No. 804,999. PATENTED NOV. 21, 1905.

W. E. BLAIR.

VARIABLE SPEED GEARING.

APPLICATION FILED JULY 8, 1904.

3 SHEETS—SHEET 1.

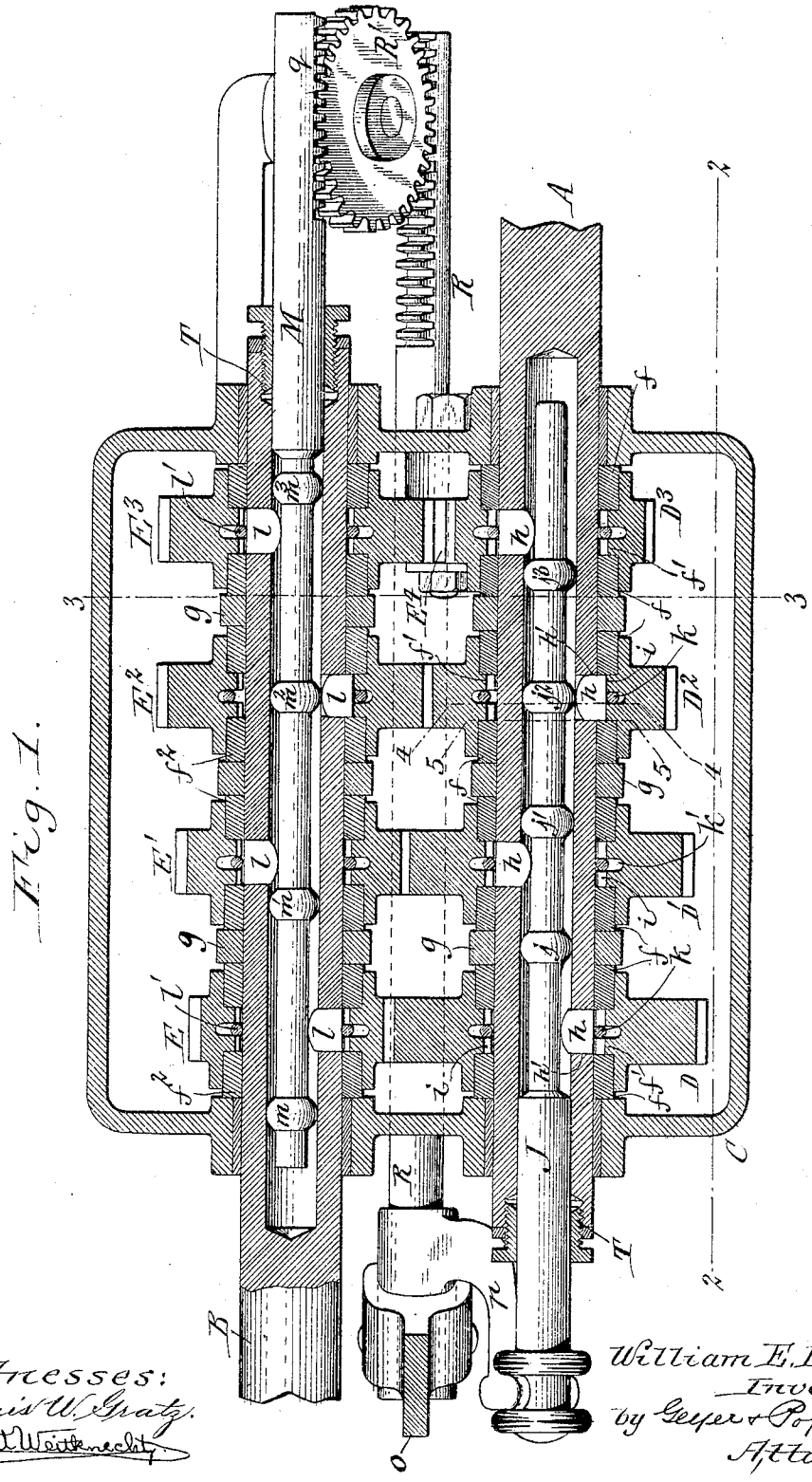


Fig. 1.

