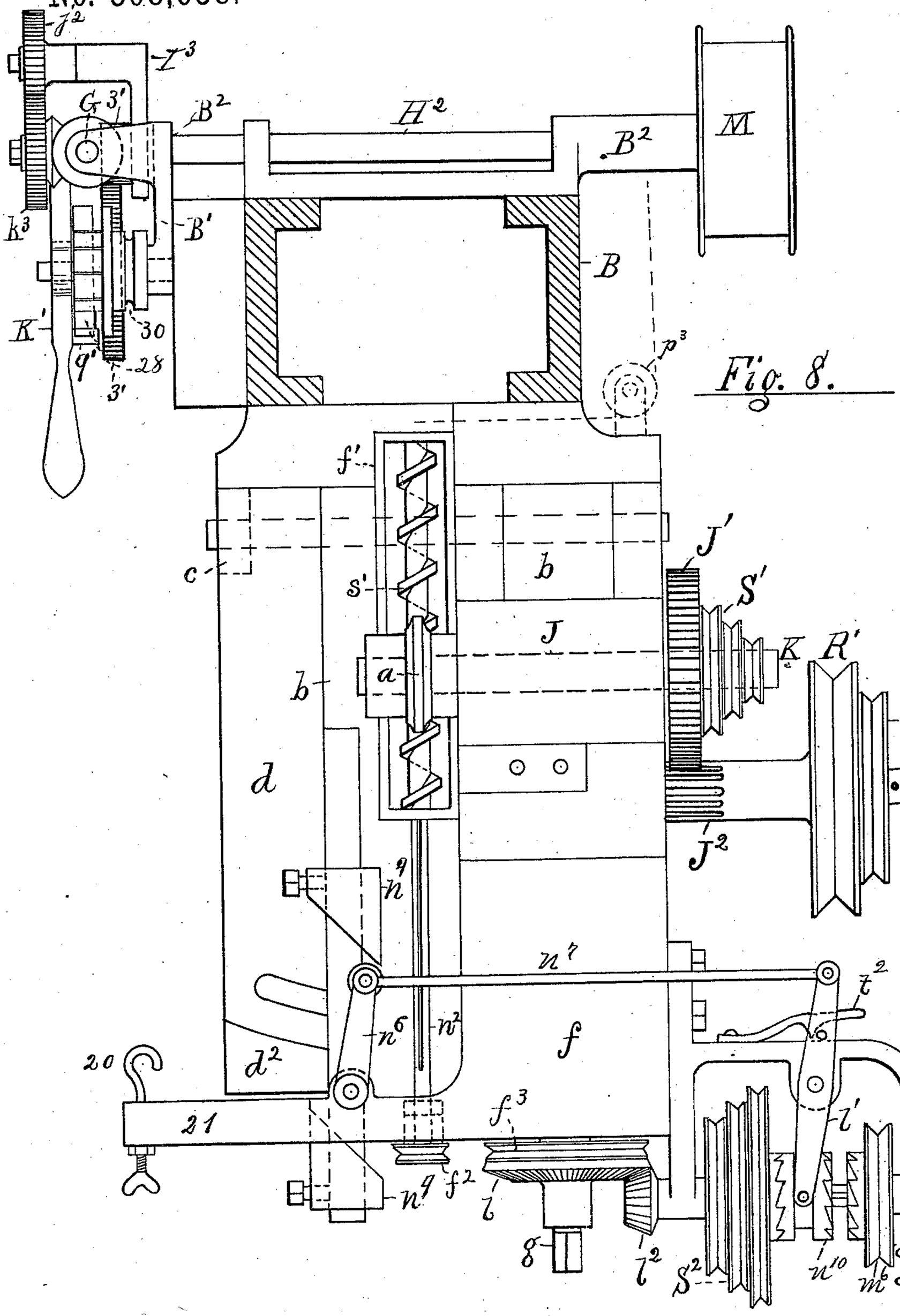

Fig. 8.

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(No Model.)

7 Sheets—Sheet 6.

U. & H. E. EBERHARDT.

GEAR CUTTING MACHINE.

No. 308,658. Patented Dec. 2, 1884.

