No. 855,068. PATENTED MAY 28, 1907.

J. PARKER.

GEARING.

APPLICATION FILED FEB. 9, 1904.

5 SHEETS—SHEET 1.

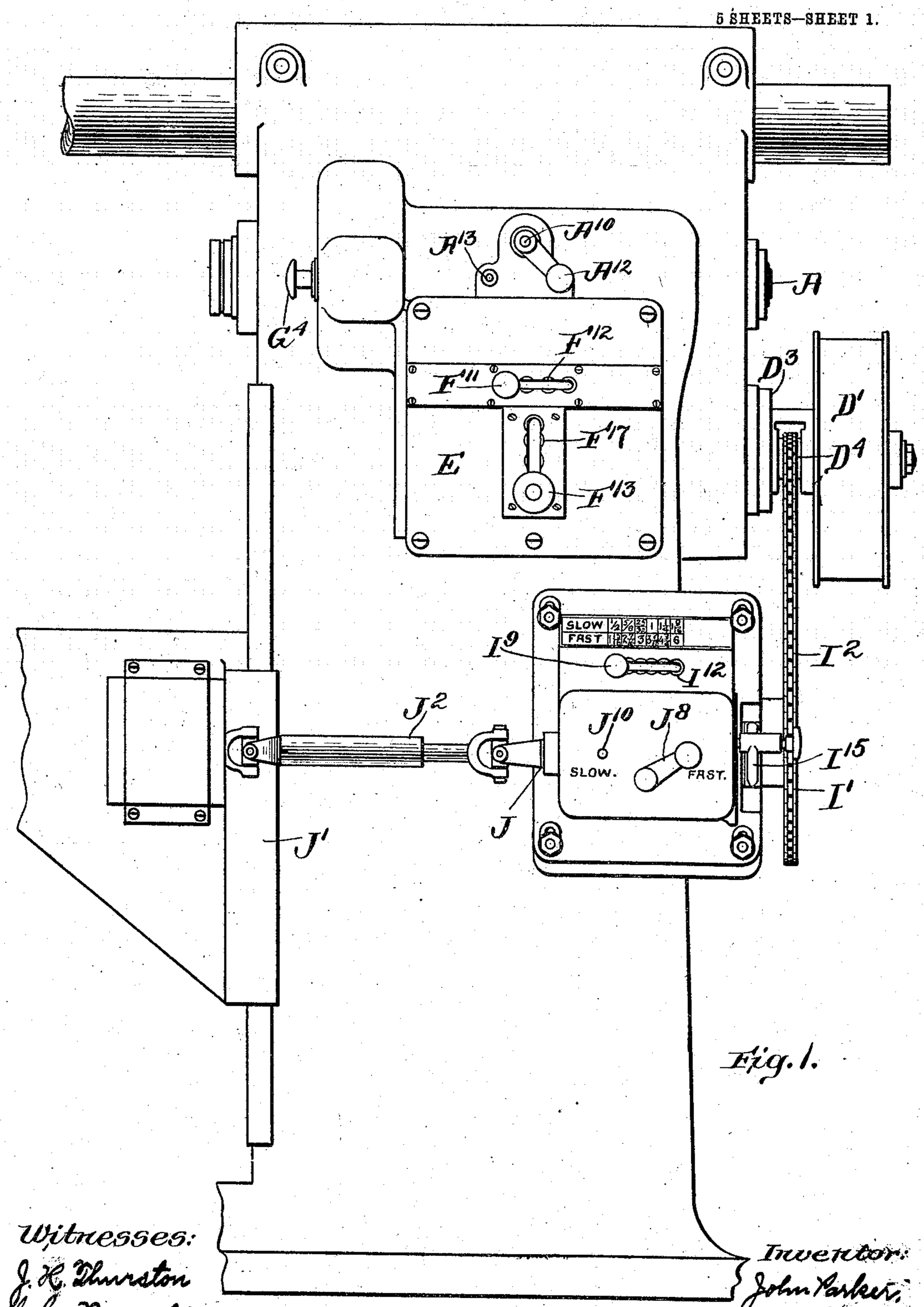

Fig. 1.

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5 SHEETS—SHEET 2.

