

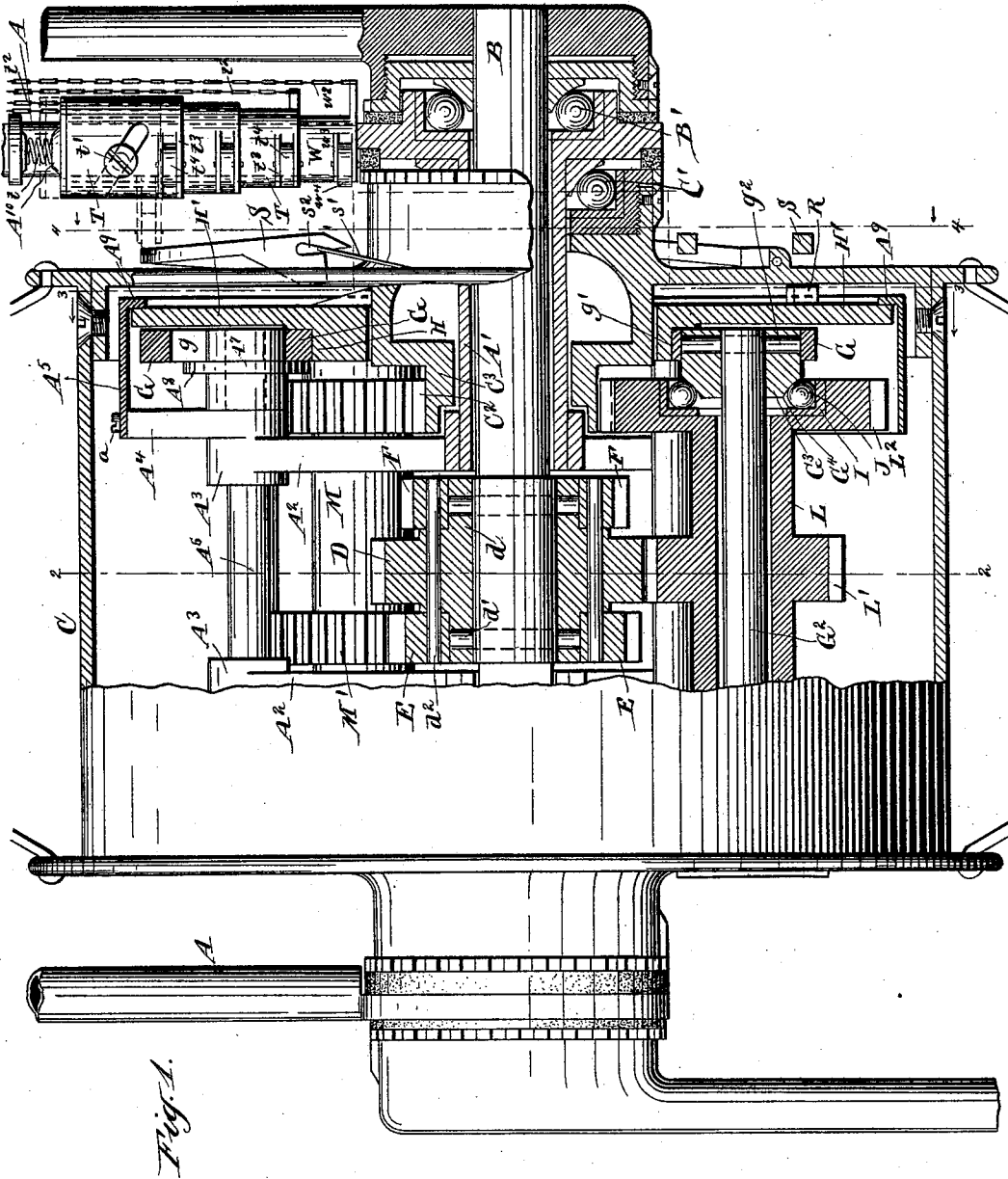
(No Model.)

