No. 740,546. PATENTED OCT. 6, 1903.

J. S. FAIRFAX.

VARIABLE SPEED GEAR.

APPLICATION FILED DEC. 1, 1902.

NO MODEL. 2 SHEETS—SHEET 1.

FIG. 1

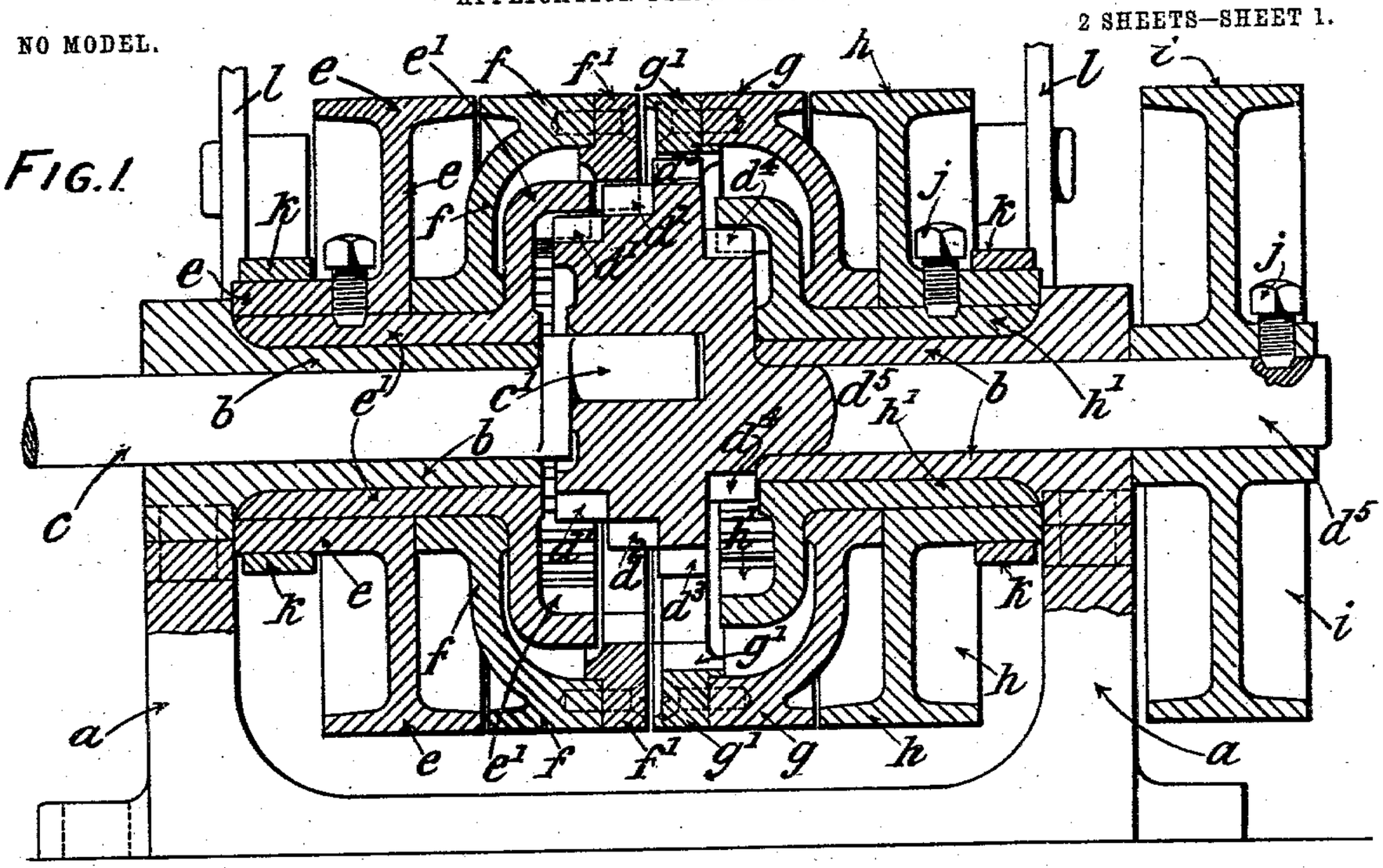


FIG. 2.