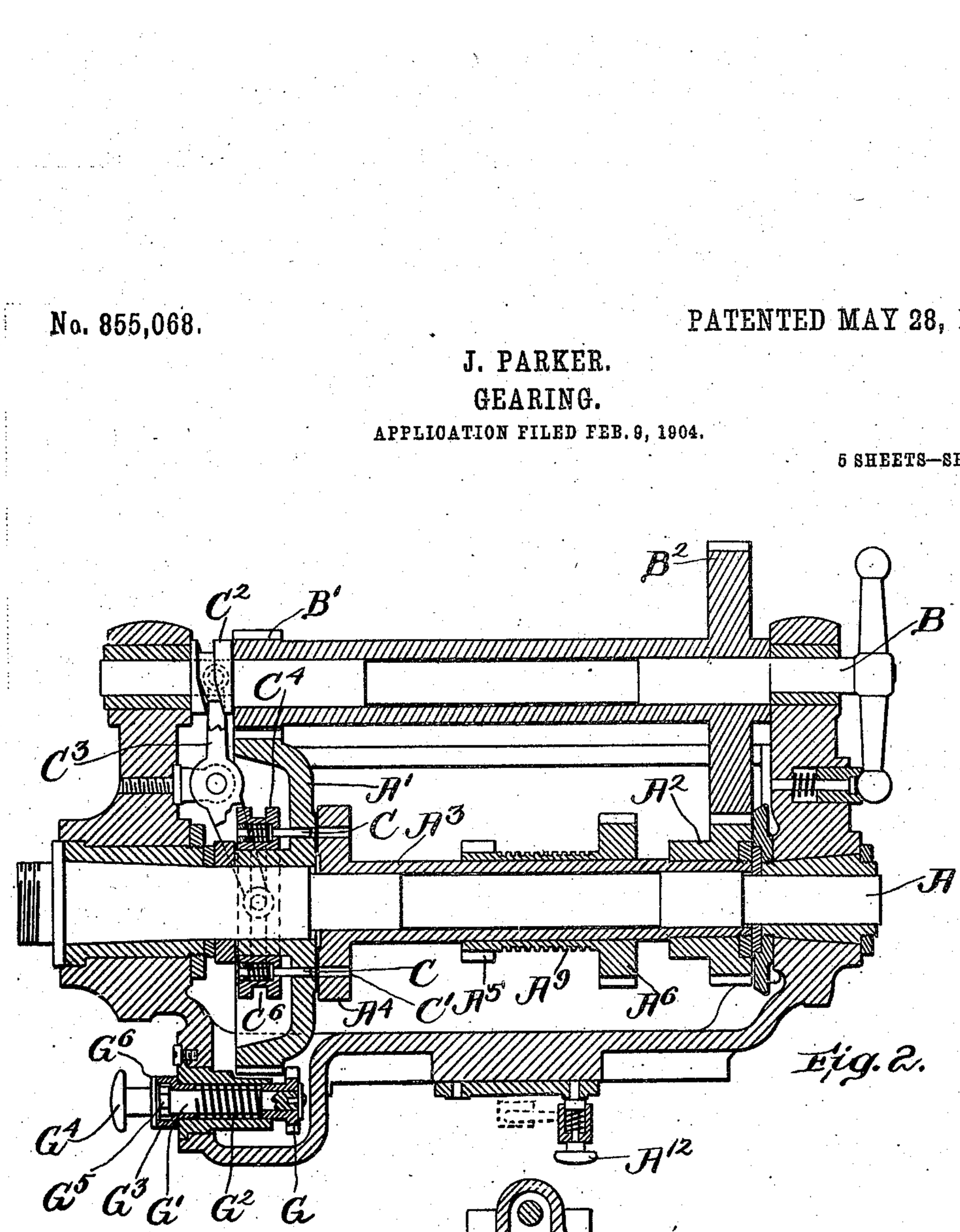

Fig. 2.

Fig. 3.

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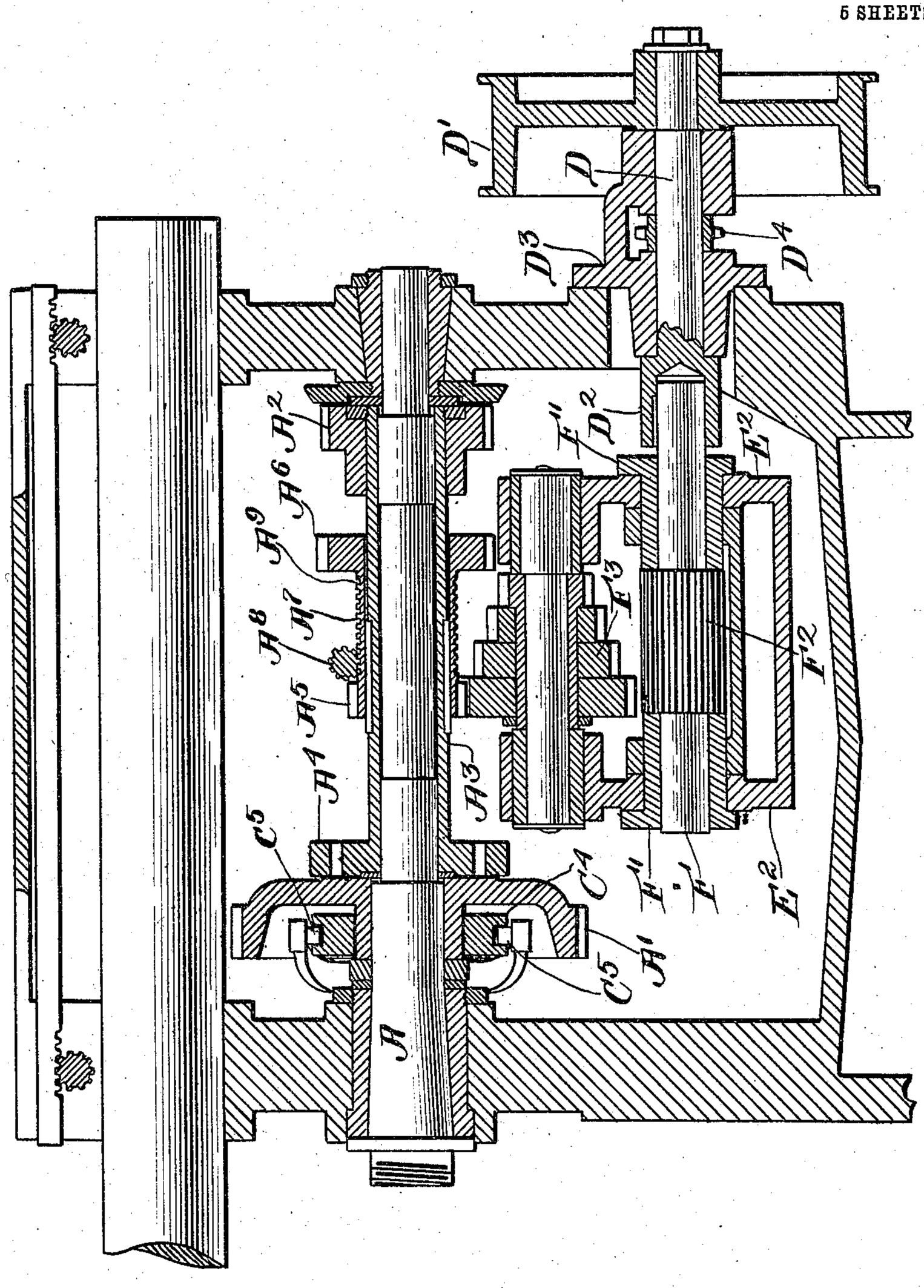

