R. MILNE.

DIFFERENTIAL POSITIVE FEED MECHANISM.

APPLICATION FILED DEC. 19, 1908.

940,342. Patented Nov. 16, 1909.

3 SHEETS—SHEET 1.

Fig. 1.

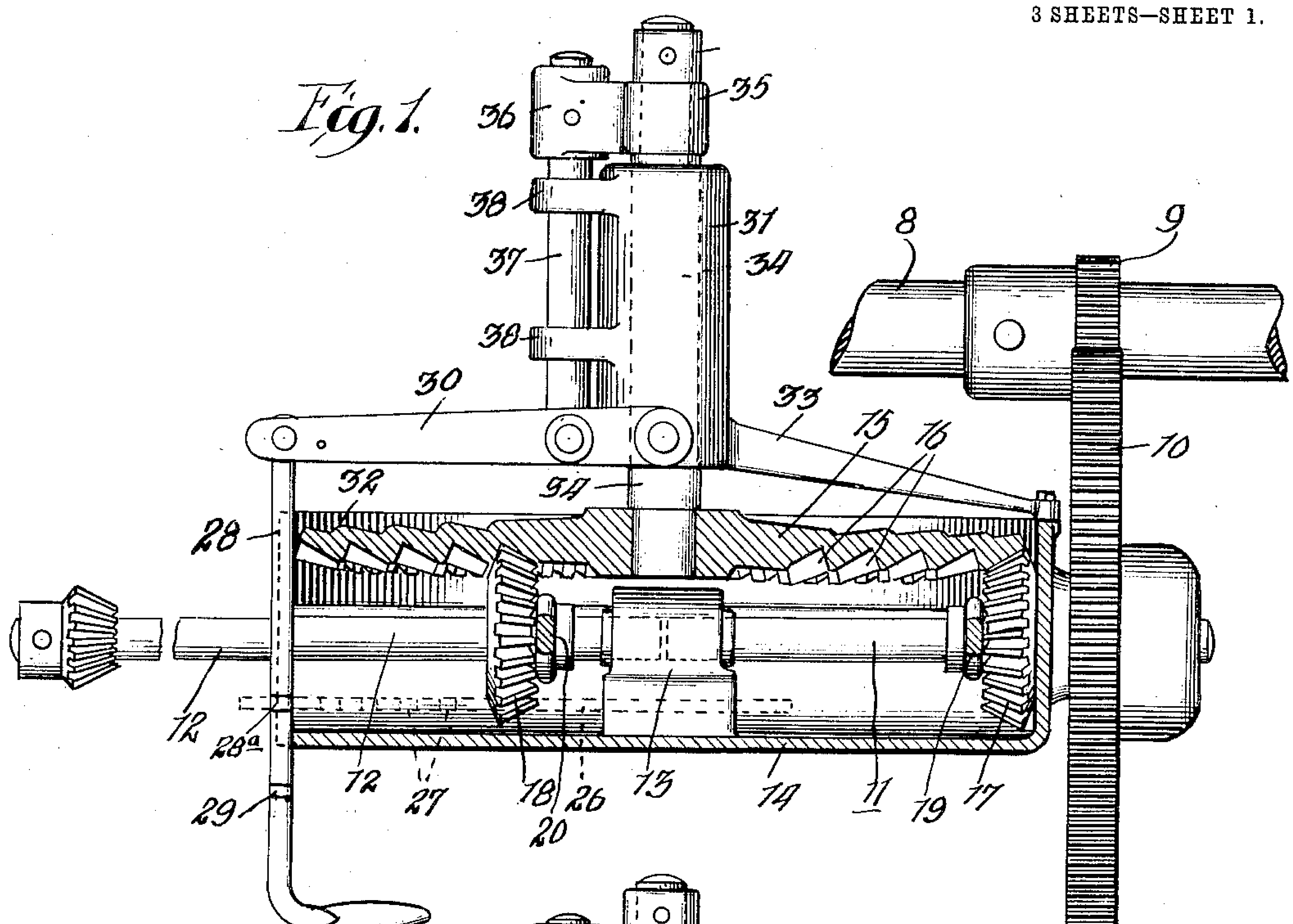

Fig. 2.

