

(No Model.)

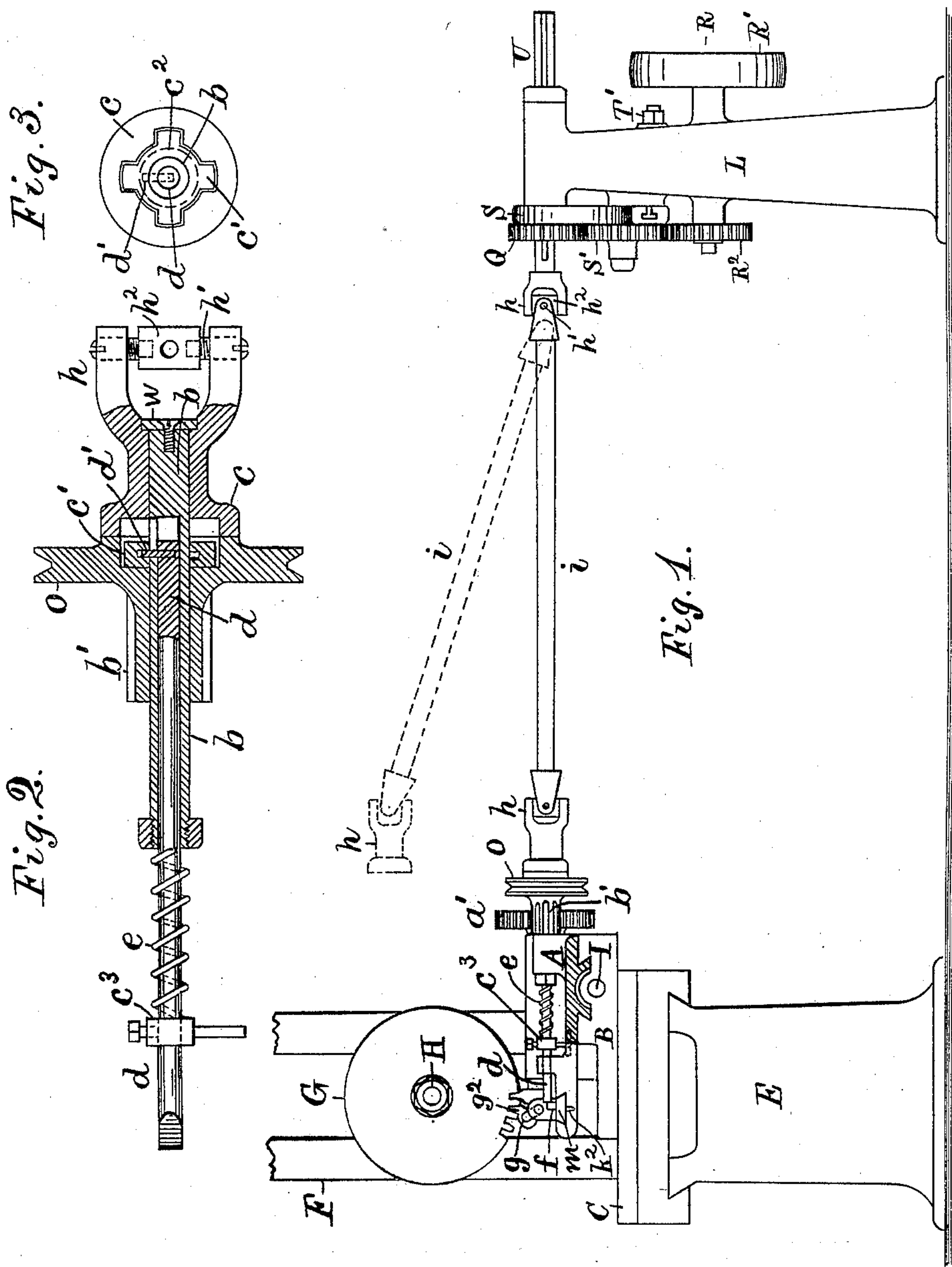
4 Sheets—Sheet 1.

U. & H. E. EBERHARDT & U. EBERHARDT, Jr.

GEAR CUTTER AND MILLING MACHINE.

No. 461,952.

Patented Oct. 27, 1891.



