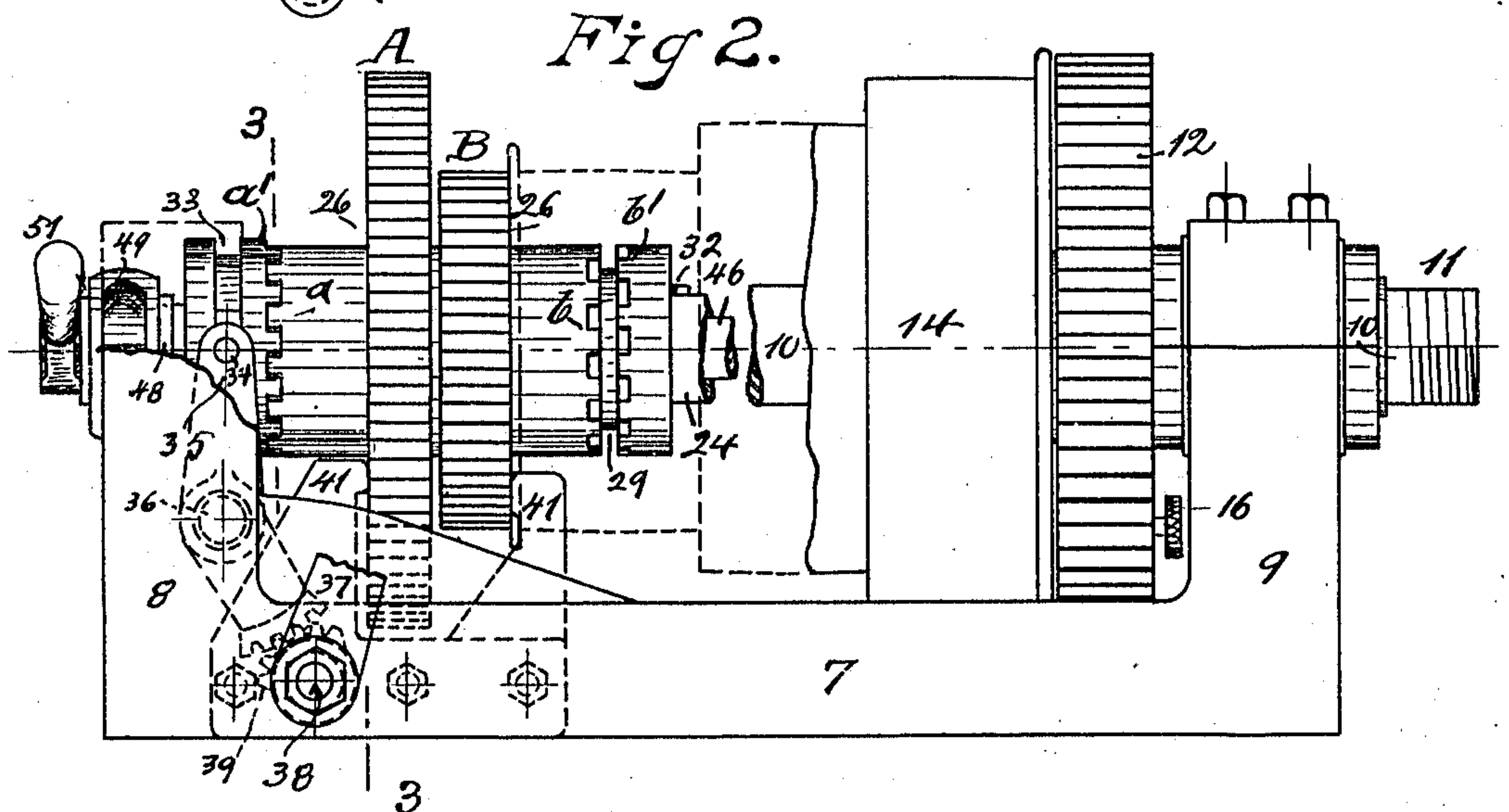