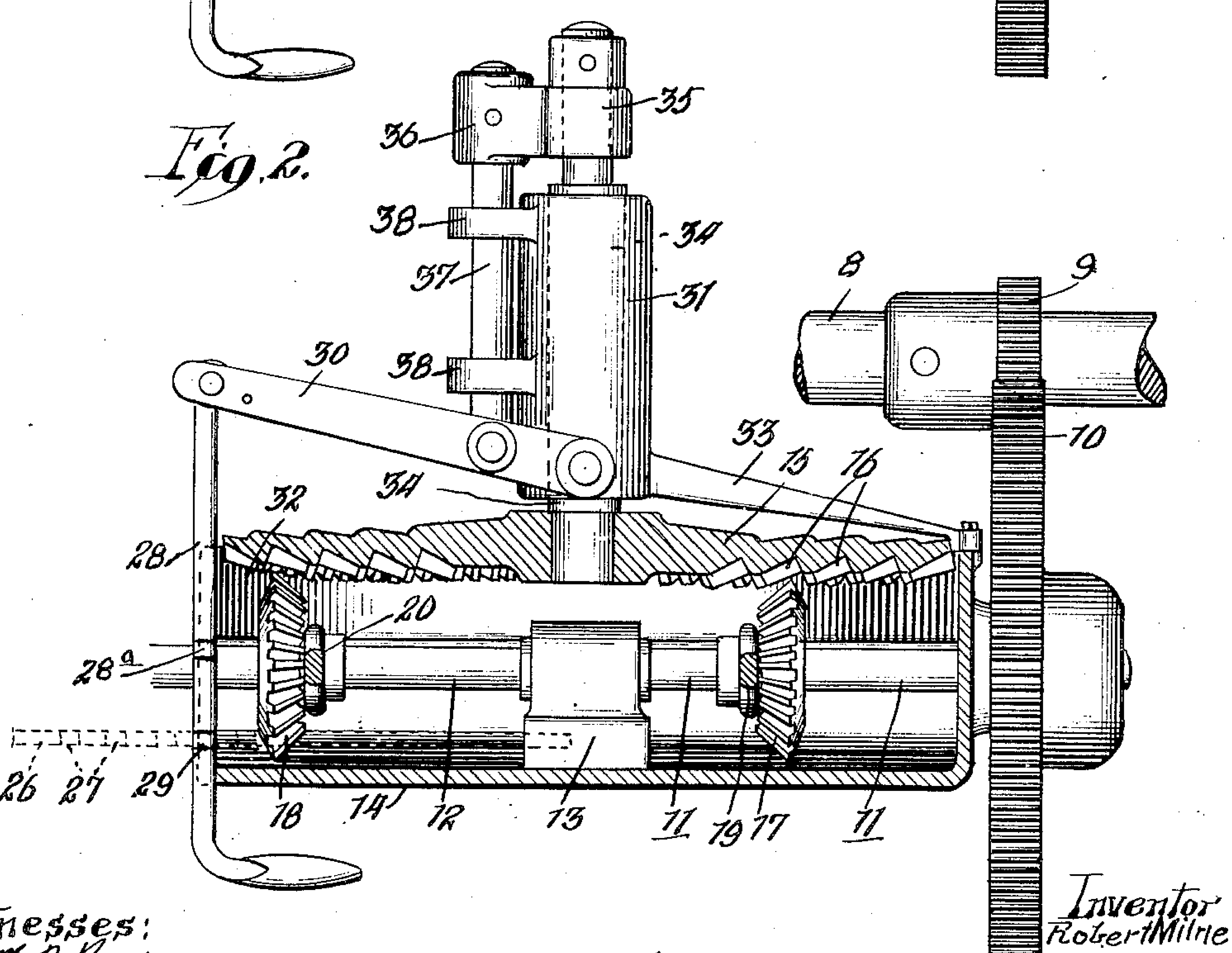

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Fig. 3.

