(No Model.) 4 Sheets—Sheet 1.

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

GEAR CUTTING MACHINE WITH SAFETY STOP.

No. 575,393. Patented Jan. 19, 1897.

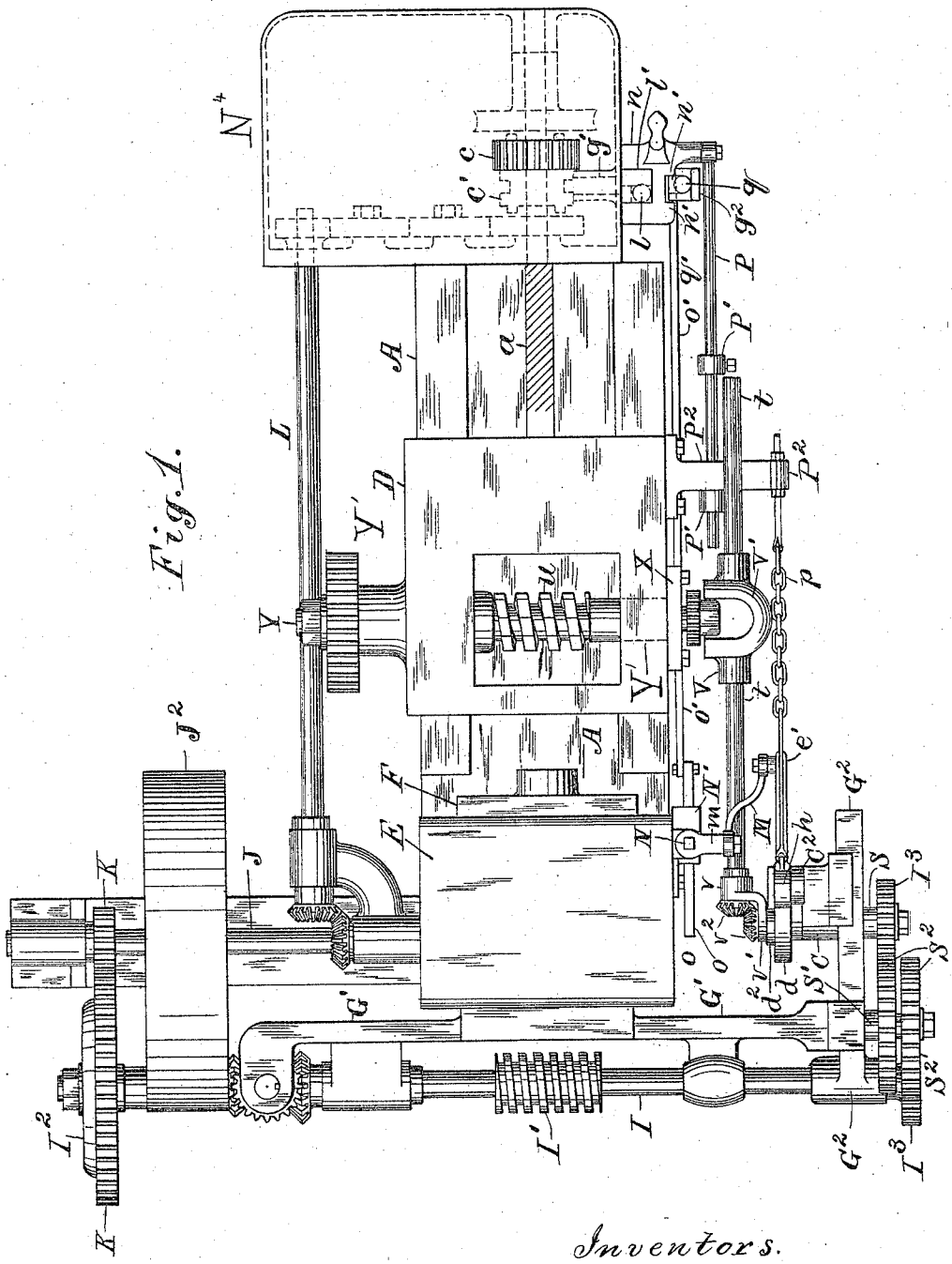


Fig. 1.

Attest:
L. Lee,
Edm. F. Kinsey.

Inventors.
Ulrich Eberhardt,
Henry E. Eberhardt, and
Fred L. Eberhardt, per J. S. Crane, atty.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

(No Model.) 4 Sheets—Sheet 2.

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

GEAR CUTTING MACHINE WITH SAFETY STOP.

No. 575,393. Patented Jan. 19, 1897.