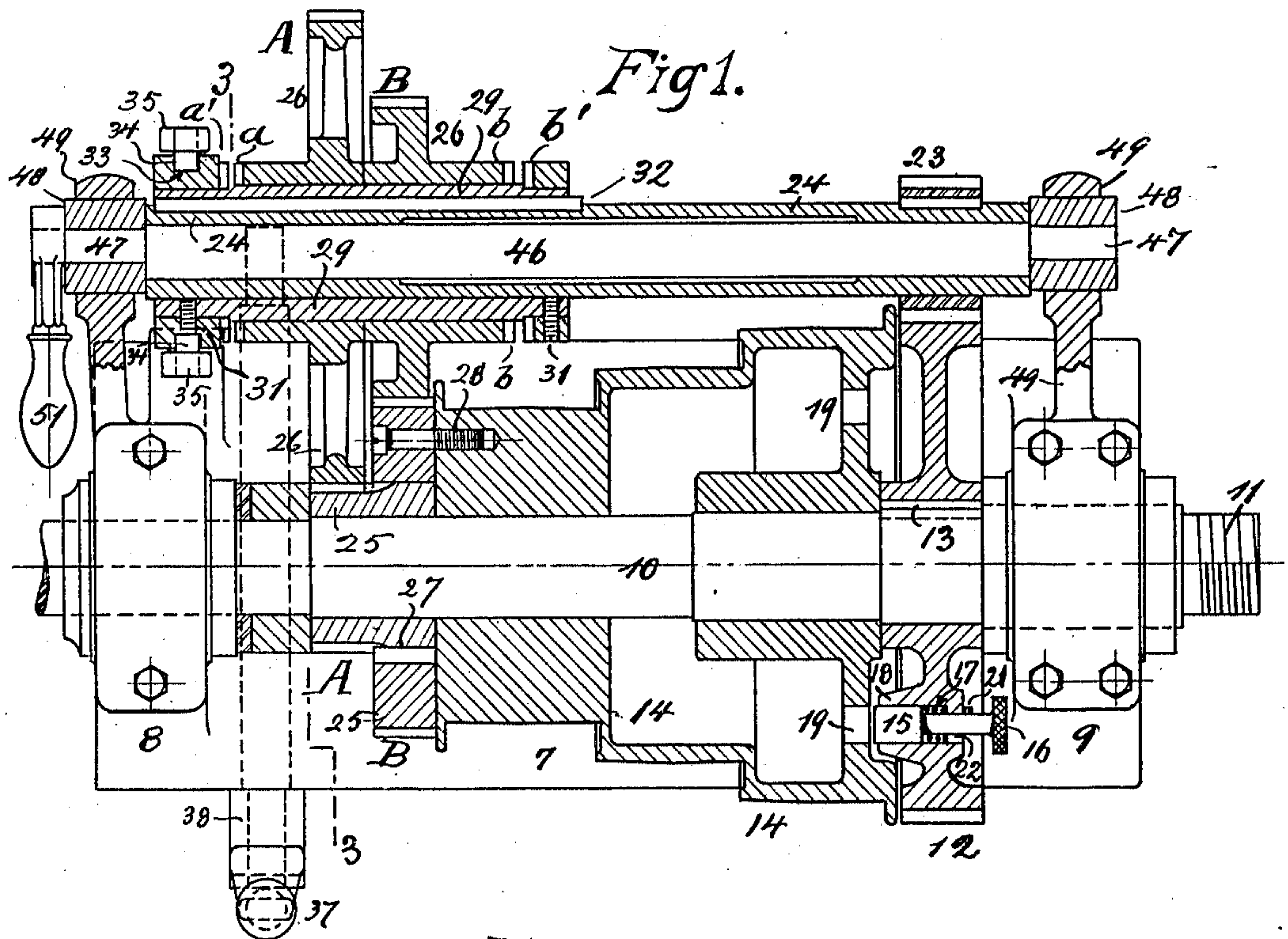