Fig. 4.

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5 SHEETS—SHEET 4

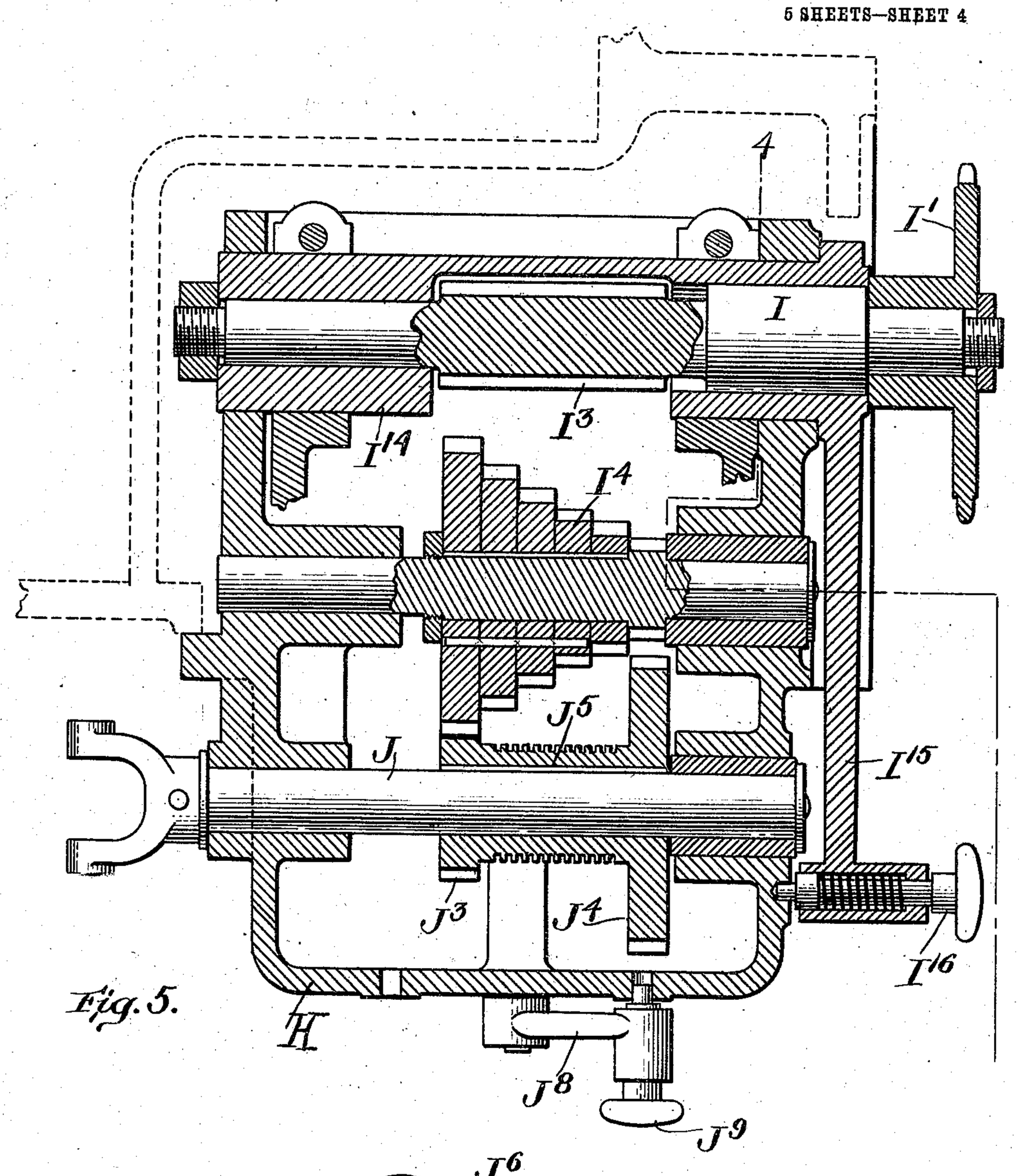

Fig. 5.

