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U. & H. E. EBERHARDT.

GEAR CUTTER.

No. 332,064. Patented Dec. 8, 1885.

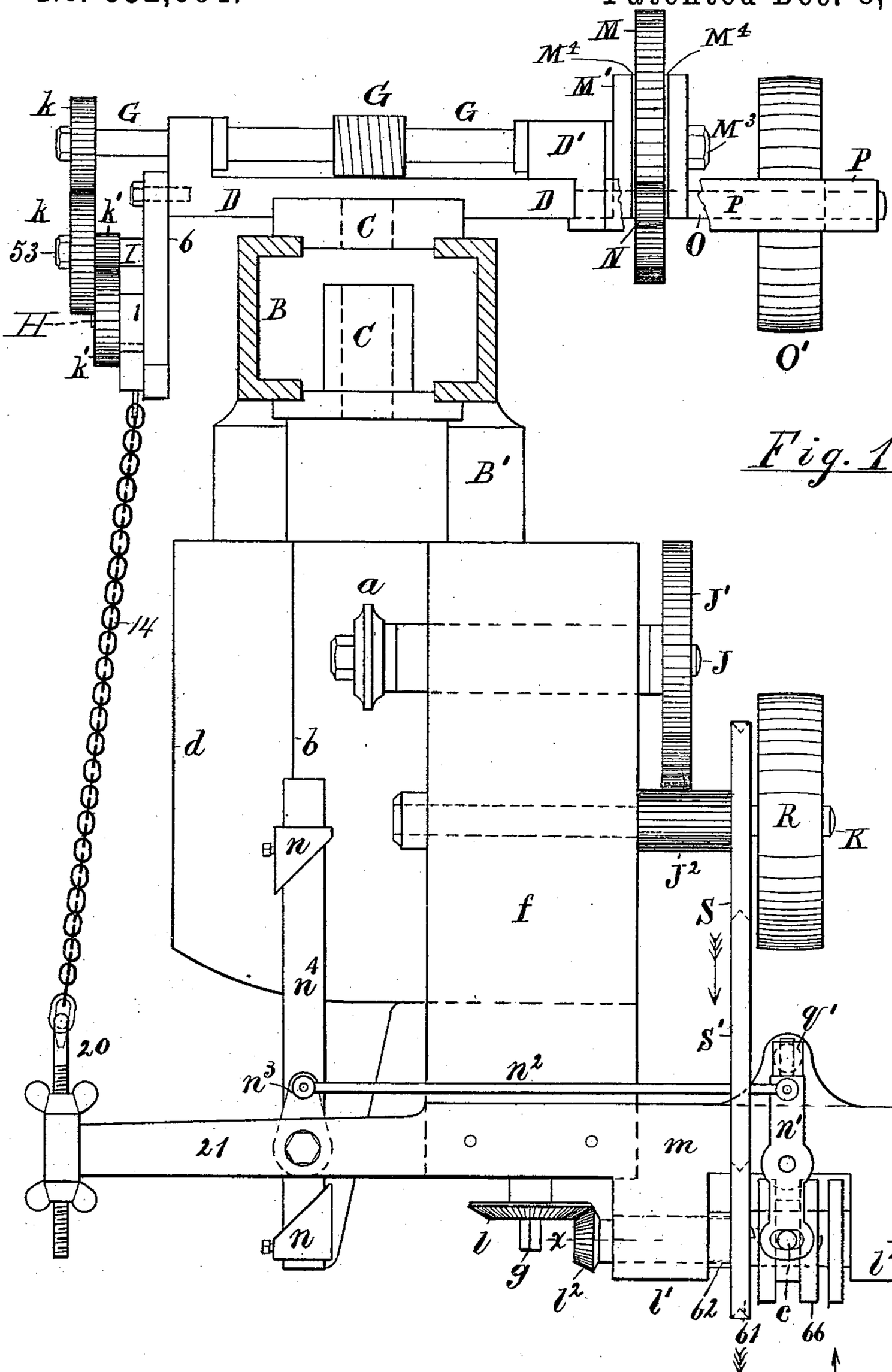

Fig. 1.

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per Thos. S. Crane, Atty.