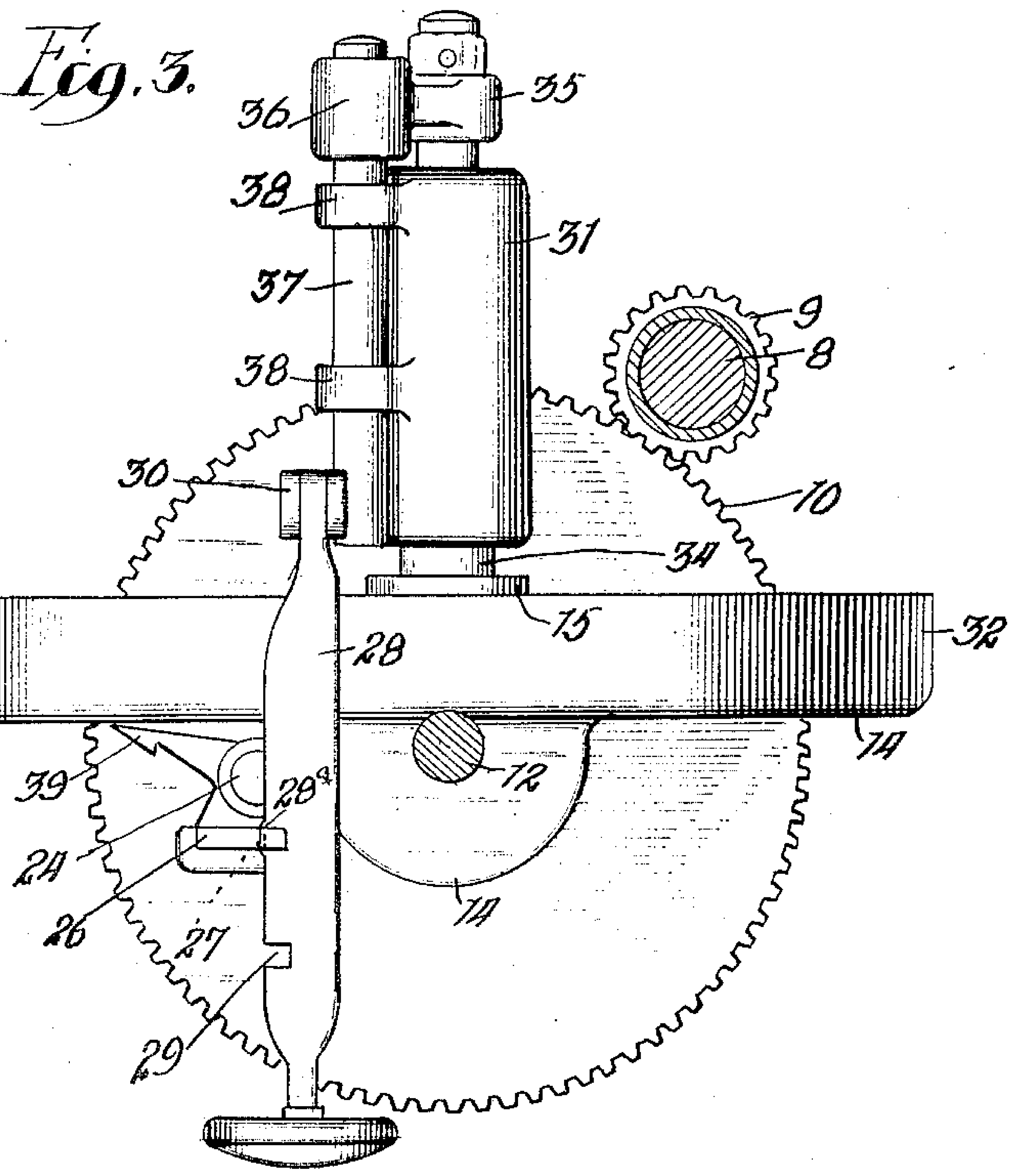


Fig. 8.

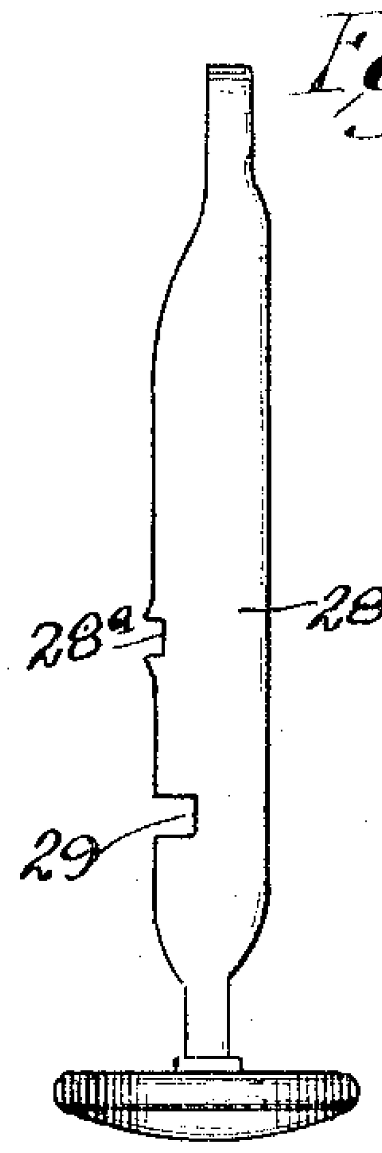
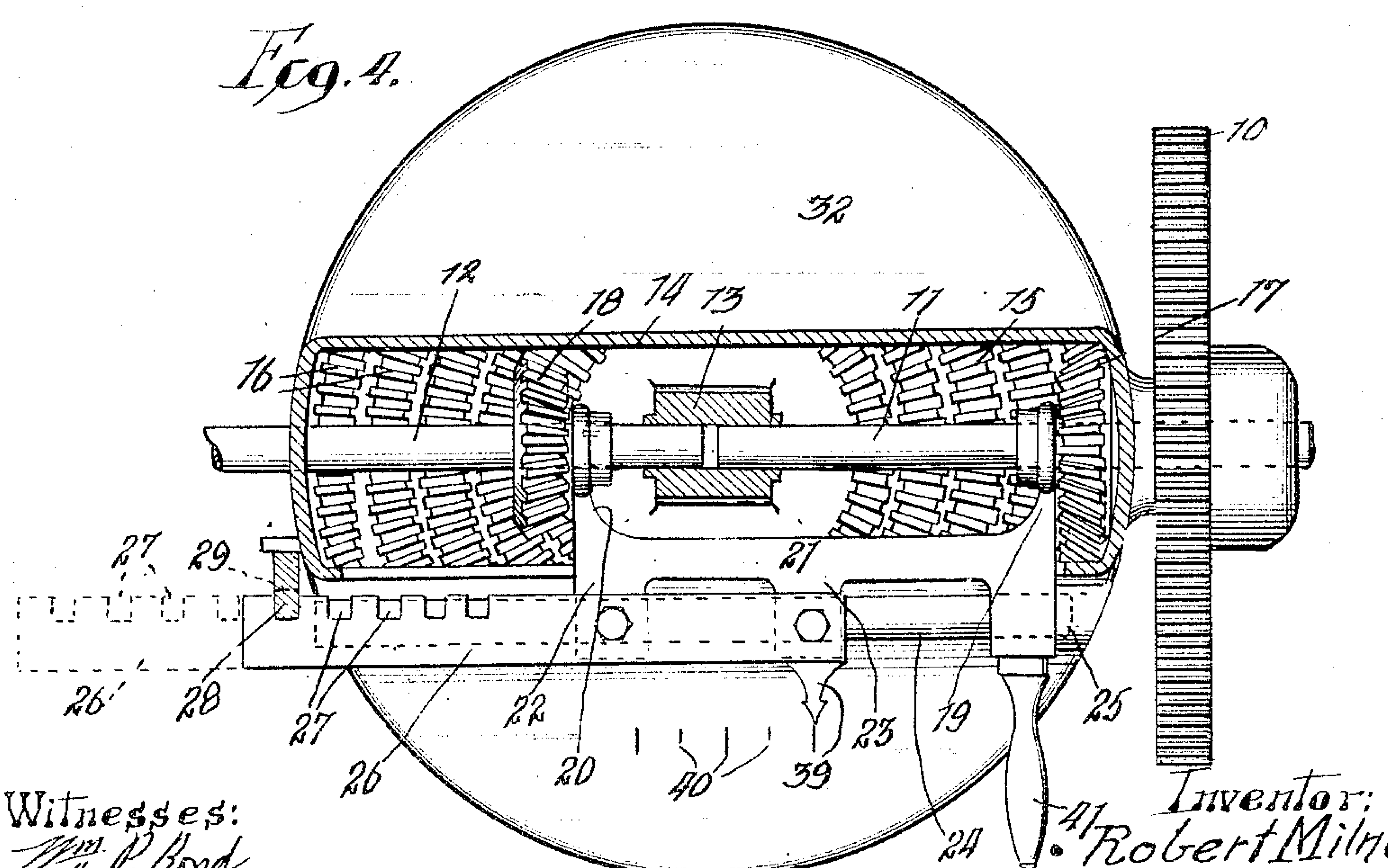