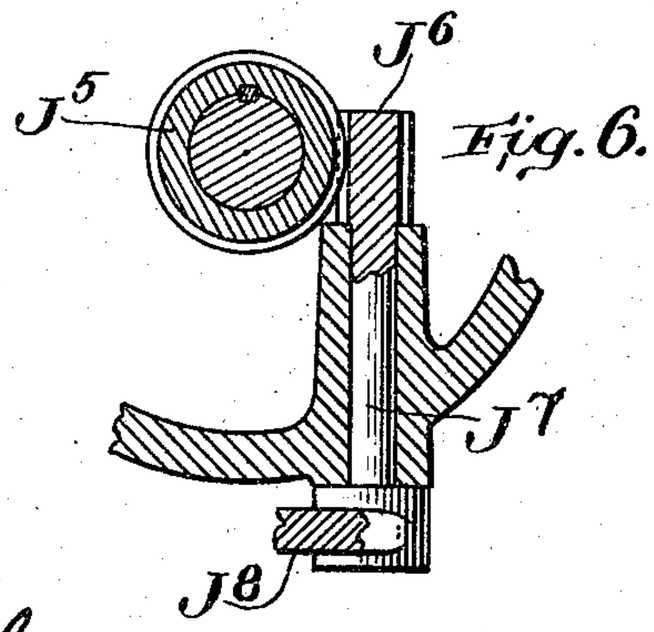

Fig. 6.

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5 SHEETS—SHEET 5.

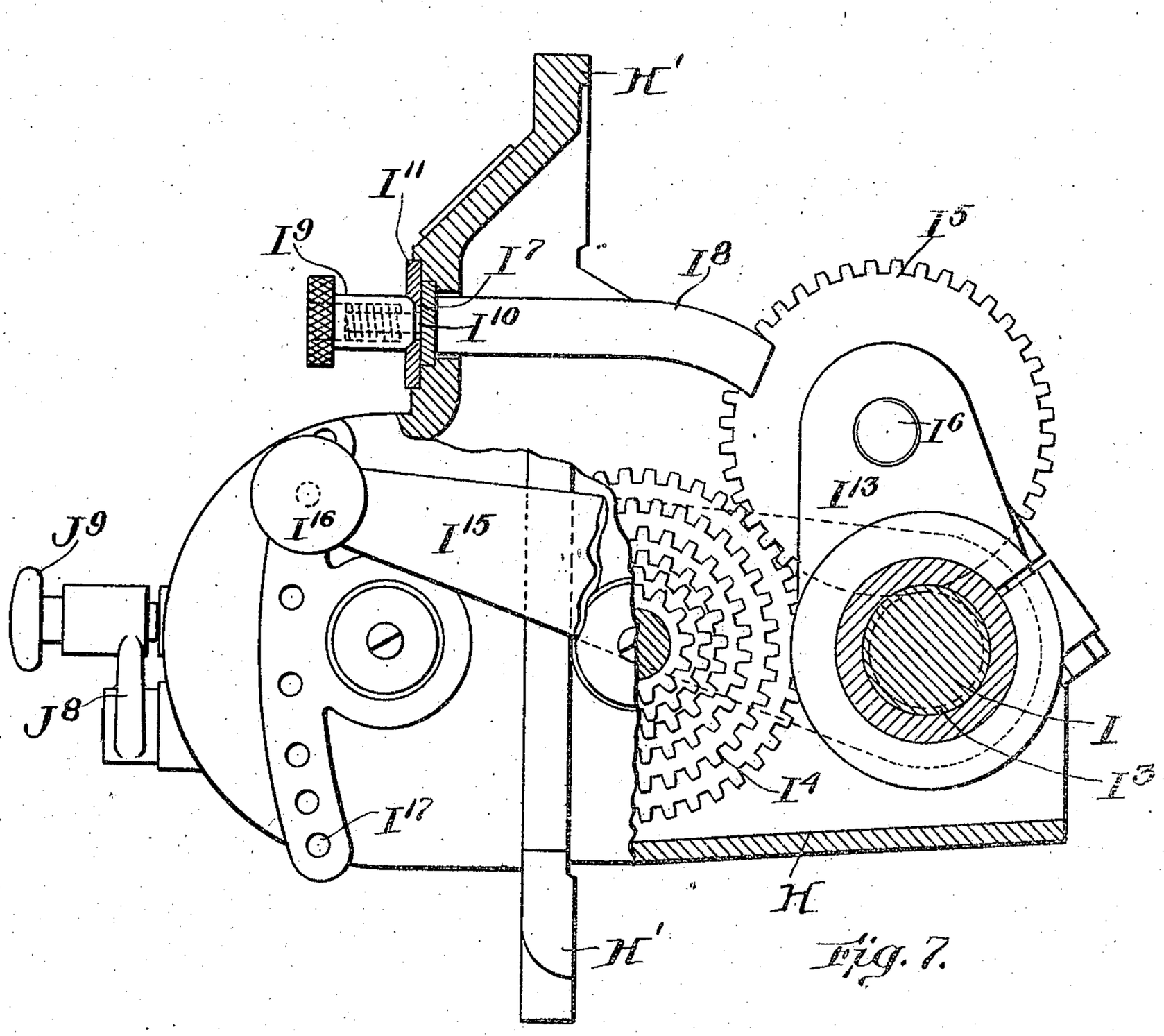

Fig. 7.