W. A. GREAVES.  
 BACK GEAR FOR MACHINE TOOLS.  
 APPLICATION FILED JAN. 4, 1909.

945,271.

Patented Jan. 4, 1910.

2 SHEETS—SHEET 1.



WITNESSES:  
 T. LeBeau  
 J. F. Rawson

INVENTOR  
 William A. Greaves  
 by C. Spengel atty

W. A. GREAVES.  
BACK GEAR FOR MACHINE TOOLS.  
APPLICATION FILED JAN. 4, 1909.

945,271.

Patented Jan. 4, 1910.

2 SHEETS—SHEET 2.

Fig 3.

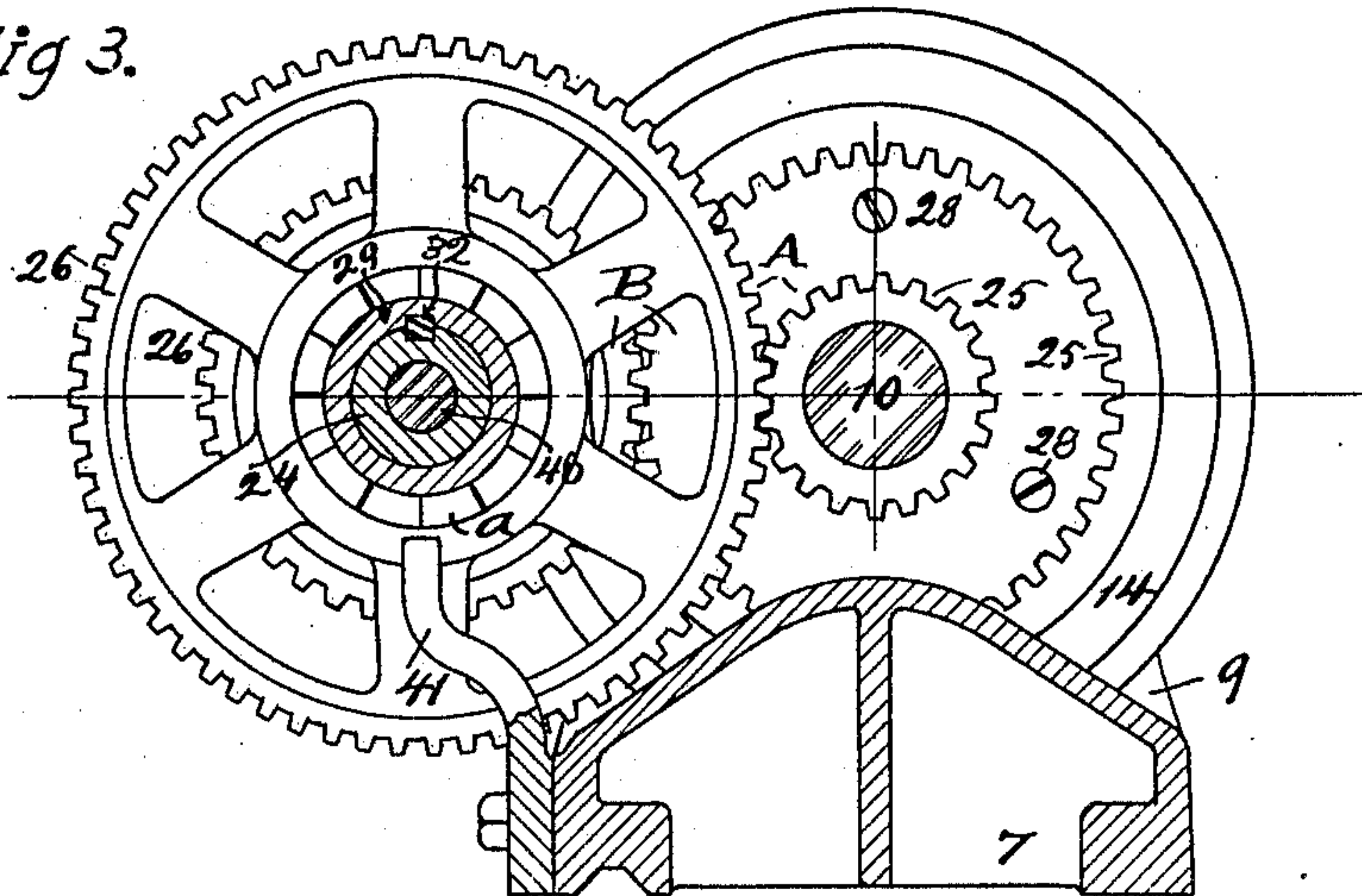


Fig 4.