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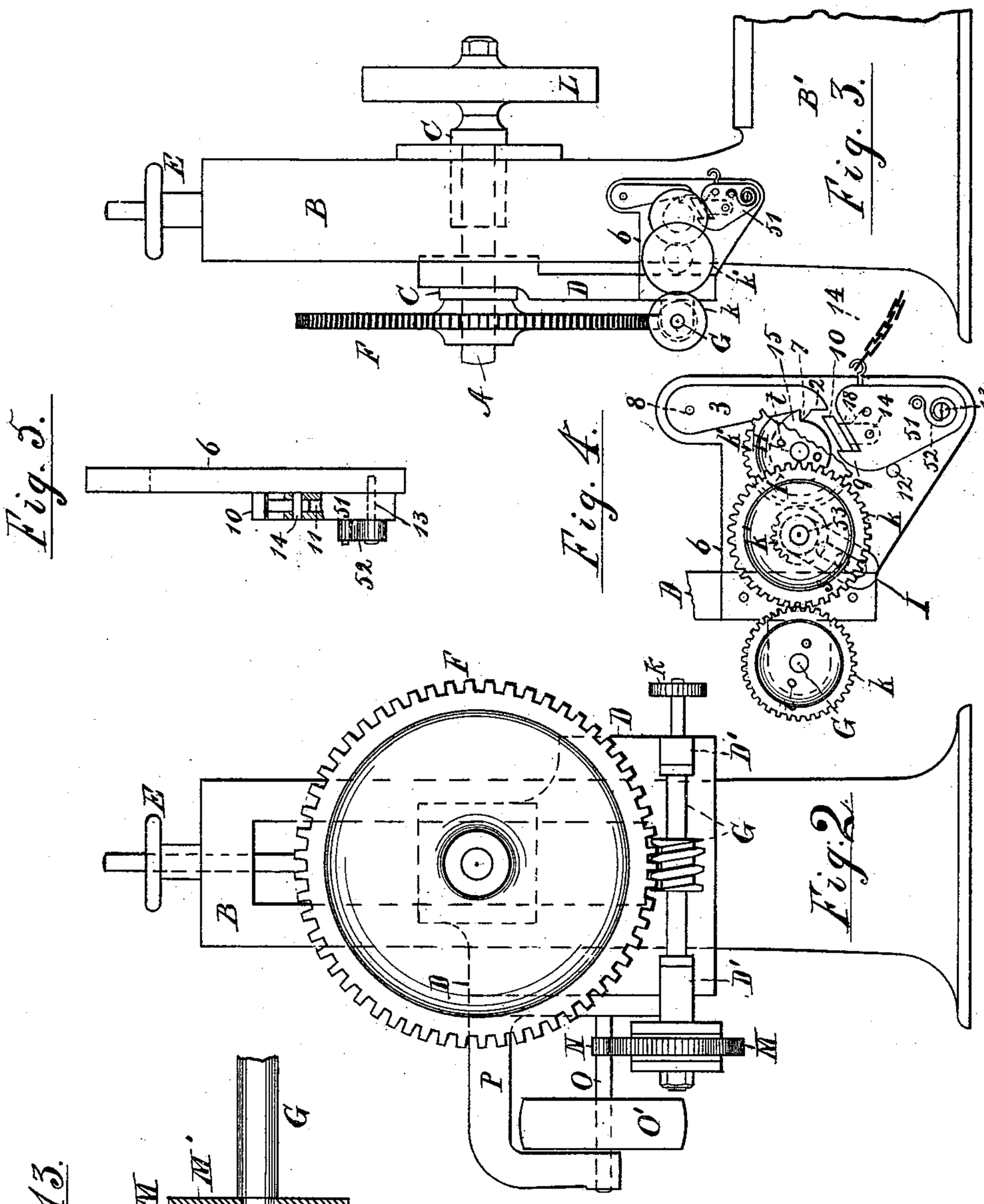

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Henry J. Sheberath

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U. & H. E. EBERHARDT.

GEAR CUTTER.

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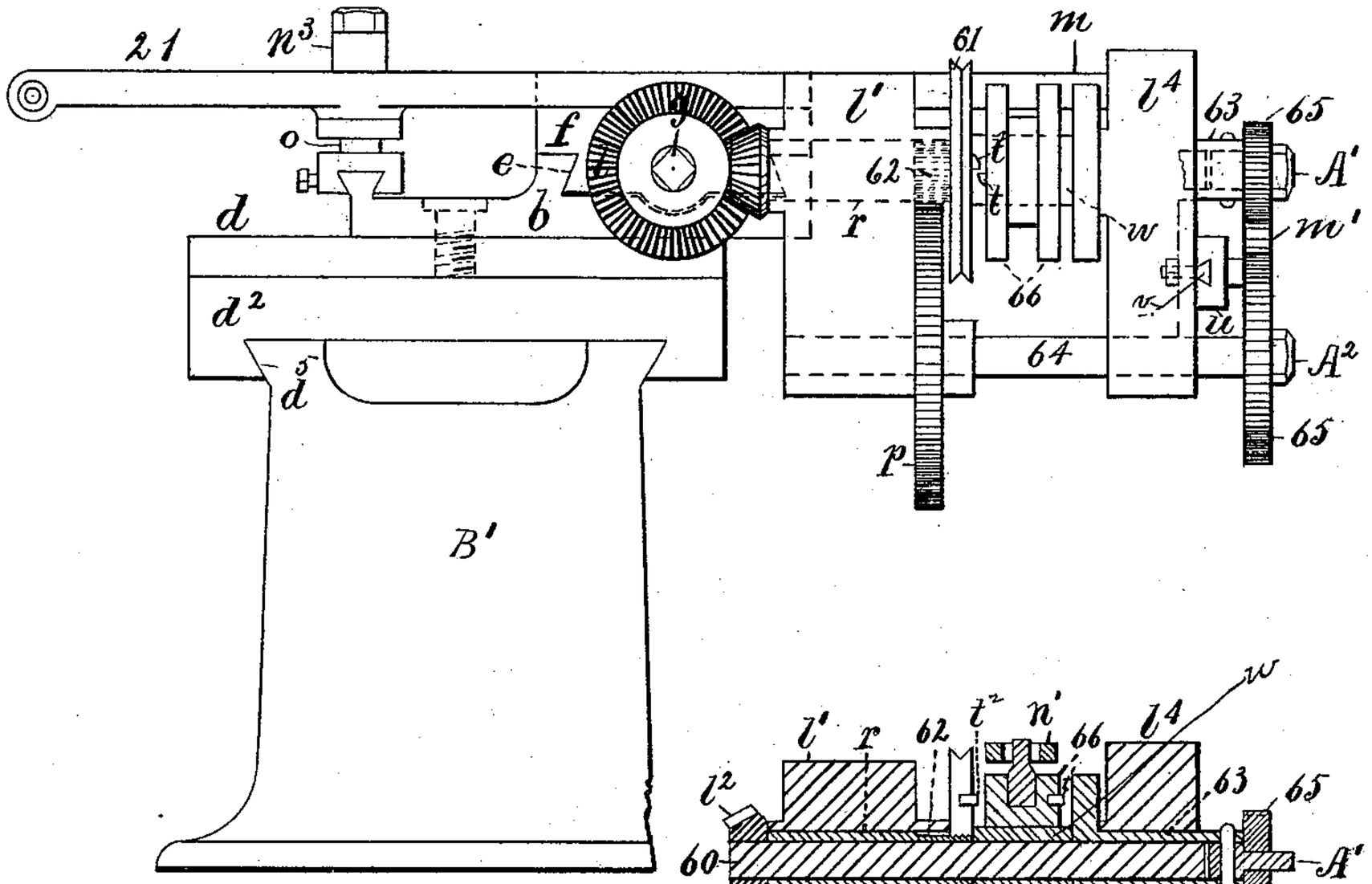