Witnesses:
Louis W. Gratz.
Robert Weitkamp

William E. Blair,
Inventor
by Geyer & Popp
Attorneys

No. 804,999. PATENTED NOV. 21, 1905.

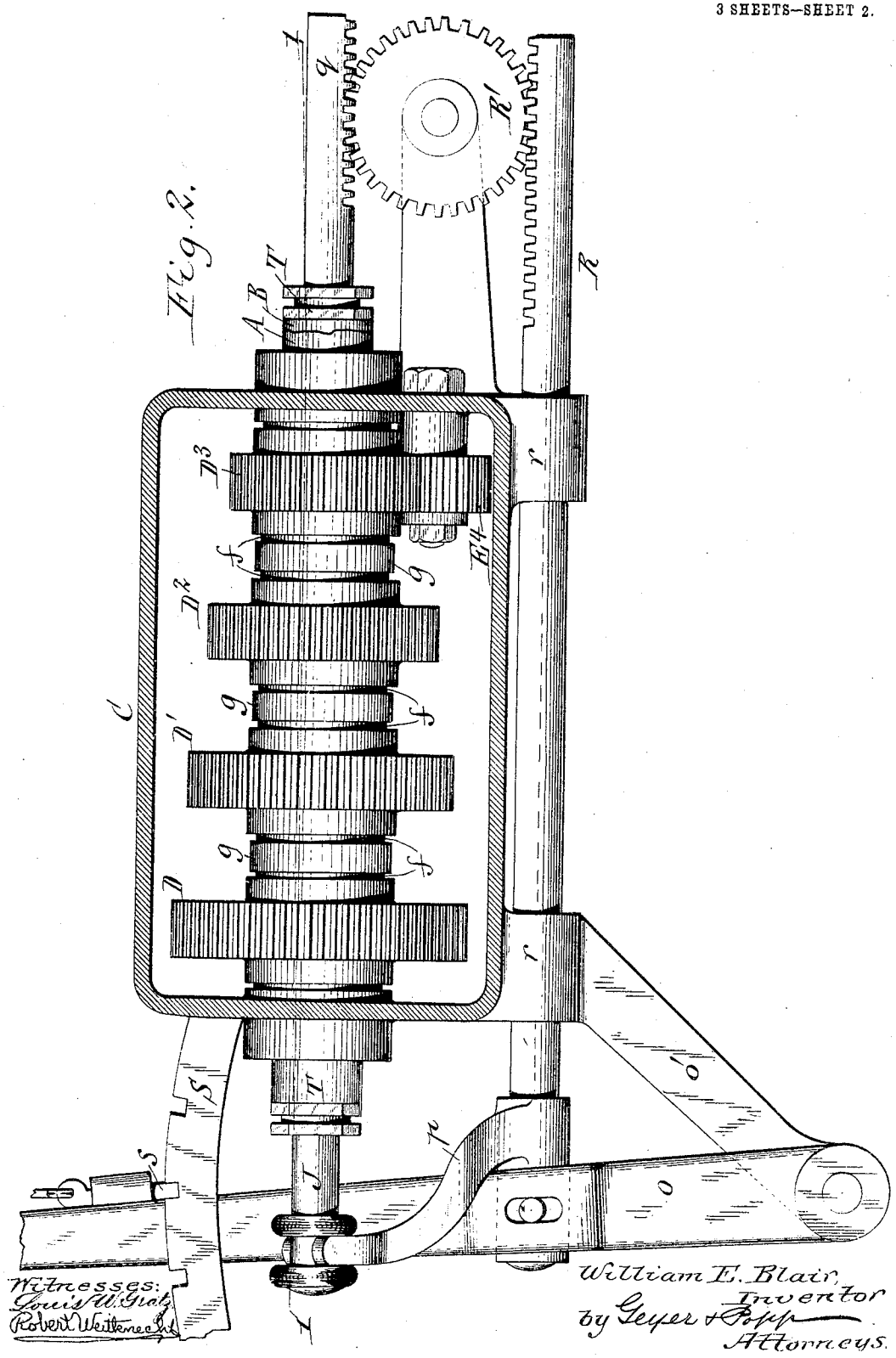
W. E. BLAIR.

VARIABLE SPEED GEARING.

