No. 735,701. PATENTED AUG. 11, 1903.

J. P. BROPHY.

SPEED CHANGING MECHANISM FOR AUTOMATIC LATHES.

APPLICATION FILED AUG. 20, 1902.

NO MODEL. 2 SHEETS—SHEET 1.

Fig. I.

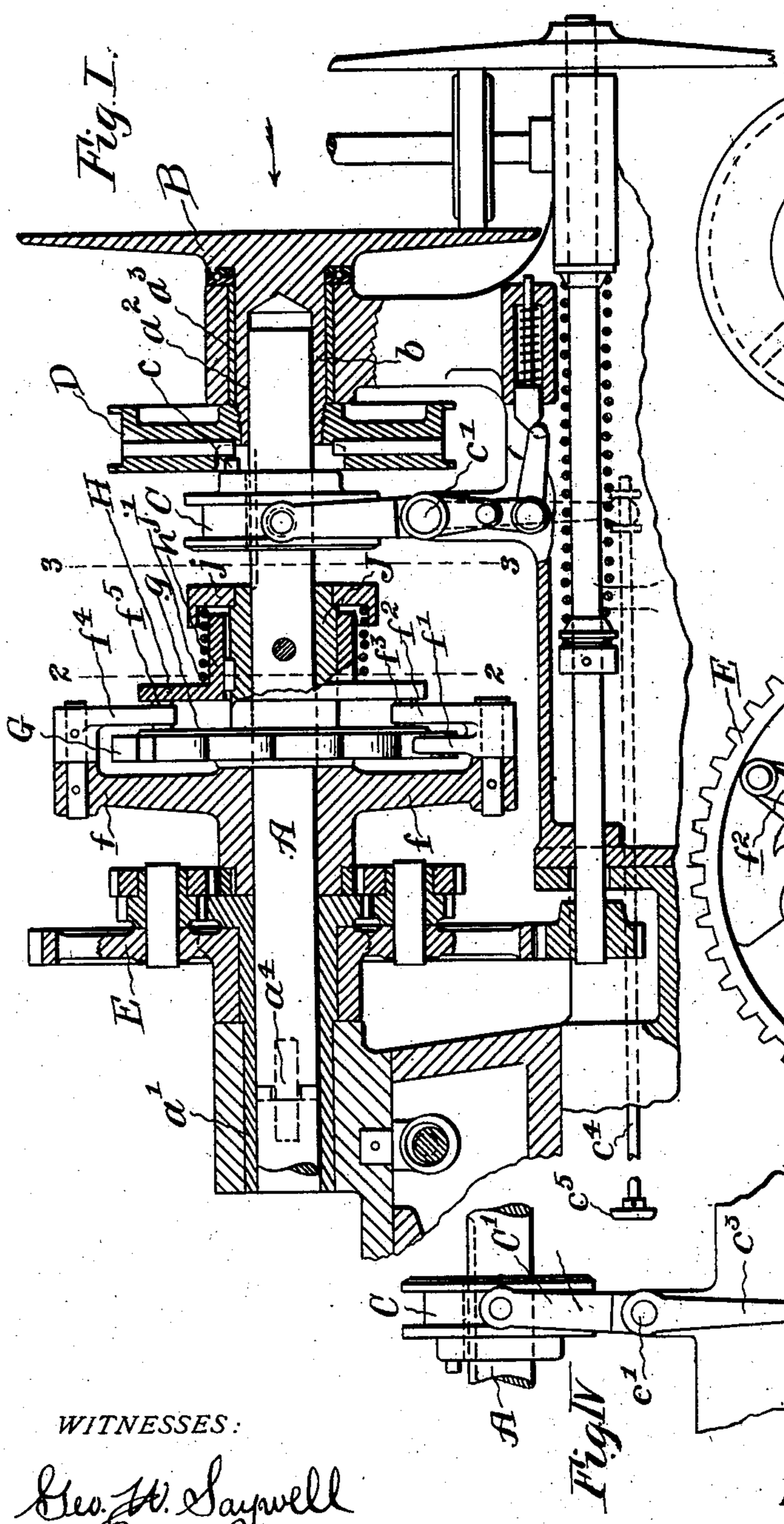

Fig. II.