Fig. 6.

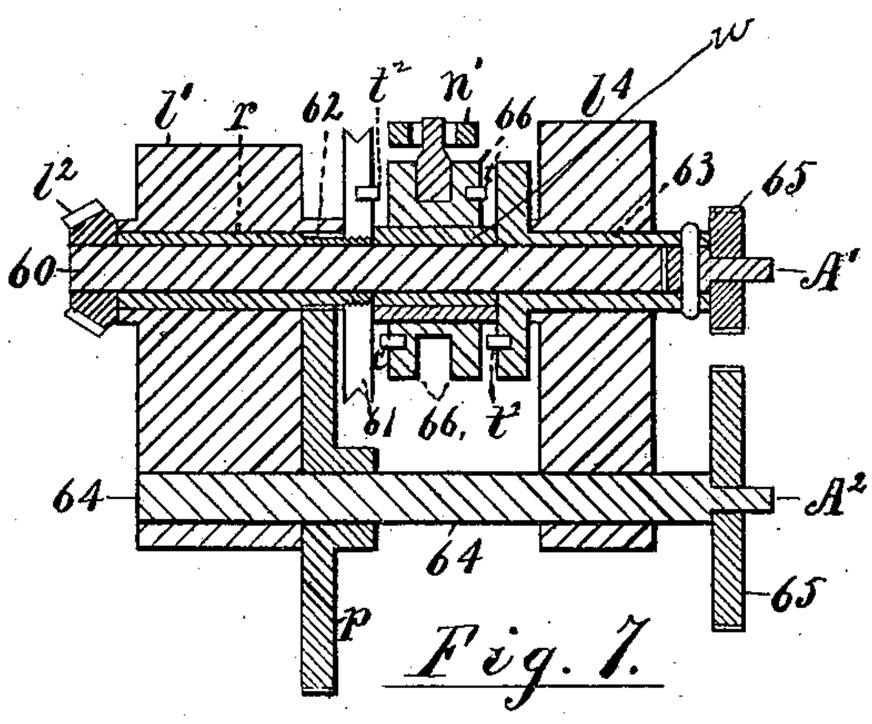


Fig. 7.

Fig. 8.

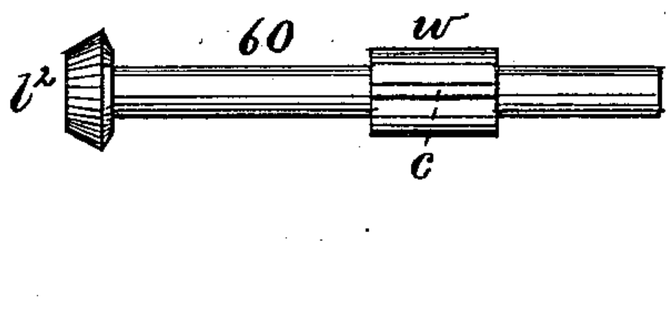
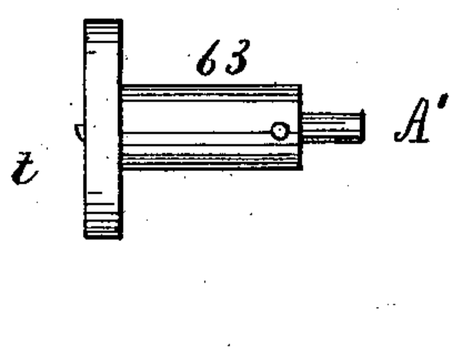


Fig. 9.



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(No Model.) 4 Sheets—Sheet 4.

U. & H. E. EBERHARDT.

GEAR CUTTER.