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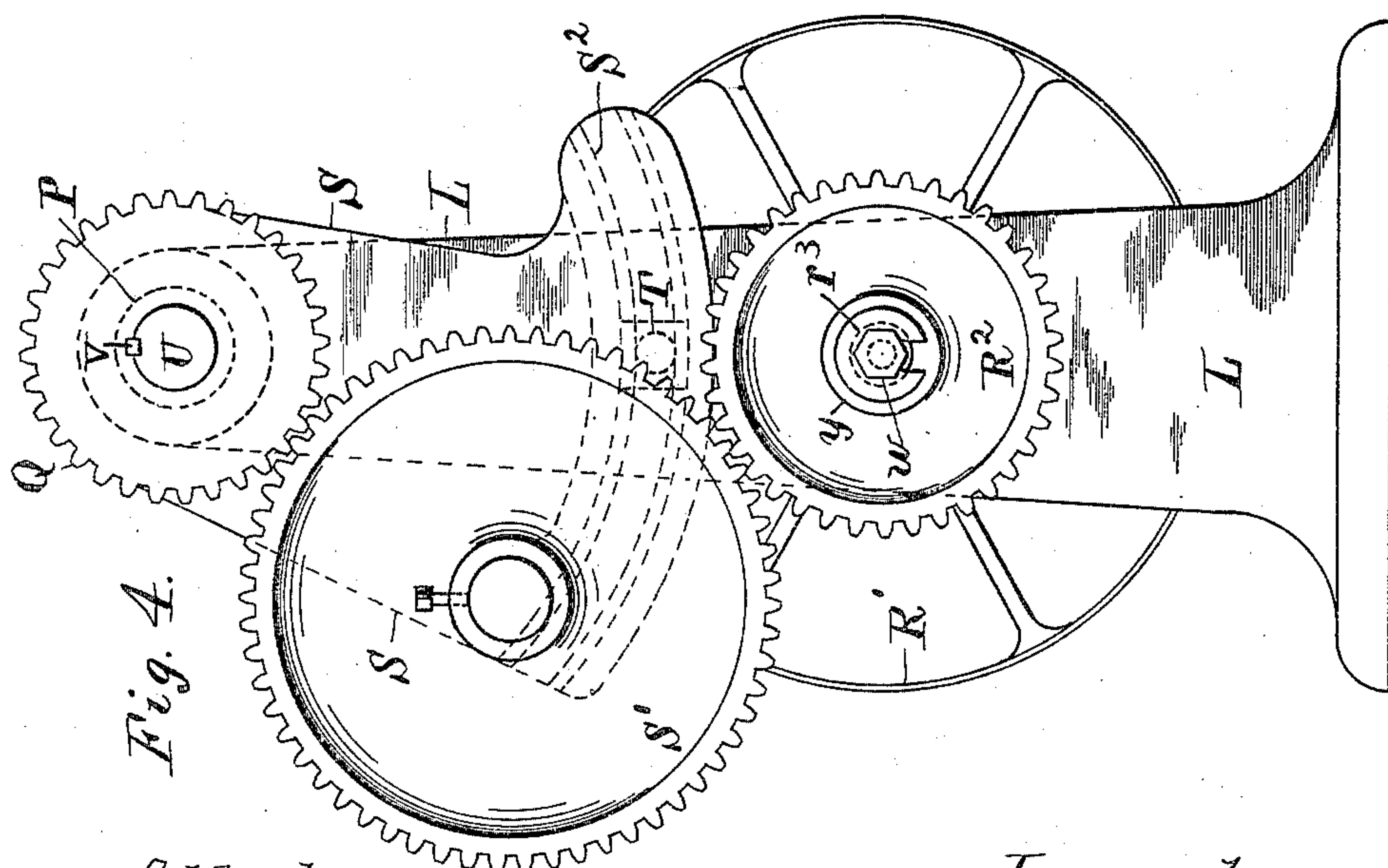
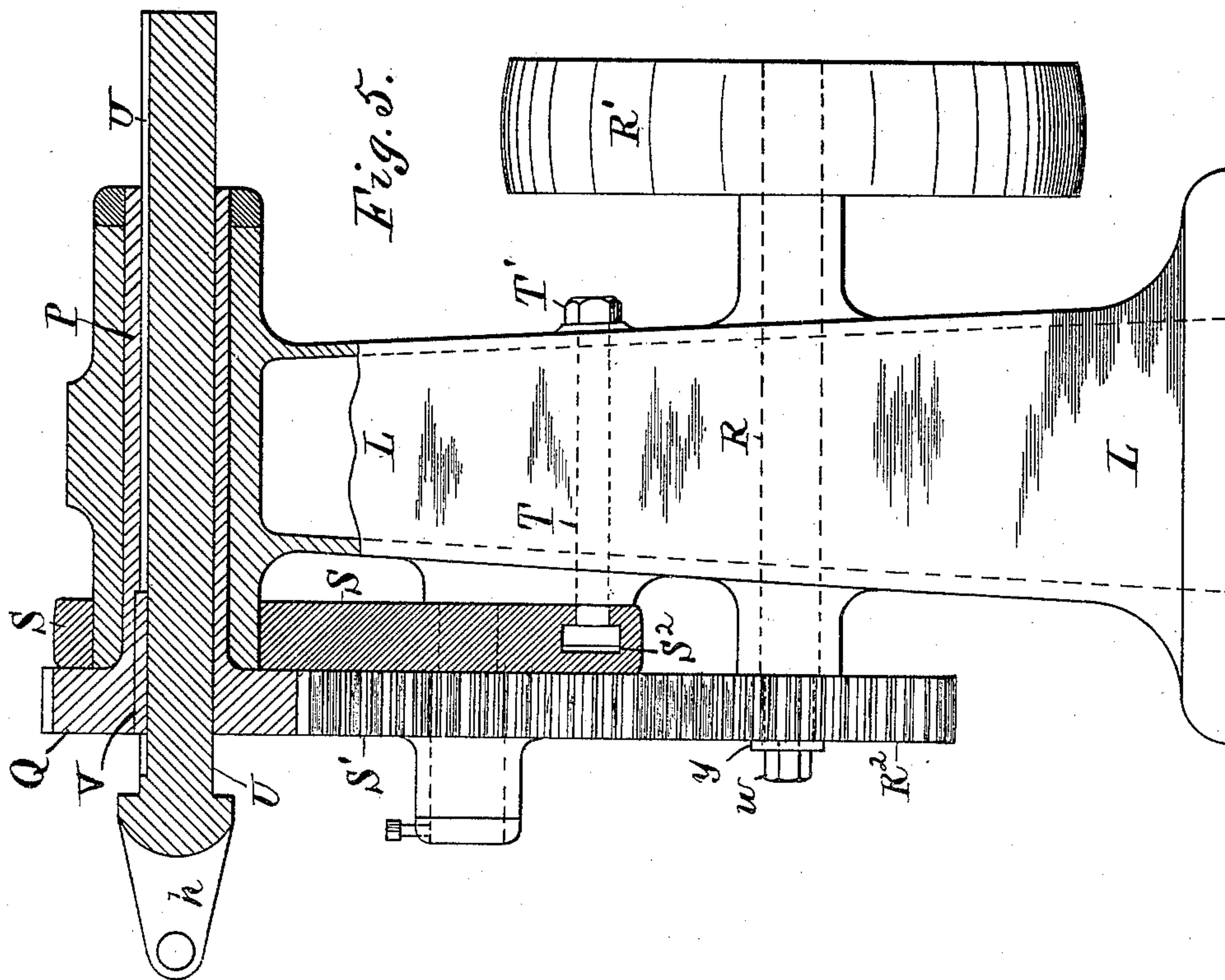
Inventors