4 Sheets—Sheet 1.

L. G. BILLINGS.
CHANGEABLE GEARING.

No. 588,316.

Patented Aug. 17, 1897.



WITNESSES:

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Patrick E. Collins

INVENTOR

Luther G. Billings,

BY

Charles R. Searle,
ATTORNEY.

(No Model.)

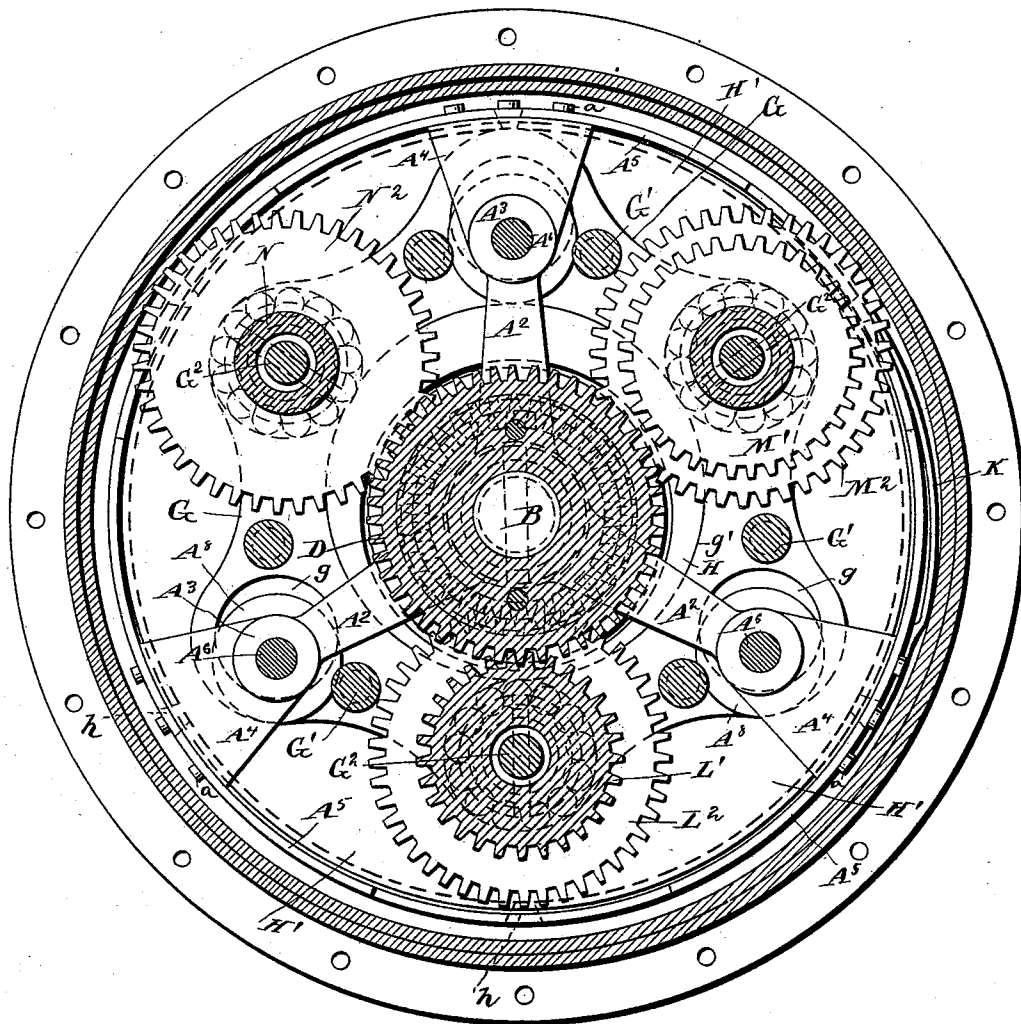
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L. G. BILLINGS.
CHANGEABLE GEARING.

No. 588,316

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Fig. 2.