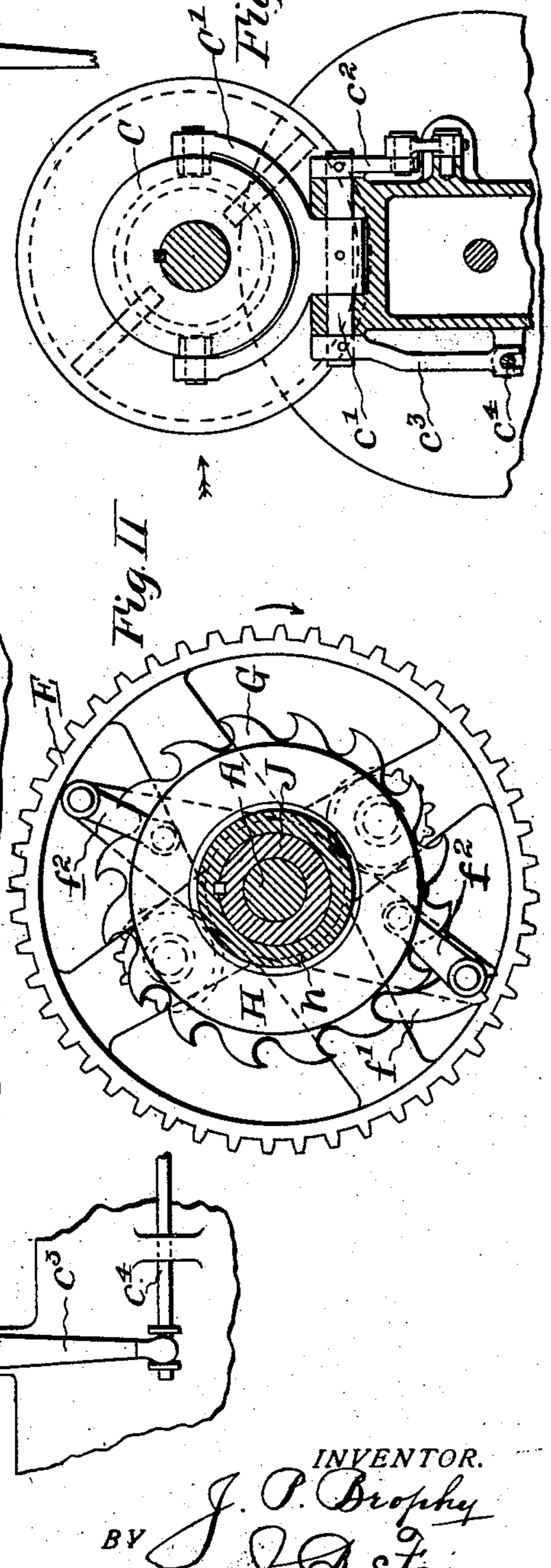

Fig. III.

Fig. IV.

WITNESSES:

Geo. W. Saywell

A. C. Merkel.

INVENTOR.

J. P. Brophy

BY J. S. Fay

ATTORNEY.