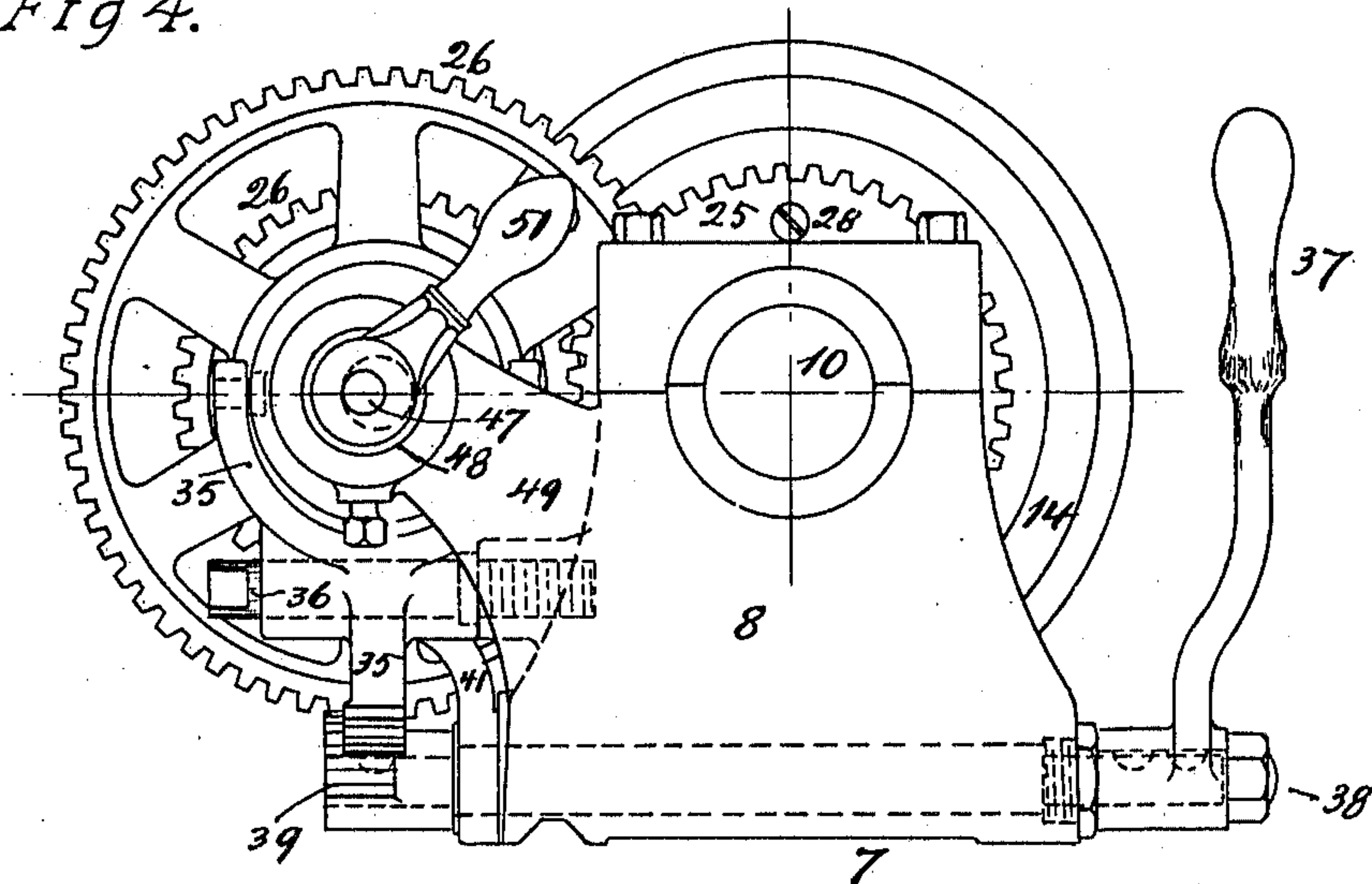
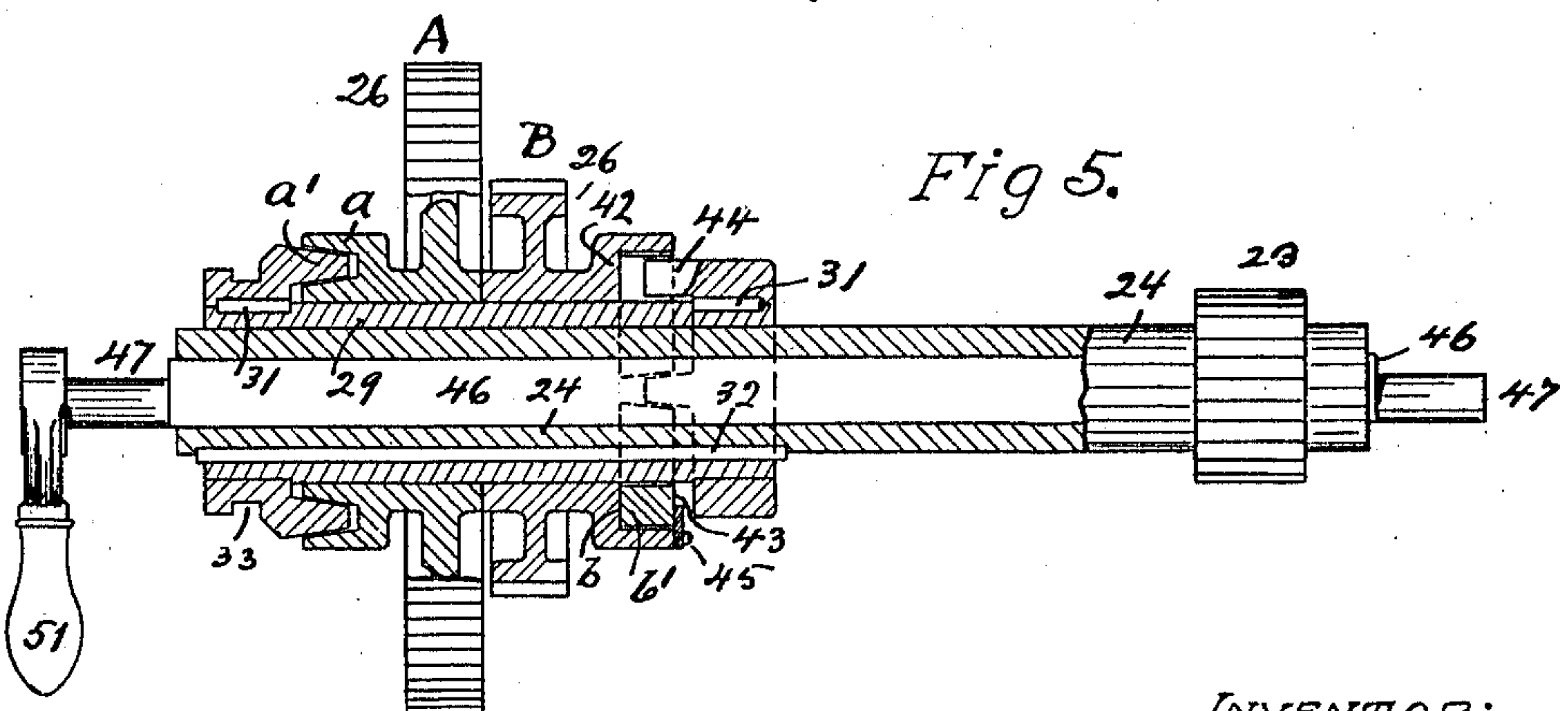