APPLICATION FILED JULY 8, 1904.

3 SHEETS—SHEET 2.

Fig. 2.



Witnesses:
Louis W. Glatz
Robert Wettneck

William E. Blair,
Inventor
by Geyer & Popp
Attorneys.

No. 804,999. PATENTED NOV. 21, 1905.

W. E. BLAIR.

VARIABLE SPEED GEARING.

APPLICATION FILED JULY 8, 1904.

3 SHEETS—SHEET 3.

Fig. 3.

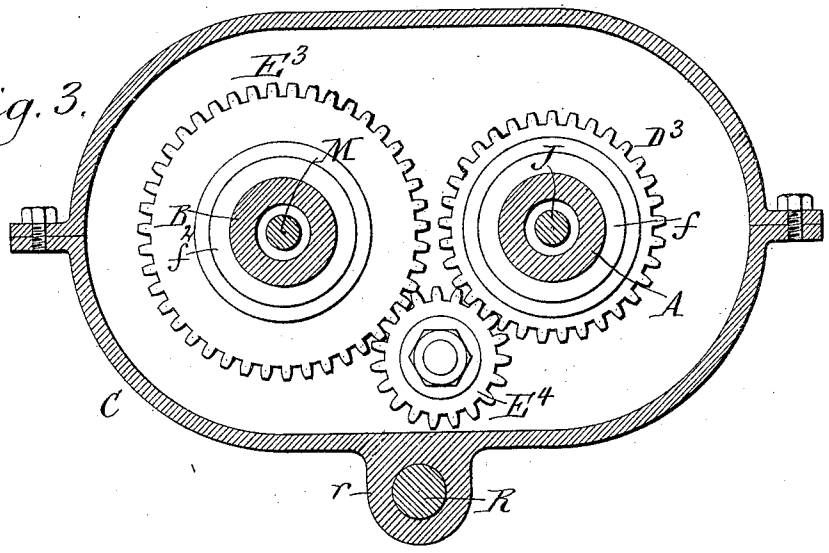


Fig. 4.

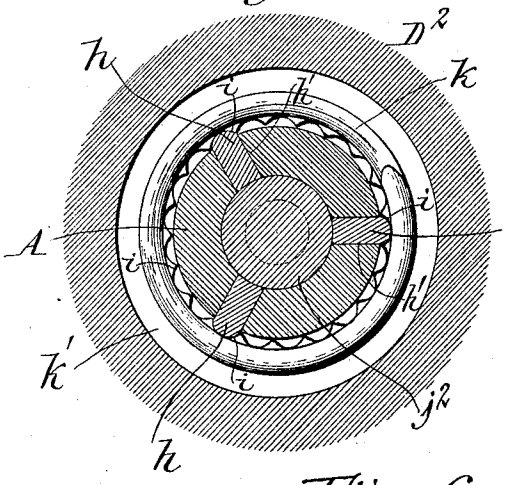


Fig. 5.

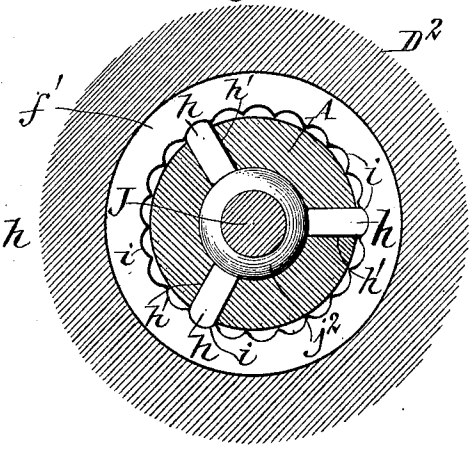
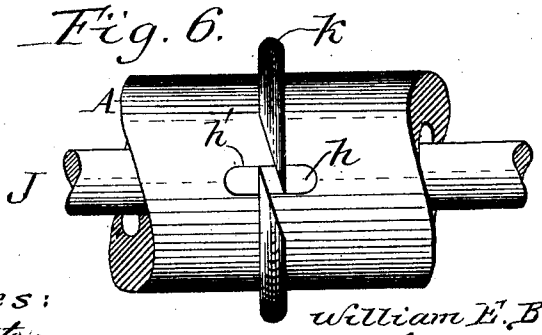


Fig. 6.