Fig. 12

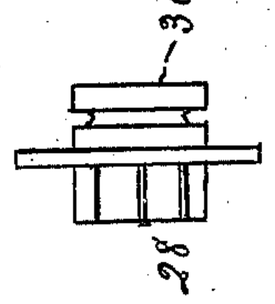


Fig. 11

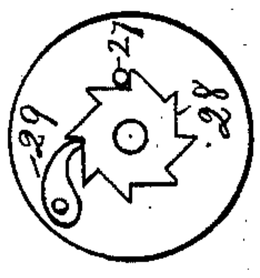


Fig. 13

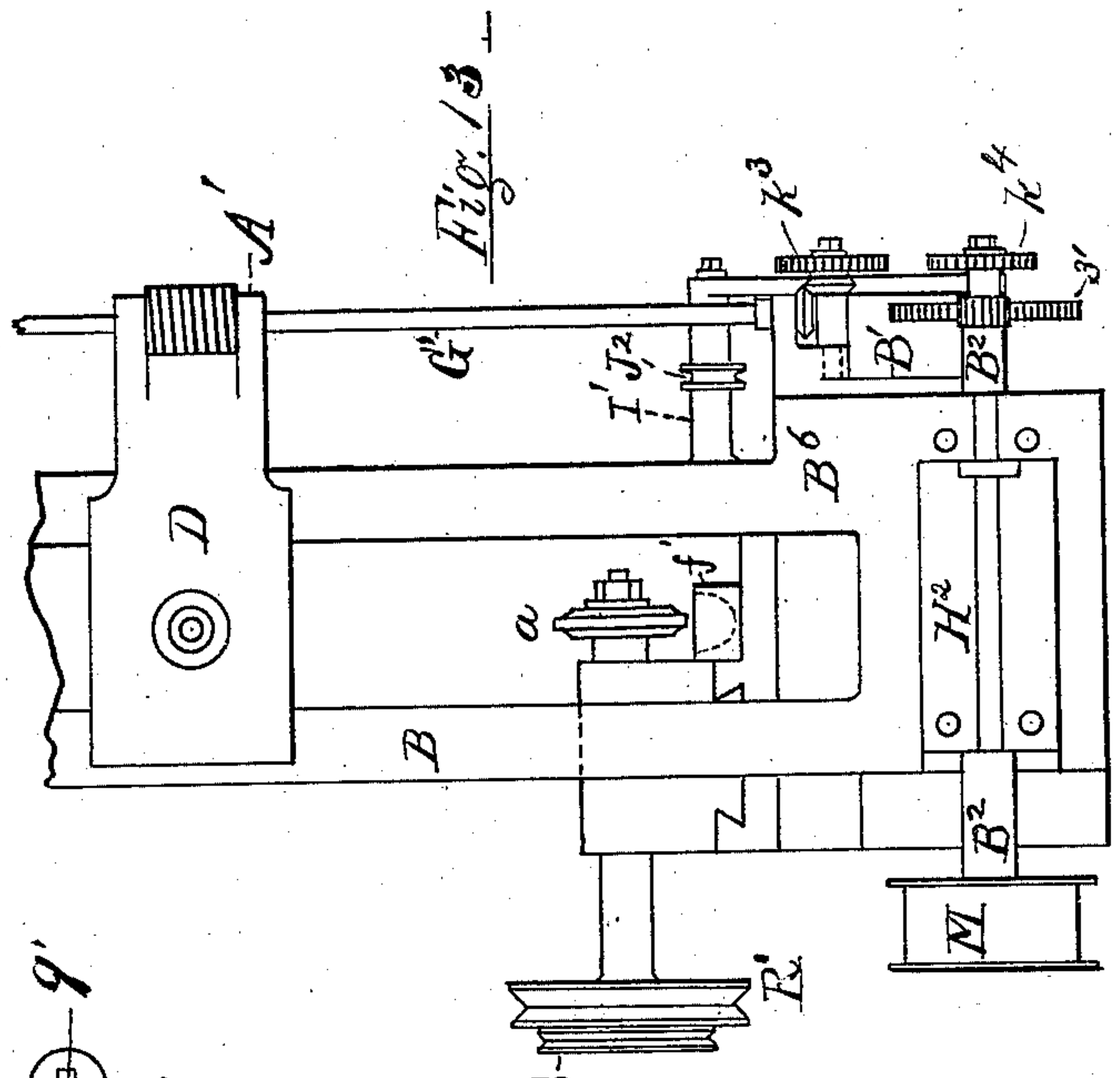


Fig. 10

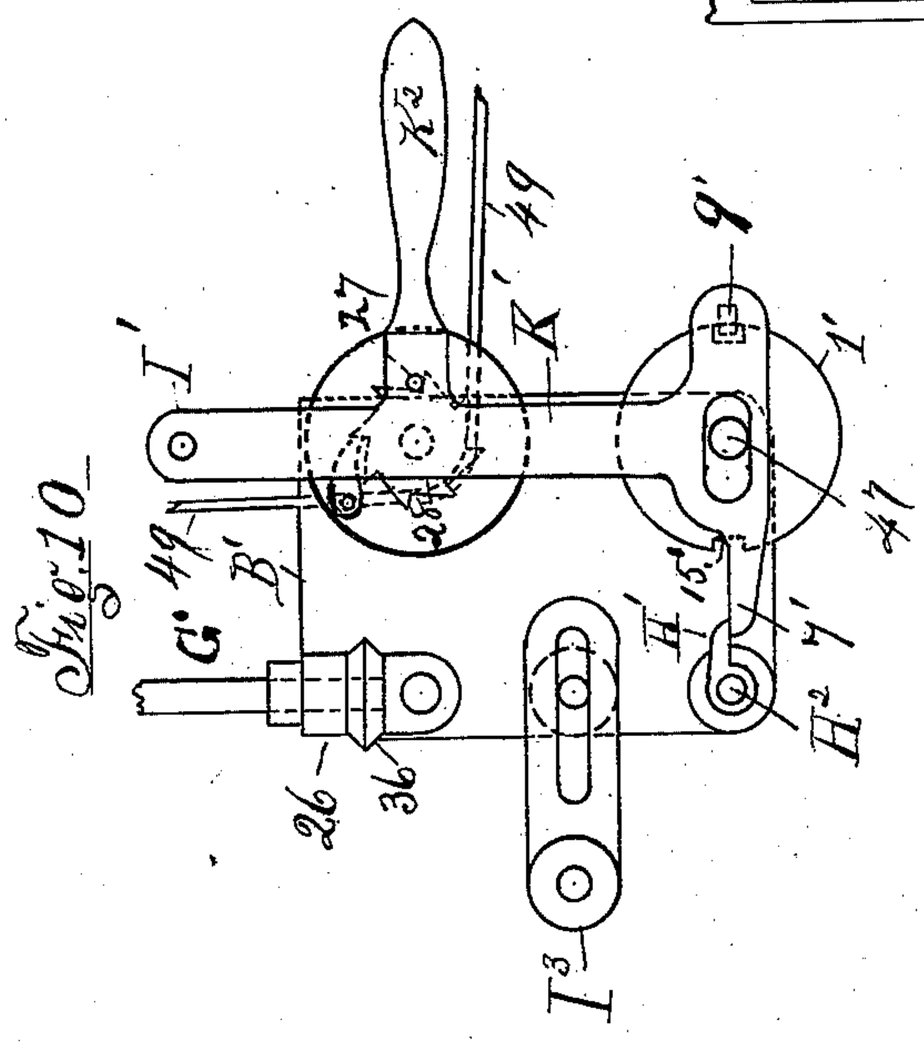
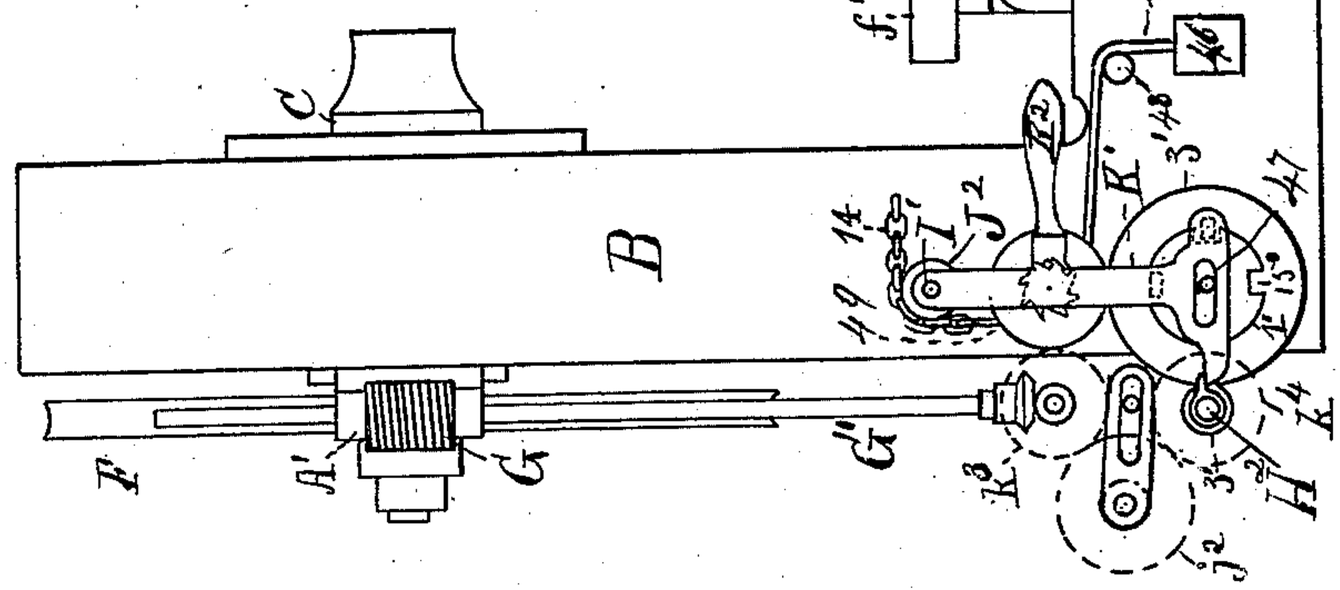