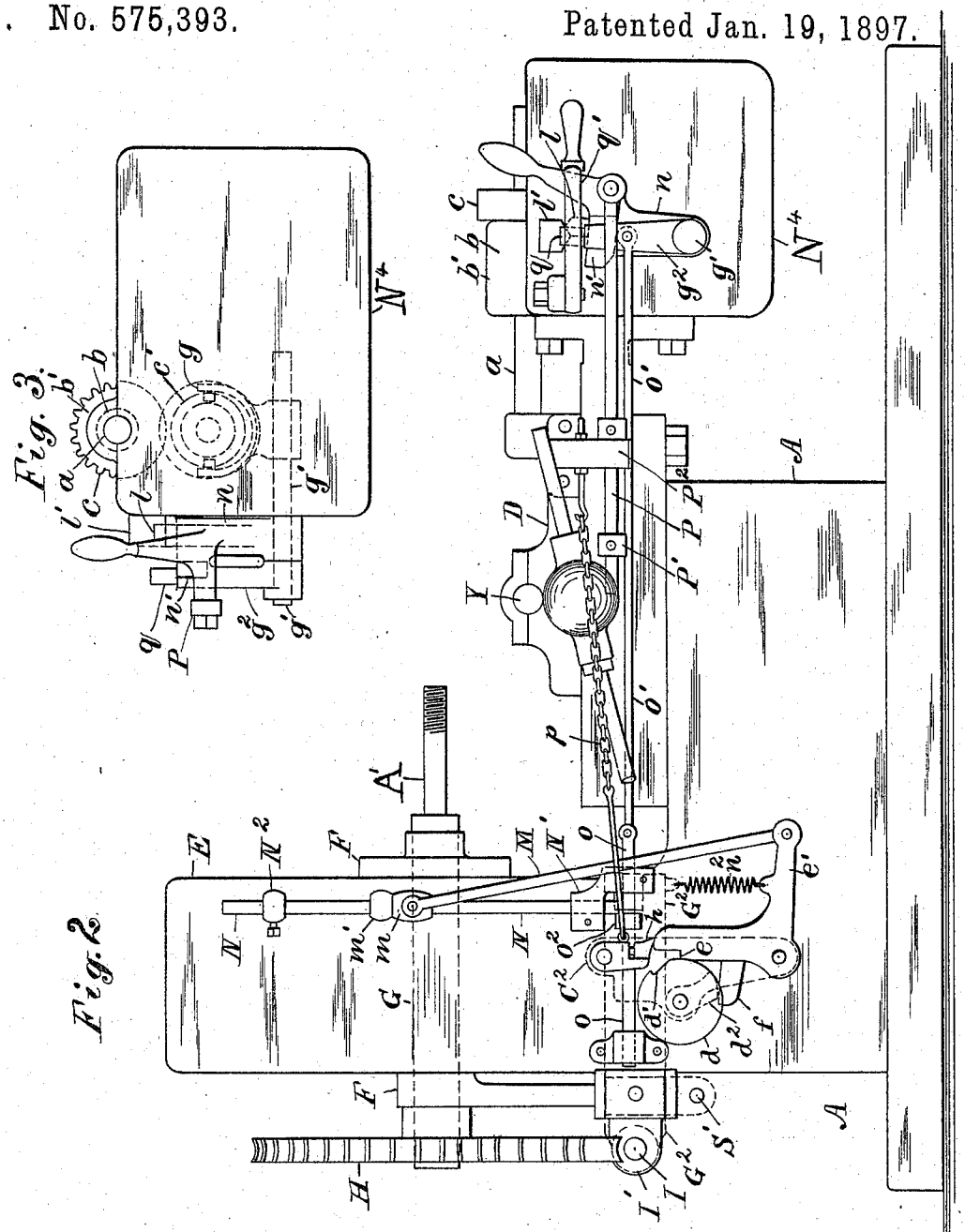


Fig. 3.

Fig. 2.

Inventors.
Ulrich Eberhardt,
Henry C. Eberhardt, and
Fred L. Eberhardt, per J. S. Crane, atty.

Attest:
L. Lee,
Edw. F. Kinsey.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

(No Model.) 4 Sheets—Sheet 3.

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

GEAR CUTTING MACHINE WITH SAFETY STOP.

No. 575,393. Patented Jan. 19, 1897.