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

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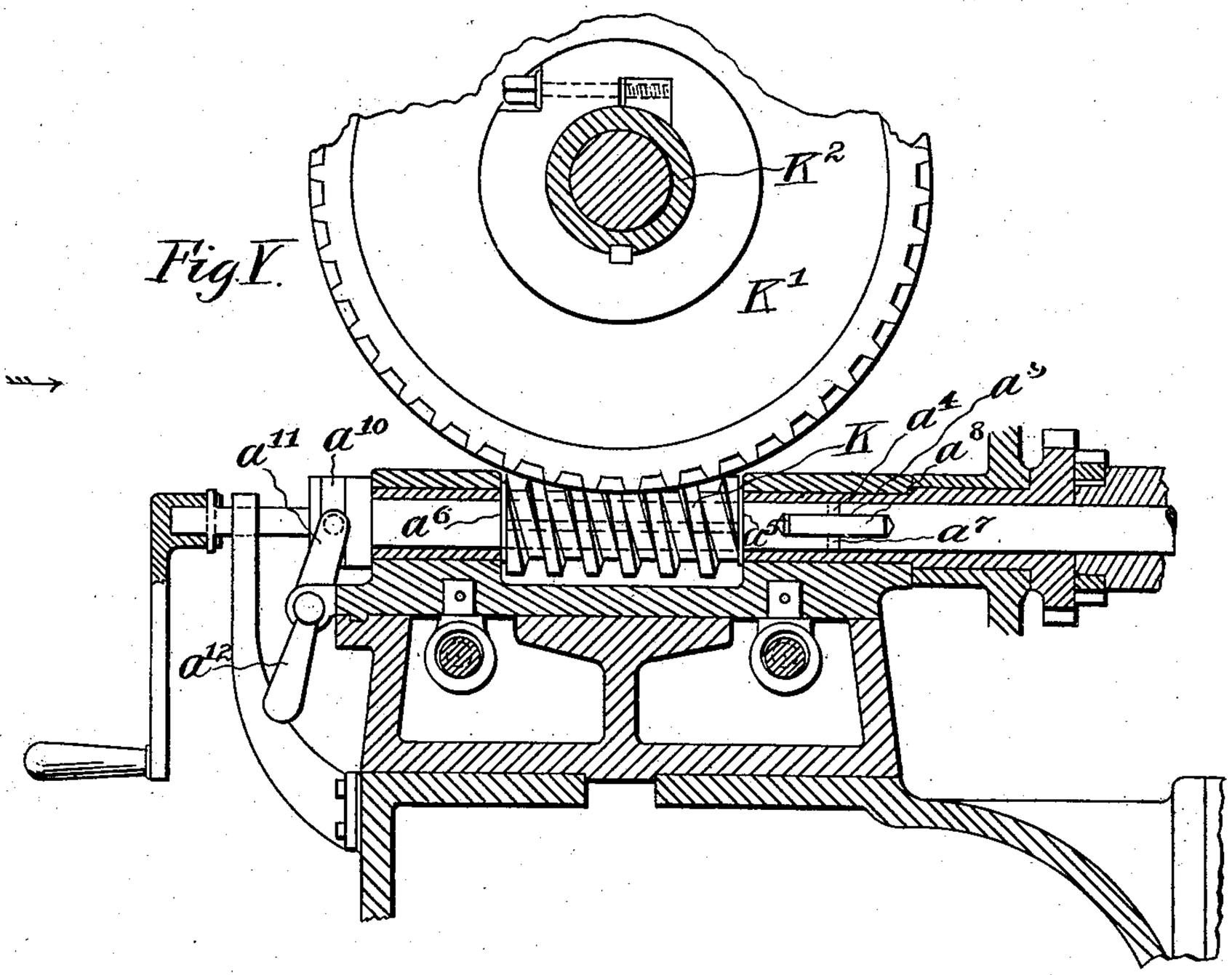
NO MODEL. 2 SHEETS—SHEET 2.

Fig V.