Fig. 4.



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3 SHEETS—SHEET 3.

Fig. 5.

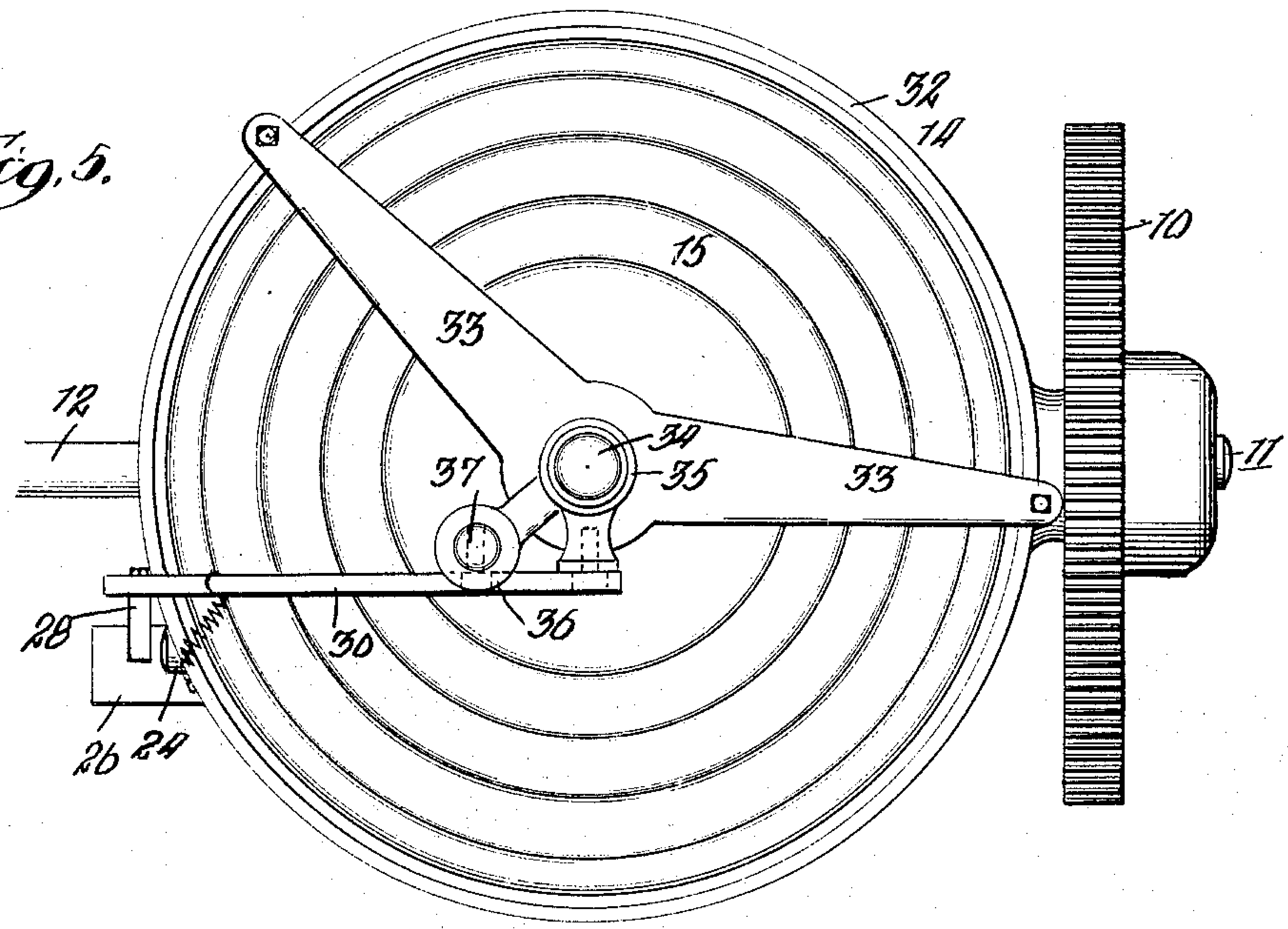


Fig. 6.