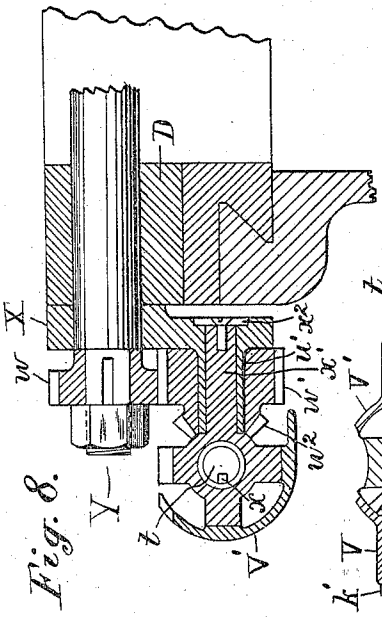


Fig. 8.

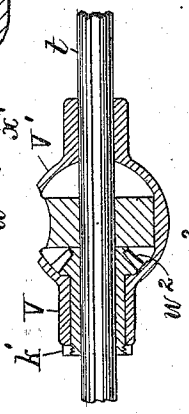


Fig. 9.

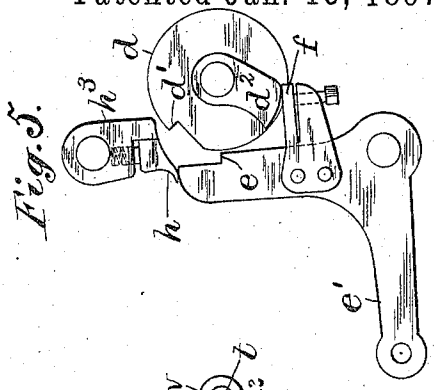


Fig. 5.

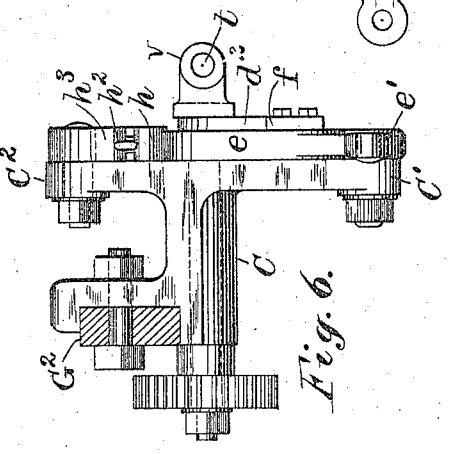


Fig. 6.

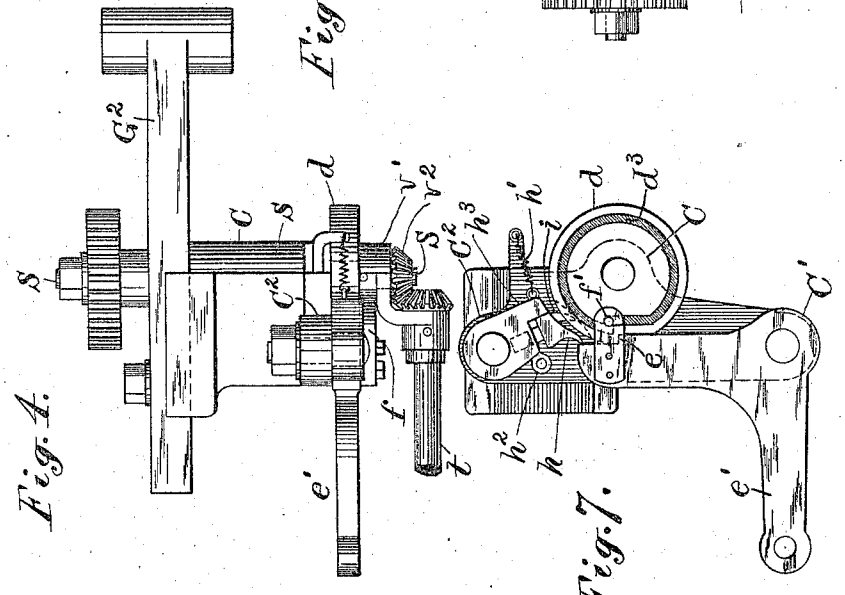


Fig. 4.

Fig. 7.

Inventors.

Attest:
L. Lee.
Edw. F. Kimzey.

Ulrich Eberhardt,
Henry E. Eberhardt and
Fred L. Eberhardt, per T. S. Crane
Atty.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

(No Model.) 4 Sheets—Sheet 4

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

GEAR CUTTING MACHINE WITH SAFETY STOP.

No. 575,393. Patented Jan. 19, 1897.

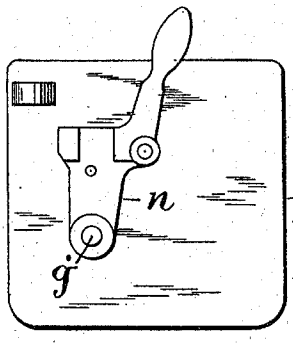


Fig. 10.