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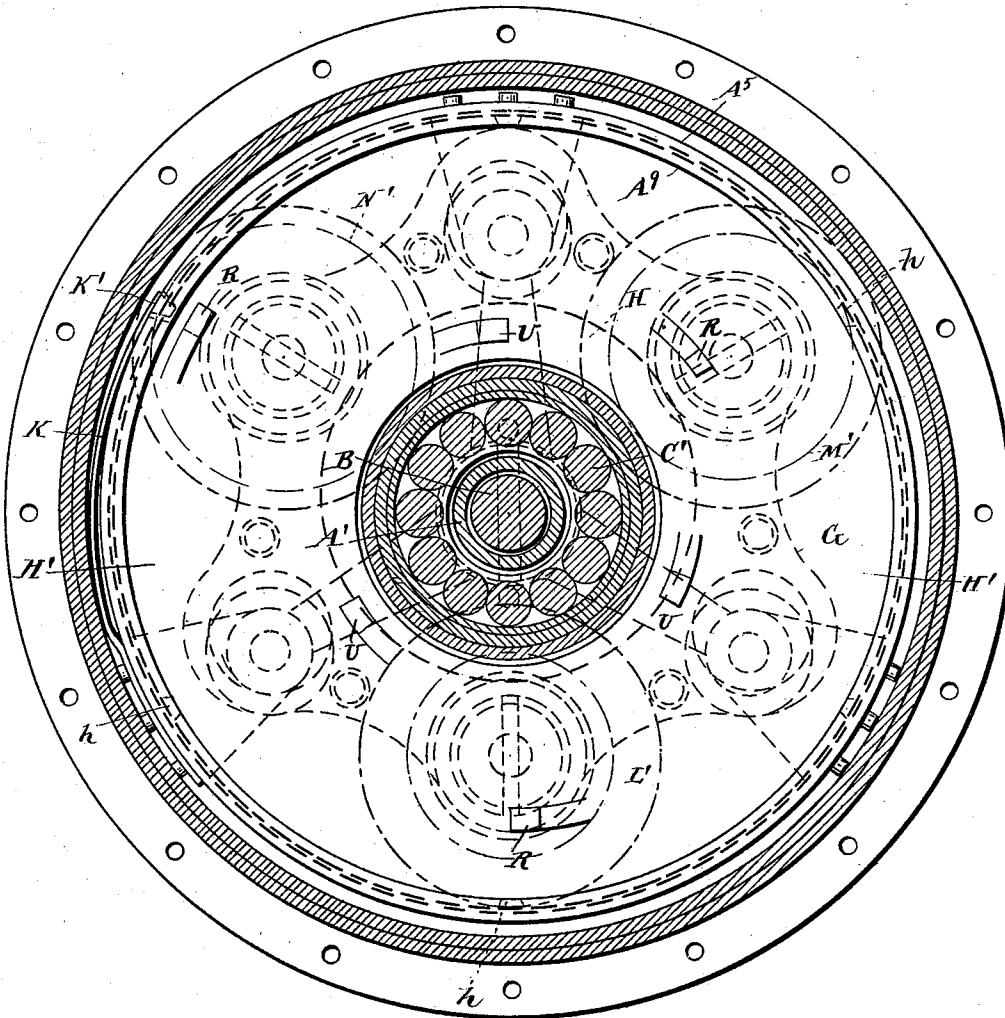
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Fig. 3.