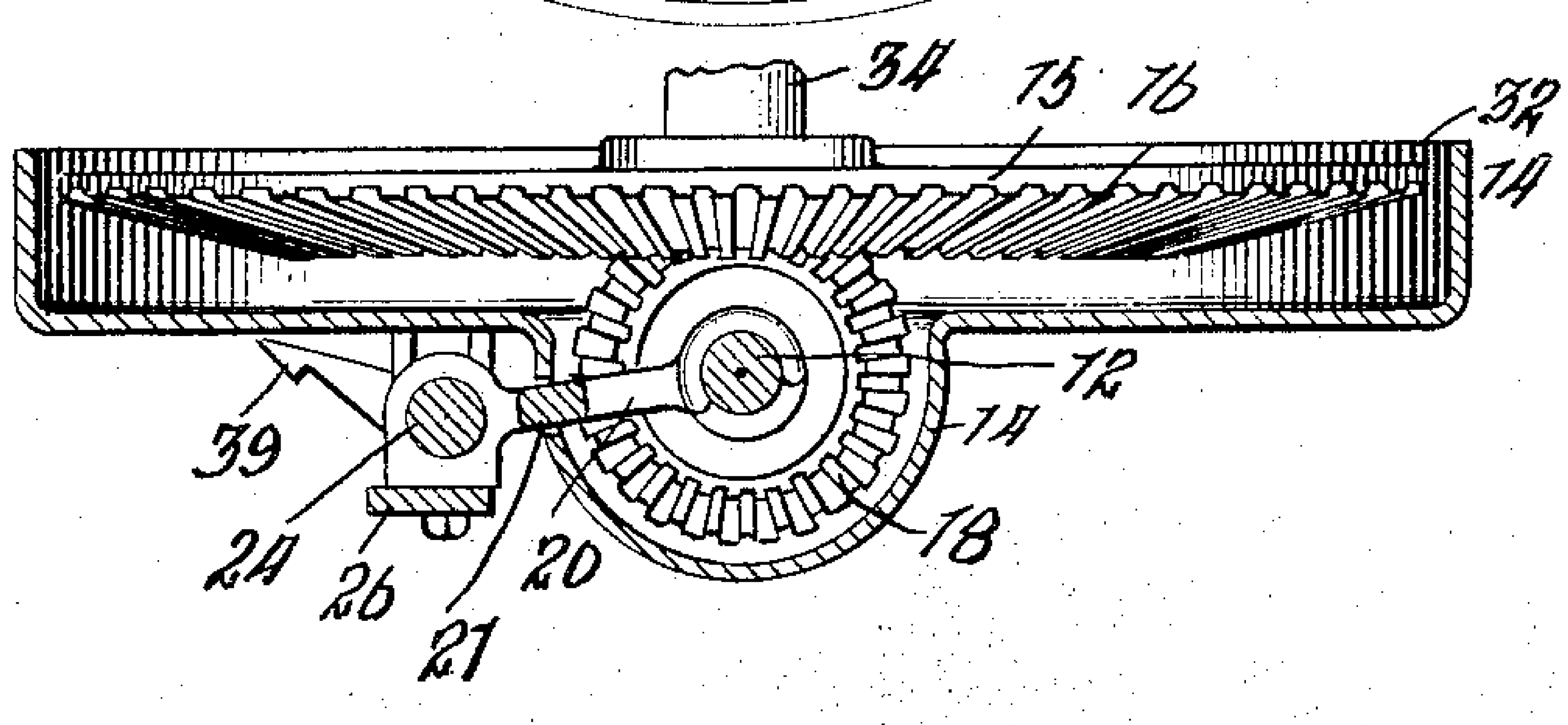
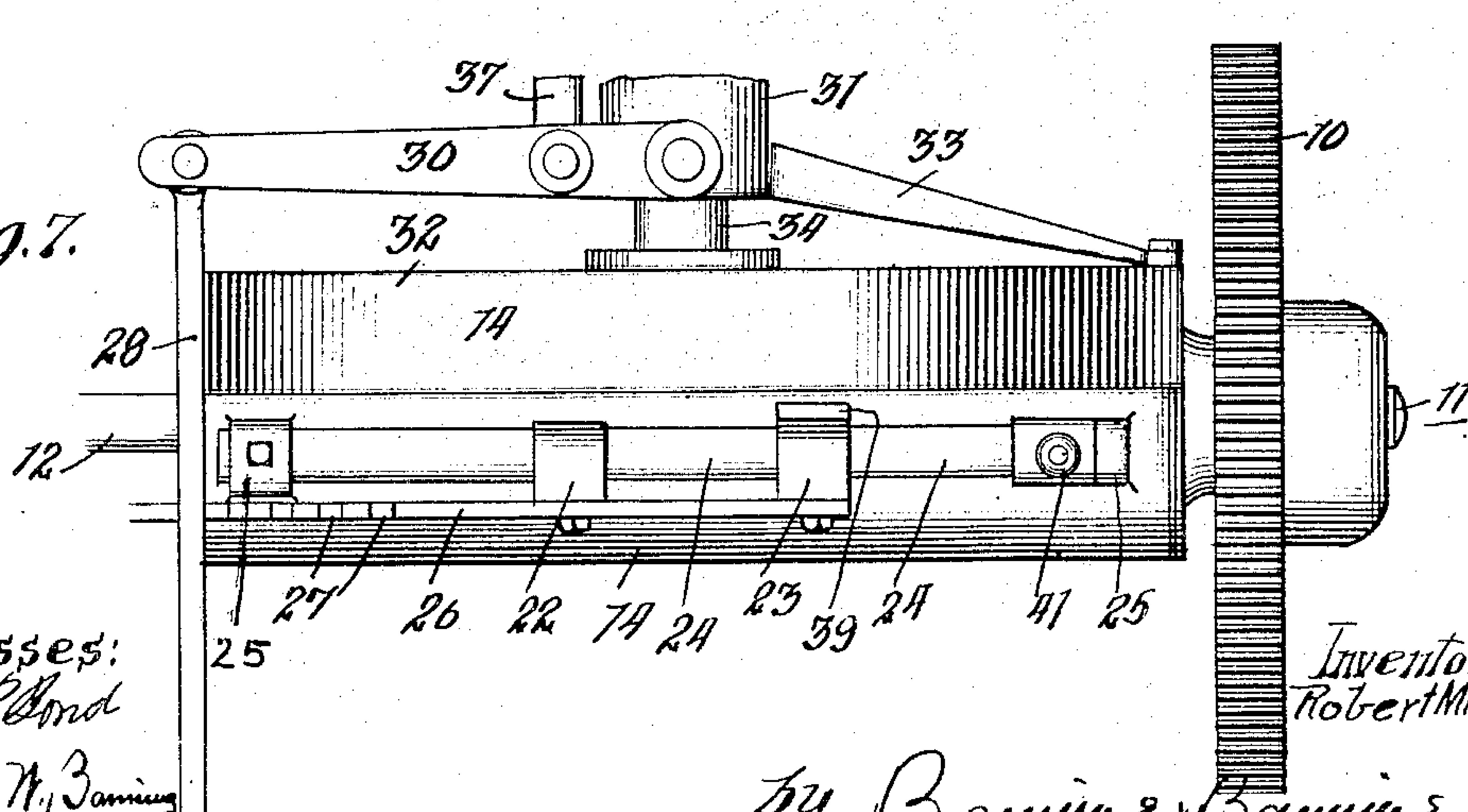