Fig. 12.

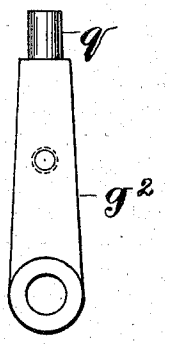
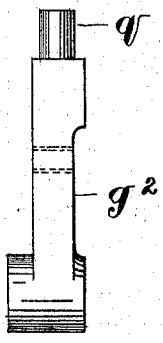


Fig. 13.



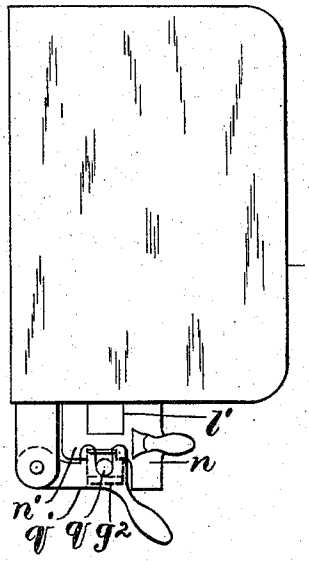
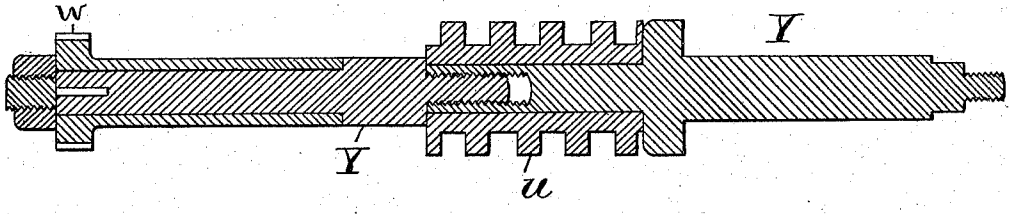


Fig. 11.

Fig. 14.



Attest:
L. Lee.
Edw. F. Kinsey

Ulrich Eberhardt,
Henry E. Eberhardt, and
Fred L. Eberhardt, per Thos. S. Crane, atty.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

ULRICH EBERHARDT, HENRY E. EBERHARDT, AND FRED L. EBERHARDT, OF NEWARK, NEW JERSEY.

GEAR-CUTTING MACHINE WITH SAFETY-STOP.

SPECIFICATION forming part of Letters Patent No. 575,393, dated January 19, 1897.

Application filed June 9, 1896. Serial No. 594,827. (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, county of Essex, State of New Jersey, have invented certain new and useful Improvements in Gear-Cutting Machines with Safety-Stops, fully described and represented in the following specification and the accompanying drawings, form ng a part of the same.

The present invention relates to that class of gear-cutting machines in which the driving-pulley is rotated continuously and operates intermittingly and automatically upon a train of change-wheels to turn the blank into successive positions for cutting a series of teeth therein, and in which the change-wheels are sometimes connected directly with the cutter-spindle, so as to rotate the same in unison with the blank when "hobbing" or cutting worm-teeth in the same. In this class of machines the cutter is reciprocated to and from the blank by a cutter-head actuated by a feed-screw with suitable clutch mechanism to reverse its rotations automatically, and the present invention furnishes a safety-stop to hold such clutch mechanism in a neutral or inoperative position until the blank is properly rotated, and thus avoid the cutting of the same at an improper point.

The invention also furnishes an improved connection between the change-wheels and the cutter-spindle for use in hobbing, a single shaft being connected by detachable gear directly with the change-wheel arbor and the cutter-spindle, the arrangement being such as not to interfere with the operation of the safety-stop when cutting spur-gears.

The invention will be understood by reference to the annexed drawings, in which—

Figure 1 is a plan of a gear-cutting machine with certain well-known parts omitted which are not required to illustrate the invention. Fig. 2 is a side elevation of the same; Fig. 3, an end elevation of the feed-clutch shifter; Fig. 4, a plan of the stop-shaft and its attachments. Fig. 5 is a diagrammatic elevation of the same upon the inner side; Fig. 6, a front view of the same; Fig. 7, a diagram of the stop-wheel with grooved cam to control the pawl; Fig. 8, a vertical section of the hobbing connections for the cutter-spindle, and Fig. 9, a longitudinal section of the gear-box for the hobbing-shaft. Fig. 10 is a front elevation of the drop-lever n, with the adjacent end of the gear-casing N^4, the shifter-arm g^2 and the latch q' being removed and the reverse position of the trip-lever being indicated in dotted lines. Fig. 11 is a plan of part of the casing N^4, with the addition of the shifter-arm and latch. Fig. 12 is a front view, and Fig. 13 an edge view of the shifter-arm g^2 detached. Fig. 14 is a section of the entire cutter-spindle with the cutter u and gear-wheel w.