Fig. 9.



Attest.
W. F. D. Crane.
Myra K. Crane

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(No Model.) 7 Sheets—Sheet 7.

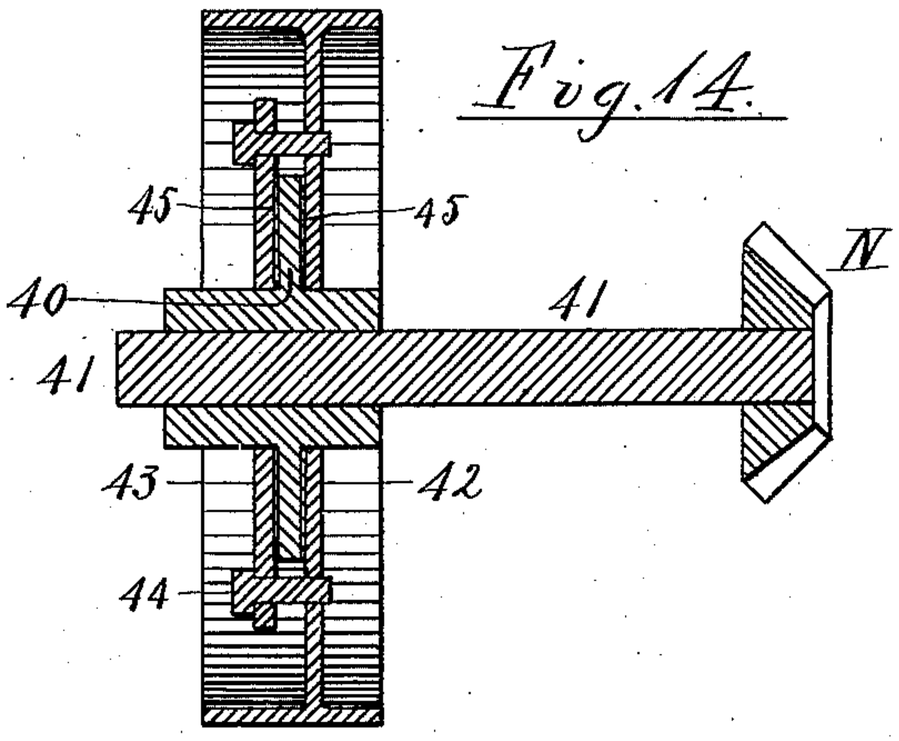
U. & H. E. EBERHARDT.

GEAR CUTTING MACHINE.

No. 308,658. Patented Dec. 2, 1884.

M

Fig. 14.