Fig 5.



WITNESSES:  
T. LeBeau.  
J. F. Lawson

INVENTOR:  
William A. Greaves  
by C. Spengel Atty.



# UNITED STATES PATENT OFFICE.

WILLIAM A. GREAVES, OF CINCINNATI, OHIO, ASSIGNOR TO THE GREAVES & KLUSMAN COMPANY, OF CINCINNATI, OHIO, A FIRM.

## BACK-GEAR FOR MACHINE-TOOLS.

945,271.

Specification of Letters Patent.

Patented Jan. 4, 1910.

Application filed January 4, 1909. Serial No. 470,662.

*To all whom it may concern:*

Be it known that I, WILLIAM A. GREAVES, a citizen of the United States, and a resident of Cincinnati, Hamilton county, State of Ohio, have invented a certain new and Improved Back-Gear for Machine-Tools; and I do declare the following to be a clear, full, and exact description of the invention, attention being called to the accompanying two sheets of drawings, with the reference characters marked thereon, which form also a part of this specification.

This invention relates to improvements in mechanism for driving the spindle of lathes and is also applicable to equivalent operating parts of similar machine-tools and where such mechanism involves the use of so-called back gearing.

One or more sets of intermeshing complementary gear-wheels, make up such a back-gear-mechanism and means are provided for adjustment in a manner to affect the operation of the spindle or equivalent working part and to change the rotary speed thereof to suit the kind of work to be done at the time.

My invention relates to means for adjusting and for selectively connecting such back-gearing in a manner that the rotary speed of the operating parts of the particular machine-tool may be changed from a slower to a faster one and vice versa, to suit certain kinds of work to be done at the time.

In the following specification and particularly pointed out in the claims at the end thereof, will be found a full description of my invention, together with its operation, parts and construction, which latter is also illustrated in the accompanying two sheets of drawings, in which:—

Figure 1, illustrates part of a suitable machine-tool, like the head-stock of a lathe for instance and as it appears when viewed from above and on a horizontal section, the plane of which passes through the center of the lathe-spindle. Fig. 2, is a front-view of this head-stock as it appears from the front of the lathe, parts being broken away. Fig. 3, shows a vertical section of it, the plane of section passing on a line indicated at 3—3 in Figs. 1 and 2. Fig. 4, is an end-view of the head-stock. Fig. 5, in part of a view similar to Fig. 1, shows two modified constructions.

The invention is illustrated in connection

with the frame which supports the spindle of a lathe, which frame is known as the head-stock of the lathe. 7 is the base of this frame, or head-stock whereby the same is rigidly secured to the bed of the lathe-frame. The upright portions 8 and 9, of this head-stock at each of its ends contain the bearings for the lathe-spindle 10 or equivalent rotary machine element. The inner end of this latter is arranged, as by a thread for instance, as shown at 11, to receive the work-holding members of the machine-tool which in this case may be a face-plate, or a chuck, or in another machine, it may be a work-performing tool or cutter, (neither being shown.)