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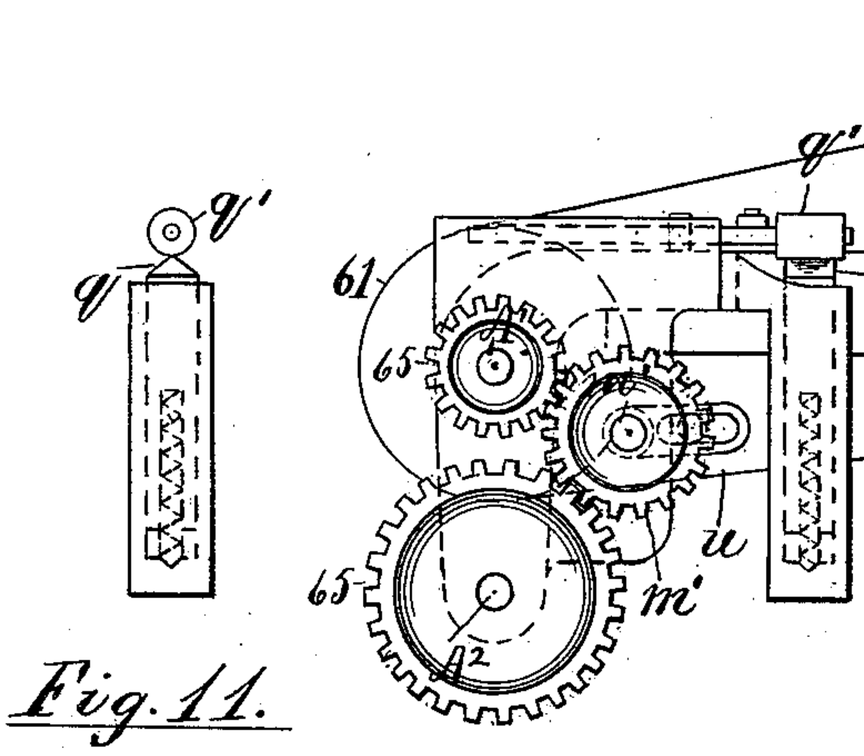

Fig. 11.

Fig. 10.

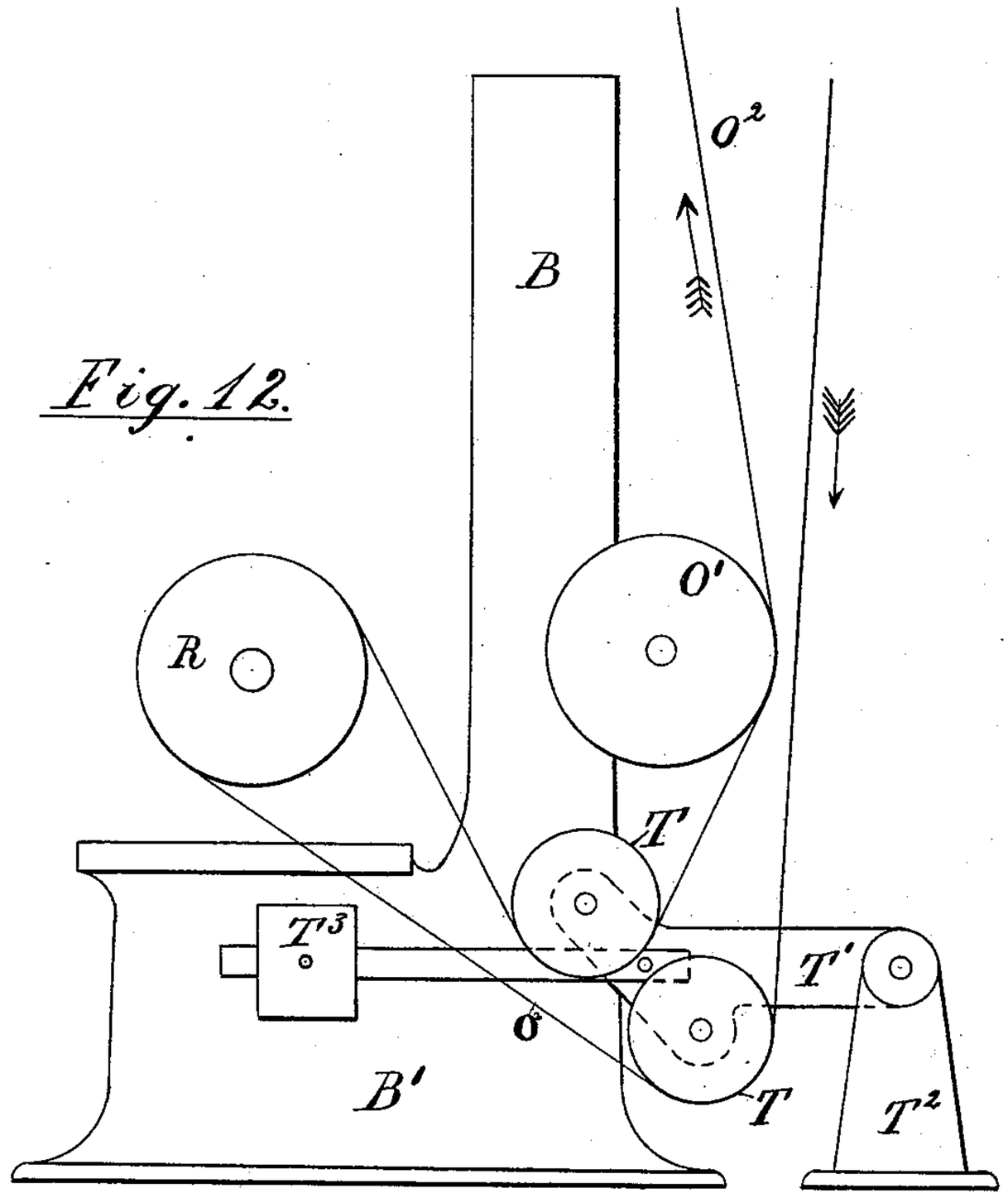

Fig. 12.

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UNITED STATES PATENT OFFICE.

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

GEAR-CUTTER.

SPECIFICATION forming part of Letters Patent No. 332,064, dated December 8, 1885.

Application filed October 18, 1884. Serial No. 145,898. (No model.)

To all whom it may concern:

Be it known that we, ULRICH EBERHARDT and HENRY E. EBERHARDT, citizens of the United States. residing in Newark, Essex county, New Jersey, have invented certain new and useful Improvements in Gear-Cutters, 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 gear-cutting machines for which we have heretofore filed applications Nos. 72,519 and 114,205 for Letters Patent of the United States.