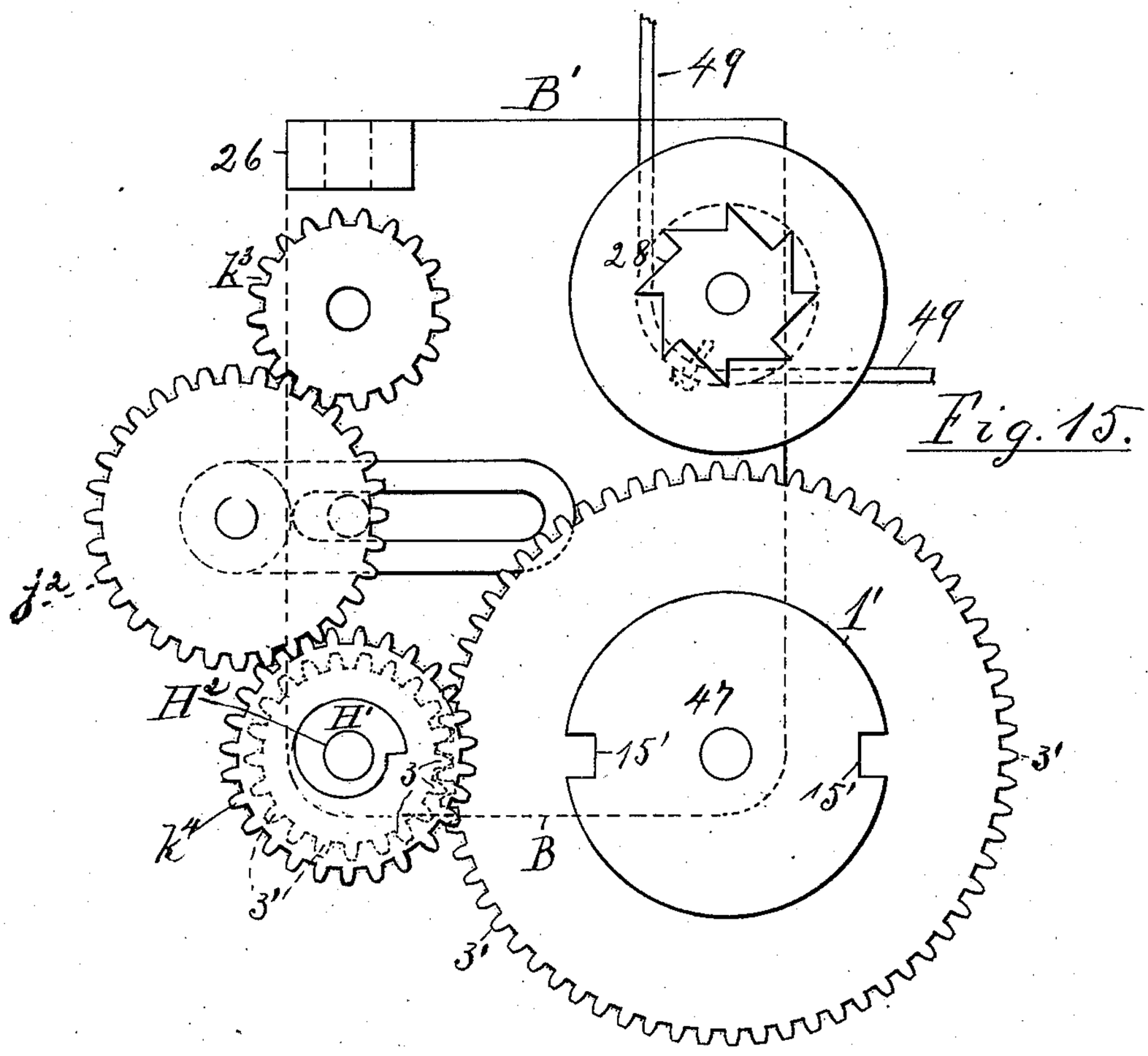


Fig. 15.

Attest.
W. F. D. Craig.
Henry J. Theberath

Inventor.
U. & H. E. Eberhardt.
per Thos. S. Craig, Atty.

UNITED STATES PATENT OFFICE.

ULRICH EBERHARDT AND HENRY E. EBERHARDT, OF NEWARK, N. J.

GEAR-CUTTING MACHINE.

SPECIFICATION forming part of Letters Patent No. 308,658, dated December 2, 1884.

Application filed December 11, 1883. (No model.) Patented in England June 19, 1883, No. 3,035.

To all whom it may concern:

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

This invention relates to the combination, in a gear-cutter, of an automatic feeding device for propelling a revolving cutter through the rim of a metallic blank for cutting teeth thereon; an automatic shifting device for turning the blank around a specific amount before cutting each tooth, and a locking mechanism for the latter, operated by the former after each tooth has been cut and the cutter retracted.

The feeding device consists in a screw provided with gearing to rotate it in either of two directions, and a clutch provided with shipping devices for reversing the motion of the screw at the proper point.

The device for rotating the blank a specified amount consists in a constantly-rotating friction-driver operating upon the shifting gearing, and in a rotary lock and bolt actuated by the movement of the cutter-slide.

Several constructions for our invention are illustrated and described herein, to show that the arrangement and construction of the parts may in some instances be modified without departing from the essential feature of the invention, which is the combination just described. We have also claimed herein some of the details of construction, but have not claimed herein certain constructive features for which we have filed other patent applications, No. 72,519, dated September 22, 1882, No. 134,413, dated June 10, 1884, and No. 145,898, dated October 18, 1884.