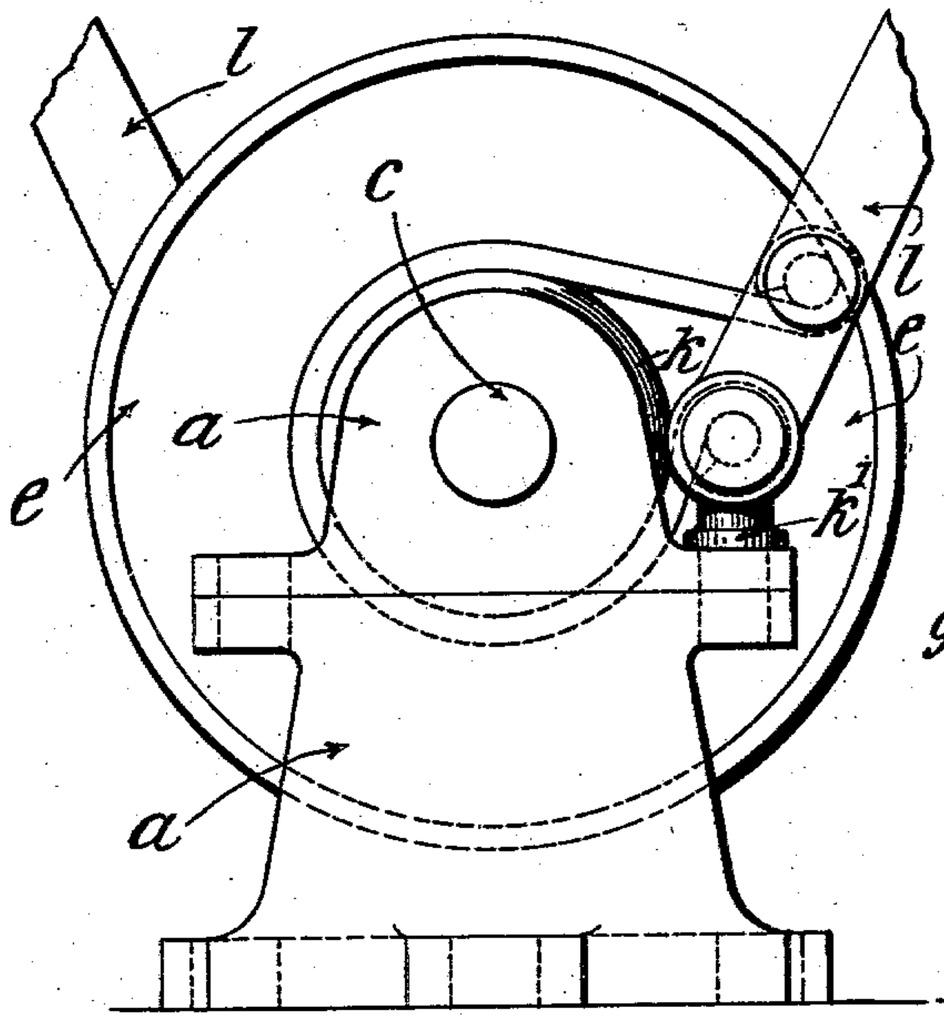
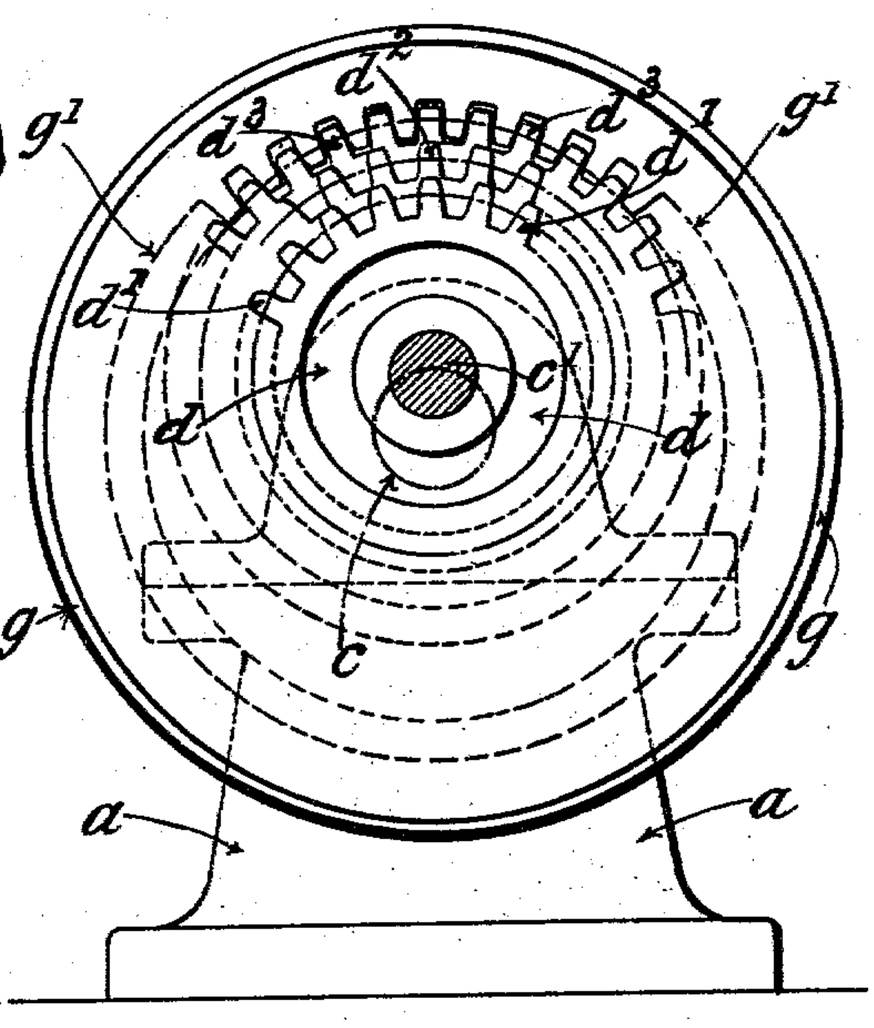