Witnesses:
Louis W. Gratz.
Robert L. Wettenachl

William E. Blair, Inventor
by Geyer & Popp
Attorneys.

UNITED STATES PATENT OFFICE.

WILLIAM E. BLAIR, OF BUFFALO, NEW YORK.

VARIABLE-SPEED GEARING.

No. 804,999. Specification of Letters Patent. Patented Nov. 21, 1905.

Application filed July 8, 1904. Serial No. 215,710.

To all whom it may concern:

Be it known that I, WILLIAM E. BLAIR, a citizen of the United States, residing at Buffalo, in the county of Erie and State of New York, have invented new and useful Improvements in Variable-Speed Gearing, of which the following is a specification.

This invention relates to a speed-changing and reversing mechanism designed more particularly for use in motor-vehicles, although the same is also desirable for lathes and other machines requiring a shaft or spindle to be driven at different rates of speed and in both directions.

The object of my invention is to provide a simple, efficient, and compact mechanism of this character which effects a prompt and reliable coupling of the loose gear-wheels to their shafts in changing from one speed to another and in which wear and noise of the parts are reduced to a minimum.

In the accompanying drawings, consisting of three sheets, Figure 1 is a horizontal section, partly in plan view, of my improved speed-changing mechanism, the plane of the section being in line 1 1, Fig. 2. Fig. 2 is a vertical longitudinal section in line 2 2, Fig. 1. Fig. 3 is a transverse section in line 3 3, Fig. 1. Figs. 4 and 5 are similar sections in the correspondingly-numbered lines in Fig. 1 on an enlarged scale. Fig. 6 is an enlarged fragmentary elevation of one of the hollow shafts, the key-actuating plunger, and the spring for retracting the keys.

Similar letters of reference indicate corresponding parts throughout the several views.

A indicates the main or driving shaft, which turns at a uniform speed, and B is the driven or counter shaft, to which motion is transmitted from the main shaft and which in turn drives the axle of the motor-vehicle or other member which it is desired to drive at different rates of speed. These shafts are journaled in suitable bearings in the usual casing C.

On the main shaft A are mounted a series of different-sized gear-wheels D D′ D^2, corresponding to the different speeds desired, and also a reversing gear-wheel D^3. The countershaft B carries a series of corresponding gear-wheels E E′ E^2 E^3, the speed-changing wheels E E′ E^2 increasing in diameter in the reverse order to the companion wheels D D′ D^2 and meshing directly therewith in a manner common to this class of gearing, while the reversing gear-wheel E^3 is connected with the gear-wheel D^3 by an intermediate idler-gear E^4, journaled on an arbor secured to the adjacent end of the casing C. Each of the gear-wheels of the main shaft is loosely mounted on the shaft and preferably provided with bushings *f*, of bronze or other suitable material, which are forced into opposite ends of the bore of the gear-wheel or otherwise secured therein. The bore is recessed or enlarged to receive the bushings, and the central portion *f*′ thereof between the bushings is just large enough in diameter to clear the shaft, so that only the bushings come in contact with the shaft.

g indicates spacing-collars secured to the main shaft between the bushings *f* of adjoining gear-wheels. Each of these gear-wheels is locked or coupled to the hollow main shaft when required by one or more radially-movable keys *h*, which are guided in corresponding slots *h*′, formed in the shaft, and adapted to interlock with notches or recesses *i*, formed in the salient central portion *f*′ of the bore of the wheel, as shown in Figs. 4 and 5. In the preferred construction shown in the drawings three of such keys are provided for each of said gear-wheels; but a greater or less number may be employed, if desired. The keys of these main gear-wheels are shifted into engagement with the wheel by a rod or plunger J sliding lengthwise in the hollow shaft and having a series of cams or convex enlargements *j* *j*′ j^2 j^3, each of which is adapted to engage the inner ends of the keys of one of the gear-wheels D D′ D^2 D^3, so as to move the keys outwardly into a set of notches *i*. The cams of the plunger are so spaced that but one of them engages a set of keys at a time, thus coupling the corresponding gear-wheel to the shaft, but allowing the remaining wheels on the shaft to remain loose or idle. For this purpose the gear-wheels are uniformly spaced on the shaft, and the cams of the plunger J are correspondingly spaced, as shown in Fig. 1.