Fig. 7.



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UNITED STATES PATENT OFFICE.

ROBERT MILNE, OF ROCKFORD, ILLINOIS, ASSIGNOR TO ROCKFORD DRILLING MACHINE COMPANY, OF ROCKFORD, ILLINOIS, A CORPORATION OF ILLINOIS.

DIFFERENTIAL POSITIVE-FEED MECHANISM.

940,342. Specification of Letters Patent. **Patented Nov. 16, 1909.**

Application filed December 19, 1908. Serial No. 468,390.

To all whom it may concern:

Be it known that I, Robert Milne, a citizen of the United States, residing at Rockford, in the county of Winnebago and State of Illinois, have invented certain new and useful Improvements in Differential Positive-Feed Mechanism, of which the following is a specification.

This feed mechanism is more particularly adapted for use in connection with drill presses, the differential feed mechanism being employed for the purpose of feeding down the drill spindle during the progress of the drilling operation. The mechanism is intended to be used in lieu of the ordinary stepped pulleys which have been usually employed in the transmission of power from the main power shaft to the drill spindle feed mechanism.

In the present invention, in place of stepped pulleys and a connecting belt, which is subject to slippage, positive feed mechanism is employed in the form of gearing, the elements of which can be shifted with regard to one another to afford very substantial variations in the speed transmitted through the gearing, the main power shaft, meanwhile, being driven at a uniform speed. The main element in the train of gears comprising the present invention is in the form of a disk gear which coöperates with pinions adapted to be shifted across the face of the disk in order to change the speed imparted. In gearing of this general type, as hitherto constructed, it has been the practice to obtain variations solely through the engagement of a single pinion with the disk gear, but the present invention greatly amplifies the variations by employing two shafts and two gears which act in unison with one another so that as one of said pair of gears approaches the periphery of the disk gear the other will be moved toward the center, thereby securing a greater ratio of variation than has hitherto been the practice.

The invention further relates to the mechanism employed for shifting the pinions; to the mechanism employed for throwing the disk gear out of train; and to the device as a whole and the individual parts thereof.

The invention consists in the features of construction and combination of parts hereinafter described and claimed.

In the drawings, Figure 1 is a side elevation of the mechanism, showing the housing partly broken away and showing the disk gear in section; Fig. 2 a similar view, showing the parts out of mesh and thrown to a different adjustment; Fig. 3 an end elevation of the housing, showing the transmission spur gear; Fig. 4 an inverted plan view, showing the housing partly broken away; Fig. 5 a top or plan view of the mechanism; Fig. 6 a cross sectional view through the housing transversely of the shafts; Fig. 7 a side elevation, showing the guide bar and shifting mechanism; and Fig. 8 a side elevation of the shifting bar.

