No. 742,025. PATENTED OCT. 20, 1903.

A. HERBERT & P. V. VERNON.

VARIABLE SPEED DRIVING MECHANISM.

APPLICATION FILED JULY 11, 1902.

NO MODEL. 3 SHEETS—SHEET 1.

Fig. 1.

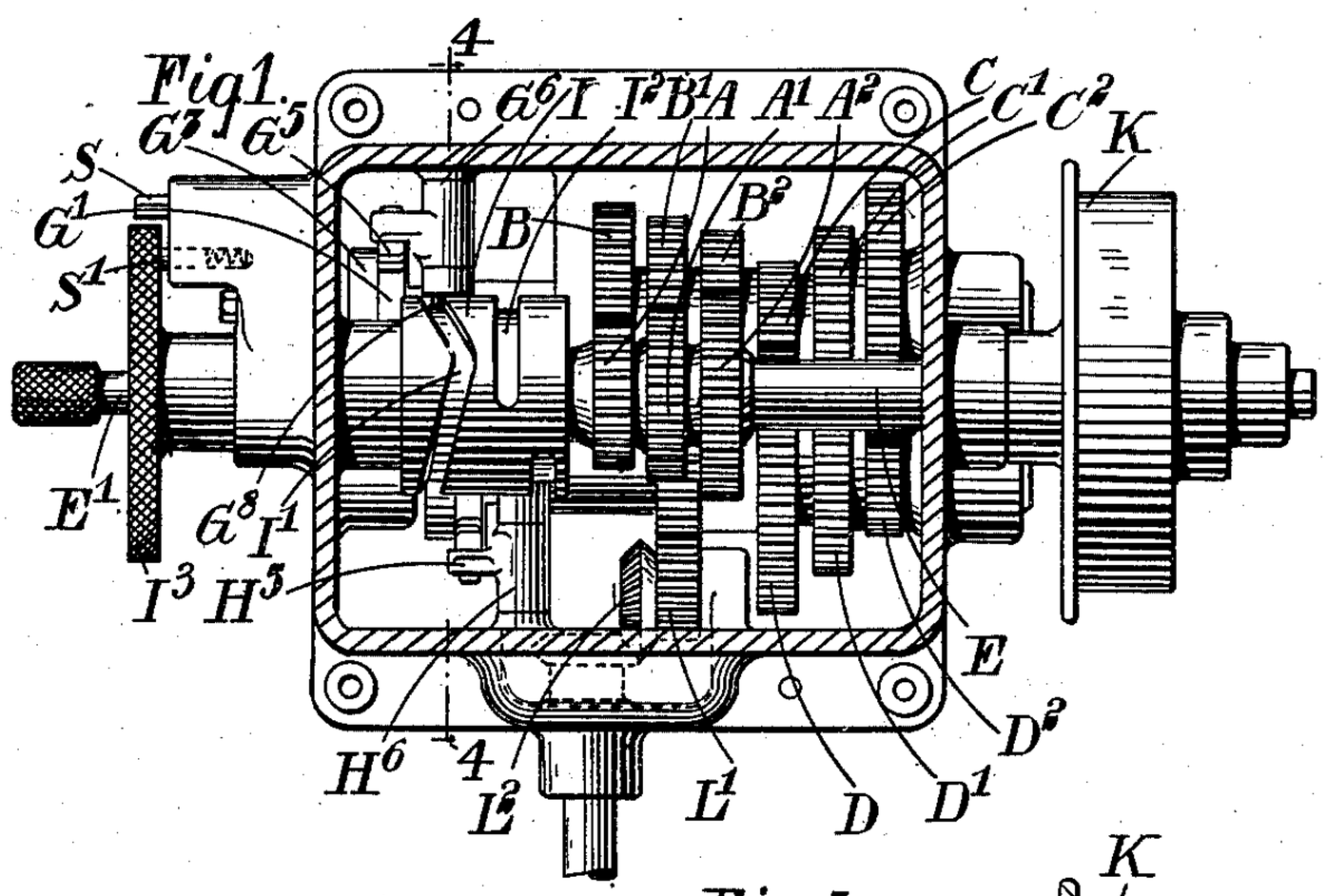
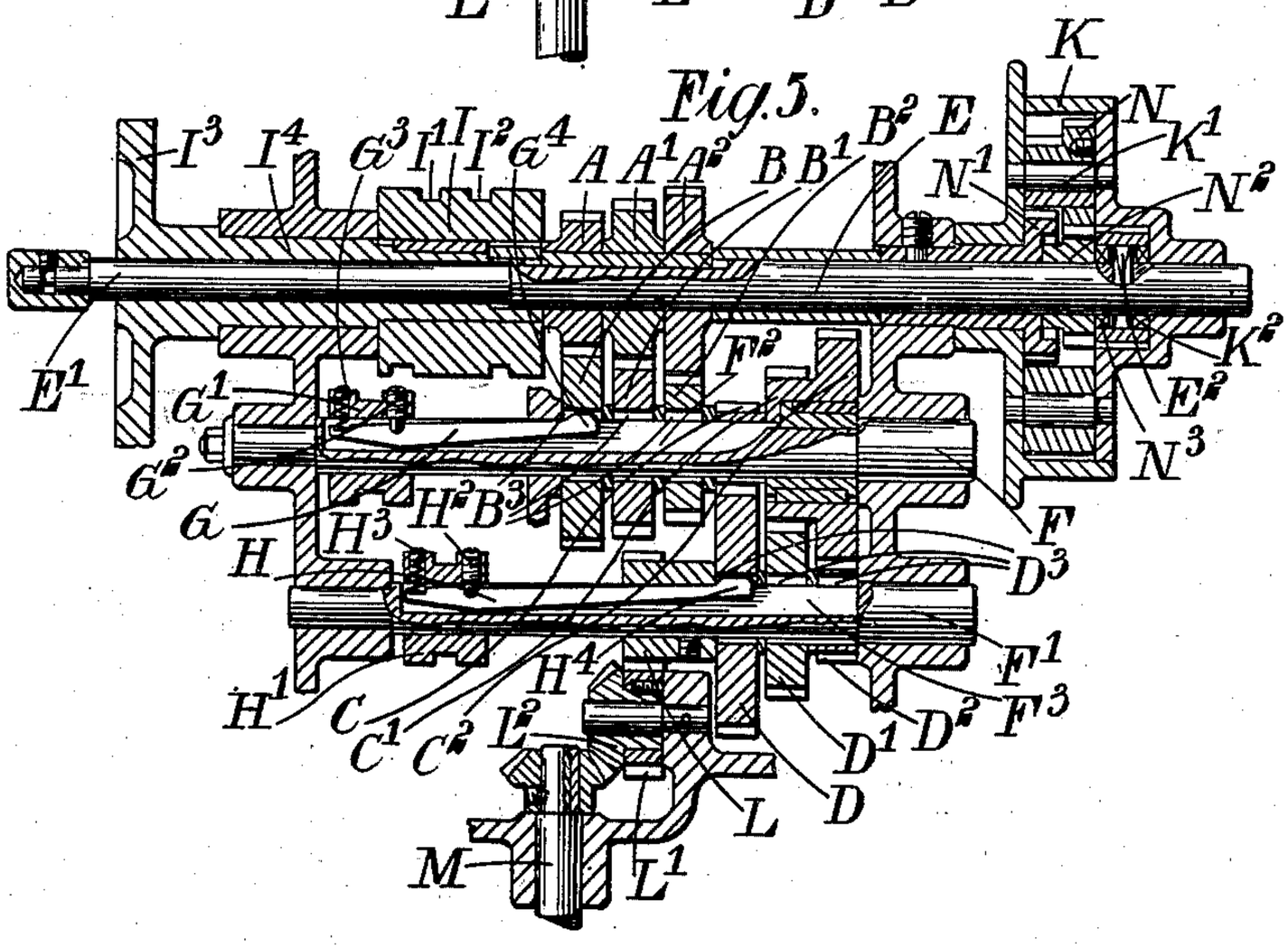