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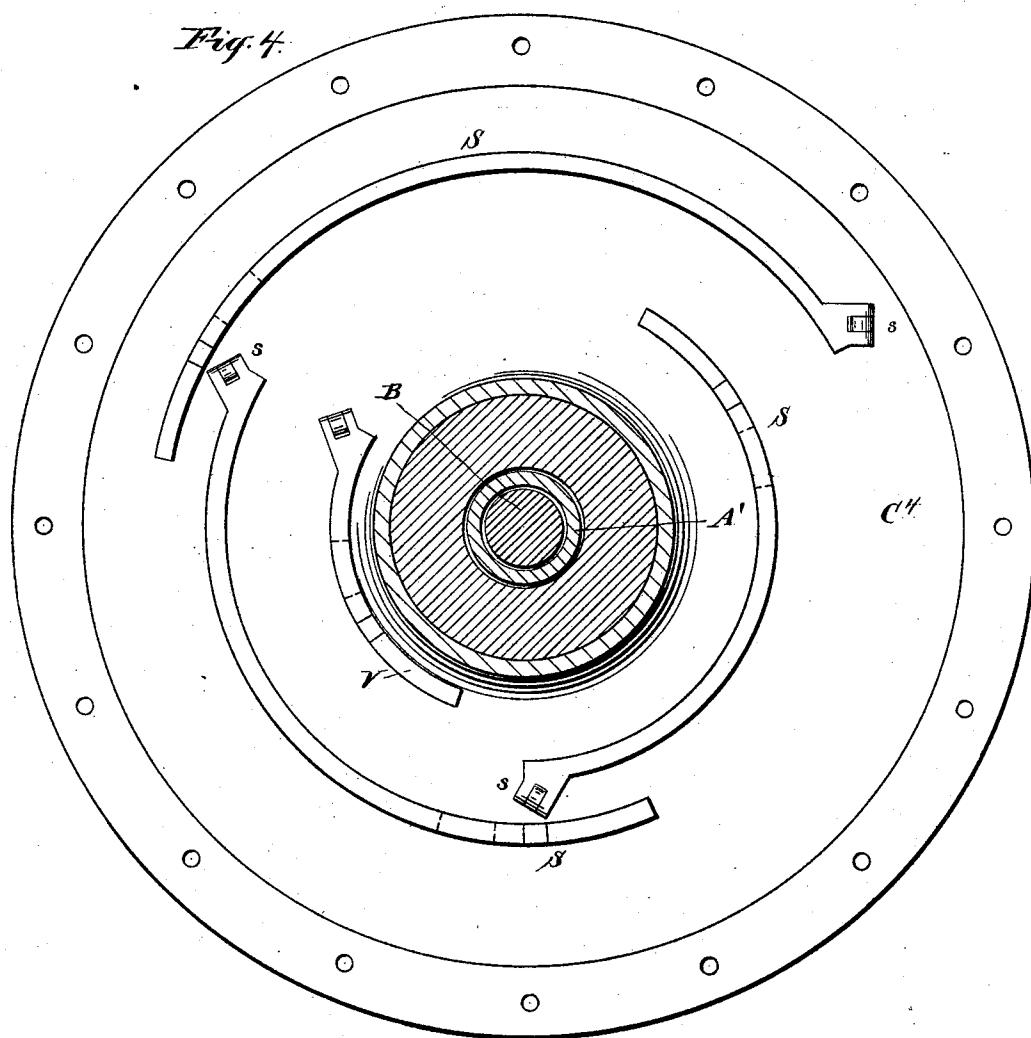
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L. G. BILLINGS.
CHANGEABLE GEARING.

No. 588,316.

Patented Aug. 17, 1897.



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UNITED STATES PATENT OFFICE.

LUTHER G. BILLINGS, OF CLIFTON, NEW YORK.

CHANGEABLE GEARING.

SPECIFICATION forming part of Letters Patent No. 588,316, dated August 17, 1897.

Application filed September 1, 1896. Serial No. 604,505. (No model.)

To all whom it may concern:

Be it known that I, LUTHER G. BILLINGS, a citizen of the United States, residing at Clifton, in the county of Richmond and State of New York, have invented a certain new and useful Improvement in Changeable Gearing, of which the following is a specification.

The invention relates to means for transmitting motion from a driving-shaft to a driven wheel or drum, and also to means for varying the ratio of speed at will.

It consists in the peculiar arrangement of a plurality of trains of gearing intermediate between the driving-shaft and driven wheel or drum, either of which may be thrown into gear at pleasure and effect a corresponding change in speed. The mechanism also provides for releasing all the trains, so that the drum may rotate freely while the shaft remains at rest.