The drawings show only such parts of the machine as are necessary to illustrate our improvements, the other features of the machine having been fully shown in the previous applications Nos. 72,519 and 114,205.

Figure 1 is a plan of the machine, with the top of the column shown in section and the elevating-screw removed. The bracket 6 is also broken away over the friction-gear. Fig. 2 is a rear elevation of the machine, omitting the bracket 6, the worm-wheel F being shown as a plain disk in Figs. 1 and 2, as is common in such small figures where the construction is already old and well understood. Fig. 3 is a side elevation of the machine, excepting the cutter slide and including the bracket, and with the bed partly broken away. Fig. 4 is a side view of the bracket and locking mechanism enlarged. Fig. 5 is an edge view of the bracket, with the arm 51 broken away to the center of the pivot 14, to show the introduction of the latch 10 into a slot in the arm. Fig. 6 is a front view of the bed, cutter-slide, and reversing mechanism, and Fig. 7 is a section of the latter upon line *x x* in Fig. 1. Fig. 8 is a view of the shaft 60 detached, and Fig. 9 is a view of the sleeve 63 detached. Fig. 10 is a side elevation of the cutter-slide and reversing mechanism detached from the machine. Fig. 11 is a rear view of the spring-wedge. Fig. 12 is an elevation of the machine upon the side opposite to that shown in Fig. 3, exhibiting the application of the same belt to both the friction-driver and the cutter-driving pulley. Fig. 13 is a sectional view of the friction driving-gear M and the end of the shaft G, to which it is attached.

The mechanism for carrying and moving the gear-spindle A consists of an upright 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 D′, supporting a worm-shaft, G, adapted to turn the wheel F when the blank gear is to be shifted, as usual.

The means for supporting the rotary cutter *a* consists of a shaft, J, fitted in a bearing upon a bed, *b*, mounted upon a plate, *d*, and table d^2, the latter being fitted to ways d^5 upon the top of the bed B′. The cutter-slide *f* is fitted to dovetails *e* in the top of the bed *b*, and is operated by a screw, *g*, so as to move forward to feed the cutter into the blank L and backward to permit the shifting of the blank, as required preparatory to cutting another tooth. The worm-shaft G is rotated automatically to shift the blank by means of a friction driving-gear, M, applied directly to such shaft adjacent to the bearing D′, and a locking device prevents the rotation of the shaft by said driver except when the locking catch or hook is released by a movement imparted from the cutter-slide.

The friction-driver consists of a toothed gear, M, fitted to turn loosely upon the shaft G, the latter being provided with two circular plates, M′ and M^2, between which the gear is clamped by means of a nut, M^3. The circular plates are fitted to turn positively with the shaft, as by a key or feather, and are preferably faced with leather, as at M^4. The toothed gear is continuously rotated during the operation of the machine by a pinion, N, on shaft O and pulley O′, and the rotary force imparted to the shaft G is regulated by tightening the nut M^3 to the desired degree. The shaft G is connected by means of change-wheels with a locking mechanism operated as claimed in our former patent; and although it is provided with a continuously-rotating friction-driver, is intended to stand still the greater part of the time and to hold the gear-blank in a fixed position while the cutter is operating upon the same.

The function of the friction-driver, as will be readily seen from its construction, is to furnish a motive power ready for immediate operation to rotate the worm-shaft, the worm-wheel, and the gear-blank at the required

time, when the cutter is retracted from the blank; and the circular plates then serve to receive the motion from the rotating gear M and to rotate the worm-shaft until the locking device operates to arrest its movement. When the worm-shaft is therefore locked, the circular plates, being held thereto, cease to rotate, and the gear M slips around between them without producing any movement.

A bracket, P, attached to the frame D, sustains the shaft O in the proper relation to the shaft G when the frame is moved up and down by operating the wheel E. The shaft O is supported at its inner end by the foot of the bracket adjacent to the frame D, and at its outer end in the end of the bracket-arm, and is rotated continuously by the power applied to the pulley O'. Motion applied to the latter thus operates, through the gear N and the friction-driver, to rotate the gear-blank L by turning the worm in contact with the wheel F; but the amount of its rotation, which necessarily varies with the number of teeth to be cut in the blank L, is governed by compound gearing mounted upon a bracket, 6, attached to the frame D. This gearing consists in cog-wheels applied to the shaft G to a fixed stud, H, provided with locking mechanism, and to a movable stud, 53, mounted upon the bracket 6, intermediate to the parts G and H, so as to receive gears of various sizes and hold them in mesh with the gears upon such parts. A pair of gears, *k*, is applied to the parts G and 53, and another pair, *k'*, to the parts 53 and H. The stud H is provided in addition to the gear *k* with a disk, 1, having a single projecting tooth, 15, such disk turning loosely upon the stud with one of the gears *k'*, to which it is clutched by pins *t*, secured in the disk and fitted to holes in the gear. All the gears in the required set of change-wheels would be furnished with holes to fit such pins *t*, so that when placed in contact with the disk 1, or with one another upon the stud 53, they may be clutched together by pins and rotate together. The movable stud 53 is held upon the bracket 6 by a carrier, I, and it is to the studs 53 and H and to the shaft G that the necessary change-wheels are applied when arranging the automatic mechanism to regulate the rotations of the worm and worm-wheel to shift a particular gear-blank. As shown in Fig. 1, the stud 53 carries two gears side by side, while the shaft G and stud H each carry but one, and the gears on the stud 53 thus serve as something more than idle intermediates, and afford a double opportunity to apply change-wheels to vary the rotation of the worm-shaft. The gears *k k'* on the stud 53 mesh, respectively, with the gears *k k'* at its opposite sides, and would be secured together so as to revolve together on the stud by the same means as the disk 1 and gear *k'*, although no pins *t* are shown for that purpose, to avoid obscuring the other features of the drawings. The motion transmitted from the shaft G by the pair of gears *k* is thus transmitted to the disk 1 by the pair of gears *k'* revolving in a different plane, and the extent to which such motion is effected is regulated and determined by the following means:

A pivoted catch, 3, is hinged upon the bracket 6 at 8, and is furnished with a hook, 7, to engage the tooth 15, and terminates at its lower end with a bevel-point, 2. The catch is pressed by its weight into contact with the disk 1, to engage the hook 7 with the tooth 15.