Each of the gear-wheels preferably has a continuous annular series of locking-notches *i*, so that the keys will promptly interlock with a set of the notches when the plunger J is shifted, thereby reducing lost motion to a minimum in coupling the gear-wheels to the shaft. The notches *i* are preferably concave and the outer ends of the keys *h* correspondingly convex, as shown, so that when the keys of one of the gear-wheels are released by the cams of the plunger J during the rotation of the shaft the curved faces of the notches and

the keys tend to move the latter out of engagement with the gear-wheel. To aid in retracting the keys, split springs *k* are preferably employed, which encircle the shaft and bear against the outer ends of the keys, such a spring being provided for the keys of each gear-wheel. The gear-wheels are provided centrally in their bores with annular grooves *k'*, which receive these split springs.

The gear-wheels E to E^3 are loosely mounted on the counter-shaft B by bushings f^2, similar to those of the gear-wheels D to D^3, and they are provided with coupling devices identical with those of said gear-wheels, *l* indicating their locking-keys, *l'* their retracting-springs, and M the plunger carrying the cams *m m' m² m³*, which coöperate with the keys of the respective gear-wheels E E' E^2 E^3. This plunger slides in the hollow counter-shaft; but preferably operates in the reverse direction to the plunger in the main shaft A, its cams being properly arranged and spaced for this purpose, as shown in Fig. 1. The two plungers J M are simultaneously and uniformly shifted in opposite directions by any suitable means, so that companion gear-wheels of the two series are locked to their respective shafts at the same time, while all of the other gear-wheels remain loose and idle.

Any suitable means may be employed for operating these plungers. The preferred devices illustrated in the drawings consist of a hand-lever *o*, pivoted at its lower end to a bracket *o'* on the casing C and connected by an arm *p* with the projecting outer end of the main-shaft plunger J, whereby the latter is caused to move in the same direction as the lever. The projecting end of the other plunger M is provided with a gear-rack *q*, to which motion is transmitted from the lever *o* by a second gear-rack or shipper-rod R, connected at one end to the lever, and a gear-pinion R', interposed between said racks and meshing therewith, whereby the counter-shaft plunger is shifted in the reverse direction to the lever. The latter may be locked in its various positions by a bolt or catch *s*, mounted on the lever and engaging a notched segment S, or by any other suitable means. The gear-rack R slides in guides *r* on the casing C.

The portions of the hollow shafts A B not occupied by the plungers J M are preferably utilized as lubricant-chambers, from which the lubricant is supplied to the locking-keys *h l* and the bushings *f f²* of the gear-wheels through the guide-slots of the keys. To prevent leakage of the oil at the outer ends of the shafts, the latter are provided with suitable stuffing-boxes T, through which the plungers pass.

The operation of my improved speed-changing mechanism is as follows: When it is desired to drive the counter-shaft B at the lowest speed, the hand-lever *o* is shifted to the position shown in the drawings, in which the cams *j² m²* of the plungers J M engage the keys *h l* of the companion low-speed gear-wheels D^2 E^2, thereby coupling these two wheels to their respective shafts, all of the other cams clearing the keys of the corresponding gear-wheels, so that the latter remain idle. When it is desired to drive the counter-shaft at the next or intermediate speed, the hand-lever *o* is moved outward sufficiently to cause the cams *j' m'* to engage the keys of the intermediate speed-changing wheels D' E', while if the counter-shaft is to be driven at high speed the hand-lever is moved outward another step to cause the cams *j m* to engage the keys of the high-speed wheels D E. When it is desired to drive the counter-shaft in the reverse direction, the hand-lever is moved inward sufficiently to cause the cams *j³ m³* to engage the keys of the reversing gear-wheels D^3E^3. The cams of the plungers are so spaced that they are all disengaged from the shaft-keys after uncoupling one set of gears and before coupling the next set of gears, leaving the speed-varying mechanism idle during each shifting operation. By this means the motor may be quickly disconnected from the driven parts by simply moving the plungers a short distance in either direction sufficient to uncouple the gears which have just been active, thereby avoiding the necessity of operating a separate clutch for disconnecting the motor from the driven parts, this being particularly desirable in case of an emergency.