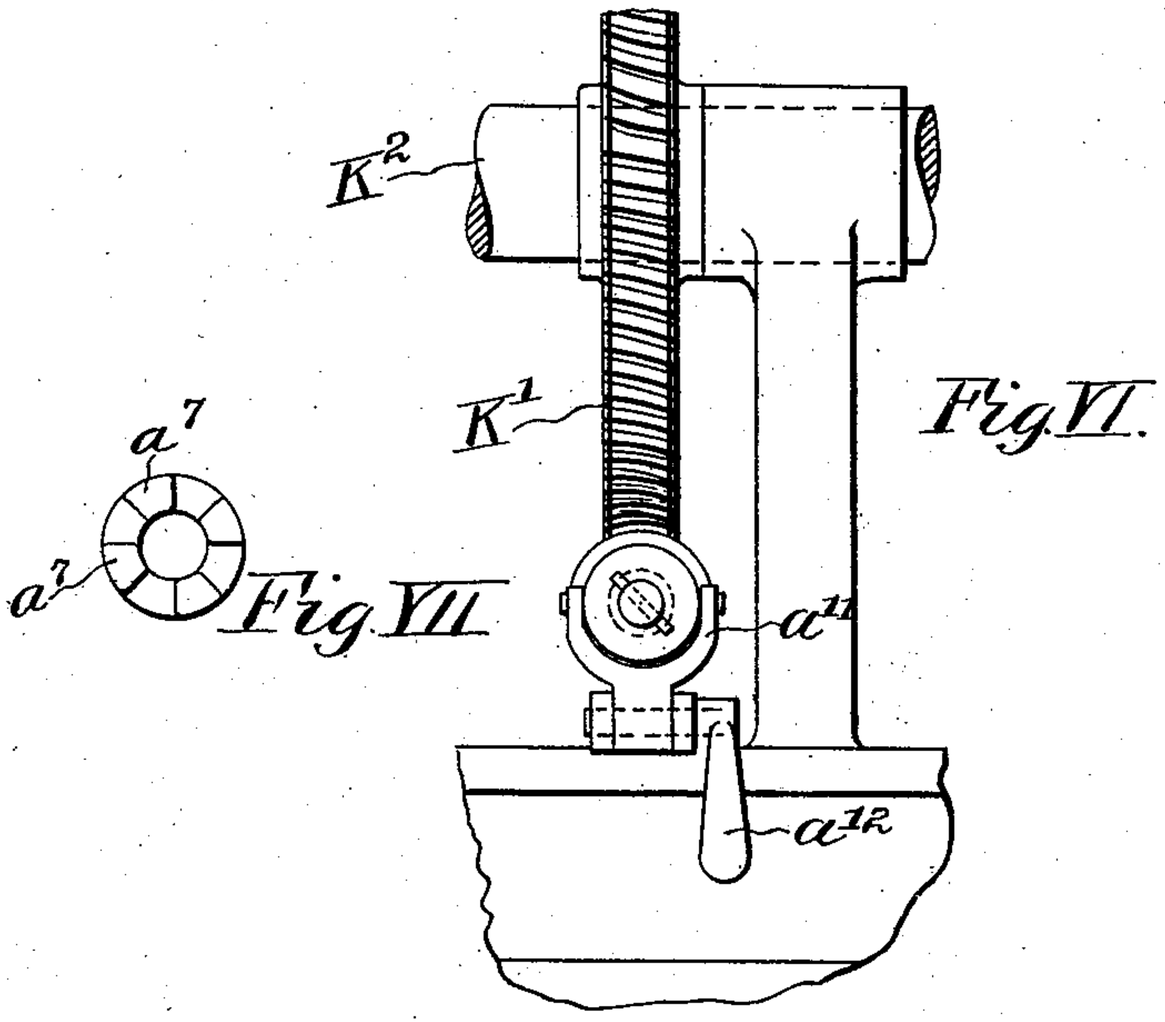


Fig VI.

Fig VII

WITNESSES:

Geo. W. Saywell

A. E. Merkel

INVENTOR.

BY J. P. Brophy

J. B. Fay

ATTORNEY.

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

No. 735,701. Patented August 11, 1903.

UNITED STATES PATENT OFFICE.

JOHN P. BROPHY, OF CLEVELAND, OHIO, ASSIGNOR TO THE CLEVELAND MACHINE SCREW COMPANY, OF CLEVELAND, OHIO, A CORPORATION OF OHIO.

SPEED-CHANGING MECHANISM FOR AUTOMATIC LATHES.

SPECIFICATION forming part of Letters Patent No. 735,701, dated August 11, 1903.

Application filed August 20, 1902. Serial No. 120,347. (No model.)

To all whom it may concern:

Be it known that I, JOHN P. BROPHY, a citizen of the United States, and a resident of Cleveland, county of Cuyahoga, and State of Ohio, have invented a new and useful Improvement in Speed-Changing Mechanism for Automatic Lathes, of which the following is a specification, the principle of the invention being herein explained and the best mode in which I have contemplated applying that principle so as to distinguish it from other inventions.