The improvements are illustrated upon a machine resembling that shown in the Patent No. 510,122, granted December 5, 1893, to Ulrich Eberhardt, Henry E. Eberhardt, and Fred L. Eberhardt.

A designates the bed of the gear-cutter frame, and D a carriage or cutter-head fitted to ways upon the top of the bed. The cutter-head is provided, as shown in Fig. 1, with a central opening to receive the cutter u, at the opposite sides of which are bearings Y' for the cutter-spindle Y. 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 at 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^2 thereon.

The clutch-hub c', which connects the two trains of gearing alternately with the rotary nut b, (through the gear c,) is shifted, as shown in the before-mentioned patent, by a clutch-fork g, which is mounted upon shaft g', having upon its outer end a shifter-arm g^2. This reversing-gearing for the feed-screw, with its clutch mechanism, is inclosed in the casing N^4, from one side of which the shaft g' projects to receive the shifter-arm. A stud q is projected from the top of the arm g^2, and a hook or latch q' is pivoted upon the casing N^4 adjacent to such arm and so adjusted to the stud that when hooked thereon it holds the clutch-fork in a central position when required to prevent the operation of the feed-

ing devices. A trip-lever n is pivoted upon the shaft g' and shifted by the carriage D through the agency of the shifter-arm g^2. The shifter-arm is oscillated by the stop-rod P and dogs P', actuated by a lug P^2 upon the carriage. The trip-lever n is provided with a radial spring-bolt l, having wedge-shaped face adapted to operate with a stationary wedge-block l' to shift and hold the trip-lever alternately at opposite sides of its central position in the usual manner. The trip-lever is provided with lugs n' to press upon opposite sides of the shifter-arm g^2, the space between the lugs being made wider than the arm, as shown adjacent to the right-hand lug in Fig. 3, to permit the bolt to move past the center of the wedge l' before the clutch becomes engaged, thus securing the engagement of the clutch, as is common in such reversing operations.

The latch q' is omitted from Fig. 1 to avoid obscuring the trip-lever and shifter-arm, but is shown in Fig. 11 in the same position as in Fig. 2, engaged with the stud q upon the shifter-arm, to hold the clutch-fork in a central and inoperative position. Figs. 10 to 13 show the construction of these parts upon a larger scale than the other figures.

E designates the column carrying the mandrel-head F, provided with the mandrel-shaft G, having upon its outer end a worm-wheel H. The pulley J^2 is connected by gears K and friction device I^2 with the worm I' to rotate the mandrel A' and the blank intermittingly.

It will be understood that the friction device or disk I^2 is fastened, as is common in such machines, to the shaft upon which it is mounted, while the gear K is fitted to turn freely upon the shaft and rotates the same only by frictional contact with the disk I^2. The rotation of the shaft is controlled by the stop-disk (hereinafter described) and its attachments and is constantly impelled to rotate by the revolving pulley J^2 and the friction device I^2.

A frame G' is fixed to the rear end of the head F and provided with bearings carrying worm-shaft I with worm I' to drive the wheel H. The frame G' supports a bracket G^2, upon which are mounted the stop-shaft S and an adjustable stud S' for carrying intermediate change-wheels S^2. The worm-shaft I is connected with the stop-shaft S (through the intermediate wheels S^2) by the change-wheels I^3.

The bracket G^2 and all of the stop mechanism are shown in detail in Figs. 4 to 7, inclusive, but the bracket and the bearings upon the same are indicated only by dotted lines in Fig. 2, so as to exhibit clearly the parts in the rear of the same.

A casting, as shown in Figs. 4 and 6, is secured upon the bracket G^2 and provided with bearing C for the stop-shaft, bearing C' for the stop-pawl, and bearing C^2 for the pawl-detent.