Fig. 5.



Witnesses

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NO MODEL. 3 SHEETS—SHEET 2.

Fig. 8.

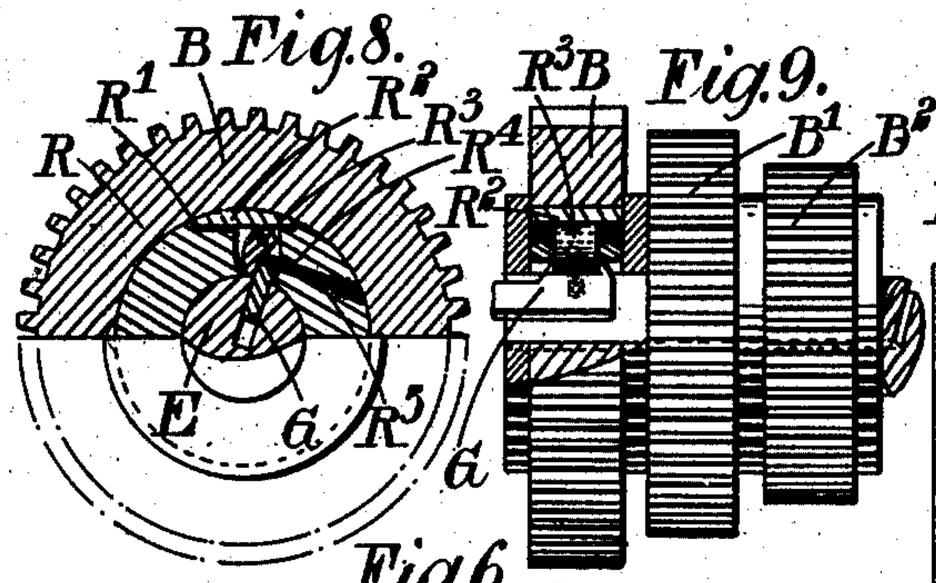


Fig. 9.