My invention relates to automatically-operated speed-changing driving mechanism.

The object of said invention is to simplify the construction and operation and add to the efficiency of such mechanism.

Said invention consists of means hereinafter fully described, and particularly set forth in the claims.

The annexed drawings and the following description set forth in detail certain mechanism embodying the invention, such disclosed means constituting but one of various mechanical forms in which the principle of the invention may be used.

In said annexed drawings, Figure I represents a vertical cross-section of driving mechanism embodying my invention as applied to an automatic lathe, taken axially of the driving-shaft and showing parts cut by the plane of the section in elevation. Fig. II represents a vertical section taken upon the plane indicated by the line 2 2, Fig. I, and viewed in the direction indicated by the arrow in said figure. Fig. III represents a vertical section taken upon the plane indicated by the line 3 3 in said Fig. I and viewed in the direction opposite that indicated by the said arrow. Fig. IV represents a detail elevation of a clutch and connected parts viewed as indicated by the arrow in Fig. III. Fig. V represents a vertical section taken axially of the driving-shaft of the remainder of the driving mechanism, showing the said shaft, worm, and worm-wheel driven thereby and secured to the turret-spindle in elevation, also other parts cut by the section-plane in elevation, the scale upon which this figure is drawn being reduced somewhat from the scale of Fig. I. Fig. VI represents a detail front elevation of the end of the driving-shaft, showing part of a worm-wheel secured to a turret-spindle; and Fig. VII represents an end view of one part of the driving-shaft.

The driving-shaft A is mounted in suitable bearings a, a', and a^2, bearing a^2 for the right-hand-shaft end being formed upon the inside of the hub b of friction driving-disk B, which hub is itself mounted in a bearing a^3, formed in the frame of the machine. A clutch C is rotatively fixed, but longitudinally slidable, by means of a groove and key upon the said right-hand-shaft end. This clutch is adapted, by means of a pin c, forming a part thereof, to engage when moved to the right a driving-pulley D, secured upon the hub b, thereby establishing a direct connection between said shaft and pulley, such shaft being thereby driven at a rate of speed equal to that of the pulley. The disk B is caused to drive a sleeve F at a reduced or comparatively low rate of speed, as will further appear. Said disk B drives a friction-wheel B', which drives a second friction-disk B^2. This disk B^2 is secured to the end of a shaft B^3, to whose opposite end is secured a pinion b. This pinion engages a gear-wheel E, mounted upon a sleeve e, which is provided with gear-teeth e'. Upon each of two studs e^2, Fig. I, are rotatively mounted two pinions e^3 and e^4. These pinions are secured to each other, so as to rotate together. The outer pinion e^4 is of greater diameter than the inner pinion e^3. Pinions e^3 engage the gear-teeth e' of sleeve e, and pinions e^4 engage gear-teeth f^6, formed upon the end of sleeve F, mounted upon the driving-shaft, as shown. By such described means, known as "differential gear" and which are old and well known, the said sleeve F is driven at a comparatively slow rate of speed by the pulley D, as will be readily understood.

The driving-shaft A has secured upon it a ratchet-wheel G, which is mounted in proximity to the sleeve F, as shown in Fig. I. This sleeve is provided with two diametrically-extending arms $f\,f$, one of which carries an oscillatory pawl f', adapted to engage the teeth of the ratchet-wheel G. This pawl is