A latch, 10, is pivoted in a slot, 11, in an arm, 51, which is hinged to the bracket 6, below the catch, and a spring, 18, is applied to the latch to hold it normally against a stop, 9, formed upon the arm at one side of the latch-head opposite to the point 2. The latch-head is inclined with reference to its path about the pivot 13, upon which the arm is moved, and the pivot is arranged at such a distance from the end of the catch 7 that the latch will engage with such point when the arm is oscillated and pull the hook away from the tooth 15. The end of a chain, 14, is shown in Fig. 4, attached to the arm 51, to connect with the cutter-slide, and such chain is shown in Fig. 1 affixed to an adjustable hook, 20, connected to the cutter-slide by a brace, 21, and thereby reciprocated with said slide.

The cutter-slide is traversed back and forth with a given movement, and the chain is so adjusted upon the hook 20 that at the extreme outer movement of the cutter-slide the latch 10 is drawn toward the point 2 and the hook 7 withdrawn from the disk 1. By the construction employed both the latch 10 and point 2 move in arcs of circles and disengage as soon as the tooth 15 is released from the hook, the latter then falling back in contact with the disk, in readiness to re-engage the tooth after one rotation of the disk. A spring, 52, returns the arm 51 into its normal position in contact with a pin, 12, on the bracket, as soon as the chain is slackened by the movement of the cutter-slide. The spring 18 and the inclined head of the latch permit the latter to turn on the pivot 14 and to slip under the point 2, when the arm 51 is thus returned to its normal position.

Without the locking mechanism provided in the disk 1 and hook 7 the motion imparted to the worm G by the gears N and M would rotate the worm continuously, whereas it is intended to stand still and hold the gear-blank L in a fixed position the greater part of the time; and such action is secured by the construction described, in which the locking of the disk serves to hold the worm and the gear-blank L stationary until the cutter-slide is retracted and the hcok 7 detached from the tooth 15. As the automatic re-engagement of the hook prevents the disk from turning around more than one revolution, the rotations of the worm are thus definitely limited, and their extent is regulated by the proportions of the change-wheels *k* and *k'*, which may be used to connect the disk and the worm.

It is obvious if the wheels *k k'* were all of one size that the combined action of the friction-driver, the disk, and catch 7 would effect one rotation of the worm-shaft G at each movement of the cutter-slide.

In our previous applications we have shown a single intermediate gear for connecting merely two change-wheels upon the shafts G and H; but by means of the compound gearing shown herein the rotations of the worm shaft may be varied in much greater variety, with the set of change-wheels commonly provided for determining the rotations of the worm-shaft. The same means is commonly employed upon turning-lathes to secure a proper rotation of the feed-screw for cutting threads of peculiar pitch, the two pairs of gear-wheels *k k* and *k' k'* affording not only two points for varying the proportions of the connected wheels, but modifying the effect of the movement imparted by the second pair. It is obvious that the catch 7 would operate the same with a notch in the disk 1, in place of the tooth 15, and we therefore consider the same as equivalent in the claims that we have made herein.

Having claimed bolts or catches of different constructions in our previous applications, we have claimed the catch shown herein only in a specific manner. It will be seen, however, that the catch claimed herein may be used without the compound gearing, and we have therefore claimed the same independently thereof. The carrier I, being slotted and clamped to the bracket 6 by a bolt, *s*, affords the means of adjusting the stud 53 into any position required by the gears with which it is connected. The cutter *a* is shown in Figs. 1 and 10 as rotated on a spindle, J, which is driven by a gear, J', and pinion J^2, the latter being mounted upon a stud, K. The stud K also carries a pulley, R, and cord-wheel S, the latter being secured to the pulley R to turn therewith, and being driven by the belt O^2, applied to the pulley O', in the manner shown in Fig. 12. In this figure the belt is shown applied in succession to the pulleys R and O' and carried over tightening-pulleys T, journaled upon a swinging arm, T', in the manner common for similar constructions. T^2 is a standard to which the arm T' is pivoted, and T^3 is an adjustable weight upon said arm to regulate the tension of the belt. The belt is shown in the drawings led, as from a counter-shaft overhead, beneath one of the pulleys T, and is led thence in a loop around the pulley R, and beneath the other pulley, T, from whence it passes to the countershaft in such a direction as to press against the pulley O'. It therefore presses upon such pulley by its outer side, while its inner side is in contact with the pulley R, and the tightening-pulleys T T operate equally to maintain the tension of the belt and its requisite pressure upon either of the pulleys R or O when such pulley is moved independently of the other.

The pulley-shaft O may be dispensed with, and the friction-driver, embodied in the gear M, may be combined with a belt-pulley upon the worm-shaft, which pulley may be driven by the same belt with the pulley R, as described above.