In the drawings, Figure 1 is a side elevation of a machine provided with these improvements. Fig. 2 is a front elevation of the same. Fig. 3 is a plan of the same, partly in section, on line *x x* in Fig. 2, and with the guard *p'* omitted. Fig. 4 is a vertical section of the machine on line *y y* in Fig. 1. Fig. 5 is a vertical section of the clutch and gearing on line *z z* in Fig. 1. Fig. 6 is a horizontal section of the gearing as applied to the end of the feeding-screw, taken on line *v v* in Fig. 3. Fig. 7 is an enlarged view of the locking mechanism detached. Fig. 8 is a plan of an alternative construction for the feeding and shifting devices shown in Fig. 3. Fig. 9 is a side elevation of an alternative construction for the shifting devices shown in Fig. 1, the gears connecting the disk and certain shafts being shown either by full or dotted circles, as the teeth could not be shown upon so small a scale. Fig. 10 is an enlarged view of the bracket B' with only the locking mechanism illustrated. Figs. 11 and 12 are respectively side and edge views of the ratchet-wheel, pawl, and chain-wheel for tripping the bolt 9'. Fig. 13 is a rear view of the construction shown in Figs. 8 to 12. Fig. 14 is an axial section of the pulley M shown in Fig. 2; and Fig. 15 is an enlarged view of the bracket B', with the gears shown more fully.

The mechanism for carrying and moving the gear-spindle A consists of an upright square column, B, spindle-bearing C, carrying the worm-wheel frame D, and adjusted vertically by a screw and hand-wheel, E. The spindle is provided with a worm-wheel, F, and the frame D with bearings supporting a worm-shaft, G, adapted to turn the wheel F when the blank-gear is to be shifted, as usual. A movable stud, I, is secured to the same frame to carry an intermediate cog-wheel, *j*, which is adjustable to change-wheels *k k'*, fitted to shafts G and H, to determine the angular movement of the gear at each revolution of the auxiliary shaft.

The means for supporting the rotary cutter *a* is that usually employed, consisting in a bed, *b*, pivoted at its inner end by a vertical bolt, *d'*, upon the surface of a hinged table, *d*, upon which the bed can be turned in a horizontal plane. The table *d* is carried by a sliding plate, d^2, fitted to ways projecting forward upon the base B^6 of the column B, the plate being moved to and from the column by a screw, d^3, and the table *d* being fitted for angular movement in a vertical plane, by being hinged to lugs *c c* at the inner end of the plate d^2. The bed *b* has dovetail ways *e* formed in it to guide the cutter-slide *f*, and is held in the horizontal plane by bolt f^4, and in the vertical plane by a toothed segment, *c'*, bolted to the bed *b*, and provided with a worm c^2,

hung in a bearing, c^3, attached to the table d^2. The slide is provided with a screw, g, secured by collars in a lug at its front end, and tapped into a nut, i, which is fastened in a mortise in bed b. The mechanism (shown in Figs. 1 to 7) for automatically turning this screw to feed the cutter through the blank consists in a worm and wheel, combined with a pair of bevel-gears and a reversing-clutch, by means of which the screw is alternately connected with the worm-wheel, to traverse the slide slowly forward, and with the bevel-gear, to move the slide and cutter quickly backward on the completion of a cut. The bevel-gear l is shown in the drawings as fitted loosely to the screw-shank next the front end of the slide f, and the worm-wheel m is applied to the shank at a suitable distance to admit the clutch n between them. The clutch is feathered to the screw-shank, and is provided with teeth to engage similar teeth in either wheel, and the wheels being rotated by suitable means, in opposite directions, the screw is turned in the desired manner by moving the clutch into contact with the proper wheel by a lever, l'. A guard, p', is bolted to the slide and serves to cover the reversing-gears and to carry portions of the reversing mechanism.

To reverse the clutch automatically a shifting-lever, n', is pivoted to a bearing upon the guard p', and a rod, n^2, is secured thereto and extended along the side of the slide and through a bearing, n^3, secured to the front end of the bed b. The rod n^2 is provided with two adjustable dogs, n^4, and reverses the clutch at each end of the stroke with the aid of a spring-stud, o, arranged to press a roller, r, upon the top of the lever n', as shown in the section in Fig. 5, so as to carry the lever to the end of its movement after the dog has brought it to its central position by contact with bearing n^3. The spring-stud is mounted in a vertical socket, p, secured at the top of the guard p', (which is bolted to the front end of the slide f to cover the gears l and m and lever l',) and is provided with a spring, q, at its upper end, and has the roller r pivoted in its lower end, as shown in Figs. 1 and 5.

By the clutch and shifting mechanism described the cutter a and its traversing slide f are automatically carried back and forth, as required, feeding the cutter slowly into the blank and withdrawing it quickly. The spindle K is shown provided with a pulley, R, to receive a belt for driving the cutter in the usual manner, and a pulley, S, to operate the reversing mechanism of the slide f. The gear l is driven by a pinion, l^2, which is carried by a short shaft, l^3, mounted in a bearing, l^4, bolted to the front end of the slide f, as shown in Figs. 3 and 5. The worm m^5 and its shaft m' are similarly supported, and the shafts l^3 and m' are connected by a pair of cog-wheels, m^2 and m^3. A pulley, m^4, upon the shaft m', would receive a belt from the pulley S, and thus operate the reversing devices from the shaft K. The pulleys S and m^4 and the gears m^2 and m^3 may be proportioned to produce any relative speed of the three shafts K, l^3, and m', as required. If preferred, the shaft l^3 may be extended outside its bearing l^4, and be connected with the spindle K by two sets of driving-pulleys to vary the speed.

In Figs. 3, 5, and 6 is shown a latch, t', hinged to the guard p', and formed with a notch to hold the lever l' in a central position when turning the screw g to set the cutter-slide by hand. To effect this, a pin, t^2, is attached to the lever and projected through a slot in the case in the path of the latch.