formed with an arm f^2, extending toward the shaft-axis and provided at its inner extremity with a friction-piece f^3. The other arm f^2 is also provided with an inwardly-extending but fixed arm f^4, also provided with a friction-piece f^5 at its inner extremity. The left-hand ends of these friction-pieces f^3 and f^5 contact the contiguous face g of the ratchet-wheel G, such face being made to slightly project for the purpose, as is shown. Adjacent to said ratchet-wheel is rotatively fixed a friction-disk H, provided with a hub h and capable of sliding movement longitudinally of the shaft by means of a groove and key. The groove is formed in a sleeve J, secured to the shaft, upon one end of which is secured a cup-shaped disk j. Intermediately of said cup-shaped disk j and the friction-disk H and upon said hub h is a helical spring j'. This spring presses against the disk H, and the latter presses against the friction-pieces f^3 and f^5, the arm carrying the latter being made sufficiently long to cause them to be included between disk H and the ratchet-wheel face, as shown. Such pressure creates frictional resistance on the part of the friction-pieces and the opposing friction-surfaces sufficient to effect the engagement of the pawl f' with the teeth of the ratchet-wheel if disengaged or its disengagement from said wheel if engaged, according as the shaft or the differential gear is the driver, the direction of rotation being always the same. In the device as illustrated such direction is that indicated by the arrow, Fig. II. It is thus seen that should the rate of rotation of the sleeve F be greater than that of disk H or should the latter be stationary the pawl f' would be moved into engagement with the ratchet-wheel as a result of the greater force of frictional contact which would be exerted by the ratchet-wheel face upon such pawl as compared with that exerted by the disk. Should the rate of rotation of the disk H be greater than that of the wheel G, then disengagement of said pawl with said wheel would be effected as a result of the greater frictional contact force exerted by said disk as compared with that exerted by said wheel. The arm f^4 and friction-piece attached thereto serve the purpose merely of a separator for maintaining parallelism between the disk H and ratchet-wheel face g, thereby preventing binding on the part of the disk-hub upon its bearing.

The mechanism as thus far described operates as follows: Assuming that the driving-pulley D is being rotated and the clutch C has just been automatically thrown over so as to engage said pulley, and thereby establish connection between the pulley and driving-shaft A, it is seen then that the latter will be driven at a speed of rotation equal to that of said pulley. The said pulley being, however, secured upon the hub of the driving-disk B, the differential intermediate gear is also driven and the rotatable sleeve F is rotated in the same direction as the shaft, but at a much slower speed. The relative speeds then of said sleeve and shaft are such as to have caused the pawl f' to disengage the ratchet-wheel C, thereby throwing the differential gear out and rendering it inoperative. When the proper time now arrives, the clutch C is thrown over so as to disengage the pulley D, which thereby ceases to become the driver. The driving-shaft rapidly but gradually slows down until the speed of the disk H is slower than that of the sleeve F, which is meanwhile being driven as before, whereupon the frictional force exerted by the ratchet-wheel face overcomes that of the disk in the friction-piece f^3, and the pawl f' is caused to engage the said wheel, thereby effecting connection between the differential gear and the driving-shaft, which gear hence becomes the driver. When the clutch C is again automatically shifted, so as to engage the driving-pulley, the disk H is immediately rotated at a higher speed than is sleeve F. The frictional force exerted on friction-piece f^3 thereby exceeding that exerted by the ratchet-wheel, the pawl is disengaged from said wheel, thereby disconnecting the differential gear and rendering same inoperative. Heretofore in machines of this character there have been three positions of clutch C—an operative position at one end of its path of travel in which it engaged the driving-pulley, an operative position at the opposite end of said path in which it is connected with the differential gear, and an intermediate inoperative position. This construction necessitated the exercise of great care, and hence slowness in manually operating the clutch to assume its intermediate position when required.

In my improved mechanism, as in such previously-constructed machines, clutch C is operated by means of an oscillatory yoke C', Figs. III and IV, mounted upon a rock-shaft c'. On one end of such rock-shaft is secured an arm c^2, which is adapted to be periodically engaged by a drum (not shown) to operate said clutch to engage or disengage the driving-pulley. The opposite end of said shaft is provided with a fixed arm c^3, to which is attached the end of a rod c^4, which extends through the frame in suitable bearings and projects from the front of the machine, as will be understood. Such projecting end is provided with a knob c^5, whereby the rod may be moved back and forward manually to effect the operation of the clutch when it is desired to effect such operation independently of the automatically-operated mechanism. My previously-described improved construction, whereby the intermediate inoperative position of the clutch is not used, renders this manually-operated mechanism particularly effective and economical, since there are but two positions of the clutch to be had, one an operative and the other an inoperative position, these positions being at oppo-

site ends of the stroke. In consequence the clutch may be thrown over quickly to either of its two positions—that is, to the extremes of its path of travel.