Referring to Fig. 1, the power is imparted from the main or power shaft 8 having thereon a spur pinion 9 which meshes with a spur gear 10 mounted upon a driving shaft 11, which is in alinement with a driven shaft 12, the abutting ends of which shafts are journaled within a bearing block 13 which is located within the center of a housing 14. Immediately above the shafts is located a disk gear 15 which is provided, on its face, with concentric rows of teeth 16, which teeth are cut on a bevel, as regards the axis of the disk, and are as best shown in Figs. 1 and 2. The teeth are all truly cut and squared so that each row of teeth constitutes, in effect, a perfect bevel gear, in which respect the disk gear of the present invention is highly superior to one having a flat plane surface provided with teeth in the form of lugs tapered or otherwise mutilated to permit adjustment of a pinion from one row of teeth to the next. The disk gear coöperates with primary and secondary bevel pinions 17 and 18, respectively, which work in unison with one another and which are splined to the shafts 11 and 12, respectively, being capable of slidable adjustment on such shafts without loss of rotative effort. The hubs of the primary and secondary bevel pinions are engaged by a pair of yoke arms 19 and 20, as shown in Fig. 4, which arms are connected with a yoke bar 21, the bar being provided with a pair of ears 22 and 23 which are slidably mounted upon a rod 24, the ends of which are entered through lugs 25 formed on the housing. The guide rod 24 extends parallel with the driving and driven shafts and is located at one side of and in parallel relation with the lower portion of the housing

14, which portion is of rectangular or box shape.

The ears 22 and 23 have bolted thereto a notched bar 26 provided, at one end, with notches 27 which are adapted to engage a shifting bar 28 provided, near its center with a shallow locking notch 28[a] and near its lower end, with a notch 29. The upper end of the shifting bar is pivoted to the free end of a lever 30, the opposite end of which is pivoted to a rigid sleeve 31, which is supported above the center of the upper housing 32 by means of radially extending arms 33 which are bolted or otherwise suitably secured to the upper part of the housing, which portion of the housing is of circular formation to properly house the disk gear. The disk gear is mounted on the lower end of a vertical stub shaft 34 which is journaled within the sleeve 31 and which extends therethrough, as shown in Figs. 1 and 2. The upper end of the vertical shaft 34 is rotatably mounted within a collar 35 which has outwardly extending therefrom a socket arm 36 which receives the upper end of an adjusting rod 37 to which the lever 30 is pivoted, so that a vertical movement of the lever will be imparted through the socket arm 36 and collar 35 to the shaft 34, which movement serves to raise or lower the disk gear. The adjusting rod 37 is slidably mounted through lugs 38 which outwardly project from the sleeve 31 and permit the adjustment to be made. In order to permit the operator to determine as to the point of adjustment of the adjustable bevel pinions, a pointer 39 is fastened to the notched bar 26, which pointer coöperates with marks or graduations 40 formed on the housing to indicate the degree of adjustment.

In use, with the parts in the position shown in Fig. 1, the minimum speed will be imparted from the main shaft through the driving and driven shafts. The driving shaft, being in train with the main power shaft, will be rotated constantly and at a fixed proportionate speed with respect to the main power shaft, and this constant speed will be imparted to the bevel pinion 17, which, however, is slidable to different positions upon the driving shaft. As shown in Fig. 1, with the bevel pinion 17 in mesh with the peripheral row of gear teeth on the disk gear, the slowest speed possible will be imparted to the disk gear. This slow speed is further reduced by the engagement of the secondary bevel pinion 18 with the innermost ring of gear teeth, so that, in the position shown in Fig. 1, the constant speed of the main power shaft is subjected to a double reduction. The parts will be locked, in the position shown, by the engagement of the outermost notch of the notched bar 26 with the shallow locking notch 28[a] in the edge of the shifting bar 28, the inner edge of which notch enters into and engages with the outermost notch and prevents any longitudinal movement of the bar, thereby locking the yoke 21 in position and holding the bevel pinions in coöperative relation and at a fixed distance with one another and in adjustment to impart minimum speed. When it is desired to secure a faster variation of speed, the shifting bar 28 will be first pulled back slightly to disengage the locking notches and then moved upwardly through the uppermost notch until a position is reached in which the edge of the notched bar is in register with the notch 29 in the shifting bar, in which the notched bar will be unlocked and permitted to slide through the notch into the desired position of adjustment. This movement of the shifting yoke 21 is accomplished by means of an outwardly extending handle 41, as best shown in Fig. 4. The upward movement of the shifting bar 28 lifts the disk gear and thereby throws it out of mesh with the primary and secondary bevel pinions, so that thereafter the shifting of the pinions can be made to the selected position. As the primary bevel pinion is shifted toward the center of the disk, thereby increasing the speed of the disk, the secondary bevel pinion will be simultaneously shifted away from the center of the disk gear, whereby the speed derived from the disk gear by the secondary bevel pinion will be increased, so that a double increase will be afforded by the shifting of the two gears, which is highly desirable in mechanism of this general class, in which the variations of necessity are not radical and which are frequently unappreciable in devices which rely on disk gears of the ordinary character and a single coöperating pinion for making the variation. By providing means for bodily lifting the disk gear entirely out of mesh with both of the coöperating pinions, it is possible to employ a disk gear of the character shown, having the rows of teeth truly cut, and each row comprising a substantially perfect bevel gear wheel.