As the friction-driver we use has already been patented to us in other combinations on December 2, 1884, as No. 308,658, we hereby disclaim the same except in the specific combinations we have claimed herein.

The friction-driver claimed includes, as in our previous application, any mechanism adapted to rotate the shaft and to slip when the shaft is locked, so as to permit the operation of our automatic shifting device in the manner described.

The reversing mechanism is shown in Figs. 1, 6, 7, and 10, *l* being a bevel wheel applied to the end of the feed-screw *g*, and l^2 a pinion fitted to the end of a shaft, 60, which is supported in bearings *l'* and l^4 upon a bracket, *m*, fixed to the front end of the slide *f*. In the bearing *l'* is secured around the shaft 60 a rotating sleeve, *r*, constructed at its inner end with teeth forming a pinion, 62, and having a belt or cord pulley, 61, rigidly fixed thereon, and rotated continuously in one direction when the cutter is in motion by a belt, S', led from the pulley S.

The teeth upon the pinion 62 are concealed in Figs. 1 and 6 by a shell of metal of inverted U shape, formed upon the bearing *l'*, and projected over the pinion 62 into contact with the pulley 61. The top of this shield is shown in section in Fig. 7, and the construction is intended to prevent end motion of the sleeve *r*, upon the extreme inner end of which the pulley 61 is secured. This shield is not a material feature, and is necessitated merely by the method of construction adopted, in which the pinion 62 is formed integral with the sleeve *r*, and of the same external diameter, and is thus unprovided with any shoulder at the inner end, except the inner side of the pulley 61. The shell of metal also serves to keep dirt from falling into the teeth of the pinion 62.

In Fig. 7 the pulley 61 is shown screwed upon the end of the sleeve with such a thread that the motion tends to hold it upon the sleeve, and a tooth, t^2, is formed on the pulley to engage a sliding clutch, 66, applied to the shaft next the pulley. In the bearing l^4 a rotating sleeve, 63, is fitted around the shaft 60, and is provided at its inner end with a tooth, t^2, to engage the clutch, and upon its outer end with a stud, A', preferably of such size as to fit the change-wheels provided for application to the shafts G and H. A back gear-shaft, 64, is also fitted to bearings upon the bracket *m*, and is furnished with a gear-wheel, *p*, to receive a reduced continuous motion from the pinion 62. The outer end of such shaft is formed with a stud, A^2, preferably of such size as to receive the change-wheels

mentioned, and an intermediate, m', is sustained in contact with such change-wheels (marked 65 where applied to the studs in Fig. 7) by a stud and a carrier, u, held adjustably to the side of the bracket by a bolt, v.

For convenience of construction, the clutch-hub 66 is mounted upon a bushing, w, (see Figs. 6, 7, and 8,) fixed rigidly to the shaft 60, the hub being driven by a feather, c, let into such bushing, and is provided at opposite ends with teeth t' to engage the tooth t^2 on the pulley 61, and the opposite tooth, t^2, affixed to the sleeve 63 upon an enlargemeut at its inner end, and the intermediate, m', applied to the change-wheels 65, produces a rotation in the sleeve 63 contrary to that imparted by said pulley to the sleeve r and pinion 62. The clutch-hub being mounted upon the feather c, furnishes the means for driving the shaft 60 and screw g in opposite directions by throwing it alternately into gear with the pulley 61 or sleeve 63. The speed of the pulley is regulated to produce a rapid motion of the screw for retracting the cutter-slide, while the back gear-shaft and change-wheels 65 afford the means for imparting a variable reduced speed to the cutter-slide for feeding the cutter into blanks of different material and dimensions.

When the pulley 61 is clutched to the shaft 60, the only gearing interposed between the pulley and the feed-screw g consists in the permanent bevel-wheels l and l^2, as the back gear-shaft, 64, the sleeve 63, and all their attached gear-wheels then turn around continuously, but idly, without producing any effect, and the quick speed at which the cutter is retracted is thus invariable; but when the motion of the pulley is transmitted to the screw through the back gearing (by clutching the constantly-rotating sleeve 63 to the shaft 60) the speed is transmitted through the wheels 65, which are made changeable for the express purpose of varying the speed of the screw g, for feeding the cutter into the blank at the required rate.

As stated above, the studs A′ and A², to which the change-wheels are applied, are made of such size as to fit the bores of the same change-wheels as are applied at k k'; and we are thus enabled to secure great variations in the speed of the cutter-slide without furnishing any additional wheels to use for the gears 65, and thus avoid any additional expense in obtaining this very desirable result. We are thus enabled to operate the cutter at the precise speed required to cut coarse or fine teeth in either brass, steel, cast or wrought iron.

The clutch-hub 66 is automatically shifted at each stroke of the cutter-slide by a shifting-lever, n', which is actuated by a connecting-rod, n^2, and a crank, n^3, pivoted upon the brace 21. This crank projects from the brace in a line with the cutter-slide and is carried to and fro therewith. The crank is provided with a projecting stud or roller, o, adapted to alternately strike against adjustable inclined dogs n, attached to a bar, n^4, upon the bed b. The lever n' is constructed with a slot where it is connected with a pin, c, with the clutch-hub 66, and a spring-stud, q, with wedge-shaped point is mounted in a socket upon the bracket m, so as to press upon a roller, q', at the rear end of the lever n', and to throw it past the central point before the teeth t' are disengaged from the teeth t^2. This construction is not a part of our present invention, and may be replaced by any other suitable means for shifting the clutch-hub. Such means is very common in such clutch-shifting mechanism, as without some device independent of the dogs n to throw the lever n' past the central point the clutch 66 would be liable to stand still when moved clear of the teeth t^2, rotating in opposite directions near its opposite ends, and the automatic movement of the cutter-slide would then be entirely arrested.