Fig. 6.

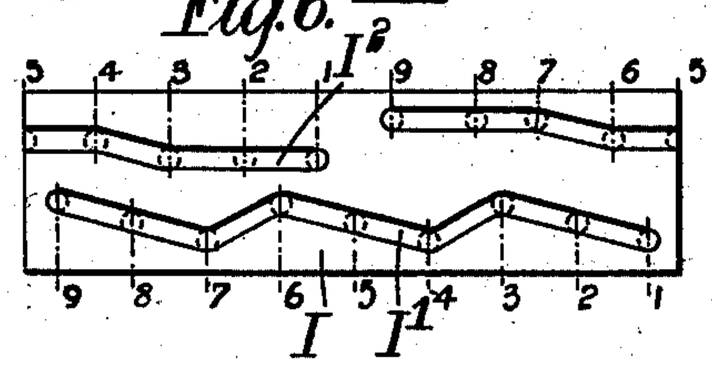


Fig. 2.

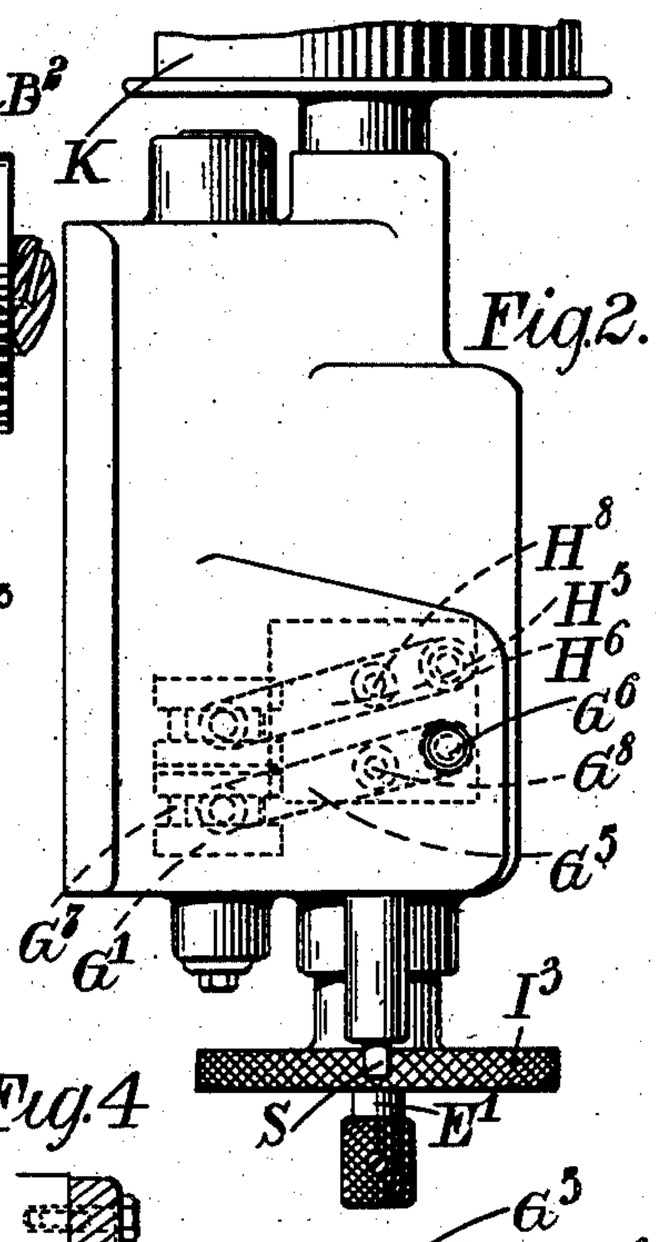
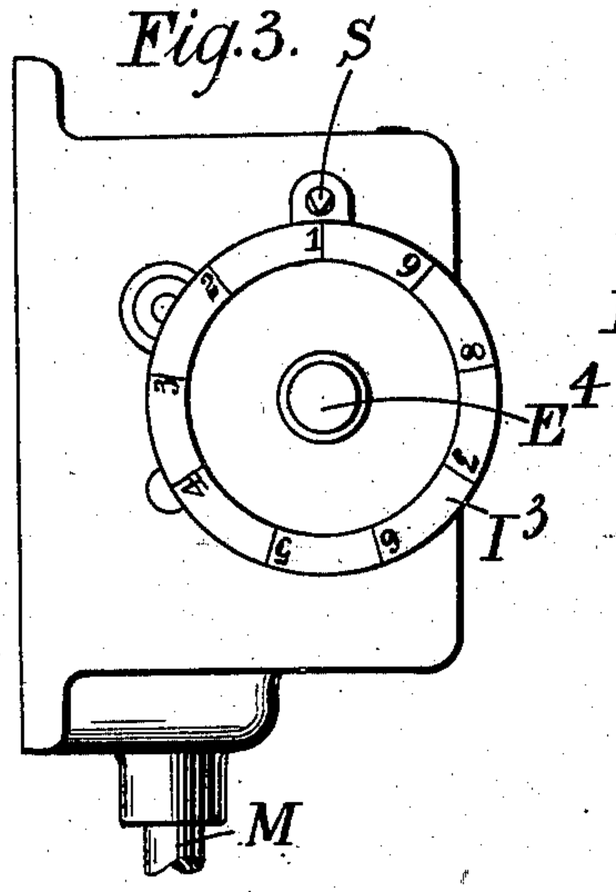
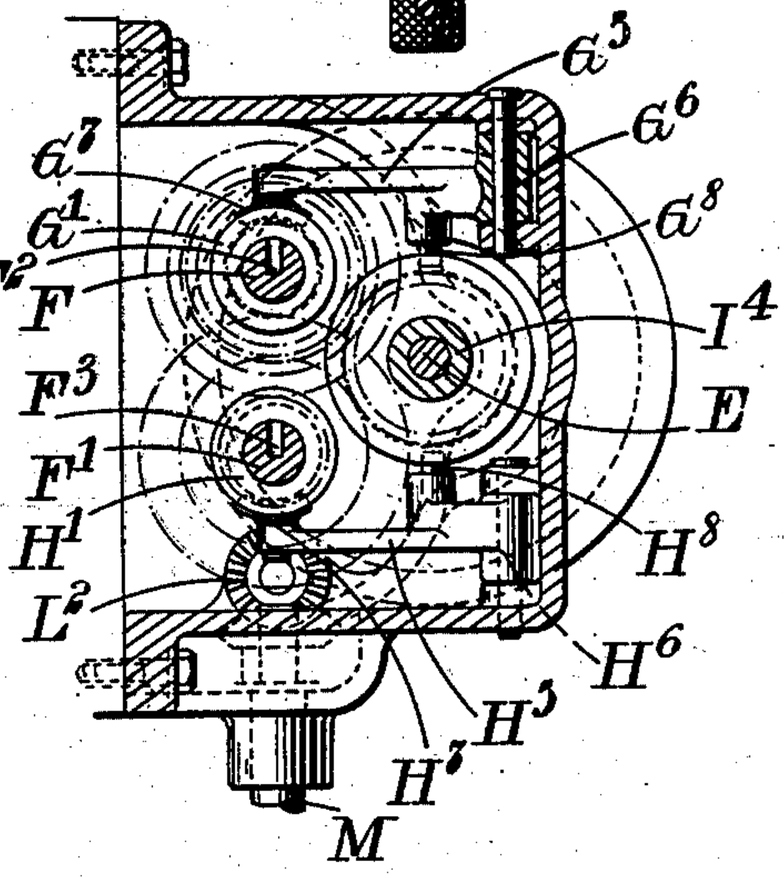


Fig. 4

Fig. 3.





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NO MODEL. 3 SHEETS—SHEET 3.

Fig. 7.