FIG. 3.



Witnesses.
Wm. Munn Andrew.
Henry J. Brockwell.

Inventor.
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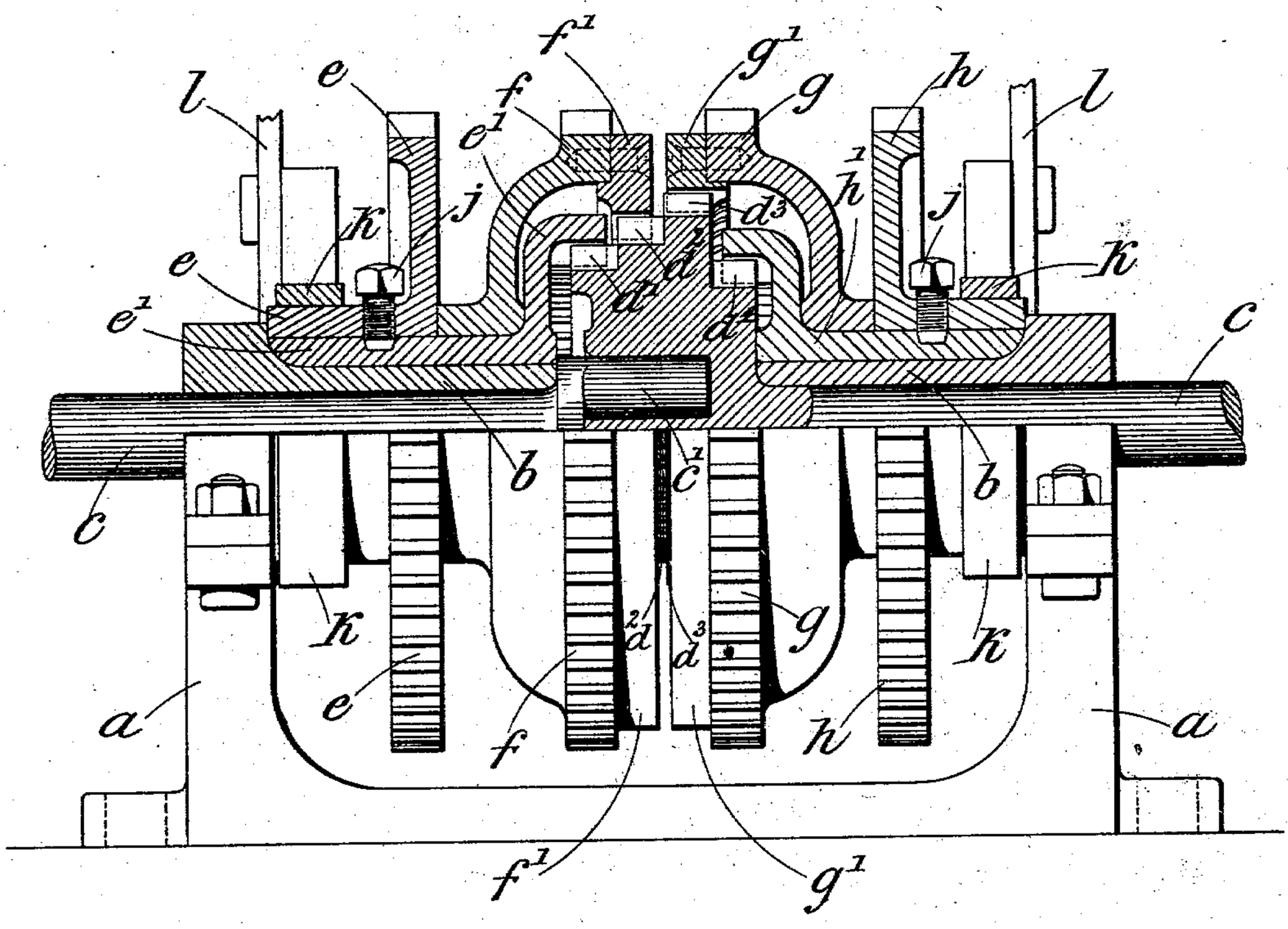
NO MODEL 2 SHEETS—SHEET 2.