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J. Van Nest Jr. } U. Eberhardt, Jr. per Crane & Miller, attys

4 Sheets—Sheet 2.

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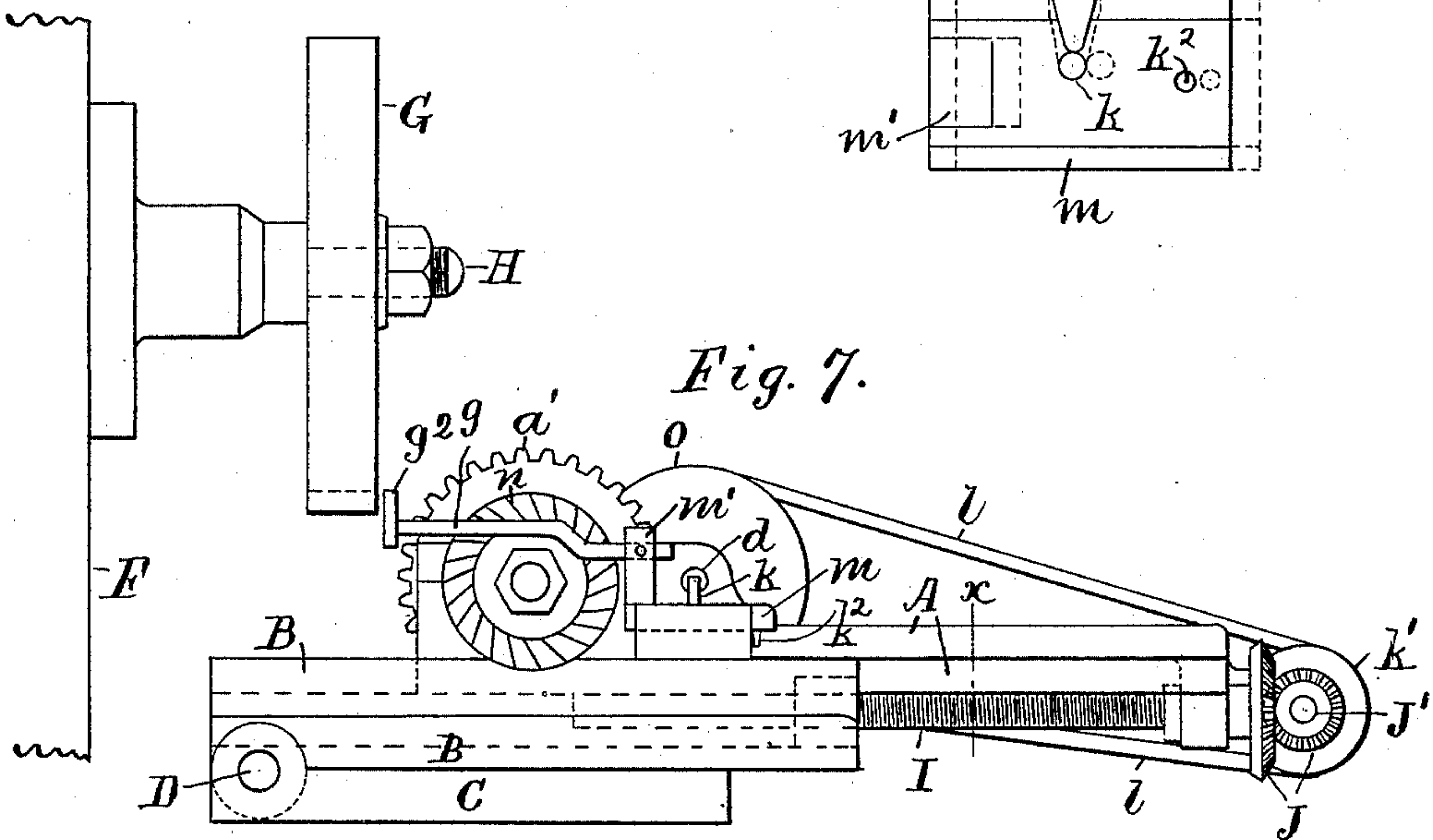
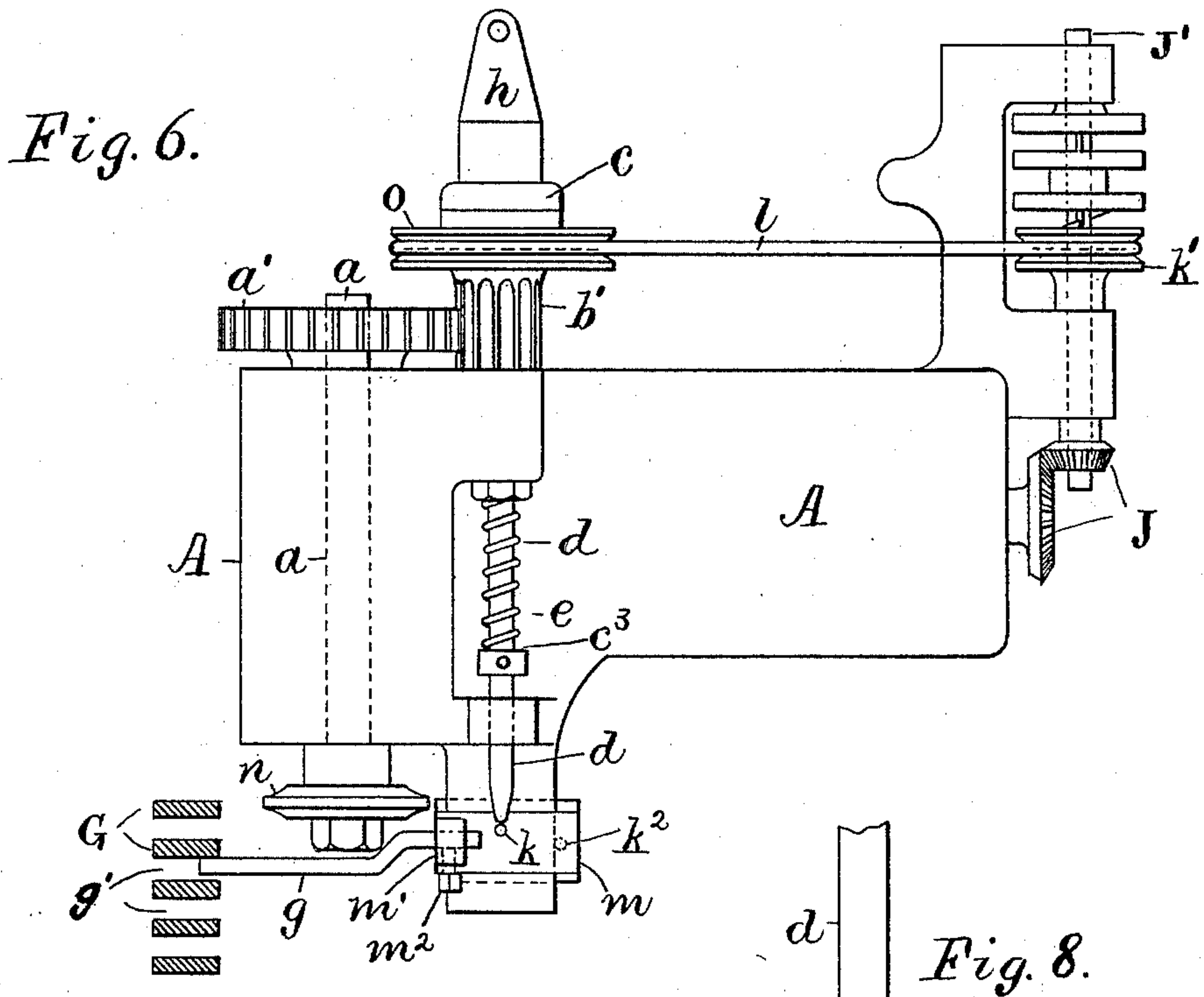
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(No Model.)