From the above-described construction of my improved mechanism it will be seen that the driving-shaft would be continuously rotated either directly by the pulley D at a comparatively high rate of rotation or indirectly by the said pulley through the medium of the differential gear at a comparatively low rate of rotation were not means provided for rendering both said differential and direct driving-gear inoperative.

Since it is frequently necessary to render the driving mechanism inoperative, especially in lathes, it is preferable to provide means to this end which will permit such manual operation to be effected without involving the necessity of stopping the driving-pulley or the driving mechanism. This was done in said former constructions by shifting the clutch into its intermediate position. In order to effect this result in the present construction, I divide shaft A at a point a^4 into two parts, the one part being directly connected, as has been seen, with the differential and direct driving-gear and the other having mounted upon it the worm K, which drives the worm-gear K′, mounted upon and secured to the turret-spindle K², Fig. V. Said worm K is slidably mounted upon the shaft by means of a groove and key between two shoulders a^5 and a^6, which prevent longitudinal movement on the part of said worm. The contiguous ends of the divided shaft portions are formed with interlocking members a^7 and with a pin a^8 and bore a^9, respectively. It is thus seen that the forward part of the driving-shaft may be moved in the direction of its axis to disengage or engage the rearward part of said shaft, the pin and bore acting as a guide during said movement. When these two shaft parts are disengaged, it is seen that without interrupting the rotation of the driving-pulley D the driving mechanism may be rendered inoperative. During such inoperation the forward portion of the shaft may be manually rotated by means of a crank L, secured to the outer end of said shaft portion. The longitudinal movement of said shaft portion is preferably obtained by providing it with a rotatably-movable collar a^{10}, on which is journaled the two arms of a yoke a^{11}, which is provided with a handle a^{12} and is journaled upon the frame, as shown in Figs. V and VI.

Other modes of applying the principle of my invention may be employed instead of the one explained, change being made as regards the mechanism herein disclosed provided the means stated by any one of the following claims or the equivalent of such stated means be employed.

I therefore particularly point out and distinctly claim as my invention—

1. The combination of a shaft, separate means for driving said shaft at different speeds, each such means embodying a rotatable member, and frictionally-operated means for connecting or disconnecting one of said driving means, the operation of such means being determined by the difference in relative speeds of the said two rotatable members.

2. The combination of a shaft, a driving-pulley, gearing intermediate of such pulley and shaft for driving the latter at reduced speed, means for connecting such pulley directly to such shaft, said intermediate gearing provided with means for connecting such gearing with or disconnecting it from said shaft, the operation of said means being determined by the difference in relative rotation of a member of such intermediate gear and said shaft.

3. The combination of a shaft, a driving-pulley, means including gearing, intermediate of said pulley and shaft for driving the latter at a reduced speed, means for connecting such pulley to said shaft to effect rotation thereof at a comparatively high rate of speed, said gearing provided with means for effecting its engagement with said shaft, and means connected with the latter for actuating said engaging means.

4. The combination of a shaft, a driving-pulley, means including gearing intermediate of said pulley and shaft for driving the latter at a reduced speed, means for connecting such pulley to said shaft so as to effect rotation thereof at a comparatively high rate of speed, said gearing and shaft provided with frictionally-operated means for operatively connecting such gearing and shaft.

5. The combination of a shaft, a driving-pulley, gearing intermediate of said pulley and shaft for driving the latter at a reduced speed, means for connecting such pulley to said shaft to effect rotation thereof at a comparatively high rate of speed, a pawl connected with such gearing for engaging said shaft to operatively connect same and said shaft, and means for actuating said pawl to effect such engagement.