A stop-disk d is formed with circular periphery having a notch d' in the edge and secured upon the stop-shaft with a cam d^2 at one side of the same. The stop-pawl is provided with a tooth e to engage the edge of the notch d' and with an arm f to engage a cam for pressing the tooth into the notch. The pawl serves, normally, by engagement with the side of said notch, to intermittently regulate the rotations of the change-wheels to shift the blank through a definite angle, and the detent h is connected by an adjustable chain p with the lug P^2 upon the cutter-head D to pull upon the detent and draw the pawl from the notch d' at each outward stroke of the cutter-head. The detent is fitted movably by a shank to a pivoted arm h^3, which is drawn backward, normally, by a spring h' and is provided with an eye h^2 to receive the chain or rod for pulling the detent. The eye h^2 is omitted from the arm h^3 in Fig. 5, as the latter figure is designed simply to illustrate the coaction of the detent, the pawl, and the stop-disk. As the change-wheels perform their entire function during one rotation of the stop-disk, it is essential that the pawl should be released by the detent before such rotation is completed, and such release is effected by forming a cam-shaped groove in the periphery of the disk and projecting a toe i from the pawl into such groove, the bottom of which is extended to the edge of the disk, so as to force the detent upwardly and release the pawl as soon as the disk has made a partial rotation. The detent is thus wholly cleared from the pawl and the latter left free to engage the notch d' before such notch can by any possibility be turned past the pawl. The detent when disengaged from the arm is pressed outwardly by a spring beneath the shank to a suitable point to catch upon the tip of the pawl, as shown in Fig. 7, being pressed inwardly to slip over the top of the pawl, as shown in Fig. 5, when the tension upon the eye h^2 is released and the detent is drawn backward by the spring h'. The pawl is also provided with an arm e', connected by link M with a loose collar m upon a stop-rod N. The rod N is mounted vertically at the side of the column E in bearings N' and N^2, and a stop-slide o is fitted to bearings at the side of the bed and connected by a rod or link o' with the clutch-shifter arm g^2.

The slide o is arranged beneath the stop-rod N and provided with a projection or block o^2, which bears against the side of the stop-rod when the shifter-arm is in the central position and the feed-clutch inoperative. One of the trains of feed-gearing is so arranged that the stop-rod must be raised to permit the movement of the slide o before the clutch can be engaged to feed the cutter forward after each shift of the blank.

The cutter-head D is shown in Fig. 2 at the end of its outward stroke in readiness to feed forward, and its previous outward movement shifts the trip-lever n a little past its central position, as shown in Fig. 2, in readiness to automatically push the shifter-arm g^2 in the

same direction (under the pressure of the spring-bolt *l*) when the shifter-arm is released from the restraint of the slide *o*. A spring n^2 is fixed to the bracket G^2 and the link M to press the stop-rod normally upward by contact with a dog *m'* upon the same. As the pawl is governed by the notch in the disk *d*, the stop-rod can only be lifted and the slide *o* released when the pawl is resting within said notch. A cam d^2, (shown in Figs. 2 and 5,) which covers a section only of the circle, operates upon the arm *f* when the pawl approaches the notch *d'*, as shown in Fig. 5, and the pawl is at other times supported by its connection with the rod N, which is then resting upon the slide *o*.

When the motion of the stop-disk is, by any defective operation of the mechanism, arrested before its completion, its circular periphery prevents the pawl, as shown in Fig. 5, from moving toward the stop-shaft, and the stop-rod then prevents the movement of the clutch-shifter, as desired.

When the stop-disk is normally rotated, as shown in Fig. 1, the arm *e'* lifts the stop-rod N to clear the corner of the block o^2, and the slide is then moved laterally, as indicated in dotted lines in Fig. 2, by the operation of the spring-bolt *l* upon the shifter-arm g^2. Such motion clutches the nut *b* to the proper train of gearing and propels the carriage forward into the blank until its movement is reversed by the dog P'. (Shown in Fig. 1.)

A slightly-different cam connection is shown in Fig. 7, where the pawl is provided with an arm *f'*, having a pin fitted to a groove d^3 in the face of the stop-disk *d*, such cam-groove holding the pawl adjacent to the edge of the disk and pulling the tooth *e* at the required time into the notch *d'* to arrest the disk. With this construction it is obvious that the entire motion of the pawl is effected by the cam connection, and that the pawl is therefore more positive in its action than when moved in one direction by a weight or spring.

Either of the cam connections operates to force the tooth *e* positively into the notch *d'* as the notch turns toward such tooth. The cam is so shaped adjacent to the notch *d* as to permit the movement of the arm with the pawl, when the detent is pulled to detach the pawl from the notch *d'* near the outer end of the cutter-head's motion, which permits the change-wheels to rotate the blank before the cutter-head is fed forward. The essential feature of this part of the invention consists in the positive movement of the pawl by means of a cam rotated with the stop-disk to force the pawl-tooth into the notch upon the disk, and thus absolutely prevent the disk from rotating past the desired point. In machines of this class the worm-shaft I and the change-wheels are rotated by friction-gearing, which continues to actuate such wheels and to rotate the blank until their motion is arrested by the stop mechanism, and this device secures positively the checking of such motion when the blank has been rotated through the required arc. The stop-rod and its control by the position of the pawl which holds the clutch in a neutral position until the stop-disk is fully rotated also positively secures the clutch from movement until the disk is fully rotated, and the intermittent movement of the blank is thus effected with absolute certainty.