The invention further consists in certain novel combinations and arrangements of parts to be hereinafter described.

The accompanying drawings form a part of this specification and represent the manner in which I have carried out the invention.

Figure 1 is a section on a plane parallel with and passing through the axis of the driving-shaft, certain portions being in elevation. Fig. 2 is a section at a right angle to Fig. 1, taken on the line 2 2 in that figure. Fig. 3 is a section on the broken line 3 3 in Fig. 1, seen in the direction indicated by the arrows and showing certain portions in face view. The dotted lines show the outlines of the cage and its connections. Fig. 4 is a section on the line 4 4 in Fig. 1 and shows the drum in end elevation.

Similar letters of reference indicate the same parts in all the figures.

The construction and arrangement of the hangers A, forming portions of the framing, the shaft B, driven drum C, and ball-bearings B' C' therefor will be readily understood and need not be specifically described.

At the mid-length of the shaft B is a pinion D, having its hub or boss *d* extended in both directions and held in place by the pins *d'*. The extensions form seats for two toothed rings E and F, of different diameters, joined to the pinion D by pins *d''*, compelling all to

turn together with the shaft B and forming in effect three pinions D, E, and F of differing diameter.

On the inner end of each sleeve A', extending inward from the hangers A, is fixed a three-armed spider A², the branches extending radially and at equal distances from each other and carrying each a boss A³, having a triangular web A⁴, fastened by screws *a* to a fixed retaining-ring A⁵, one on each side and each the counterpart of the other. The spiders A² are joined by short studs A⁶, passing through the bosses A³ and carrying on their overhanging ends rollers A⁷, to be presently described.

G is one of a pair of end plates, joined to its companion by rigid stay-rods G' G², the latter performing the additional function of supporting the tubular counter-shafts carrying the intermediate gears, the whole forming a frame or cage held against rotation by the rollers A⁷, extending through openings *g* in the end plates, and held against displacement axially by the flanges A⁸ on the rollers, lying in contact with the inner faces of the plates. Each of the latter is provided with a central concentric opening *g'*, and one, the right in Fig. 1, receives an eccentric H, formed on the inner face of a disk H', loosely held by a flange A⁹ on the retaining-ring A⁵ and rotatable therein by means to be described.

The stay-rods G² are provided at each end with a head G³, secured thereto by pins *g''* and fitted in corresponding openings in the end plates G. The inner faces of the heads are turned to form cones G⁴, which with the hardened-steel rings I form raceways for a series of interposed antifriction-balls J. The rings I are secured each in a recess turned out in the ends of the tubular shafts L, M, and N, provided at the mid-length with pinions L', M', and N', matching, respectively, to the pinions D, E, and F on the driving-shaft B, and also carry at each end gears L², M², and N², of equal diameter, adapted to mesh when required with two pinions C², one at each side, formed by cutting a series of teeth on the periphery of an inwardly-extending sleeve C³, cast in one with each end plate C⁴ of the drum C and loosely inclosing the fixed sleeve A', as shown.

It will be seen that as either pinion D, E, or F on the driving-shaft B is engaged by its corresponding pinion L', M', or N' the transmitted motion will be again transferred by the tubular shaft L, M, or N through the gears L², M², or N² and pinions C² to the drum C and the latter will be revolved, the rate of speed relatively to the shaft B depending on the ratio of the pinions making up each train.

If the train of gearing consisting of the pinion D, having forty-three teeth, meshing into the pinion L², having twenty-nine teeth, the pinion L² on the same shaft, with forty-three teeth, meshing into the drum-pinion C², with twenty-nine teeth, the number of revolutions of the drum C relatively to the shaft B will be as 1,849 to 841. The next train, consisting of the pinion E, having forty teeth, intermediate pinion M', having thirty-two teeth, the pinions M² and C² being as before, gives a ratio of 1,720 to 928, and the remaining train, consisting of the pinion F, having thirty-seven teeth, with the intermediate pinion N', having thirty-five teeth, produces with the gears N² and C², same as above, the ratio of 1,591 to 1,015, or, first, 2.19 to 1; second, 1.85 to 1, and, third, 1.57 to 1, approximately. As shown in the drawings, all the pinions L², M², and N² are the same in diameter and mesh with the drum-pinions C² without distinction.