The spindle is directly rotated by the so-called face-wheel 12 rigidly mounted upon it by suitable means as for instance by a key 13. The actuation of the face-wheel is derived from a pulley, there being usually a number of them of different diameters, to transmit different speeds. They are generally contained in one structure, called a cone-pulley and indicated at 14. As shown there, three pulleys or steps of graduated sizes are contemplated, each transmitting a speed different from the other. These pulleys are loosely mounted upon the spindle, the latter serving merely as a supporting center for them and they are driven from a line-shaft, either directly or by means of an intermediate counter-shaft. (Neither shown.)

The actuation of the face-wheel by the cone-pulley is either an immediate one, by direct connection of one to the other, or it is an indirect one by intermediary operatively connected means consisting of a set, or of one of a number of sets, of complementary gear-wheels which constitute the so-called back-gears. The first form of connection, the direct one, is by any suitable means whereby pulley and face-wheel are coupled to each other.

A conventional, usual device consists of a locking plug 15, preferably carried by the face-wheel, to be accessible for adjusting manipulation, for which purpose it is provided with a knob-handle 16. It may be spring-actuated for which purpose a spring 17 is provided back of it, both plug and spring being contained in a housing 18 provided on the face-wheel. One or more complementary openings 19 are provided in the



opposite end of the cone-pulley and which may receive the end of this plug when opposite it. This locking-device is shown in-operative in Fig. 1, it being held out of connection with the cone-pulley by means of a pin 21 on the shank of the knob-handle. When connection is to be established, handle 16 is turned to bring this pin opposite a notch 22 in the end of housing 18, whereby the plug is released so that spring 17 may push it into one of the openings 19, as soon as one appears opposite the end of the plug. When so connected, pulley and face-wheel rotate together as one, so that the spindle is driven at a speed as directly transmitted to it by the cone-pulley, and by that particular one of the three steps thereof which carries the belt.

In the other form of connection the spindle is driven indirectly, by intervention of the back-gearing above referred to, and at which time the face-wheel is disconnected from the cone-pulley by the withdrawal therefrom of locking-plug 15, which is held disconnected by pin 21 as shown in Fig. 1. In such case face-wheel 12 is driven by a pinion 23 which forms part of the back-gear-mechanism, the face-wheel constituting for such purpose also a cog-wheel, to permit its operative connection with said pinion. This latter is mounted upon a shaft 24 which constitutes the back-gear-shaft and is suitably supported for rotation. When this shaft is positively driven pinion 23 rotates with it, they forming either an integral structure, or one connected by means like a key for instance. In such case the lathe-spindle is driven by the face-wheel at a speed as transmitted to it by pinion 23, and as this latter receives it from shaft 24. The cone-pulley serves at this time for the purpose of operating the back-gear mechanism which it does by driving shaft 24, by means of intermeshing, complementary gear-wheels, said gear-wheels together with shaft 24 and pinion 23, constituting the back-gear-mechanism of the particular machine-tool. Two sets of such intermeshing gear-wheels are used, each set differently proportioned, so that either one of two rates of speed may be transmitted by the cone-pulley to the back-gear-shaft 24. These wheel-sets are indicated at A and B, set A transmitting a slower speed and set B a faster speed. The drivers of each set, indicated at 25, are connected to rotate with pulley 14, and the complementary followers in mesh with them and indicated at 26, are arranged to be connected to back-gear-shaft 24 to drive this latter at the speed received by them. The connection of the drivers to the cone-pulley is a permanent and rigid one, accomplished by any suitable means. For instance, one may be mounted upon the other one and rigidly connected to it by a key 27.

The two, so connected, may be attached to the end of the cone-pulley by screws 28.