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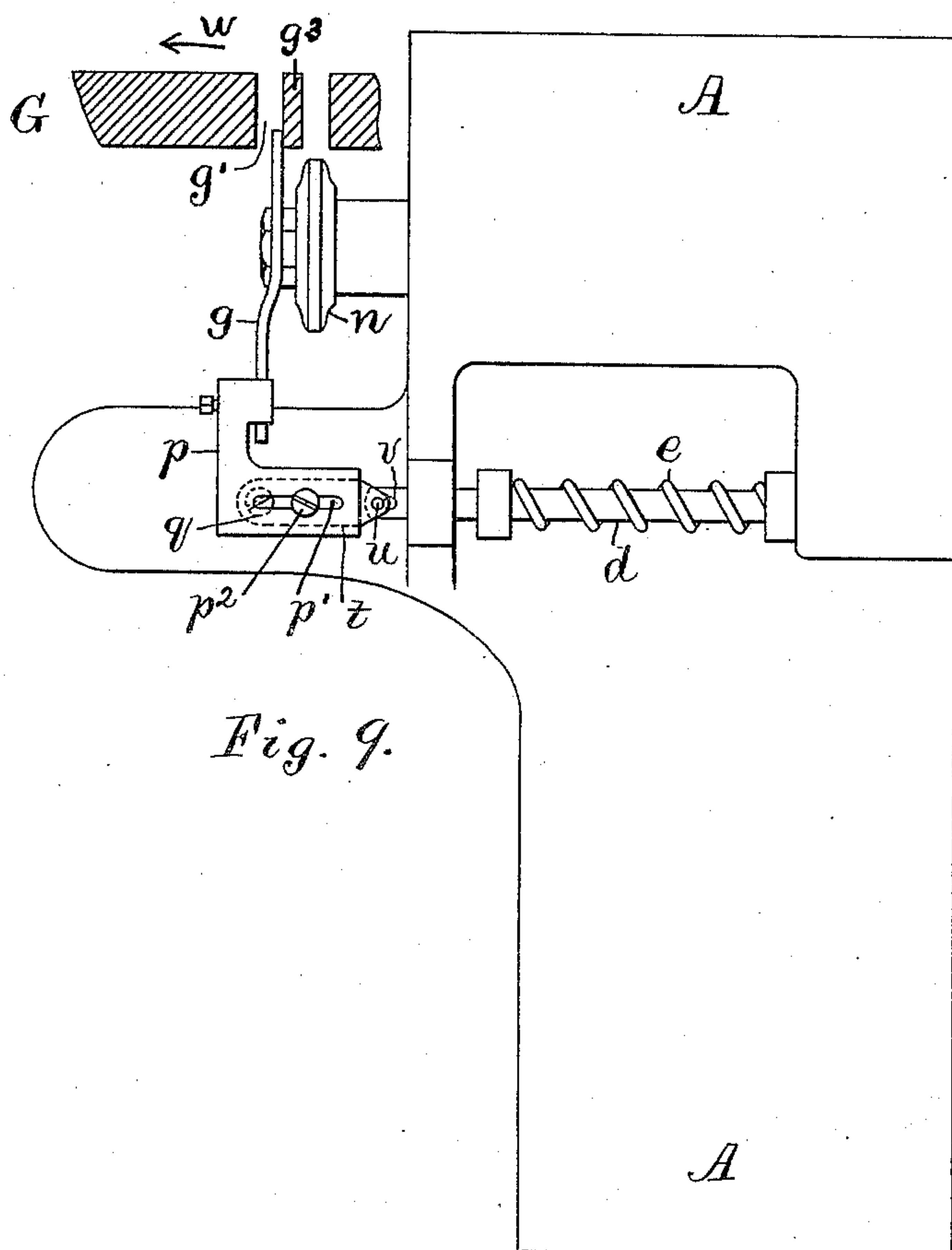


Fig. 9.