The mechanism shown in Figs. 1, 2, 3, and 7 for shifting the gear-spindle A consists in a frictional driving device operated by a belt or other continuous mover in a rotary disk or lock applied to the shaft H, or to a train of gearing connected therewith, and in a bolt or locking device applied to the rotary lock and detached by any suitable means after each tooth has been cut and the cutter retracted. The frictional driver is arranged to rotate the worm G continuously, except as controlled by the locking device, which device determines the extent of such rotation accurately, and thus secures a specific rotary movement of the spindle A whenever the bolt is detached or withdrawn. Several disks graduated differently may be applied to the same locking device, and the bolt be adjusted to either disk desired. A shaft, H, intended to rotate slower than the disks, and to be connected with the worm-shaft G by change-wheels, is shown mounted in a bracket attached to the frame D. Four notched disks (lettered 1) are shown applied to a short shaft, 2, mounted in the bracket 6, which carries the shaft H, and is thus adjusted with the latter at any height whenever the frame D, carrying the bracket 6, is raised or lowered.

In Figs. 1 and 2 the bearing C is shown carrying a gear-blank, L, upon the spindle A, the whole being considerably raised above the cutter a to show the latter more clearly.

The shafts 2 and H are connected by gears 3, and the latter shaft is also provided with a bevel-gear, 4, which meshes with a similar gear, 5, (carried by a bearing, 16, in the bracket 6,) adjacent to the shaft H.

The friction-driver, as shown in Figs. 2 and 14, consists in a friction-pulley, M, which is connected by a pair of bevel-gears, N, to a shaft, O, which is secured at its lower end to the bevel-gear 5, and is splined to the upper gear, N, through which it slips when the bearing C and the locking device are raised and lowered. Such friction-driver produces a constant tendency in the disk 1 and worm G to rotate, and the lock is designed to make the rotations of the worm and consequent movements of the gear-blank L depend upon the reciprocations of the cutter-slide by means of a suitable connection (as a chain or link) between the locking device and slide.

Fig. 14 shows the construction for a pulley, (similar to that indicated in Fig. 2 at M,)

being a smoothly-turned circular plate attached to the shaft 41, and revolving with the gears N O and disk 1 when the latter is free to move.

42 is an annular flange cast fast to the rim of the pulley; 43, a similar flange bolted thereto by bolts 44 outside of the plate 40, and 45 are leather washers or disks interposed between the plate and flanges.

By clamping the screws and flanges with the required tightness the device constitutes a friction-driver adapted to rotate the disk at pleasure, while the pulley can slip around in contact with the leather-faced plate when the shifting mechanism is locked, and is always ready to move the same when required.

The construction of the friction-pulley forms no part of our invention, as any other form of friction-driver already in use may be used without affecting our invention. Thus a belt and a tightener adjusted to slip at a given resistance may be applied to the flanged pulley M (shown applied to the shaft H^2 in Figs. 8 and 13) to produce the same effects. The shaft O extends upward along the side of the column B, and the pulley M and gears N are carried in suitable bearings, P, secured to the top of the column. A belt drives the friction-pulley M continuously; but the shaft H, being connected to the disk 1 by the gears 3, is prevented from rotating so long as the disk is locked, and the pulley therefore revolves at such times without moving the gears N or shaft O by reason of such obstruction. The disk 1 may be provided with any desired number of holes or notches, 15, in or near its periphery, and is locked by means of a bolt pressed into such apertures, as by a spring or weight. The bolt is so operated that as soon as it is withdrawn from the disk it is allowed to press again upon the surface of the latter between the notches, and therefore arrests the disk by falling into the notch next to the one from which it was drawn. Should the disk 1 be formed with two notches, it would therefore not make more than half a revolution until unlocked again, and in like manner for any number of notches. It only remains, therefore, to form a connection between the locking-bolt and the reciprocating cutter-slide to render the intermittent movements of the worm-wheel F and gear-blank L alternate with the movements of the cutter *a*.

In the locking mechanism shown in Figs. 1, 2, and 3 the bolt 7 is shown guided in a bearing, 8, secured to the front end of the bracket 6, and projecting from the rear of the bearing, to which bearing a spring, 9, is attached to press the bolt toward the disk. A pivoted button, 10, is fitted to a notch, 11, upon the rear of the bolt, and is mounted upon a lever, 12, which is pivoted to an arm, 13, at the lower part of the bearing 8, so that the upper corner of the button will move in a curve when drawn back, and will slip out of the notch 11 when retracted sufficiently to withdraw the bolt from the notches 15. The button, being pivoted at its center to the lever 12, is adapted to enter the notch 11 again by turning on its own pivot when the lever 12 is released from the tension of the chain. A spring, 19, draws the lever toward the bearing 8 in opposition to the pull of the chain, and a spring, 18, upon the side of the lever tends to hold the button in its normal position by pressing the lower end of the button against the head of the bolt in bearing 13, on which lever 12 is pivoted. The chain 14 is shown in Fig. 1, and is attached at one end to the lever 12 and at the other end to a hook, 20, provided with a screw-shank, and mounted in an arm or brace, 21, projecting from the bearing J. By this chain a movement is conveyed from the reciprocating slide *f*, carrying the cutter *a*, to the spring-bolt 7 at the end of each retracting movement of the slide. The screw upon the shank of the hook 20 is provided to adjust the length of the chain to any desired degree below the length of a single link, as any link of the chain may be hooked upon the hook when the slide is run back to secure the necessary movement of the lever 12 at that time. When the slide is moved forward to cut the blank, the chain is slackened, but is tightened again at the end of each outward stroke to unlock the bolt 7, as required.

Having thus described the construction of the feeding and gear-shifting devices and the connection between the two formed by the chain 14, it will be perceived that the gear-blank L can be turned any required amount by properly proportioning the gears 3 and the change-wheels *k* and *k'*.

In practice the gear 3 upon the shaft 2 has been made just three times the size of the gear 3 upon the shaft H, which meshes into it, so that a third of a revolution of the shaft 2 or its attached disk would cause the shaft H to make one exact revolution. If the disk 1 were therefore provided with three of the openings 15, into which the bolt 7 could fall, the shaft H would be rotated once for each reciprocation of the cutter slide and cutter.