The form of the cam which moves the pawl-tooth into the notch upon the stop-disk is immaterial, as also the precise construction and arrangement of the stop-rod which connects the pawl detachably with the clutch-shifter.

It is very desirable that machines of this class should be provided with a direct connection between the worm-shaft I and the cutter-spindle Y, so that they may be adjusted to rotate in unison when hobbing or cutting worm-teeth upon the blank. The present construction is therefore provided with such a hobbing attachment, the hobbing-shaft *t* being shown in Fig. 1 connected with the stop-shaft S, and the spindle Y provided with a hob or worm-cutter *u*. A bearing *v* for the shaft *t* is fitted by a swivel-collar *v'* to the stop-shaft and the shafts are connected by bevel-gears v^2, and the shaft is fitted to slide longitudinally through a bearing V, which is swiveled upon a stud *x'*, attached to the cutter-head D, adjacent to the spindle Y. A part only of the shaft *t* (with the bearing V) is shown in Fig. 2, so as not to obscure the safety-stop mechanism.

A gear-wheel *w* is secured to the outer end of the spindle Y, and an auxiliary gear-wheel *w'* (meshing therewith) is fitted to the stud *u'*, and bevel-wheels w^2 connect the wheels *w'* with the hobbing-shaft *t*, which is fitted by a splined joint *x* to the wheel w^2, through which it passes, such wheel, as shown in Fig. 9, being furnished with a sleeve to rotate in the bearing V. A key *x* is secured removably in the sleeve and is fitted to a keyway in the shaft *t*, thus forming the splined joint to rotate the bevel-wheel with the shaft when required.

When the hobbing device is not required for use, the key *x* may be removed, thus permitting the hobbing-shaft to rotate without affecting the cutter-spindle.

The wheel w^2 may, if preferred, be made detachable from the cutter-spindle, as it is immaterial what gear-wheel be removed or rendered inoperative to disconnect the hobbing-shaft and spindle. The bearing is provided with a casing V' to inclose the wheel w^2 and is swiveled to the stud *u'* by means of a shank *x'*, which is projected from the casing through the stud and secured upon the inner end of the latter by a screw and washer x^2. The stud is shown connected by bracket X with the bearing of the cutter-spindle, but it is immaterial how the stud or auxiliary wheel be supported.

The hobbing-shaft is connected with the auxiliary wheel *w'* instead of with the wheel

w upon the cutter-spindle to permit the manipulation of the cutter-spindle Y, which is required in applying and removing various kinds of cutters, so formed upon the top as to permit the withdrawal of the spindle Y with the gear-wheel w when it is necessary to change the cover or hob upon the spindle. The wheel w is shown fitted removably upon the end of the spindle, so that it may be removed when the hobbing attachment is not in use, and the gear thus forms a direct detachable connection between the cutter-spindle and the hobbing-shaft.

We have made special claim herein to a cam-groove rotated with the stop-disk and a projection from the pawl fitted to such groove, so as to effect the entire motion of the pawl by the cam, as such construction secures a positive action of the safety-stop device, and obviates any of the uncertainty that exists in the use of weights or springs to partially control the movement of the pawl.

From the above description it will be understood that we do not claim a safety-stop for the cutter-head of the gear-cutting machine, but the combination, with the other elements, of a stop-disk having a circular periphery with notch in the edge and a pawl which is adapted to hold the clutch-shifter in a neutral position throughout the entire rotation of the stop-disk and to permit the clutch-shifter to operate only when the pawl-tooth enters the notch in the disk. The stop-disk in such machines, by its connection with the change-wheels, revolves with considerable rapidity, and the time required for the pawl-tooth to enter the notch is very small; but the clutch-shifter is held stationary during the time that the pawl-tooth enters such notch and is released only at the end of such movement by the interference of the stop-rod N with the movement of the stop-slide, which is prevented from motion until the stop-rod is drawn wholly away from the block or projection o^2 upon the slide. The feed is thus positively prevented from operating and the cutter from penetrating the blank unless the stop-disk is completely rotated and the blank fully shifted into the required position for operation.

We have made no broad claim herein to a safety-stop upon cutter-head or gear-cutters, because such a stop has within our knowledge been used for twenty years past in a large machine-shop, and such a safety-stop is not therefore patentable.