FIG. 4.



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UNITED STATES PATENT OFFICE.

JOSEPH SINCLAIR FAIRFAX, OF CHISWICK, ENGLAND.

VARIABLE-SPEED GEAR.

SPECIFICATION forming part of Letters Patent No. 740,546, dated October 6, 1903.

Original application filed July 14, 1902, Serial No. 115,457. Divided and this application filed December 1, 1902. Serial No. 133,526. (No model.)

To all whom it may concern:

Be it known that I, JOSEPH SINCLAIR FAIRFAX, a subject of the King of the British Dominions, and a resident of Sunview, Fauconberg Road, (formerly Sutton Lane,) Chiswick, in the county of Middlesex, England, have invented certain new and useful Improvements in Variable-Speed Gear, (for which I applied for Letters Patent in the United States July 14, 1902, Serial No. 115,457, from which this is divided,) of which the following is a specification.

My invention relates to improvements in variable-speed gear by which when worked by an internal or central shaft, which may be the main shaft of an engine or other motor or a counter-shaft, the revolutions of the said driving-shaft are reduced in number at the driven part and adapted to give a choice of reduced speeds. With these may be combined known means for obtaining other speeds, thus increasing the range of its usefulness. It is adapted for driving motor road or rail vehicles, machine-tools, lifting or conveying apparatus, and other useful purposes either by belting or spur-gearing, and the points of novelty relied on will be set out in the claims.

In the further description of this invention reference is made to the accompanying drawings, in which—

Figure 1 is a longitudinal section through a four-speed gear adapted for belt-driving. Fig. 2 is an end elevation of the same. Fig. 3 is a transverse section through Fig. 1. Fig. 4 is a half longitudinal section and half elevation of a similar four-speed gear to that shown in Fig. 1, but modified to drive by spur-gearing.

In the drawings, *a* denotes any suitable form of frame or support to a compound bearing *b*, which may either be cast integral with the frame *a* or formed separately and secured thereto, as indicated. This compound bearing *b* is an important part of my invention, and it is bored to receive a central shaft *c*, which is journaled and rotatable therein. The outside of the bearing *b* is turned so that a pulley or wheel is rotatable thereon, as described more fully hereinafter. The shaft *c* is formed as a crank-shaft with a pin *c'*, on which is mounted a compound pinion having four sets of teeth d', d^2, d^3, and d^4 of different diameters at the pitch-line. These teeth respectively mesh with the internal teeth *e'*, *f'*, *g'*, and *h'* of the corresponding pulleys or wheels *e*, *f*, *g*, and *h*. The gearing is of a well-known type of differential gear in which it is necessary to hold one of the pulleys or wheels (*h*, for example) from moving to enable the other wheels *e*, *f*, and *g* to revolve against the internal teeth of *h'* as a fulcrum or else to similarly prevent *e e'* from moving when the wheels *f*, *g*, and *h* are required to revolve. The speed and direction of motion are determined by the relative number of teeth in the different sets and relative diameter of the fixed wheel to the moving ones, as is well known. A band-brake *k* at each end, operated by a lever *l* against a fulcrum pin *k'*, is shown for the purpose of stopping either pulley or wheel *h* or *e*; but other known means may be used for this purpose.