In certain prior constructions it has been customary to merely shift the pinion across the face of the disk without seeking to throw the two elements out of mesh, and this mode of operation necessitates the employment of a flat faced disk with imperfectly formed teeth, which greatly impairs the efficiency of the device for power transmission purposes. In the present case, the adjustments and regulations can be very quickly and easily made, and the parts are so designed that it will be impossible to attempt shifting of the pinions while in mesh with the disk gear, thereby avoiding possible breakage or wear of the parts.

In speaking of driving and driven shafts, it will be understood that these terms are used only as a convenient means of designation, since, obviously, the power could be transmitted in either direction without in any manner altering the construction or operation of the device.

What I regard as new and desire to secure by Letters Patent is:

1. In mechanism of the class described, a disk gear having a plurality of concentric rings of teeth, a slidably mounted bevel pinion adapted to engage with the teeth of any selected ring, a shaft on which the disk gear is mounted, a sleeve within which the shaft is mounted, a member connected with the shaft, a slidably mounted rod connected with said member, and a lever engaging said slidably mounted rod to throw the disk gear into and out of mesh with the pinion, substantially as described.

2. In mechanism of the class described, the combination of a disk gear provided with a plurality of rings of teeth, a shaft upon which the gear is mounted, a lever and connections for imparting longitudinal movement to said shaft, a shaft set at an angle to the disk gear shaft, a pinion mounted thereon and adjustable to different positions to engage with a selected ring of teeth, a notched bar connected with said pinion, a shifting bar entered through one of the notches of the notched bar and connected with the lever for shifting the disk gear shaft, and provided, at a suitable point, with a notch adapted to permit longitudinal movement of the notched bar when moved to a position to disengage the gearing, substantially as described.

3. In mechanism of the class described, the combination of a disk gear provided with concentric rings of teeth, two shafts, each provided with a pinion, a member for connecting said pinions and moving them in unison to engage selected rings of teeth on the disk gear, a shaft upon which the disk gear is mounted, a shifting member for imparting longitudinal movement to said shaft, connected with the pinion connecting member in a manner to lock the pinion connecting member against movement, save when the member is moved to a position to throw the gearing out of mesh, substantially as described.

4. In mechanism of the class described, the combination of a disk gear provided with concentric rings of teeth two shafts journaled adjacent to the disk gear, a bevel pinion on each of said shafts, a member connecting said bevel pinions and adapted to shift them in unison to engage with selected rings of teeth, a notched bar connected with said pinion connecting member, a shifting bar adapted to engage with the notches of said notched bar and lock the same, and provided, at a suitable point, with a notch adapted to register with the notched bar to permit longitudinal movement of the latter, a shaft upon which the disk gear is mounted, and connections between said shaft and said shifting bar for moving the shaft by a movement of the shifting bar such that when the gearing is disengaged the notch in the shifting bar will be brought into register with the notched bar, substantially as described.

5. In mechanism of the class described, the combination of a disk member, two shafts mounted adjacent to the disk member, companion members mounted upon the shafts and adapted to engage with the disk member, means for moving one of said companion members toward and from the axis of the disk member, and means for effecting a break in the train of transmission, the two last mentioned means being held in engagement in a manner to lock the former against movement, save only when a break in the train of transmission is effected, substantially as described.

6. In mechanism of the class described, the combination of a disk member, two shafts mounted adjacent to the disk member, companion members mounted upon the shafts and adapted to engage with the disk member, means for moving the companion members in unison toward and from the axis of the disk member, and means for effecting a break in the train of transmission, the two last mentioned means being connected in a manner to lock the former against movement, save only when a break in the train of transmission is effected, substantially as described.

7. In mechanism of the class described, the combination of a disk gear provided with a plurality of concentric rings of teeth, two shafts mounted adjacent to the disk gear, companion pinions mounted upon the shafts and adapted to register with selected rings of teeth, means for moving one of the pinions toward and from the axis of the disk gear, and means for retracting the disk gear to perfect a break in the train of transmission, the two last mentioned means being held in engagement in a manner to lock the former against movement, save only when a break in the train of transmission is effected, substantially as described.

8. In mechanism of the class described, the combination of a disk gear provided with a plurality of concentric rings of teeth, two shafts mounted adjacent to the disk gear, companion pinions mounted upon the shafts and adapted to register with selected rings of teeth, means for moving the pinions in unison toward and from the axis of the disk gear, and means for retracting the disk gear to perfect a break in the train of transmission, the two last mentioned means being held in engagement in a manner to lock the former against movement, save only when a

break in the train of transmission is effected, substantially as described.

9. In mechanism of the class described, the combination of a disk gear provided with a plurality of rings of teeth, a shaft adjacent to said disk gear, a pinion thereon adjustable to different positions to engage with a selected ring of teeth, means for moving the pinion toward and from the axis of the disk gear, and means for retracting the disk gear to perfect a break in the train of transmission, the two last mentioned means being held in engagement in a manner to lock the former against movement save only when a break in the train of transmission is effected, substantially as described.

10. In mechanism of the class described, the combination of a disk member, a shaft mounted adjacent to the disk member, a member mounted upon said shaft and adapted to engage with the disk member, means for moving said member toward and from the axis of the disk member, and means for effecting a break in the train of transmission, the two last mentioned means being held in engagement in a manner to lock the former against movement save only when a break in the train of transmission is effected, substantially as described.

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Witnesses:

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