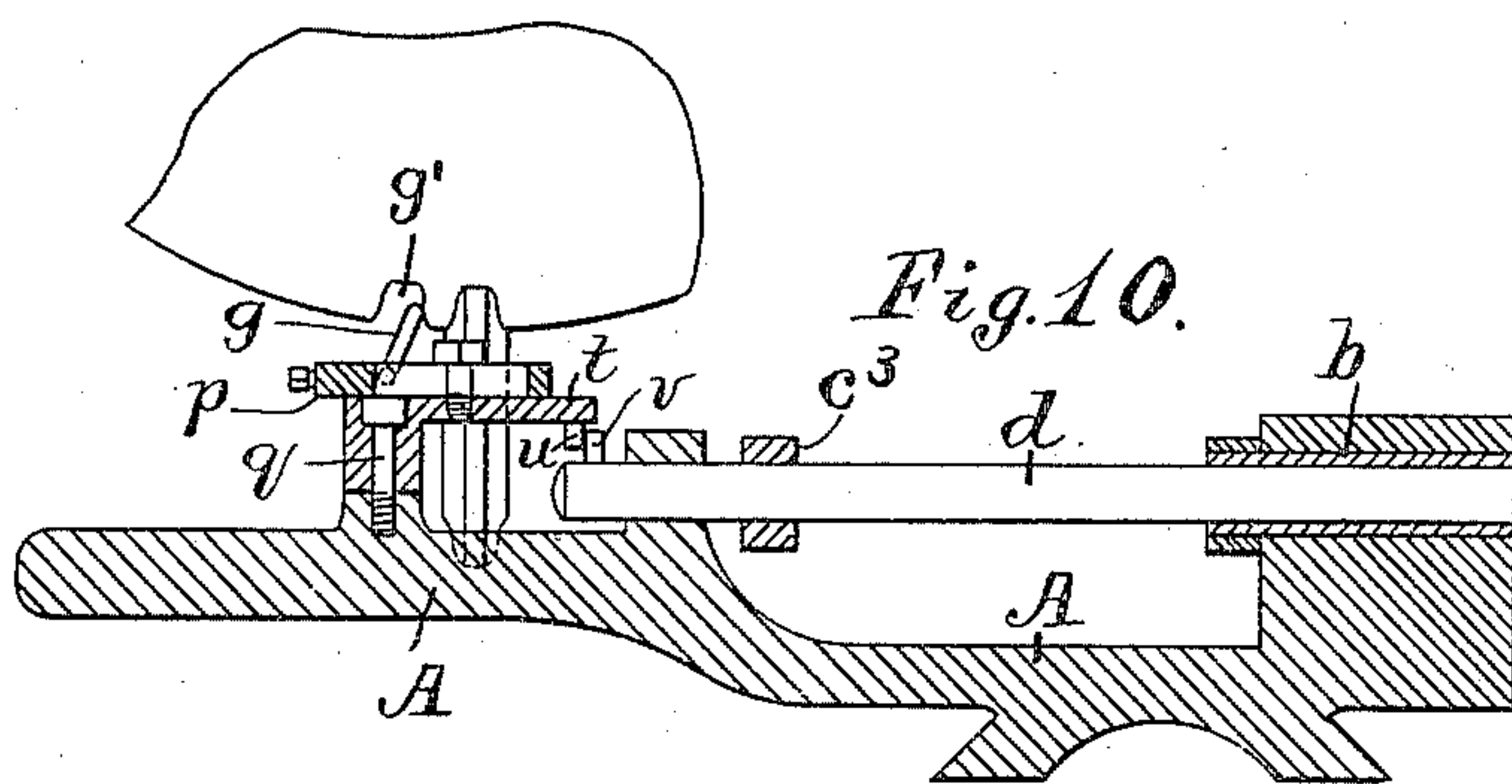


Fig. 10.

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UNITED STATES PATENT OFFICE.

ULRICH EBERHARDT, HENRY E. EBERHARDT, AND ULRICH EBERHARDT,
JR., OF NEWARK, NEW JERSEY.

GEAR-CUTTER OR MILLING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 461,952, dated October 27, 1891.

Application filed May 16, 1891. Serial No. 392,971. (No model.)

To all whom it may concern:

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

This invention is applicable to gear cutting or milling machines, or to any others in which the work-piece or blank is intermittingly rotated and a cutter then fed into the same.

The object of the invention is to prevent the imperfect cutting of the blank which sometimes arises from the defective operation of the spacing devices which intermittingly rotate the blank.