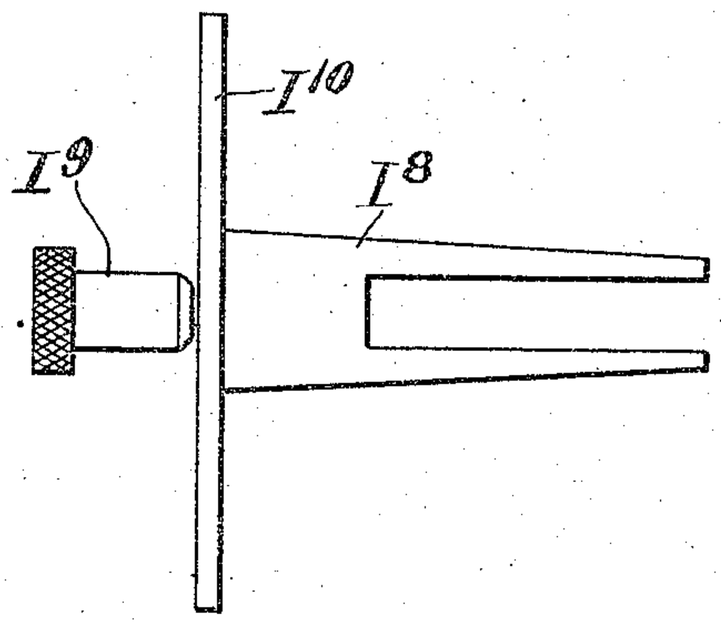

Fig. 8.

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UNITED STATES PATENT OFFICE.

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GEARING.

No. 855,068. Specification of Letters Patent. Patented May 28, 1907.

Application filed February 9, 1904. Serial No. 192,852.

To all whom it may concern:

Be it known that I, JOHN PARKER, of the city and county of Providence and State of Rhode Island, have invented certain new and useful Improvements in Gearing; and I do hereby declare the following specification, taken in connection with the accompanying drawings, forming a part of the same, to be a full, clear, and exact description thereof.

The invention relates to gearing and is illustrated embodied in milling machines in which the cutter is carried by a spindle which may be driven at different speeds to suit the character of the cutter used and the work being operated upon and in which the work is carried upon a table which may be fed at different speeds according to the requirements of the particular work being done.

The features of invention relate more especially to the gearing employed for driving the spindle and table feed at the various required speeds and to devices for automatically disconnecting the spindle from its driving sleeve when the back gears are thrown in and for again connecting the spindle with its driving sleeve when the back gears are thrown out.

The various features of construction and the combinations constituting the invention will be more fully explained in connection with the detailed description of the machine in which they have been embodied and will be set forth in the claims.

The machine in which the various features and combinations of the invention have been embodied is illustrated in the accompanying drawings in which

Figure 1 is a side elevation of so much of the machine as is necessary to show the application of the present improvements thereto. Fig. 2 is a horizontal section through the cutter spindle and back gear shaft. Fig. 3 is a transverse vertical section through the shaft A^{10} Fig. 1. Fig. 4 is a longitudinal vertical section through the spindle. Fig. 5 is a horizontal section through the axis of the feed shaft. Fig. 6 is a sectional detail of parts shown in Fig. 5. Fig. 7 is an end elevation partly in section of the feed box and gearing carried thereby. Fig. 8 is a detail of parts shown in Fig. 7.

The machine shown in the drawings is a horizontal milling machine provided with the usual cutter carrying spindle A and with the usual back gears B' B^2 mounted upon the eccentric portion of the back gear shaft B. The back gear B' is arranged to be thrown into and out of engagement with a gear A' secured to the spindle A while the gear B^2 is thrown into and out of engagement with a gear A^2 secured to a sleeve A^3 mounted on the spindle. When the back gears are thrown out the driving sleeve A^3 is connected directly to the spindle by means of locking pins C which pass through holes in the gear A' and enter holes C' in a flange A^4 formed on the end of the driving sleeve. When the back gears are thrown into engagement with the gears A' A^2 the locking pins C are withdrawn from the holes C' so that the sleeve A^3 is disconnected from the spindle and drives the spindle through the back gearing. In order that the sleeve may be automatically connected with and disconnected from the spindle as the back gears are thrown out of or into operation connections are provided between the locking pins C and the back gearing shaft B whereby the movement of the shaft in throwing the back gears into and out of engagement with the gears A' A^2 operates the pins C. These connecting devices are shown in Fig. 2 and consist of a cam C^2 secured to the back gear shaft and engaging one end of a lever C^3 the opposite end of which is connected with a sleeve C^4 in which the pins C are mounted. The lever C^3 is connected with the sleeve C^4 by means of pins C^5 (Fig. 4) which engage an annular groove C^6 formed in the sleeve C^4. The sleeve C^4 is mounted upon the hub of the gear A' and rotates with said gear by reason of the engagement of the pins C with the holes in the gear. The pins C are spring mounted in the sleeve C^4 so that they may yield as the sleeve C^4 is moved forward in case the holes C' are not in register with the pins when the back gears are thrown out. In such case the pins are forced back against the tension of their springs by engagement with the flange A^4 but snap forward into the holes C' as soon as these holes are brought into register with the pins by the rotation of the sleeve A^3.