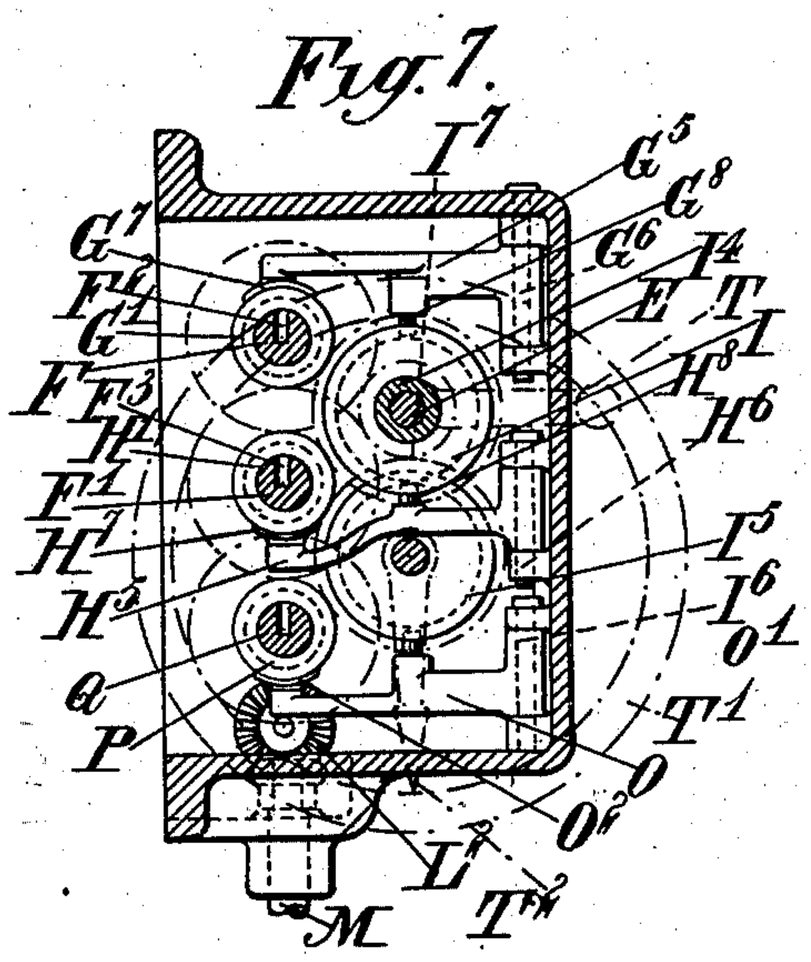
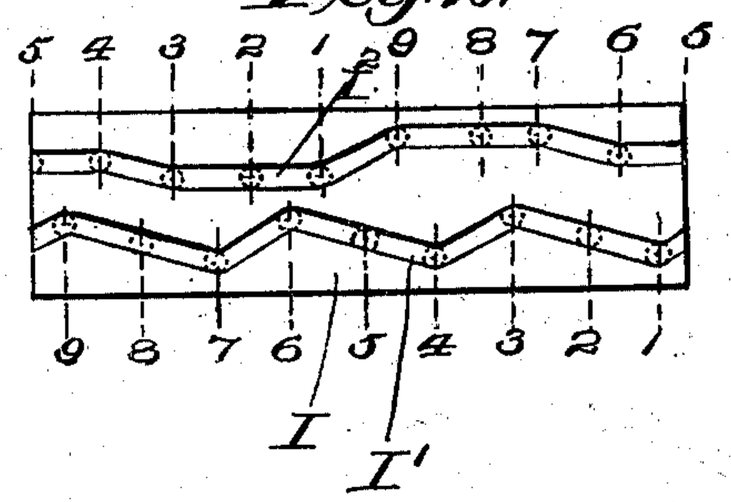


Fig. 10.



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No. 742,025. Patented October 20, 1903.

UNITED STATES PATENT OFFICE.

ALFRED HERBERT, OF KENILWORTH, AND PERCY VENABLES VERNON, OF COVENTRY, ENGLAND.

VARIABLE-SPEED DRIVING MECHANISM.

SPECIFICATION forming part of Letters Patent No. 742,025, dated October 20, 1903.

Application filed July 11, 1902. Serial No. 115,225. (No model.)

To all whom it may concern:

Be it known that we, ALFRED HERBERT, residing at Kenilworth, and PERCY VENABLES VERNON, residing at Coventry, county of Warwick, England, subjects of the King of England, have invented certain new and useful Improvements in or Relating to Variable-Speed Driving Mechanism, of which the following is a specification.

This invention relates to variable-speed driving mechanism, and refers more particularly to a change-speed device or mechanism for gearings in which two or more trains or sets of gear-wheels are employed.

The chief object of this invention is to provide means for operating the locking-keys or controlling-levers of each set of gears simultaneously or in the desired order, so that by moving a single lever, rod, or equivalent in one or other direction the required increase or decrease of speed is obtained.

Referring to the drawings, Figure 1 is a front sectional elevation, Fig. 2 a plan, and Fig. 3 an end elevation, of a variable-speed gear having controlling or change mechanism in accordance with our invention. Fig. 4 is a section on the line 4 4 of Fig. 1; and Fig. 5 is a distorted section of the gear, the various shafts being arranged in the same plane to show the parts clearly. Fig. 6 is a developed view of the cam-drum. Fig. 7 is a sectional end view of a modified construction, showing the employment of two cam-drums; and Figs. 8 and 9 are vertical and cross sections of a yielding connection disposed between the key and the wheel-hub. Fig. 10 is a developed view of the cam-drum, having the cam-slots formed continuously around it.