The present improvements relate to means for stopping the feed-motion of the slide and to means for rotating the cutter by a positive connection to a pulley upon a stationary stand. It is obvious that when the blank is uniformly rotated each space cut in succession in the blank will be moved to precisely the same spot; and we take advantage of this circumstance to apply a dog to the space last cut to operate automatically for detaching the feed mechanism and arresting the motion of the cutter-slide in any case where the blank is not uniformly rotated. Supposing the dog to be attached movably to the cutter-slide and connected with a feed-clutch, the operator carefully cuts a space in the blank and after carefully rotating the blank through the desired arc to make the next cut he fits the dog into contact with one or both sides of the space, and so long as the successive spaces are presented at the same spot the dog will enter such spaces as the cutter-slide is moved to cut the blank; but should the gear be imperfectly moved the dog will encounter the tooth at one side or the other of the space, and as the cutter-slide advances the dog will be pushed backward thereon and may, by proper connections to the feeding mechanism, be caused to detach or unclutch the same and thus arrest the motion of the slide before the cutter has

encountered the blank. The blank is thus prevented from defacement by the cutter penetrating the same, and the stoppage of the slide indicates to the operator that the gear is imperfectly moved.

In carrying out this invention the dog may be mounted upon the cutter-slide or in any other convenient manner, and may be connected with any species of clutching mechanism to stop the feed, as required.

From the above statements it will be seen that the improvements in the mechanism consist in a dog fitted to the spaces cut in the blank-gear, and a connection from such dog to the feed-gearing for tripping a clutch or otherwise arresting the feed. The improvements also include means for rotating the cutter, which consists in a stand provided with a driving-shaft and an intermediate shaft connected by universal couplings to such driving-shaft and to the rotary cutter. The stand would in most cases have a pulley-shaft independent of the driving-shaft and connected thereto by change-wheels, by which means the driving-shaft and the cutter upon the cutter-slide could be made to rotate at various speeds without the use of cone-pulleys or the shifting of belts. The system of change-gearing shown herein is adapted to produce the required variations of velocity by removing only a single gear, which can be done with less trouble than the shifting of a belt upon cone-pulleys.

In the annexed drawings the connection is made with the rotary cutter-shaft through a pair of toothed gear-wheels; but it may be made directly with the cutter-spindle, if required.

The operation of the dog in the gear-cutting machine illustrated disengages a clutch, which rotates the cutter and also propels the feeding devices; but the dog may be connected exclusively with the feeding devices, as it would not be necessary in all cases to stop the rotation of the cutter if the cutter-feed were arrested.

The invention will be understood by reference to the annexed drawings, in which the improvements are shown in connection with

a gear-cutter of the type described in the United States Patent No. 332,064, dated December 8, 1885.

Figure 1 is a front elevation of a gear-cutter frame and carriage, with the stand for actuating the cutter, the cutter-slide being divided in section on line $x x$ in Fig. 7, and the intermediate shaft being shown in two positions, one represented by dotted lines. Fig. 2 is a view of the clutch mechanism, partly in section, upon the center line where hatched. Fig. 3 is a view of the face of the clutch-hub, with the clutch-collar and its catch-rod connected therewith. Fig. 4 is a side elevation of the driving-stand. Fig. 5 is a front elevation of the same, with the parts shown in section at the center line where hatched. Fig. 6 is a plan of the cutter-slide, with a diagram representing the teeth cut on the blank gear, with the dog inserted in one of the spaces. Fig. 7 is a side elevation of the cutter-slide, with its bed and the plate to which it is hinged for angular adjustment and a portion of the column with the gear-blank mounted thereon; and Fig. 8 is a plan of the catch and the detent, upon a larger scale, in two positions, one being shown in dotted lines. Figs. 9 and 10 show a plan and end view of a cutter-slide with dog of alternative construction.

A is the cutter-slide, B its bed, and C the plate to which it is hinged by pivot D.

In Fig. 1 the end of the frame E is shown with a portion of the column F and the blank-gear G and the spindle H to which it is secured.

In Figs. 6 and 7, n is the cutter; a , the cutter-spindle; a' , a cog-wheel upon the end of the same; b , a tubular stud adjacent to the same, and b' a toothed pinion or gear rotated upon the stud to drive the gear a' . c is the clutch-hub movably mounted upon the stud b and provided with a fork h , to form a universal coupling with the intermediate shaft i . The gear b' is formed with a pulley o to drive the feed-screw I, which is connected therewith by gears J, a shaft J', and reversing devices upon said shaft, as described in the said Patent No. 332,064. The reversing devices are furnished with a pulley k' , which is connected with the pulley o by belt l . The end of the gear b' and the clutch-hub c are provided each with notches or teeth to engage a collar c' , and such collar may be retracted entirely within the teeth upon the gear or projected partly into those upon the hub. This is effected by a catch-rod d , having a pin d' projected through a slot in the shaft b into an annular groove c^2 within the collar c' . A shoulder c^3 is formed upon the rod, and a spring e operates against the shoulder to hold the collar c' normally disengaged from the clutch-hub. The clutch-hub is designed to rotate continuously by connection with driving gearing of suitable character, and would thus drive the cutter-spindle and the feed-

screw I so long as the spring e is compressed and the collar c' engaged with the hub. To thus compress the spring the catch-rod is held by a detent in the form of a pin k , which is movable transversely to the end of the catch-rod and operates to hold the rod with the collar c' engaged when the pin is in line with the rod. The surfaces of the rod and detent in contact are preferably round, as shown in Fig. 8, so that a slight lateral movement of the detent will cause the spring to press it forcibly to one side, and thus release the rod, permitting the disengagement of the clutch-collar c' . The detent may be mounted movably in any convenient manner, but is shown fixed upon a sliding bar m , having a lug m' , in which the shank of the dog g is affixed and a stop-pin k^2 to determine the adjustment of the bar m .

In Fig. 6 the dog is shown as a round rod having its end in contact with one side of one of the teeth of the blank gear G, such teeth being shown in section as the gear above the teeth is removed.