The driving shaft D (Fig. 4) through which power is transmitted to the cutter spindle, is driven at a constant speed by means of a belt passing over a pulley D' secured to the shaft

This constantly driven shaft is connected with the spindle by a variable speed mechanism so that the spindle may be driven at the speed required for the efficient operation of the machine upon the particular class of work being done.

The various parts of the variable speed mechanism through which the spindle is driven are mounted in a box or casing E the front of which is provided with projecting flanges E′ for securing the casing to the frame of the machine. The casing is provided with inwardly projecting side pieces E^2 connected by a web E^3. The parts of the variable speed mechanism may be constructed and assembled in the box or casing E and the mechanism then introduced bodily into the machine and the box or casing secured in place. In order that the driving shaft D may be conveniently connected with the variable speed mechanism when thus introduced into the machine, the shaft D is provided with a coupling D^2 for connecting it with the shaft F of the variable speed mechanism and the shaft D is mounted in a bracket D^3 made separate from the frame of the machine and secured thereto when the shaft is brought into proper relation with the shaft F.

The driving shaft F of the variable speed mechanism is mounted in bearing bushings F′ in the side pieces E^2 of the casing E and between the inner ends of the bushings is provided with an elongated gear or pinion F^2. A cone gear F^3 comprising four gears of varying size is mounted in the casing E opposite the gear F^2 and may be connected therewith by an intermediate gear F^4 (Fig. 3). The gear F^4 is mounted upon a stationary shaft F^5 carried in a frame F^6 which is journaled on the bushings F′ so that the gear F^4 remains in engagement with the gear F^2 as the frame is swung upon its journals. The gear F^4 is loosely mounted on the shaft F^5 and is moved laterally on the shaft to bring it into position to register with any one of the gears in the cone gear by means of a slide F^7 mounted in the front of the casing E and provided with arms F^8 arranged on opposite sides of the gear. The slide F^7 is held in position in its guides by an overlying locking plate F^9. The locking plate is provided with a longitudinal slot and the slide F^7 is provided with a stud F^{10} projecting through this slot. A spring pressed sleeve F^{11} is mounted upon the stud F^{10} and engages one of a series of locking recesses F^{12} formed in the locking plate. When the gear F^4 is to be shifted laterally the sleeve F^{11} is withdrawn from the recess with which it is engaged and is moved laterally into position to engage the recess corresponding with the desired position of the gear F^4. When the gear F^4 has been thus brought into position to register with the desired gear in the cone gear, the frame F^6 is swung about the axis of the gear F^2 to bring it into engagement with the cone gear and thus connect the gear F^2 with the cone gear. The frame is thus operated by means of a sleeve F^{13} spring mounted upon a stud F^{14} projecting from the frame F^6 through a vertical slot F^{15} in a locking plate F^{16} secured at the front of the casing E. The locking plate F^{16} is provided with a series of locking recesses F^{17} corresponding to the positions of the frame F^6 when the gear F^4 is in engagement with the various gears of the cone-gear. By this arrangement of gearing the cone gear may be driven at any one of four different speeds and the arrangement of the devices for adjusting the intermediate gear for the different speeds enables the adjustments to be readily and conveniently made.

The sleeve A^3 through which the spindle is driven and which when directly connected with the spindle is in effect a part of the spindle, is connected with the cone gear F^3 through one or the other of two gears A^5 A^6 connected with the sleeve. The gears A^5 and A^6 are connected together by a sleeve A^7 so that they form a quill gear and the sleeve is connected with the sleeve A^3 so that it may slide longitudinally thereon. The gear A^5 is of a size to engage the largest gear of the cone gear while the gear A^6 is of a size to engage the smaller of the two center gears of the cone gear and the gears are so spaced upon the sleeve A^7 that the movement of the sleeve which engages one gear with the cone gear disengages the other from the cone gear. The sleeve A^7 is moved longitudinally to engage either the gear A^5 or the gear A^6 with the cone gear and thus bring it into the active train of gearing by means of a pinion A^8 engaging annular teeth A^9 formed on the sleeve A^7. This pinion is formed on the end of a shaft A^{10} which carries an operating arm A^{11} at its outer end. A spring pressed pin A^{12} is mounted in the end of the operating arm and is arranged to engage one or the other of two holes A^{13} according to which of the gears A^5 A^6 is in engagement with the cone gear. By means of these gears A^5 A^6 the sleeve A^3 may be driven at either of two speeds for each speed of the cone gear. The spindle may therefore be driven at any one of eight speeds with the back gears thrown out and at any one of eight additional speeds with the back gears thrown in or in other words, the mechanisms described enable any one of sixteen different speeds to be given to the spindle.