6. The combination of a shaft, a driving-pulley, gearing intermediate of said pulley and said shaft for driving the latter at a reduced speed, means for connecting said pulley to said shaft to effect rotation at a comparatively high rate of speed, a pawl connected with a member of said gearing, a member connected with said shaft, a ratchet-wheel on said shaft adapted to be engaged by said pawl, said ratchet-wheel and the member connected with said shaft being provided with friction-surfaces engaging the said pawl whereby such surfaces are connected with said shaft and gearing respectively and adapted to actuate said pawl to engage or disengage said ratchet-wheel according as the said gearing or shaft is the driver.

7. The combination of a shaft, a ratchet-wheel secured to said shaft, a rotatable member coaxial with the latter, a pawl connected

with same and adapted to engage said wheel, means on said shaft for frictionally engaging said pawl, and means for positively driving either said shaft or said rotatable member.

8. The combination of a shaft, a ratchet-wheel secured to said shaft, a member rotatively mounted upon said shaft, a pawl mounted thereon and adapted to engage said wheel, and a disk rotatively mounted upon said shaft and adapted to effect frictional engagement of said pawl with one face of said ratchet-wheel whereby said pawl may be actuated to engage or disengage said wheel according as the said member or shaft is positively driven.

9. The combination of a two-part shaft, means for driving said shaft at a comparatively low speed and means for driving said shaft at a comparatively high speed, means for connecting one part of said shaft to one or the other of said driving means, and means for separating the two parts of said shaft whereby the one part may be rendered inoperative.

10. In speed-changing mechanism, the combination of a shaft having a disconnectible portion, differential gearing for driving said shaft indirectly at a comparatively low rate of speed, and means for driving such shaft directly at a comparatively high rate of speed, means for connecting one or the other of such driving means with said shaft, and manual means for separating such two shaft parts, whereby a portion of said shaft may be rendered inoperative.

11. In speed-changing mechanism, the combination of a driving-shaft consisting of a main and a disconnectible portion, a worm-wheel, a worm rotatively mounted upon said disconnectible portion and engaging said wheel, said disconnectible portion being longitudinally slidable through said worm, means for driving the main-shaft portion.

12. In speed-changing mechanism, the combination of a longitudinally-fixed driving-shaft, a longitudinally-slidable shaft coaxial with said fixed shaft and adapted to engage and disengage same, means for driving such fixed shaft, a longitudinally-stationary worm rotatively mounted upon said slidable shaft, a worm-wheel engaging said worm, and means for moving said slidable shaft to engage or disengage said fixed shaft.

13. In speed-changing mechanism, the combination of a driving-shaft, a ratchet-wheel fixed upon such shaft, a member rotatable upon the latter, a pawl on such member adapted to engage and disengage such wheel, and means for establishing frictional engagement between said wheel and pawl tending to move the latter upon its axis.

14. In speed-changing mechanism, the combination of a driving-shaft, a ratchet-wheel fixed upon such shaft and provided with a friction-surface transverse relatively to its axis of rotation, a member rotatable upon such shaft, a pawl on such member adapted to engage and disengage said wheel, and provided with an arm extending in the vicinity of such friction-surface, and means for establishing frictional engagement between said wheel and pawl-arm.

15. In speed-changing mechanism, the combination of a driving-shaft, a ratchet-wheel fixed upon said shaft, a member rotatable upon the latter, a pawl carried by said rotatable member and adapted to frictionally engage such wheel so as to move itself upon its axis and thereby engage or disengage the ratchet-teeth, and spring-actuated means on said shaft engaging said pawl to effect such frictional engagement.

16. In speed-changing mechanism, the combination of a driving-shaft, a ratchet-wheel fixed upon said shaft, a member rotatable upon the latter, a pawl carried by said rotatable member provided with an arm adapted to frictionally engage said wheel so as to move itself upon its axis and thereby engage or disengage the ratchet-teeth, and a spring-actuated disk slidable longitudinally of and rotatively fixed to the said shaft, said disk engaging said pawl-arm to effect such frictional engagement.

Signed by me this 12th day of August, 1902.

JOHN P. BROPHY.

Attest:

GEO. W. SAYWELL,

A. E. MERKEL.