The operation of the entire machine is as follows: The gear-blank L is secured upon the spindle A, and change-wheels adapted to rotate the worm G, the desired amount (after cutting each tooth in the blank) are applied at k and k', suitable tables of change-wheels being used to determine their proportions, as in setting change-wheels in other analogous machines. Change-wheels 65 are also applied to the studs A′ and A² to produce a feeding motion of the slide b and cutter a toward the gear-blank, at a rate adapted to the material of the blank, and the dogs n are also adjusted to reverse the clutch 66 when the cutter-slide is at the extremes of its required movement. When the slide is in its outer position, the chain 14 is applied to the hook 20, and the latter is adjusted to actuate the arm 51 and latch 10, while the slide is running back after the cut, and before the clutch 66 is reversed to feed the slide forward. The retraction of the latch permits the rotation of all the gearing actuated by the friction-driver M, and thus effects the shifting of the blank automatically just after each gear-tooth has been cut, and the re-engagement of the tooth 15 by the hook 7, as described above, then locks and holds the worm-wheel, worm, and gear-blank in the required position until the succeeding gear-tooth has been cut.

As the dogs n operate regularly and intermittently at each end of the strokes made by the cutter slide, and as each outward stroke serves to tighten the chain 14 and unloose the latch of the shifting mechanism, it is evident that the intermittent action of the cutter will be continuous, and that the machine will continue not only to operate until all the teeth are formed upon the gear-blank L, but until the motion of the driving-belt O² is checked or the clutch-lever n' is placed and held in its central position. When this is done, the cutter slide will stand still, and the cut gear may be removed and replaced with a gear-blank to be cut in like manner.

As we have shown and claimed, the means for holding the clutch in its central position (and free from the teeth t^2 on both sides of it) in our said Patent No. 308,658, we have not introduced it in our present drawings.

From the above description it will be seen that the machine requires no attendance during the cutting of an entire blank after it has been properly adjusted to operate upon the same, and that the improvements which we have described herein are adapted chiefly to simplify the construction and operation of the locking mechanism and of the belting connections to the gear-blank-shifting devices, and to the reversing mechanism for the cutter-slide.

In our present construction but one belt, O^2, is required to actuate the pulley O′ and the pulley R, and but one belt, S′, is required to actuate the feed-reversing mechanism in place of the mechanism shown in our former patent, No. 308,658.

Our improvements in the arrangement of the gears *k k′* also enables us to dispense with a large proportion of the change-wheels required when a single intermediate only is used, as in our former patent; and the application of such change-wheels to the feed-reversing mechanism also affords the means of securing a more exact adjustment of the cutter-slide speed to the size of the teeth and the material in which they are cut.

The disk 1 is shown herein as provided with a single tooth; but the same may be made with two or more teeth or notches, as shown in our previous patent applications; but the use of the compound gearing described herein enables us, in general, to use a disk with but one notch or tooth.

It is obvious that any means of tightening the belt O^2 may be used in place of the pulleys T and arms T′, such devices being common in other constructions, and the precise nature of the tightener not being an essential feature of our invention.

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

1. In a gear-cutter constructed with a worm-wheel, worm, and worm-shaft for shifting the blank L, the combination, with the said worm-shaft, of a friction driving gear or pulley applied directly to the said shaft and adapted to slip when the shaft is locked, as and for the purpose set forth.

2. In a gear-cutter in which the mechanism for shifting the gear-blank is operated by a friction-driver, a worm and a worm-wheel, the locking device connected with the worm-shaft by change-wheels, as described, and consisting in the combination of the disk I, the pivoted catch adapted to engage with or lock such disk, the swinging arm 51, provided with spring 52, and carrying the latch 10, provided with spring 18, and connected with the cutter-slide, as by chain 14, the whole arranged and operated substantially as and for the purpose set forth.

3. In a gear-cutter, the means for varying the rotations of the worm-shaft for each rotation of the locking-disk, consisting in the combination, with such worm-shaft and disk, of a movable intermediate stud, 53, and four gear-wheels, *k k′*, arranged in two planes to form independent pairs of wheels, the intermediate stud, 53, carrying two of said wheels secured together, but turning loosely on the stud, the whole arranged and operated as herein shown and described.

4. In a gear-cutter, the combination of the shaft 60, the sleeve *r*, provided with the pinion 62, and driven continuously in one direction upon said shaft, a rotary sleeve, 63, mounted upon the said shaft and connected with the pinion 62 by a back gear-shaft, 64, and change-wheels, as described, and a shifting-clutch hub, 66, adapted to engage alternately with the pulley 61 and the sleeve 63, the whole arranged and operated to reverse the movement of the cutter-slide, substantially as herein set forth.

5. The means for varying the speed of the cutter-slide in its feeding movement only, consisting in the combination of the shaft 60, the sleeve *r*, provided with the pinion 62, and driven continuously in one direction upon said shaft, a rotary sleeve, 63, mounted upon the said shaft and connected with the pinion 62 by a back gear-shaft, 64, and change-wheels, as described, and a shifting-clutch hub, 66, adapted to engage alternately with the wheel 61 and the sleeve 63, the shaft 64 and the sleeve 63 being provided with the similar studs, A′ and A^2, for the application of change-wheels thereto, the whole arranged and operated to reverse the movement of the cutter-slide, 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.

Witnesses:
THOS. S. CRANE,
L. LEE.