The connection of the followers to back-gear-shaft 24 is a detachable and adjustable one, and is so arranged that either one of them may be connected with shaft 24, or only one of them at a time. The means whereby this is accomplished and the construction of these means is as follows: Each of the followers 26, is loosely mounted upon a sleeve 29, and each is provided on its outside with a clutch-face or clutch-member, they being indicated respectively at *a* and at *b*. These clutch-faces may be formed directly in the ends of the hubs of these wheels as shown in Figs. 1 and 2, or these hubs may be extended and enlarged for the purpose as shown in Fig. 5. Sleeve 29 extends sufficiently beyond the hubs of the followers on each side, to permit connection to it of clutch-members complementary to clutch-members *a* and *b*, there being one member *a'*, at one end of the sleeve complementary to, and opposite to member *a*, and another member *b'*, at the other end of the sleeve complementary to, and opposite member *b*. These members *a'* and *b'* are rigidly connected to sleeve 29 by suitable means for instance keys, as shown in Fig. 5, or set-screws which latter are most conveniently shown at 31 in Fig. 1. Sleeve 29 is mounted upon back gear-shaft 24 in a manner to be shiftable lengthwise thereon, so that either of the opposite, complementary clutch-members *a* and *a'*, or *b* and *b'* may engage each other, or the sleeve may occupy an intermediate position as shown in Fig. 1, in which case none of the clutch-members engage each other. While the sleeve is free to be so shifted lengthwise on back-gear-shaft 24, it remains nevertheless at all times in operative connection with the same for the purpose of rotating it, a spline 32 being used for this purpose. It will now be readily understood that if clutch-sleeve 29 is shifted either to the right, or to the left, the follower 26 of either of the two sets of back-gears A or B will be locked to sleeve 29 and by it rotate back-gear-shaft 24.

If follower 26 of back-gear-set A is locked to sleeve 29 as shown in Fig. 2, pinion 23 on back-gear-shaft 24, both rotating now with said sleeve, will drive face-wheel 12 and spindle 10 with a slower speed. If the follower of the other set B is connected, the lathe-spindle is driven with a faster speed. Each of these speeds as so transmitted by the back-gearing may again be modified according to which one of the steps of the cone-pulley carries the belt, so that in the present case, the cone-pulley being capable of three speed-adjustments, six speed-changes become available for driving the lathe-spindle.

In the intermediate position, shown in Fig. 1, both followers 26 rotate, being moved



by the drivers, but none transmits any motion to sleeve 29.

In the adjusted position shown in Fig. 2, both followers rotate also, but one only, the one clutched to sleeve 29, transmits motion to the sleeve.

For shifting clutch-sleeve 29 an annular groove 33 provided in one end of it, into which two pins 34, carried by a forked shifting-lever 35 extend. This lever is pivotally mounted upon a stud 36, supported on the head-stock-frame. A handle 37 is provided in conveniently accessible position and operatively connected to lever 35. A rocker-rod 38 is used, supported in the head-stock and mounting a segmental gear 39 which engages the toothed end of the shifting-lever 35.

Means must be provided to counteract any tendency of the followers 26—26, to move with and follow sleeve 29 axially when the same is shifted endwise by the clutch-adjusting lever.

Two stops 41 are provided for such purpose, shown in Fig. 2, and confining between them gear-wheels 26—26, to a fixed position between the ends of the clutch-sleeve without interfering with their rotation around or with said sleeve. They are in form of a bracket attached to the rear side of the base and project therefrom as shown in Fig. 3.

As to the particular arrangement and construction of the complementary clutch-faces, any of the customary forms of clutches are available.

The engagement of opposite members may be a positive, mechanical connection as shown in Figs. 1 and 2, or it may be by frictional contact as contemplated in Fig. 5. In this latter form it may become probably necessary to extend and to enlarge the outer ends of the hubs of followers 26—26, to permit formation thereon of clutch-faces which are to interact with complementary clutch-faces carried at the ends of sleeve 29. Two possible forms of this kind are illustrated. In the form at the left of Fig. 5, connection is effected by direct frictional engagement between the contacting opposite clutch-faces. In the form shown at the other end of said figure, a recess 42 is provided at the outer enlarged end of the hub into which a split friction-ring 43 is loosely fitted. The complementary clutch-member on sleeve 29 carries a key 44 adapted to enter between the opposite ends of the split-ring, (observe dotted lines), thereby spreading this latter and forcing it into frictional contact with the hub of the particular gear-wheel. A stop 45 confines the ring in the recess and prevents it from following the key.

Since cone-pulley 14 rotates continuously while the tool is in use, it follows that part or all of the back-gear-mechanism is also constantly in motion during that time