To allow the several sets of pinion-teeth to mesh with the internal teeth of the pulleys or wheels at one part of their diameter and clear themselves of the surrounding teeth at the opposite part of the pinion's diameter, it is necessary for the revoluble members to be mounted upon two axial lines parallel with, but eccentric to, each other. The outside of the bearing *b* is concentric with the driving-shaft *c*, and therefore the wheels *e*, *f*, *g*, and *h*, mounted on the bearing, have the same axis of revolution as the shaft; but the pinion, being mounted on the pin *c'*, has an eccentric axis of revolution to the other revoluble members, and consequently is able to mesh with and clear itself in driving the internal teeth of the wheels. The pinion may be mounted on an eccentric formed on the shaft *c* and the latter journaled in both bearings; but the crank-pin *c'* is preferred, as it enables the parts to be kept small in diameter and reduces the frictional area within the pinion to a minimum. By extending a pin d^5 from the pinion in line with the shaft *c* (and therefore in eccentric relation to the axis *c'*, on which the pinion rotates) through the right-hand bearing and mounting a pulley *i* upon it an additional slow speed is obtained.

To allow the parts to be fitted together, as

shown, the hub of e', having internal teeth meshing with the teeth d' of the pinion, is prolonged as a sleeve the full length of the outer part of the bearing b and placed thereon after the outer portion of the pulley f has been fitted on the sleeve and the external portion of the pulley e has been secured to the sleeve e' by the set-screw j or other suitable means. The overhanging portion f', which carries the internal teeth meshing with d^2, is screwed to and completes the pulley f. The latter has thus an independent motion and speed from the pulley e, but both are revoluble upon the axis of the compound bearing b. The internal-toothed portion h' of the pulley h is prolonged to form a sleeve in the same manner as e', and the pulley g is fitted on the sleeve portion before the pulley h is secured to h' by the set-screw j or other equivalent means. The overhanging portion g', having internal teeth, is then screwed to g, and thus completes that pulley also, both g and h being then mounted on the right-hand compound bearing b. Consequently the internal teeth g' mesh with the set of pinion-teeth d^3, and the teeth d^4 are smaller in diameter at the pitch-line than the other sets d', d^2, and d^3, so that if h' is held by the brake k acting on h the pulleys e, f, and g will have three different speeds, all in the same direction, when driven by the shaft c and crank-pin c', e being the slowest and g the fastest, owing to the difference in the number of their teeth as compared with h', or, in other words, the difference in the number of the driving-teeth d', d^2, and d^3 as compared with d^4; but if e' is held by the opposite brake acting on e, h being released, the pulleys f and g will turn in the same direction as before, only slower, while the pulley h will turn in the reverse direction. This arrangement of speeds may be modified by changing the relative diameters of d' and d^4 and the corresponding internal-toothed members e' and h'.

It will be seen that while the pulleys e, f, g, and h in Fig. 1 are all of the same external diameter they are revoluble at different speeds and some of them in reverse direction. Consequently a belt may easily be shifted from one to another to vary the speed or direction, the brakes $k\,k$ and levers $l\,l$ being suitably operated. Likewise the spur-wheels e, f, g, and h (shown in the modification, Fig. 4) are all of the same diameter, so that a sliding spur-wheel (not shown) on a shaft arranged parallel with c may be brought in successive contact with them to be driven at various speeds, as aforesaid, or thrown out of gear by placing it in the wide spaces between the teeth. It will also appear that the parts shown in Fig. 4 may be put together in the same or an equivalent manner to that described for the pulleys in Fig. 1 and that instead of mounting four pulleys or wheels in lines two or three may be used—as, for instance, two wheels or pulleys mounted on one compound bearing only, with two sets of pinion-teeth, where that arrangement is sufficient, or two on one bearing and one wheel or pulley on the other bearing, the pinion having in this case three sets of teeth of different diameters at the pitch-line.