The engagement of either train is effected by partially rotating the disk H' until the eccentric thereon moves the cage to the required position. The mechanism through which this is accomplished may be described as follows: On the outer face of the disk are three lugs R, similar to ratchet-teeth, equally spaced circumferentially, but at different distances radially from the center, and arranged with their working faces in the same direction. On the outer face C⁴ of the drum C are three segmentally-shaped dogs S, having their ends properly formed to engage the lugs and lying in closely-fitting slots cut in the end plate C⁴. The dogs are hinged at the opposite end to the face-plate at s and are held normally away from the face and out of engagement with the lugs by springs s', attached to the face-plate, with their free ends in the notches s², cut to receive them in the dogs S.

T T are sleeves inclosing the stud A¹⁰ and arranged to slide axially thereon against the force of springs t and for compactness telescoping one within the other, as shown. Each is provided with an oblique slot receiving a screw t', tapped into the stud, and a chain or other connection t², leading to any convenient point on the framing within the reach of the rider, by which either sleeve may be pulled axially on the stud against the force exerted by the spring t. Each sleeve carries a radial arm t³, having an anti-friction-roller t⁴ in its outer end. By reason of the oblique slot and screw t' the axial move-

ment of the sleeve also produces a partial rotation on the stud and turns the arm t³ into the position shown in dotted lines in Fig. 1, with its roller in the path of its corresponding dog S, and the latter in passing will be pressed inward, so that its working face will engage its lug R and through the latter turn the disk H' until the dog is released by passing out of the influence of roller. The first effect of the turning motion is to throw out of engagement any previously-engaged train. This will be accomplished by one-sixth of a complete revolution, and on reaching the predetermined point at which the dog is released one-third of a revolution, as here shown, the eccentric H will have gyrated the cage carrying the several trains to the position in which one of the pinions L', M', or N' corresponding to the chain pulled will mesh with its pinion D, E, or F on the driving-shaft, and the corresponding ratio be established.

In order to allow the rider to disengage all the trains without substituting another, I provide a second series of lugs U on the disk within the others, but equally spaced and each at the same radial distance from the center. Either of these may be engaged by a dog V, similar in all respects to one of the dogs S above described, but extending only one-sixth of the circumference of its circle instead of one-third, as in the others, and actuated by a sleeve W, having an arm w³ and roller w⁴, operated by a pull on the chain w², as before. The engagement with either lug U turns the disk H' one-sixth of a revolution and gyrates the cage into a position in which the gears and pinions are all out of mesh, and therefore leaves the drum C free to revolve in its bearings C' entirely independent of the driving-shaft B and its connections. The bicycle is then in the best condition for coasting. The intermediate trains of gearing are to be thrown into and out of engagement or substituted one for another as the inclination or condition may dictate, as will be understood. The rider is enabled by the peculiar mechanism shown to change from one speed to either of the others indiscriminately and without throwing into gear any but the train desired.

The holes g, receiving the rollers A⁷, are of sufficient diameter to allow all the required gyratory motion of the cage while still held between the flanges A⁸ on the rollers and the disk H'.

K is a spring dog or latch having the faces of its head K⁷ beveled, as shown, to match the beveled notches h produced in the periphery of the disk H', properly spaced to engage and hold the latter in either position determined by the dogs S and V and their lugs with sufficient force to insure against accidental disengagement, but having the angles of the faces and notches at such inclination as will release the disk under the strong force exerted by the dogs S and V.

Modifications may be made in the forms

and proportions without departing from the principles of the invention or sacrificing its advantages.