whether it is used or not, because the drivers and the followers of gear-sets A and B, and face-wheel 12 and pinion 23 are all simultaneously in mesh. Thus for instance when the cone-pulley is coupled to face-wheel 12 by locking plug 15 and drives the spindle direct, the clutch being then in the intermediate position shown in Fig. 1, drivers 25—25, will rotate followers 26—26, and at the same time sleeve 29 rotates within these followers, but entirely independent from them, being carried around by shaft 24, pinion 23 on which is driven by the face-wheel. If the face-wheel be disconnected from the cone-pulley, followers 26—26 remain still in motion. Obviously this is neither necessary, nor desirable and therefore provision has been made for shifting that part of the back-gear-mechanism which is mounted on back-gear shaft 24 bodily away from the cone-pulley and from the face-wheel so that for the time being all operative connection ceases between the parts carried on the spindle and between those carried on the back-gear-shaft. For such purpose back-gear-shaft 24 is supported in a manner which permits it to be moved away from the spindle, a distance sufficient for the purpose, that is to disengage the teeth of followers 26—26, and of pinion 23 from their complementary teeth of drivers 25—25, and of face-wheel 12. The back-gear-shaft is moved for such purpose, a feature which broadly considered is not new in machine-tools. In this case it is done by movement of the means whereby shaft 24 is supported, which means consist of a rod 46 upon which shaft 24 is loosely sleeved, the latter being made hollow for such purpose. The ends of this rod are reduced to form journals 47—47, eccentrically arranged with reference to the rod proper and occupying bearings 48—48, supported in brackets 49—49 which extend from the head-stock-frame. One of these ends is also extended sufficiently to permit mounting thereon of a handle 51 for adjustment of this rod. This adjustment is a rotary one, the journals turning in bearings 48, and their eccentricity is sufficient to provide the movement required for the purpose.

The forked clutch-shifting lever 35, the position of which is affected by this adjustment, is loosely seated upon its supporting stud 36 so as to be free to follow. This movement which is very limited does not disturb its operative connection with segment 39.

No special means are required to secure the back-gear-shaft against movement in an axial direction, since it extends over the entire length of rod 46 on which it is supported and is confined at its ends between the bearings which support this rod.

Conventional locking means of customary type may be used to hold the parts in their adjusted positions. These means are usually



so applied as to operate in conjunction with the manipulating handles 37 and 51 and are not new.

Having described my invention, I claim as new:

1. In back-gear-mechanism for machine-tools, the combination of a work-performing-member, a back-gear-shaft, operative connection between the two whereby one  
 10 actuates the other, a lengthwise shiftable sleeve mounted thereon for rotation, driven gear-wheels loosely mounted upon this sleeve side by side, mechanism to shift this latter lengthwise independent of the gear-  
 15 wheels, stops, one on each side of these gear-wheels to hold them to a fixed position axially and to prevent them from following the sleeve during its lengthwise adjustment, clutch-members, one on each of the gear-  
 20 wheels, and additional clutch-members on the sleeve, one for each gear-wheel and complementary to the clutch members thereon.
2. In back-gear-mechanism for machine-tools, the combination of a work-perform-  
 25 ing-member, a back-gear-shaft, operative connection between the two whereby one actuates the other, a lengthwise shiftable sleeve having an annular groove in one of its ends mounted thereon for rotation, driven  
 30 gear-wheels loosely mounted side by side upon this sleeve and having the ends of their hubs on their outer sides extended and provided each with a clutch-member, additional clutch-members, one provided at each one  
 35 of the ends of the sleeve and a forked clutch-lever to shift this sleeve lengthwise inde-

pendent of the gear-wheels by engaging the groove in the sleeve.

3. In back-gear-mechanism for machine-tools, the combination of a lathe-spindle, a  
 40 hollow drive shaft for it arranged parallel thereto, a rod upon which this shaft is supported for rotation, operative connection whereby this rotation is transmitted to the lathe-spindle, a sleeve provided with an an-  
 45 nular groove in one of its ends mounted upon this hollow shaft and connected so as to rotate with it, but free to be lengthwise adjustable thereon, gear-wheels loosely mounted upon this sleeve, clutch-members, one on each  
 50 gear-wheel, additional clutch-members on the sleeve, one for the clutch-member of each gear-wheel and complementary thereto, means to adjust the rod mentioned and the hollow shaft and sleeve mounted thereon to  
 55 and from the lathe-spindle, a lever forked at one end and in engagement with the groove in the adjustable sleeve and provided with teeth at its other end, a stud which forms the pivotal support for this  
 60 lever and upon which this latter is slidably seated, a segmental gear in mesh with the toothed end of this lever, a rocker-rod upon which it is mounted and a handle to manipu-  
 65 late this rocker-rod.

In testimony whereof, I hereunto affix my signature in the presence of two witnesses.

WILLIAM A. GREAVES.

Witnesses:

C. SPENGEL,  
T. LE BEAU.

It is hereby certified that in Letters Patent No. 945,271, granted January 4, 1910, upon the application of William A. Greaves, of Cincinnati, Ohio, for an improvement in "Back-Gears for Machine-Tools," an error appears in the printed specification requiring correction, as follows: Page 2, line 70, the word "one" second occurrence should read *none*; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 22d day of February, A. D., 1910.

[SEAL.]

C. C. BILLINGS,  
*Acting Commissioner of Patents.*