What I claim, and desire to secure by Letters Patent of the United States, is—

1. A variable-speed gear having in combination a stationary tubular bearing, a revoluble shaft journaled in said bearing, wheels mounted on the exterior of said bearing and revoluble thereon concentric with said shaft, and intervening rotatable means engaging with said shaft and said wheels, substantially as set forth.

2. A variable-speed gear having in combination a stationary bearing, revoluble wheels mounted thereon having the same external diameter, a shaft journaled and revoluble in said bearing on the same axial line as said wheels, and intervening rotatable means engaging with said shaft and said wheels to actuate the wheels at diverse speeds substantially as set forth.

3. A variable-speed gear having in combination a stationary bearing, revolubie wheels mounted on said bearing, a revoluble shaft journaled in said bearing, and intervening rotatable means engaging with said shaft and said wheels having an axis of rotation eccentric to the axis of said shaft and wheels to operate the latter at diverse speeds, substantially as set forth.

4. A variable-speed gear having in combination a stationary bearing, a revoluble shaft journaled in said bearing, a revoluble wheel mounted concentrically on said bearing, a second wheel mounted to rotate concentrically with the first, and intervening rotatable means engaging with said shaft and said wheels having an axis of rotation eccentric to the axis of said shaft and wheels, substantially as set forth.

5. A variable-speed gear having in combination a compound bearing, a revoluble shaft journaled therein, a plurality of wheels having internal teeth mounted and revoluble concentrically on said bearing, and a compound pinion mounted eccentrically on said shaft and meshing with said internal teeth, substantially as set forth.

6. A variable-speed gear having in combination a compound stationary bearing, a revoluble shaft journaled therein, a plurality of revoluble wheels of the same exterior diameter but each having internal teeth of diverse diameter concentrically mounted on said bearing, and a compound pinion mounted eccentrically on said shaft and meshing with said internal teeth, substantially as set forth.

7. A variable-speed gear having in combination a compound bearing, a revoluble shaft journaled therein, revoluble wheels mounted concentrically thereon, means to support the said bearing in stationary relation between

said shaft and wheels, and a pinion mounted eccentrically on said shaft adapted to operate said wheels, substantially as set forth.

8. A variable-speed gear having in combination a compound bearing, a revoluble shaft having a crank-pin journaled therein, revoluble wheels having internal teeth mounted concentrically thereon, a compound pinion rotatably mounted on said crank-pin meshing with said internal teeth, means to support said bearing in stationary relation between said shaft and wheels, and means to hold one of said wheels against rotation, substantially as set forth.

9. A variable-speed gear having in combination two compound bearings in axial line with each other, a rotatable member or members journaled centrally in said bearings, a rotatable driving member eccentrically mounted, one or more driven members revoluble concentrically on and with said bearings, and means to hold one of said driven members stationary, substantially as set forth.

10. In a variable-speed gear, the combination of a compound bearing, a rotatable shaft journaled therein, a rotatable pinion eccentrically mounted on a crank-pin part operated by said shaft, and a revoluble wheel having internal teeth concentrically mounted on said bearing, substantially as set forth.

11. In a variable-speed gear, the combination of a stationary bearing, revoluble members mounted thereon, a central rotatable shaft journaled therein, and means for communicating rotary motion from said shaft to said members or reversely, substantially as set forth.

12. In a variable-speed gear, the combination of a stationary bearing, revoluble members mounted thereon, a central shaft journaled therein, and a pinion adapted to communicate rotary motion between said shaft and said members, substantially as set forth.

13. In a variable-speed gear, the combination of a stationary bearing, revoluble members mounted thereon, a central shaft journaled therein, and a compound pinion having its axis of rotation eccentric to the axis of said members adapted to communicate rotary motion between said shaft and said members, substantially as set forth.

14. In a variable-speed gear, the combination of a compound bearing, a central shaft journaled therein, a revoluble wheel mounted concentrically with said shaft on the outside of said bearing, and a second wheel mounted and concentrically revoluble on an extension of the first wheel, substantially as set forth.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

JOSEPH SINCLAIR FAIRFAX.

Witnesses:

HENRY J. BROCKWELL,

WALTER E. ROCHE.