It will be observed that by this improved mechanism but a single pair or set of gear-wheels is in operation at a time, thereby greatly lessening noise and reducing wear of the parts.

By providing the plungers J M with an individual spreading-cam for the keys of each gear-wheel the changes of speed and the reversal of the counter-shaft can be effected by a comparatively short stroke of the plungers, rendering the mechanism correspondingly compact and convenient in operation.

The unbroken series of locking-notches *i* of the gear-wheels not only insure a prompt coupling of the wheels to their shafts in changing from one speed to another and in reversing, but also reduce the jar incident to these operations to a minimum, rendering the mechanism especially desirable for use on automobiles.

While I have herein shown and described a construction in which both shafts are provided with loosely-mounted gear-wheels having individual locking devices, the gear-wheels of one of the shafts may be permanently keyed thereto, if desired. This construction, though somewhat inferior to that shown in the drawings, would embody some of the features and advantages of my invention, and I do not, therefore, wish to be limited to the particular construction herein shown and described.

I claim as my invention—

1. The combination with a main shaft and a counter-shaft a series of gear-wheels loosely mounted on each of said shafts, the wheels of the main shaft meshing with the corresponding wheels of the counter-shaft, of individual locking devices for coupling said gear-wheels to their respective shafts, oppositely-moving plungers sliding lengthwise in said shafts and each having a plurality of actuating devices coöperating respectively with the locking devices of the corresponding gear-wheels, and means for simultaneously shifting said plungers, substantially as set forth.

2. The combination with a main shaft, a counter-shaft, and a series of gear-wheels loosely mounted on each of said shafts, the wheels of the main shaft meshing with the corresponding wheels of the counter-shaft, of individual locking devices for coupling said gear-wheels to their respective shafts, oppositely-moving plungers sliding lengthwise in said shafts and each having a plurality of actuating devices coöperating respectively with the locking devices of the corresponding gear-wheels, one of said plungers having a gear-rack, an operating-lever connected with the other plunger, a second gear-rack connected with said lever, and a pinion meshing with both of said gear-racks, substantially as set forth.

3. The combination of a shaft, a plurality of different-sized gear-wheels loosely mounted thereon and each provided in its bore with an unbroken annular series of concave recesses, radially-movable keys guided on said shaft and each having a convex outer end adapted to interlock with one of said recesses, and means for shifting the keys into engagement with said recesses, substantially as set forth.

4. The combination of a shaft, a plurality of different-sized gear-wheels loosely mounted thereon and each provided with locking-recesses, radially-movable keys guided on said shaft and each adapted to interlock with one of said recesses, means for shifting the keys outwardly into engagement with said recesses, and retracting-springs encircling the shaft and bearing against the keys, substantially as set forth.

5. The combination of a shaft, a plurality of different-sized gear-wheels loosely mounted thereon and each provided in its bore with an annular groove and an annular series of locking-recesses, radially-movable keys guided on the shaft and each adapted to interlock with one of said recesses, means for shifting the keys outwardly into engagement with said recesses, and retracting-springs for the keys encircling the shaft and each seated in one of said grooves, substantially as set forth.

6. The combination of a shaft, a plurality of different-sized gear-wheels loosely mounted thereon and each provided in the ends of its bore with enlargements and having the raised portion of its bore between said enlargements provided with recesses, bushings seated in said enlargements, radially-movable keys guided on the shaft and each adapted to interlock with one of said recesses, and means for shifting the keys into engagement with said recesses, substantially as set forth.

7. The combination of a main shaft, a counter-shaft, a plurality of intermeshing gear-wheels mounted on said shafts, means for coupling and uncoupling each shaft with the gear-wheels thereon comprising a plunger, and a shipper-rod operatively connected at one end with the plunger of one shaft and at its opposite end with the plunger of the other shaft, substantially as set forth.

Witness my hand this 5th day of July, 1904.

WILLIAM E. BLAIR.

Witnesses:

THOMAS J. HART,

THEO. L. POPP.