It is desirable that the speeds of the spindle should vary from the highest to the lowest in a geometrical progression and the gears of the cone gear therefore vary in substantially geometrical progression. I have discovered that the same progression may be maintained in doubling up the number of different speeds given by the cone gear and at the

same time gears in the cone gear may be employed for coöperating with the two gears which are used for thus doubling the number of variations in the speed provided an even number of gears be employed in the cone gear and the two gears which are arranged to engage the gears of the cone gear are so proportioned that one engages the largest gear of the cone gear and the other engages the smaller of the two center gears of the cone gear. That is to say, the geometric progression in the different feeds is substantially maintained in effecting the change from the slowest speed when the smaller of the two gears is in the active train, to the fastest speed when the larger of the two gears is in the active train, and consequently the speeds vary in substantially geometric progression from the highest to the lowest. With the gears thus arranged and proportioned a large number of different speeds may be procured with the employment of a small number of gears and the speeds may be made to vary in a substantially regular geometrical progression. In practising this feature of the invention it is not essential that the gears corresponding to gears A^5 A^6 in the construction above described should be connected in the form of a quill gear nor is it essential that they should be arranged so that they are driven from the cone gear. It is only essential that the cone gear comprise an even number of gears varying in substantially geometrical progression and that the two gears corresponding with gears A^5 A^6 engage the largest gear in the cone gear and the smaller of the two center gears of the cone gear and that some means be provided for throwing either one or the other of these gears into the active train.

It is frequently desirable, especially in setting up or adjusting the work with relation to the cutter, to turn the spindle manually. The operator should be able to thus turn the spindle while in a position where he can closely inspect the relation between the cutter and the work and in order to enable this to be conveniently done the machine is provided with devices for manually turning the spindle which are located adjacent to the front end of the spindle and thus within convenient reach of the operator when standing opposite the feed table. The devices which I have employed for this purpose are shown in Fig. 2 and consist of a pinion G secured to the end of a shaft G′ and normally held out of engagement with the gear A′ by a spring G^2. The spring G^2 is interposed between the hub of the pinion G and a bushing G^3 in which the shaft G′ is mounted. The spring acts to hold the pinion G in the position shown in Fig. 2. When it is desired to turn or adjust the spindle manually, the shaft G′ is pulled forward by means of a handle G^4 thus bringing the pinion G into engagement with the gear A′. This longitudinal movement of the shaft G′ also withdraws the polygonal part G^5 of the shaft from a recess in the end of the bushing G^3 and into position to be engaged by a wrench or operating handle. When the handle has been applied to the part G^5 it lies between the end of the bushing G^3 and a collar G^6 on the shaft G′ and prevents the return of the pinion G to normal position under the influence of the spring G^2. So long as the wrench remains upon the part G^5 the shaft G′ may be turned manually by means of the wrench to adjust or turn the spindle and when the wrench is removed the shaft and pinion G return to normal position. This device for manually operating the spindle may be employed upon any type of milling machine but is of especial importance and advantage in machines in which the driving mechanism is so arranged or constructed that it cannot be conveniently moved by the operator.

The variable speed mechanism for giving to the feed table the different speeds required for various classes of work is mounted in a feed box or casing H provided with projecting flanges H′ by which the feed box is secured in the machine after the various parts of the mechanism have been assembled therein. This variable speed mechanism is similar in many respects to the mechanism already described for driving the cutter spindle and is shown in Figs. 5—8. The driving shaft I of the feed mechanism is provided with a sprocket wheel I′ and is driven at a constant speed from the shaft D by means of a sprocket chain I^2 (Fig. 1) which passes over the sprocket wheel I′ and a sprocket wheel D^4 on the shaft D. The driving shaft I is provided with an elongated pinion or gear I^3 and with a cone gear I^4 arranged opposite the gear I^3. The gear I^3 is connected with any one of the gears in the cone gear by means of an intermediate gear I^5 loosely mounted on a shaft I^6. This gear I^5 is moved laterally on the shaft I^6 to bring it into register with any one of the gears in the cone gear by means of a slide I^7 similar to the slide F^7 and provided with arms I^8 engaging opposite sides of the gear. The slide I^7 is operated and locked in position by means of a spring pressed handle I^9 mounted on a stud I^{10} projecting from the slide I^7 through the stop plate I^{11}. This stop plate is provided with a series of locking recesses I^{12} corresponding to the positions of the gear I^5 when in engagement with the various gears or the cone gear I^4. The manner of mounting the spring pressed sleeves I^9, F^{11}, and F^{13}, is the same, and is indicated in Fig. 7. The shaft I^6 is secured in arms I^{13} which are clamped upon a sleeve I^{14} mounted in the casing H and forming the bearings for the shaft I. This sleeve I^{14} is recessed as shown in Fig. 5 for the gear I^3 and to enable the

intermediate gear to engage and slide along the gear I^3. The sleeve I^{14} is rocked to bring the gear I^5 into engagement with the gears of the cone gear by means of an arm I^{15} projecting from the end of the sleeve outside the casing H and provided at its outer end with a spring pressed locking pin I^{16} arranged to engage any one of a series of locking holes I^{17} at the end of the casing H. There are six gears in the cone gear and consequently six locking holes I^7 corresponding with the position of the gear I^5 when in engagement with the different gears of the cone gear and there is also a seventh locking hole I^7 which corresponds to the position of the gear I^5 when it is thrown so far back that it will not engage even the largest gear of the cone gear.