In Figs. 1 and 7 the dog is shown formed at the end with a templet g^2 , fitted closely to the space g' between two of the teeth, so that it will only enter such space when it is presented accurately in line with the movement of the templet. The dog, being attached to the cutter-slide or carriage A, moves parallel with the path of the cutter and is projected sufficiently in advance of the same to encounter the blank G (if imperfectly rotated) and operate the unclutching device before the cutter n would penetrate the blank. In case the blank were not moved uniformly after each cut, the space between the teeth would not be presented in line with the templet or dog, the latter would strike the tooth on one side or the other of the space, and the farther movement of the slide would operate to push the dog backward, thus shifting the detent k and releasing the catch-rod d , whereupon the spring would draw back the collar from the clutch-hub. When the blank is adjusted for cutting, the catch-rod is pushed by the operator to engage the collar c' with the clutch-hub, and the bar m is pushed as far as the stop k^2 will allow. The detent is thus set in line with the catch-rod, and the clutch then imparts the necessary movement to the cutter-spindle and the feed-screw, which movement is arrested in the manner described should the blank be turned improperly.

The bar of which the dog g is formed is bent between its support and the point where it enters the space in the blank gear, and the dog is formed with a round shank which is clamped upon the bar m by a set-screw m^2 . By turning the shank of the dog in the lug m' its end may thus be moved laterally and accurately adjusted to the space in the blank gear. Any other means of adjustment may be provided, as it is common to form such dogs with a slotted foot through which a bolt

is inserted, and such a foot would be an equivalent for the bent bar, which furnishes the means of adjustment shown herein.

The templet g^2 in Fig. 1 is shown of the same shape where it fits between the teeth as the cutter which forms the space, and the templet thus wholly fills such space, and with such a construction a separate templet would be required for each form of tooth or space; but it is obvious that a templet of any form may be used, provided it touches opposite sides of the space, and is thus adapted to engage with the blank adjacent to the space if the wheel be improperly shifted. The clutching apparatus shown herein constitutes detachable feed-gearing, as it furnishes a means of detaching the feed-gearing from the driving power, and thus arresting the motion of the cutter-slide with very slight pressure upon the dog. A very slight derangement of the blank, even that which suffices to vary its normal position one-hundredth of an inch, would therefore engage the dog positively and would push it with sufficient force to release the catch d and permit the spring e to automatically disengage the clutch and detach the feed-gearing from the driving power. As before stated, the clutch shown in the drawings also detaches the cutter from the driving power; but this is only an incident to the construction, as it is not necessary that the cutter should be arrested if the feed-gearing be stopped.

In Fig. 7 the bed B, holding the cutter-slide movably, is shown hinged to the plate C by a pivot D, to permit the inclination of the cutter-slide in cutting bevel-gears, as is already well-known in the art. The slide would also be shifted laterally in cutting worm-gears. To maintain a connection between the driving power and the cutter-spindle when the cutter-slide moves back and forth upon its bed, and when the slide is elevated in cutting bevel-gears, it has been common heretofore to employ a driving-belt with a tightener to take up the slack automatically, and where it has been necessary to vary the speed of the cutter it has been common to furnish the belt-pulleys with cone-speeds upon two separate shafts, to any of which the belt could be shifted at pleasure. The floor stand connected with the cutter-spindle by an intermediate shaft and universal couplings wholly dispenses with shifting belts and pulleys and furnishes a means of transmitting power positively to the cutter-spindle in any position and of changing the speed of the spindle by toothed change-wheels.

L is the floor-stand, having bearings in which are fitted a sleeve P and pulley-shaft R. The sleeve is provided at one end with a gear Q and the pulley-shaft is provided at opposite ends with a pulley R' and a neck r^3 for change-wheels R². A segment S is mounted to turn about the sleeve by fitting it to the

end of the bearing which sustains the same and carries an intermediate gear S', which is fitted to mesh permanently with the gear Q and also by swinging the segment with any change-wheel fitted upon the shaft R. The segment is provided with a curved slot S² and the head of a bolt T is fitted to the slot and held by a nut T' to clamp the segment when the intermediate gear is adjusted. A driving-shaft U is fitted movably to a key or spline V in the sleeve, and the end of such shaft is provided with a fork h to form a universal coupling with the intermediate shaft i . The shaft, by means of pins h' and blocks h^2 , is coupled to the shaft U and to the fork upon the clutch-hub c . The motion from the pulley R' is thus transmitted to the cutter-spindle in any position, as when the cutter-slide is elevated to cut bevel-gears, such position of the clutch-hub and the stud carrying the same being shown in dotted lines in Fig. 2, with the intermediate shaft i connected thereto at an angle. The intermediate shaft i also assumes various angular positions in a horizontal plane when the cutter-slide is not elevated, but moved back and forth each time it cuts the blank. The shaft U in such movements slides in and out of the sleeve in a slight degree while it is rotated by the spline V. A nut w , as small as the neck r^3 , is applied to the end of the pulley-shaft R and operates to hold the change-wheels upon the neck by means of a notched washer y , which may be removed by merely slacking the nut. A change-wheel may thus be removed or changed by slightly turning the nut and removing the washer y , and a change of speed in the motion transmitted from the pulley R' to the driving-shaft U may thus be effected as readily as by shifting a belt upon speed-cones. This is especially the case where a wide range of speeds is desired, as in large gear-cutting machines, as it is common in such cases to supply two counter-shafts with speed-cones, which counter-shafts when located upon the ceiling are too far from the operator to permit the convenient shifting of the belt thereon.

The invention has been described and illustrated in connection with a machine for cutting cog-teeth in blank gears; but it is obvious that all the appliances described may be applied to milling-machines which are used for fluting taps and reamers, and to any other machines in which the work-piece is intermittently rotated through a uniform space.