To turn the shaft H by hand, it is provided with a hand-crank adjusted to a stationary stop upon the frame D, so as to set it exactly in its initial position after each revolution, and the various coincident rotations of the worm and shaft G are proportioned and effected by the use of change-wheels applied as shown at *k k'*. Such a hand-crank is shown at U in Figs. 1 and 3, but is made detachable from the shaft H, and when the latter is operated automatically, as described, the change-wheels produce the same effect in turning the shaft G as is effected in other machines by the rotation of the hand-crank.

When the hand-crank U is applied to the shaft H and the bolt 7 is withdrawn from the notches in the disk, the shaft G may be rotated and the gear-blank L changed in position, the same as in any machine having a hand-crank and change-wheels. The hand-crank is shown in Fig. 1 as fitted to the shaft H with a feather, to secure a similar relation to the

notches 15, when applied after a removal, and is fastened thereon by a set-screw, *s*, when required. A spring-tongue, *t*, is shown fitted into the back of the crank to engage a notch in a stop, V, which is shown in the plan in Fig. 3; but the front end only of the stop is shown in Fig. 1. The stop V is attached to the bracket 6, and serves to insure an exact rotation of the shaft H when turned by the crank, as in similar machines. To obtain a movement of the shaft H greater or less than one exact rotation other disks may be applied to the shaft 2, having less or more than three notches, 15, therein. Thus with a disk having but one notch and with the gears 3 proportioned as above the shaft H would rotate three times at each movement of the cutter-slide *f* and disk 1; a disk with two teeth would rotate it one and one-half times; one with four teeth, three-quarters of a revolution; one with six teeth, one-half a revolution, and so on for other disks.

In Figs. 2 and 3 four disks are shown secured together upon the shaft 2, and the bearing 8 is represented in Fig. 2 as secured to the front of the bracket 6 by a slotted foot and bolt, 22. With this construction the bolt 7 can be moved to coincide with any of the four disks, and the rotation of the shaft 2 be regulated by the number of notches provided in such disk. If desired, the disks 1 may be made removable, and a disk with any number of notches thus be applied. The precise arrangement of the disk and bolt is obviously immaterial, and the former might be made with round holes formed in its flat face, and the bolt arranged to stand at right angles to the plane of the disk and enter the holes to hold it in the desired positions.

Figs. 8, 9, and 13 show a construction in which the frictional driver is applied to a stationary shaft, H^2, mounted upon the base of the machine, the worm being connected therewith by change-wheels k^3 and k^4, and a disk, 1′, being also connected with it by gears 3′. An intermediate gear, j^2, connects the change-wheels, and an upright splined shaft, G′, is connected with the gear k^3 and slips through the worm G, the latter being arranged at the side of the wheel F in bearings A′ upon the frame D. The shifting-gearing is by this means all removed from the frame D and affixed to the base B^6, a stud, 47, serving to carry the notched disk 1′, by which a bolt, 7′, is actuated automatically to lock the shaft H. The latter is connected with the disk by the cog-wheels 3′, and a revolving lock, consisting in a toothed hub, H′, is affixed to the shaft to engage the bolt, the rotary pressure upon the locking device being thus made much less than if the bolt were applied to the disk, with the latter geared to revolve slower than the hub H′, and therefore with more force. The power required to withdraw the bolt from the lock is thus less than in the arrangement of bolt and disk shown in Figs. 1 and 2.

In the arrangement just described in Figs. 9 and 10 the bolt is made pendulous, being a part of or affixed to a swinging arm, K′, which also carries a bearing-block, 9′, arranged to bear upon the notched disk 1′, and to thus regulate the movement of the bolt 7′ toward the hub H′. The arm K′ is pressed toward the hub by a weight applied at one side, as by a handle, K^2, and the arm is retracted by the intermittent rotation of a ratchet-wheel, 28, the teeth of which operate successively upon a pin, 27, attached to the arm. The ratchet-wheel turns independently upon a stud, 28, (see Fig. 15,) and is actuated by the oscillations of a pawl, 29, which is mounted with a wheel, 30, upon the stud 28, and is connected by a cord, 49, with the chain 14. The cord is fixed to one side of the wheel 30, and is extended over a pulley, 48, to a weight, 46, and the latter thus serves to return the pawl to the next preceding tooth of the ratchet-wheel, when the chain is slackened, after each actuation of the slide *f*. The function of the notches 15′ in the disk 1′ is only to determine the movement of the bolt 7′ toward the toothed hub H′, and they are not therefore constructed to fit the block 9′, and the latter does not therefore receive any pressure from the sides of the notches. By a comparison of this construction with that shown in Figs. 1 to 7 the function of the lock is seen to be, first, the regulation of the frictional driver so that the movements of the latter shall alternate with those of the cutter-slide; and, secondly, the regulation of the rotations of the gear-spindle A through the change-wheels, the latter determining the ratio that the spindles' rotations shall bear to those of the rotary lock. The toothed hub H′ is also seen to be an equivalent of the disk 1 when in co-operation with a sliding or swinging bolt. A variation in the construction of the feeding mechanism is illustrated in Figs. 8 and 9, to show that the operation of our automatic blank-shifting devices are not dependent upon any particular construction of the feeding apparatus. In this arrangement both the direct and reverse movements of the slide are imparted through the bevel-gears *l* and l^2, thus dispensing with the worm and worm-wheel *m*.