The gearing consists of two trains or sets of gear-wheels, each set consisting of three pairs of wheels and adapted to give nine speeds in a forward and also in a reverse direction. In the upper set the wheels A A′ A^2 are the drivers and B B′ B^2 the followers. C C′ C^2 are the drivers and D D′ D^2 the followers of the lower set or train. The drivers of the upper set are keyed or otherwise fixed to the main or driving shaft E, and the followers B B′ B^2 are mounted loosely on a secondary or counter shaft F, upon which also the drivers C C′ C^2 of the lower train are keyed or otherwise secured. The followers of the lower set are mounted loosely on a third shaft F′, which carries a gear-wheel from which the motion may be taken, or the motion may be taken from either end of this shaft.

The followers of each set of gears are adapted to be connected to their shafts by rise-and-fall keys G and H, which are mounted in longitudinal grooves or slots F^2 F^3 in their respective shafts F F′. One end of the key G is connected by a pivot-pin G^2 to a sleeve G′, which is mounted loosely on the shaft and is provided with a spring G^3, resting in a recess in the sleeve and bearing on the end of the key in such a manner as to cause the other end of the key or a projection G^4 thereon to enter one or other of the grooves or slots B^3, which are formed in the hubs of the wheels B B′ B^2, by means of which any one of the wheels can be connected to the shaft as desired. A controlling-lever G^5 for the key G is pivoted to the casing at G^6 and carries a shoe or fork G^7. The key H is connected to a similar sleeve H′ by a pin H^2, and a projection H^4 on its free end is pressed into engagement with slots D^3 in the hubs of the wheels D D′ D^2 by a spring H^3.

H^5 is a controlling-lever for the key H and is pivoted to the casing at H^6. The lever carries at its free end a shoe or fork H^7, which rests in a radial groove in the sleeve H′.

The keys G and H are operated in the proper order to give the sequence of speeds by means of a drum or cylinder I, which is mounted on the shaft E and is provided with two separate and independent cam-grooves I′ I^2, formed as shown in the developed view Fig. 6. The groove I′ controls the lever G^5 for key G and the groove I^2 controls the lever H^5 with the key H. A projection G^8 on the lever G rests in the cam-groove I′ at the upper side of the drum, and a projection H^8 rests in the groove I^2 at the lower side thereof. (See Fig. 4.) As the drum is rotated in one or the other direction the keys move longitudinally to connect one or other of the gear-wheels to their respective shafts to give the requisite speeds. The corresponding numbers on the two cam-grooves in Fig. 6 denote the position of the projections of the controlling-levers for each speed, and similar numbers

are placed upon the disk I^3, by which the drum is rotated. This disk is connected to a sleeve I^4, upon which the drum is mounted, and any numbers or other marks corresponding to the different speeds obtainable are placed on the outer face of the disk, or they may be placed around its periphery. An indicator S or other mark is placed upon the casing contiguous to the disk and is so arranged that by bringing a numeral or other mark on the disk beneath this pointer the speed indicated by that numeral is at once obtained as the cams are moved to connect to their respective shafts the necessary wheels for that speed, or the disk may carry a pointer, and the numerals or other indicating-marks may be carried on a scale or the like mounted contiguous to the disk.

In order to prevent the cam from rotating accidentally, a spring-bolt S′ is provided and is adapted to enter one of the series of notches or openings in the disk to hold it stationary, or any other appropriate means may be provided for preventing the drum from rotating.

Instead of employing a disk we may employ a crank arm or lever having a suitable handle or other device for facilitating its rotation, and we may provide on this arm a pointer or other indicator.

The shaft E is driven by a pulley K, and the motion is taken from a toothed wheel L on the shaft F′, which gears with a wheel L′, connected with a bevel-wheel L^2, gearing with a corresponding wheel on a shaft M.

When the shaft M is being driven at the lowest speed, the keys G and H are in engagement with the wheels B and D, respectively, as shown in Fig. 5, the projections on the controlling-levers being in the positions 1 in the cam-grooves I′ I^2, respectively, and the dial in the position shown in Fig. 3.