The feed shaft J is connected with the usual feeding mechanism on the knee J′ by the usual connections J^2 shown in Fig. 1. This feed shaft is driven from the cone gear I^4 through one or the other of two gears J^3 J^4. The gear J^3 is arranged to engage the largest gear of the cone gear while the gear J^5 is arranged to engage the smaller of the two center gears of the cone gear. These gears J^3 J^4 are connected together by a sleeve J^5 so that they form a quill gear and the sleeve J^5 is connected with the feed shaft J so that it may slide longitudinally thereon. The sleeve J^5 is moved longitudinally to bring either gear of the quill gear into engagement with the cone gear by means of a pinion J^6 formed on the end of a shaft J^7 to the outer end of which is secured an operating handle J^8. The handle J^8 carries at its outer end a spring pressed locking pin J^9 similar to A^{12} arranged to engage one or the other of two locking holes J^{10} formed in the front of the feed box.

By the gearing described the feed shaft J may be driven at any one of twelve different speeds since there are six gears in the cone gear I^4 and the gears J^3 J^4 enable the shaft J to be driven at double this number of speeds. It is desirable that the different feeds given to the speed table may be varied from the highest to the lowest in regular geometrical progression, therefore the features of invention above explained in connection with the cutter spindle are also embodied in the variable speed mechanism in the feed box. That is to say, the cone gear is provided with an even number of gears which vary in substantially geometrical progression and the two gears on the feed shaft for doubling the number of speeds given by the cone gear are arranged to engage the largest of the cone gears and the smaller of the two center gears of the cone gear.

What I claim and desire to secure by Letters Patent is;

1. The combination with the spindle, the driving member therefor, the back gearing, a cam on the back gear shaft, a lever operated thereby, a sleeve connected with the lever, a locking pin carried by the sleeve for connecting and disconnecting the spindle and driving member, substantially as described.

2. The combination with the spindle, the driving member therefor, the back gearing, a cam on the back gear shaft, a lever operated thereby, a sleeve connected with the lever, a spring pressed locking pin carried by the sleeve for connecting and disconnecting the spindle and driving member, substantially as described.

3. The combination with a spindle, a driving member therefor and back gearing, of one or more spring pressed devices for connecting and disconnecting the driving member and spindle, and connections between said devices and the back gear shaft for operating the devices through their springs, substantially as described.

4. The combination with a spindle, a driving member therefor and back gearing, of a spring pressed locking pin for connecting the driving member and spindle, a cam on the back gear shaft, and connection between the cam and pin, substantially as described.

5. The combination with a shaft of a driving mechanism therefor comprising a cone gear having an even number of gears varying in substantially geometrical progression, two gears for engaging the largest cone gear and the smaller of the two center cone gears respectively, and means for throwing either of said gears into the active train, substantially as described.

6. The combination with a shaft of a driving mechanism therefor comprising a cone gear having an even number of gears varying in substantially geometrical progression, two gears connected with the shaft arranged to engage the largest cone gear and the smaller of the two center cone gears respectively, and means for throwing either gear into the active train, substantially as described.

7. The combination with a shaft of a driving mechanism therefor comprising a cone gear having an even number of gears varying in substantially geometrical progression, two gears mounted on the shaft and arranged to engage the largest of the cone gears and the smaller of the two center cone gears respectively, and means for throwing either gear into the active train, substantially as described.

8. The combination with a shaft of a driving mechanism therefor comprising a cone gear having an even number of gears varying in substantially geometrical progression, a quill gear on the shaft having gears to engage the largest cone gear and the smaller of the two center cone gears, and means for shifting said quill gear longitudinally of the shaft, substantially as described.

9. The combination with a shaft of a driving shaft, a variable speed mechanism, a casing in which said mechanism is mounted, de-

vices for securing the casing in place, connecting gears between the shaft and said mechanism and a coupling device between the driving shaft and the driving shaft of the variable speed mechanism, substantially as described.

10. The combination with a shaft A of a driving shaft D, a bracket D^3 in which it is mounted, a casing E, variable speed gearing mounted in the casing provided with a driving shaft F, devices for securing the casing E to the machine frame, a coupling between the shafts D and F, and gears connecting the shaft A and variable speed gearing, substantially as described.

11. The combination with a shaft of a cone gear F^3 connected to drive the shaft, a gear F^2, a casing E in which said gears are mounted, having a vertical slot, a frame F^6 mounted in the casing to swing about the axis of gear F^2, a shaft F^5 in the frame, an intermediate gear F^4 on the shaft F^5, a stud projecting from the frame through the slot, locking recesses, a locking sleeve on the stud, and devices for adjusting the gear F^4 on the shaft F^5, substantially as described.

12. The combination with a shaft of gears A^5, A^6, connected therewith, devices for throwing either gear into the active train, a cone gear F^3 for driving said gears, a gear F^2, an intermediate gear F^4, a frame F^6 in which gear F^4 is mounted, a casing in which the gearing is mounted, locking devices carried by the frame and located outside the casing, and a device for adjusting the gear F^4 laterally, substantially as described.

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