In Fig. 8 the cutter-spindle is shown provided with a cog-wheel, J′, and a pinion is mounted upon an adjacent stud and provided with a pulley, R′. The pulley S is connected with the latter, and arranged to operate with a pulley, m^6, for retracting the slide rapidly at the end of the cut. The gear J′ is provided with a cone, S′, arranged to operate with a cone, S^2, upon the spindle of the gear l^2. This cone S^2 and the pulley m^6 are provided with teeth adapted to operate with a clutch, n^{10}, which is mounted between them, and operated by the lever l', pivoted to a bracket l^7, which is provided to sustain the clutch-shaft at one side of the slide *f*. A latch, t^4, is shown pivoted upon the bracket l^7 to lock the lever l' in its central position, so that the slide may be operated by

hand when desired. The clutch-lever is connected by a rod, n^7, to a lever, n^6, carrying a roller at the end to operate with dogs n^9, having inclined faces to strike the roller and shift the clutch, as required. A spring, t^2, is fastened to the bracket l', and operates upon a pin on the lever l' to throw it out of the central position when not engaged with the latch t^4.

By the use of the cones S′ and S² the speed of the feed may be materially varied to suit the hardness of the blank and size of the cutter employed.

An attachment for clearing the chips from the adjustable bed b is shown in Figs. 1, 2, 3, 4, and 8, and consists in a combination of parts adapted to operate in any position of the cutter-slide and its bed b, as when tipped up to cut bevel-gearing or inclined sidewise upon the pivot d'.

The device consists in a trough, f', affixed to the bed beneath the cutter, of sufficient length to receive the chips during the traverse of the latter, and in a coarse-threaded screw, s', inserted in the trough and rotated by a connection to the moving parts. The outline only of the screw is indicated in Fig. 1, where its driving mechanism consists in a splined shaft, n^6, held in a bearing upon the guard p', and furnished with a pulley, f^2, adjacent to the end of the screw g. A pulley, f^3, is attached to the screw g, and a belt, s^3, is shown applied to these pulleys in Fig. 2 to rotate the worm-conveyer s' when the screw g revolves, the splined shaft sliding back and forth in the bore of the conveyer-screw as the slide is traversed in and out. The trough is formed with a discharging-hole, e', at the inner end, as seen in Fig. 3, and a connection may be made to the conveyer at that point by applying a pulley to that end of the conveyer and leading a belt over suitable guides thereto from other rotating shafts, as, for instance, from the rear shaft, H², (shown in Fig. 8,) the path of such a belt being indicated by dotted lines, and the guide-pulley being similarly indicated at p^3 in the same figure.

We are fully aware that a screw-conveyer is old, and do not, therefore, claim the same as our invention, but only the combination of the same with the parts sustaining the cutter in such manner that the conveyer-trough may be adapted to move with said parts when they are tipped or adjusted for cutting various kinds of gearing, and the conveyer itself be rotated by an unbroken connection when thus tipped or adjusted.

We are also aware that a toothed segment has been used for an analogous purpose in similar machines, and do not, therefore, claim the segment c' and worm c, except in combination with the bed b, carrying the cutter-slide, as described, and with the bearing c^3, attached to the table d^2 and having the worm-shaft mounted vertically therein, so that it may operate equally upon the segment whether the latter be raised or lowered.

It will be seen that the rotary lock operates in the same manner whether constructed either with teeth or notches, and that the form shown at H′ in Figs. 9 and 10 consists merely in a projection from the shaft to engage with the bolt 7′. The bolt would therefore arrest the lock after one rotation if not sustained in some manner during a longer period, and the gears 3′ and notches in the disk may be so proportioned that the lock may make two or more rotations before the block 9′ falls into a notch and arrests the motion of the lock. Thus, if the gears 3′ were in the proportion of four to one, and the disk 1′ were formed with two notches, as shown in Fig. 10, the lock would rotate twice before the block would fall into a notch and the bolt engage the lock.

Having thus fully set forth the nature and operation of our invention, we claim the same in the following manner:

1. The combination, in an organized gear-cutting machine, of the following instrumentalities combined together so as to co-operate in producing automatic intermittent rotation of the blank-gear spindle, namely: a blank-gear spindle, a frictional driver connected therewith by suitable gearing, a locking device connected with the said spindle by change-wheels, a cutter-slide, and means connected with the cutter-slide for operating the locking mechanism, the whole operated substantially as and for the purpose set forth.

2. The combination, with the change-wheels k and k' and the shaft H, operated therewith, of a disk provided with notch or tooth, as described, the bolt 7, pressed against the same, and means actuated by the cutter-slide for retracting the bolt and releasing the disk and change-wheels automatically.

3. The combination, with the disk provided with notch or tooth, as described, and the spring-bolt 7, guided in bearing 8, of the means for retracting it, consisting in the lever 12, having pivoted button 10, fitted to a notch, 11, in the bolt 7, and a connection from the lever 12 to the cutter-slide, substantially as and for the purpose set forth.

4. The combination and arrangement, with the base B⁶, of the mechanism for tipping the cutter-slide, consisting in the bed b and table d, both being pivoted, as described, and mounted upon the sliding plate d^2, so as to be adjustable therewith to and from the column B, the worm-segment c', attached to the edge of the table d, as set forth, the bracket c^3, attached to the edge of the plate d^2, and the worm c^2, mounted on a vertical shaft in the said bracket, and operated to raise and hold the plate d^3, substantially as herein set forth.

5. The combination, with the cutter-slide and its screw g, constructed and arranged to set the slide by hand, of the reversing-gears and shifting-clutch for operating the screw automatically, the shifting-lever actuated by dogs upon the cutter-slide, as set forth, a spring for shifting the clutch from its central position, and the catch t', arranged and operated to hold the shifting-lever and clutch in

a central position when operating the screw by hand.

6. The combination, with the cutter *a* and its movable carrying-slide *f*, of the table *b*, adjustable as described, and the trough affixed to the bed beneath the cutter, the worm to discharge the chips from the trough, and means, substantially as described, for rotating the worm in the trough.

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

ULRICH EBERHARDT.
HENRY E. EBERHARDT.

Witnesses:
JOS. B. PIERSON,
CHAS. F. HILL.