When the dial is rotated to bring the numeral "2" thereon under the pointer, the cam I′ causes the lever to move the key G out of engagement with the wheel B and into engagement with the wheel B′, and the third speed is obtained by a further rotation of the disk until the numeral "3" is under the pointer, which causes the key G to move in the manner stated into engagement with the wheel B^2. During these motions the cam I^2 does not move the lever H^5, controlling the key H, which remains in engagement throughout these three speeds with the wheel D, as will be obvious from the formation of the cam-slots, as shown in Fig. 6. A further rotation of the drum for the fourth speed causes the controlling-lever for the upper train to move into the position 4 of its respective cam, causing the key G to move back into engagement with the wheel B, and the key H is now moved from engagement with the wheel D into engagement with the hub of the wheel D′, its controlling-lever H^5 being now in the position 4, indicated on its cam-slot. These series of motions are continued throughout the entire cycle of the speeds, the key G being moved successively from engagement with the wheel B to the wheel B′ and then to the wheel B^2 and back again to the wheel B, and the key H of the lower train is advanced from one wheel to the other only when the key of the upper train moves back from the wheel B^2 into engagement with the wheel B. The cams may be arranged to move through any other convenient series of motions to give the desired sequence of speeds. When the ninth or highest speed has been reached, the direction of rotation of the cam-drum is reversed, so that a corresponding sequence of speeds can be obtained in a gradually-decreasing ratio, or the mechanism can be returned by a single revolution of the cam-drum from the highest to the lowest speeds, or the cam-slots may be formed continuously around the drum, so as to obtain a quicker translation from the highest speed, as will be obvious.

The belt-pulley K is provided with reversing-wheels, so that the direction of rotation of the gear can be reversed. Inside the pulley are mounted on an axle K′ double planet-pinions N, which gear with a central stationary pinion N′ and with a pinion N^2, mounted loose on the shaft E. The wheels A A′ A^2 are connected to the shaft in such a manner as to be rotated thereby, but also to allow the shaft to move axially independent of the wheels. Formed on or connected to the other end of the shaft is a rod E′, which extends through the center of the disk and is provided with a suitable head or other device for convenience in pulling the rod so as to move the shaft axially. At the driving end the shaft is provided with projections or cotters E^2, which, according to the position of the shaft, are moved into engagement with teeth or notches K^2 in the hub of the pulley K or with similar notches N^3 on the wheel N^2. When the cotters on the shaft are in engagement with the teeth on the pulley-hub, direct driving is obtained, and when they are in engagement with the teeth in the pinion N^2 this latter is locked to the shaft and is driven by the planet-pinions, which rotate epicyclically around the stationary pinion and cause the shaft to be rotated in the opposite direction, and when the teeth are in the central or mid position the driving-pulley is disconnected from the shaft and no motion is communicated thereto.

We do not wish to confine ourselves to the cams precisely as shown, as these may be modified to cause the keys to operate to give changes of speed in any other order or sequence. Additional wheels may also be added to each set or nest and the cam-grooves modified to suit these additions and cause the keys to engage successively with the four, five, or other number of wheels in the set. Instead, however, of increasing the number of wheels in each set one or more additional independent sets mounted on additional shafts may be provided, and an additional and separate cam-drum may be employed for each set. In or-

der to permit of both or all of the cam-drums being operated by a single disk or arm, it or they is or are geared with the first cam-drum in such a manner as to be rotated by it at a suitable relative speed thereto. For example, we may, as shown in Fig. 7, provide a secondary cam-drum I^5, having a toothed wheel I^6, gearing with a toothed wheel I^7 on the main drum I, the relative proportion of the wheels I^6 I^7 being preferably two to one, so that this secondary cam will be rotated at half the speed of the main cam. The first nine speeds are obtained by rotating the main drum I, as above described. A lever O, having a projection O′ resting in a cam-slot in the drum I^5, is provided with a fork or shoe O^2, which engages with a collar or sleeve P, which controls the movement of the rise-and-fall key of the additional wheels, which are mounted on a shaft Q. These additional wheels are similar to the wheels D D′ D^2 and receive motion from drivers on the shaft F′ similar to the drivers C C′ C^2. During the first nine speeds the key of the addition set remains in contact with the hub of the first wheel thereof, which is thereby locked to the shaft, and after the first cycle of the main cam has been completed the cam-slot in the drum I^5 causes the sleeve to move into engagement with the hub of the second wheel, in which position it remains through another complete cycle of operations of the main cam, and so on with the other wheel or wheels in the set.

Instead of employing gear-wheels I^6 I^7 on the cam-drums in the proportions of two to one these two gears may be of any convenient proportion to each other so long as they impart to the various controlling-levers and keys the movements necessary to produce the desired sequence of speeds.

In order that the main cam may be rotated successively in one direction, the cam-slots therein are carried entirely around the periphery of the drum.

A handle T is provided for rotating the main cam-drum, and a circular scale T′ is mounted coaxial with the second cam-drum, which carries a pointer T^2.