The essential part of the invention consists in applying a dog to the space last cut before the cutter is permitted to again penetrate the blank and connecting such dog with the feed-detaching mechanism or the driving mechanism of the cutter, so that if the work-piece or blank is improperly rotated such defective movement will be detected by the dog, and the dog will, through intermediate agencies,

arrest the movement of the feed mechanism or the cutter and prevent the cutter from defacing the blank.

In machines in which the blank and cutter-slide are both moved intermittingly by automatic devices it sometimes happens that the mechanism for rotating the blank is prematurely actuated upon the retraction of the cutter before the cutter has quite withdrawn from the space last formed. Such an accident causes the defacement of the gear by the cutters intersecting the corner of the blank and cutting off the same improperly, and the present invention may be applied to prevent such damage.

Figs. 9 and 10 show a modification adapted for this purpose, the dog g being held adjustably in a foot p , which, by means of a slot p' and a screw p^2 , is attached to a vibrating arm t , pivoted upon a bolt q , which is fixed to the cutter-slide in line with the catch-rod d . The end of the arm t is provided with a pin u in line with a pin v , fixed upon the catch-rod, and such pins would in practice be slightly flattened upon their adjacent faces, so that the pin upon the arm may be engaged with the pin upon the catch-rod to hold the feed mechanism in an operative condition.

The dog g is shown in Figs. 9 and 10 adjusted against one side of a space g' , cut in a large blank gear, a portion of which gear is shown in Fig. 10, and a section of such portion concentric with its periphery through the space g' is shown in Fig. 9. The gear would be rotated in the direction of the arrow w in Fig. 9 after each reciprocation of the cutter, and should such rotation occur before the cutter was fully retracted from the space last cut, it is obvious that the tooth g^3 would press the dog laterally, and by rotating the arm t around its pivot q would disengage the pins u and v and permit the spring e to actuate the feed-detaching mechanism as desired.

With a construction for the cutter-driving mechanism like that shown in Figs. 1 to 7, the rotations of the cutter would be arrested simultaneously, and the cutter would thus be prevented from defacing the blank gear. It will thus be seen that the device is intended to arrest the feed-detaching mechanism or the cutter-driving mechanism, or both, if the work piece or blank is improperly rotated.

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

1. In a gear-cutter or milling-machine, the combination, with the cutter-slide and detachable feed mechanism for propelling the same, of a dog fitted to the spaces cut in the blank and operated to actuate the feed-detaching mechanism when pressed by the blank, substantially as herein set forth.

2. In a gear-cutter or milling-machine, the combination, with the cutter-slide, of a detachable clutch for rotating the cutter-spindle, a spring for throwing the clutch out of

gear, a catch for holding the clutch in gear, a detent for said catch, and a dog fitted to the spaces cut in the blank and operated to shift the detent and release the catch when the dog is pressed by the gear-teeth, substantially as herein set forth.

3. In a gear-cutter or milling-machine, the combination, with the movable cutter-slide and the cutter-spindle thereon, of an independent floor-stand carrying a rotary sleeve, a pulley, and gearing for rotating such sleeve, a driving-shaft fitted to a spline in such sleeve, and an intermediate shaft connected by universal couplings to such driving-shaft and to the cutter-spindle, as and for the purpose set forth.

4. In a gear-cutter or milling-machine, the combination, with the movable cutter-slide and the cutter-spindle thereon, of an independent floor-stand carrying a rotary sleeve and a shaft provided at one end with the belt-pulley and at the opposite end with a neck for change-wheels, a gear attached to the rotary sleeve, and an intermediate gear adjustable to such gear and to the change-wheel upon the pulley-spindle, a driving-shaft fitted to a spline in such sleeve, and an intermediate shaft connected by universal couplings to such driving-shaft and to the cutter-spindle, substantially as herein set forth.

5. In a gear-cutter or milling-machine, the combination, with the movable cutter-slide and the cutter-spindle thereon, of an independent floor-stand sustaining a driving-shaft connected to the cutter-spindle by an intermediate shaft and universal couplings, the stand being provided with the sleeve P , having gear Q thereon, the pulley-shaft R , provided with pulley R' and change-wheels R^2 , the segment S , rotary about the sleeve and carrying the intermediate gear S' and provided with the slot S^2 , and the bolt T , fitted to the slot S^2 for clamping the segment, the whole arranged and operated substantially as herein set forth.

6. In a gear-cutter or milling-machine, the combination, with the cutter-slide A , of the cutter-spindle a , provided with gear a' , the tubular shaft b , carrying the gear b' , the clutch-hub c and a clutch-collar for engaging the same with the gear b' , a driver for rotating the clutch-hub, the catch-rod d and spring e for normally disengaging the clutch, the detent f , applied to the catch or rod d for holding the clutch engaged, and the dog g , fitted to the spaces cut in the gear-blank and connected with the detent, as and for the purpose set forth.

7. In a gear-cutter or milling-machine, the combination, with the cutter-slide and detachable feed mechanism for propelling the same, of a dog attached to the slide and adjustable laterally thereon to fit the spaces cut in the blank-gear and operated to actuate the feed-detaching mechanism when pressed by the blank, substantially as herein set forth.

8. In a gear-cutter or milling-machine, the
combination, with the cutter-slide and mech-
anism attached thereto for rotating the cut-
ter and actuating the feed mechanism, of a
5 dog fitted to the spaces cut in the blank and
operated to stop the cutter and feed mechan-
ism when pressed by the blank, substantially
as herein set forth.

In testimony whereof we have hereunto set

our hands in the presence of two subscribing 10
witnesses.

ULRICH EBERHARDT.
HENRY E. EBERHARDT.
ULRICH EBERHARDT, JR.

Witnesses:

THOS. S. CRANE,
E. N. EBERHARDT.