A greater or less number of trains of intermediate gearing may be employed instead of the three shown, and the ratios may be changed.

I claim—

1. In changeable gearing, the drive-shaft, a plurality of pinions of differing diameters fixed on the shaft, a drum or wheel mounted concentrically with said shaft and carrying an inwardly-projecting sleeve having a pinion thereon, in combination with the fixed sleeves inclosing said shaft, spider-frames carried by said fixed sleeves, retaining-rings secured to the spider-frames, the disks mounted on the said drum-sleeves and guided at their peripheries by the said rings, eccentrics carried by the disks, a cage gyrated by the eccentrics and carrying a plurality of counter-shafts equipped with pinions of differing diameters adapted to mesh with the said drive-shaft pinions, and gears adapted to mesh with the said drum-pinions, all substantially as herein specified.

2. The fixed sleeves A', spider-frames A² and retaining-rings A⁵, carried thereby, the studs A⁶, rollers A⁷ and flanges A⁸ on the latter, in combination with a disk H' guided in one of said retaining-rings and carrying an eccentric H, a cage gyrated by the latter and carrying a plurality of counter-shafts equipped with pinions of differing diameters as L', M' and N' and gears L², M² and N², a drive-shaft B having pinions D, E and F of differing diameters matching said counter-pinions, and an inclosing drum C having inwardly-projecting sleeves C³ and pinions C² carried on the latter and adapted to be engaged by said gears L², M² and N², all substantially as herein specified.

3. In changeable gearing, a drive-shaft, a plurality of pinions of differing diameters fixed thereon, a drum or wheel mounted concentrically with said shaft and carrying inwardly-projecting sleeves having pinions thereon, a plurality of counter-shafts each carrying an intermediate pinion of differing diameter adapted to mesh with said shaft-pinions, and mounted in a cage adapted to be shifted to effect the engagement of either intermediate pinion with its shaft-pinion, a disk H' and eccentric H thereon for shifting said cage, the lugs R on said disk, the dogs S

carried by the drum and adapted to engage each its respective lug and thereby partially rotate the disk to engage the corresponding train of gearing and means for depressing either of said dogs at will, all substantially as herein specified.

4. In changeable gearing, a drive-shaft, a plurality of pinions of differing diameters fixed thereon, a drum or wheel mounted concentrically with said shaft and carrying inwardly-projecting sleeves having pinions thereon, a plurality of counter-shafts each carrying an intermediate pinion of differing diameter adapted to mesh with said shaft-pinions, and mounted in a cage adapted to be shifted to effect the engagement of either intermediate pinion with its shaft-pinion, a disk H' and eccentric H thereon for shifting said cage, the lugs R on said disk, and dogs S carried by the drum and adapted to engage each its respective lug and thereby partially rotate the disk to engage the corresponding train of gearing, and the sleeves T and arms T³ and rollers T⁴ thereon and means as the oblique slots and screws T' therein for engaging said dogs with their respective lugs by an endwise movement of said sleeves, all substantially as herein specified.

5. In changeable gearing, a drive-shaft, a plurality of pinions of differing diameters fixed thereon, a drum or wheel mounted concentrically with said shaft and carrying inwardly-projecting sleeves having pinions thereon, a plurality of counter-shafts each carrying an intermediate pinion of differing diameter adapted to mesh with said shaft-pinions, and mounted in a cage adapted to be shifted to effect the engagement of either intermediate pinion with its shaft-pinion, a disk H' and eccentric H thereon for shifting the cage, the lugs U on said disk and the dog V carried on the drum and adapted to engage either of said lugs and thereby partially rotate the disk to disengage either of the trains of gearing and allow the said drum to revolve independently of said drive-shaft, all substantially as herein specified.

In testimony that I claim the invention above set forth I affix my signature in presence of two witnesses.

LUTHER G. BILLINGS.

Witnesses:

J. P. FIRENG,

JOHN A. DELVES.