In order to minimize or obviate any shock that may come on the parts when changed from one speed to another and to enable these changes to be made at high speed without sudden stress on any part of the mechanism, there is or may be disposed between the hubs of the wheels and their shafts a sleeve R, which is a loose fit on the shaft and has in its periphery a slot or recess R′, adapted to receive wedges or locking-pieces R^2, corresponding to each wheel, and which form a friction-clutch to connect each wheel-hub to the sleeve. Beneath each locking-piece is placed a pivoted cam or eccentric R^3, which is pressed forward by a pin R^4, controlled by spring R^5, so as to allow the rise-and-fall key to retain the eccentric in the position in which the locking-piece is in frictional engagement with the wheel-hub and the sleeve is connected to the shaft by the rise-and-fall key and the eccentric. When the key is raised to lock the wheel to the shaft, the end of the key or a projection thereon comes into contact with the eccentric, which is therefore caused to rotate on its pivot by the relative movements of the part for a short distance before it acts to lift the locking-piece against the wheel-hub, and this yielding motion provides at the moment of engagement a small amount of slipping between the parts, thus preventing or minimizing any sudden stress or shock. When the rise-and-fall key is withdrawn, the mechanism revolves freely on the shaft without any relative movement of the parts.

What we claim as our invention, and desire to secure by Letters Patent, is—

1. In variable-speed gearing the combination with a plurality of sets or trains of fast and loose gears of a locking device for each set of loose gears an operating-lever connected with each locking device and a rotatable cam-drum having peripheral slots for moving all the operating-levers relatively substantially as described.

2. In variable-speed gearing the combination with a plurality of sets or trains of fast and loose gears of a rise-and-fall key for each set of loose gears a collar on the end of each key an operating-lever connected with the collar a cam-drum having peripheral slots with which the operating-levers engage and means for rotating the cam-drum to move all the operating-levers relatively substantially as described.

3. In variable-speed gearing the combination with a plurality of sets or trains of fast and loose gears of a spring-controlled rise-and-fall key for each set of loose gears, a collar on the end of each rise-and-fall key, a controlling-lever for each key, a rotatable drum, having separate cam-slots for each controlling-lever and means for rotating the drum substantially as described.

4. In variable-speed gearing the combination with a plurality of sets of fast and loose gears of a rise-and-fall key for each set of loose gears, a controlling-lever for each key, a rotatable drum, having separate cam-slots for each controlling-lever, a sleeve connected to the drum, a handle on the sleeve, a spring-pin for preventing the accidental rotation of the drum, a driving-pulley and reversing-gear in the pulley, substantially as described.

5. In variable-speed gearing the combination with a plurality of sets of fast and loose gears, of a rise-and-fall key for each set of loose gears, a controlling-lever for each key, a rotatable drum, having separate cam-slots for each controlling-lever, a sleeve connected to the drum, a handle on the sleeve, a spring-pin for preventing the accidental rotation of the drum, a driving-pulley and reversing-gear in the pulley, and means for operating the reversing-gear, substantially as described.

6. In variable-speed gearing the combination with a plurality of sets or trains of fast and loose gears of a spring-controlled rise-and-fall key for each set of loose gears a collar on the end of each rise-and-fall key a controlling-lever for each key a rotatable drum having separate cam-slots for each controlling-lever means for rotating the drum and means for preventing sudden shock between the parts at the moment of engagement of each loose gear substantially as described.

7. In variable-speed gearing the combination with a plurality of sets or trains of fast and loose gears of a spring-controlled rise-and-fall key for each set of loose gears a collar on the end of each rise-and-fall key a controlling-lever for each key, a rotatable drum having separate cam-slots for each controlling-lever, means for rotating the drum, means for preventing sudden shock between the parts at the moment of engagement of each loose gear, and means for reversing the gear substantially as described.

8. In variable-speed gearing the combination with a plurality of trains of fast and loose gears, of a rise-and-fall key for each set of loose gears, a controlling-lever for each key, a rotatable drum, having separate cam-slots for each controlling-lever, a sleeve connected to the drum, a handle on the sleeve, a spring-pin for preventing the drum from rotating accidentally, a scale and pointer for determining the position of the drum for the various speeds, a driving-pulley, planet-pinions carried by the pulley, a fast pinion and a loose pinion gearing with the planet-pinions, means for moving the shaft axially to connect the driving-pulley or the loose pulley thereto and means for preventing sudden stress to the parts at the moment of engagement of the gears, substantially as described.

9. In variable-speed gearing the combination with a plurality of sets or trains of fast and loose gears, of a rise-and-fall key for each set of loose gears an operating-lever for each key rotatable drums having cam-slots for each key a single device for rotating all the cam-drums simultaneously substantially as described.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

ALFRED HERBERT.
P. V. VERNON.

Witnesses:
FRANK FLOYD,
JOSEPH JOHNSON.