Although our device is intended to secure the same object, it operates with more certainty and is more simple in construction than anything that has within our knowledge been previously used for the same purpose.

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

1. In a gear-cutter, the combination, with a cutter-head and reversing-gear having a clutch-shifter, of change-wheels and a stop-disk rotated thereby, and having a circular periphery with notch in the edge, and a pawl suitably connected to the clutch-shifter and provided with a tooth to engage the notch, and adapted to rest upon the circular periphery of the stop-disk, and to thereby hold the clutch-shifter in a neutral position throughout the entire rotation of the disk until the tooth enters such notch, substantially as herein set forth.

2. In a gear-cutter, the combination, with a cutter-head and reversing-gear having a clutch-shifter, of change-wheels and a stop-disk rotated thereby, and having circular periphery with notch in the edge, a pawl suitably connected to the clutch-shifter and provided with a tooth to engage the notch and with the arm f, and a cam rotated with the stop-disk and adapted by pressure upon the arm to force the pawl-tooth into the said notch to positively arrest the disk, substantially as set forth.

3. In a gear-cutter, the combination, with a cutter-head and reversing-gear having a clutch-shifter, of change-wheels and stop-disk rotated thereby and having circular periphery with notch d' in the edge, a pawl with tooth to rest upon the edge of such disk and engage the notch, and a stop-rod controlled by said pawl, and a slide linked to the clutch-shifter and having a projection to engage the stop-rod, the whole arranged and operated substantially as herein set forth.

4. In a gear-cutter, the combination, with a cutter-head and reversing-gear having a clutch-shifter, of the mandrel-head F with change-wheels and stop-disk carried thereby, a vertical stop-rod supported adjacent to the stop-disk, a horizontal slide connected with the clutch-shifter and provided with a projection to engage the stop-rod, a pawl fitted to bear upon the edge of the stop-disk, a loose collar upon the stop-rod and a link to move the same with the pawl, and an adjustable dog upon the stop-rod to contact with the loose collar in various positions of the mandrel-head, substantially as herein set forth.

5. In a gear-cutter, the combination, with a cutter-head and reversing-gear having a clutch-shifter, of the mandrel-head F with change-wheels and stop-disk carried thereby, a vertical stop-rod supported adjacent to the stop-disk, a horizontal slide connected with the clutch-shifter and provided with a projection to engage the stop-rod, a pawl fitted to bear upon the edge of the stop-disk, a loose collar upon the stop-rod, a link to move the same with the pawl, an adjustable dog upon the stop-rod to contact with the loose collar in various positions of the mandrel-head, and a spring applied to the link to balance the same and normally lift the stop-rod, as and for the purpose set forth.

6. In a gear-cutter, the combination, with the bed A, column E, and mandrel-head provided with frame G' carrying the worm-spindle I change-wheels and stop-shaft S, of cutter-head D provided with cutter-spindle Y, and a single hobbing-shaft connected at its

opposite ends by suitable gearing to the contiguous ends of the stop-shaft and cutter-spindle, substantially as set forth.

7. In a gear-cutter, the combination, with the bed A, column E, and mandrel-head provided with frame G′ carrying the worm-spindle I change-wheels and stop-shaft S, of cutter-head D provided with cutter-spindle Y, and a stud adjacent to the spindle, a gear upon the spindle and an auxiliary gear upon the stud, and a hobbing-shaft connected with the stop-shaft and with the auxiliary gear upon the stud by swivel-bearings and bevel-gears, substantially as herein set forth.

8. In a gear-cutter, the combination, with a cutter-head and reversing-gear having a clutch-shifter, of change-wheels and a stop-disk rotated thereby and having notch in the edge, a pawl suitably connected to the clutch-shifter and provided with a tooth to engage the notch, a detent pivoted adjacent to the pawl and provided with a spring-shank, a connection from the detent to the cutter-head to pull the detent, and a cam rotated with the stop-disk and operating upon such detent to detach it from the pawl before the disk has completed one revolution, substantially as herein set forth.

9. In a gear-cutter, the combination, with a cutter-head and reversing-gear having a clutch-shifter, of change-wheels and a stop-disk rotated thereby and having circular periphery with notch in the edge, a pawl suitably connected to the clutch-shifter and provided with a tooth to engage the notch, a cam-groove rotated with the stop-disk, and a projection from the pawl to engage such groove, the entire motion of the pawl being effected by such cam, and the clutch being thereby held in a neutral position until the disk is wholly rotated, 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:
THOMAS S. CRANE,
HENRY J. RUESCH.