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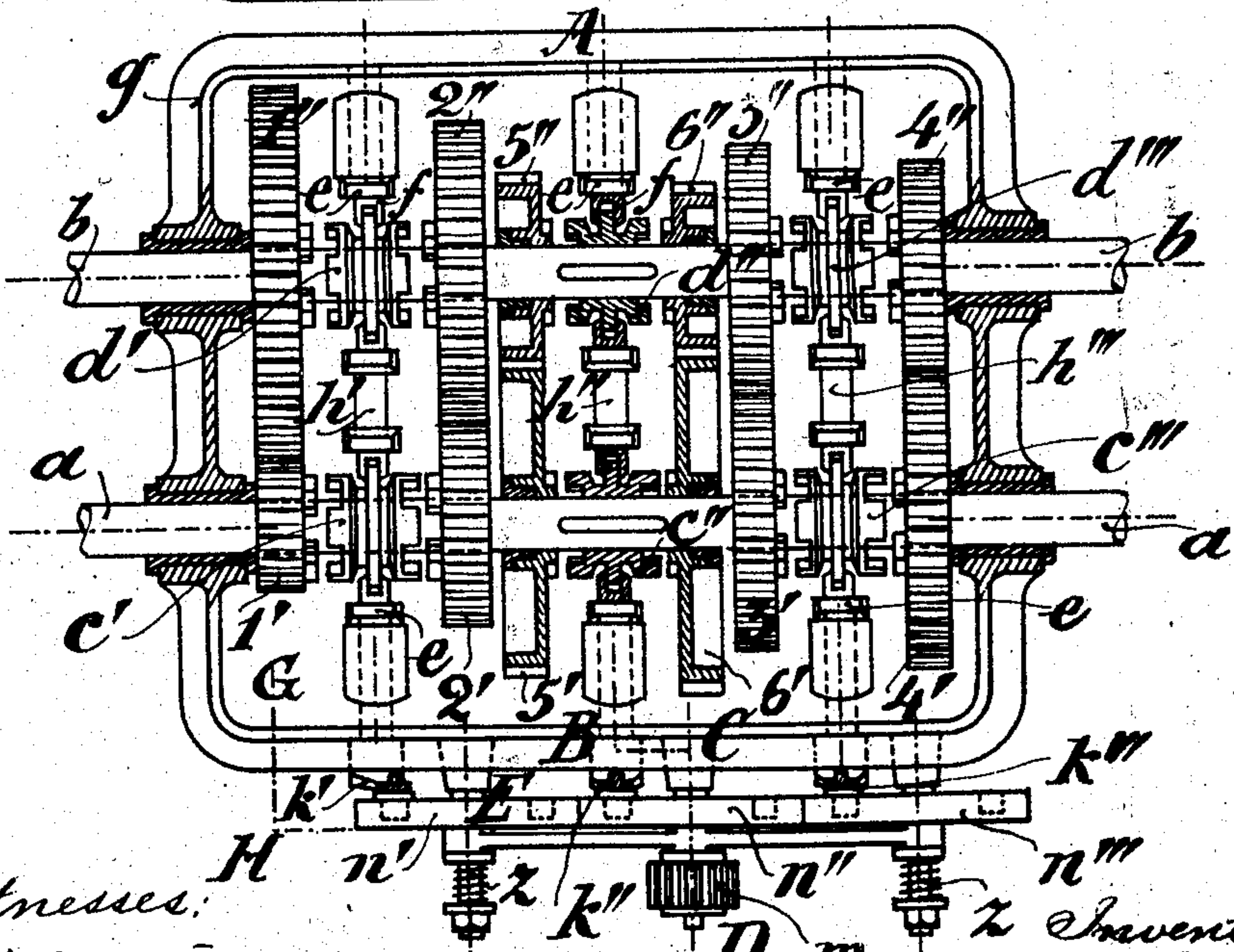
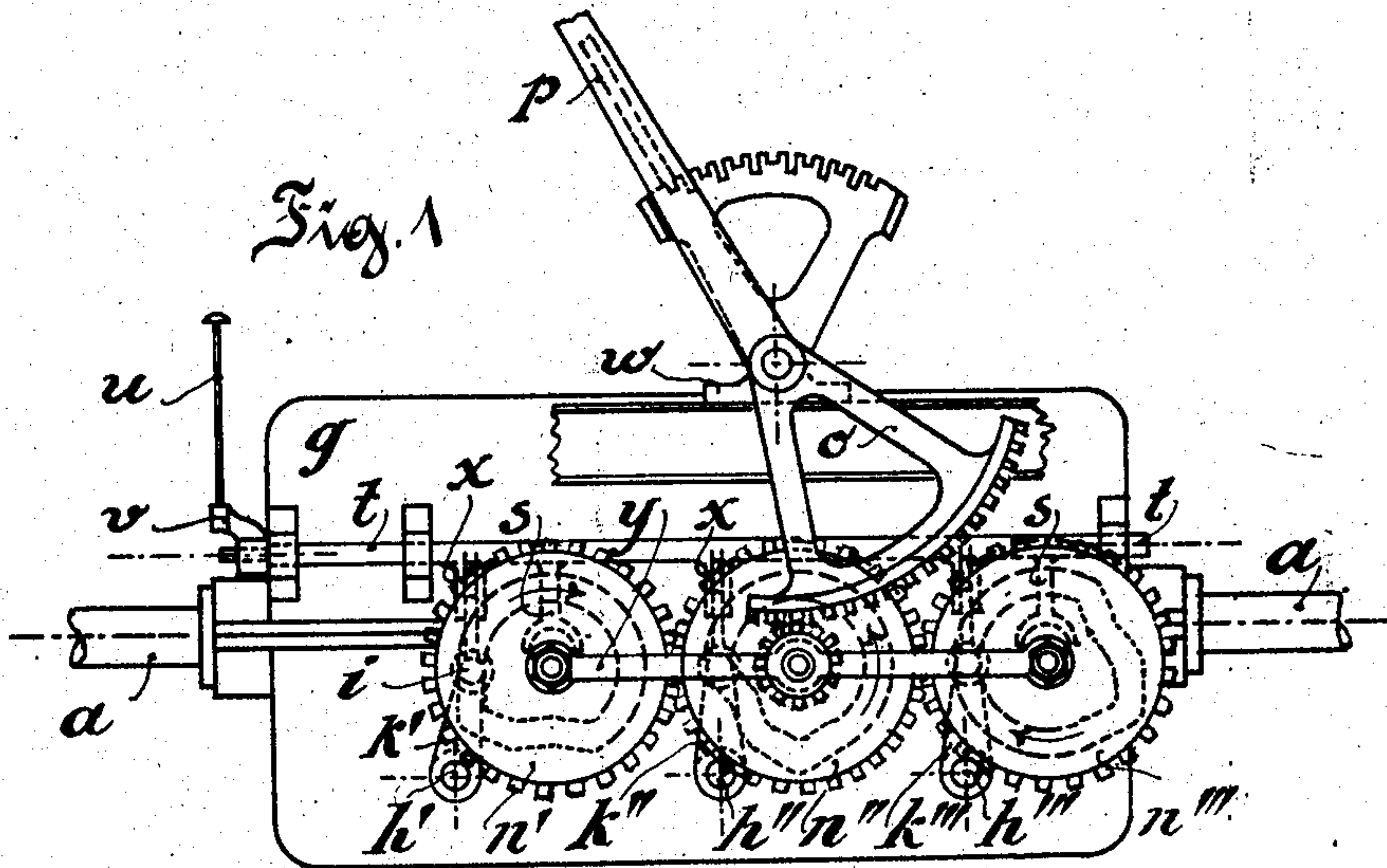
PATENTED MAR. 20, 1906.

E. SOLLER & F. HOTTINGER.

CHANGE SPEED GEARING.

APPLICATION FILED APR. 29, 1904.

2 SHEETS—SHEET 1



Witnesses:

W. K. Buelin

A. G. Thompson

F

Fig. 2

D m

Inventors

Eugen Soller,

Friedrich Hottinger

By J. E. Boulter, attorney

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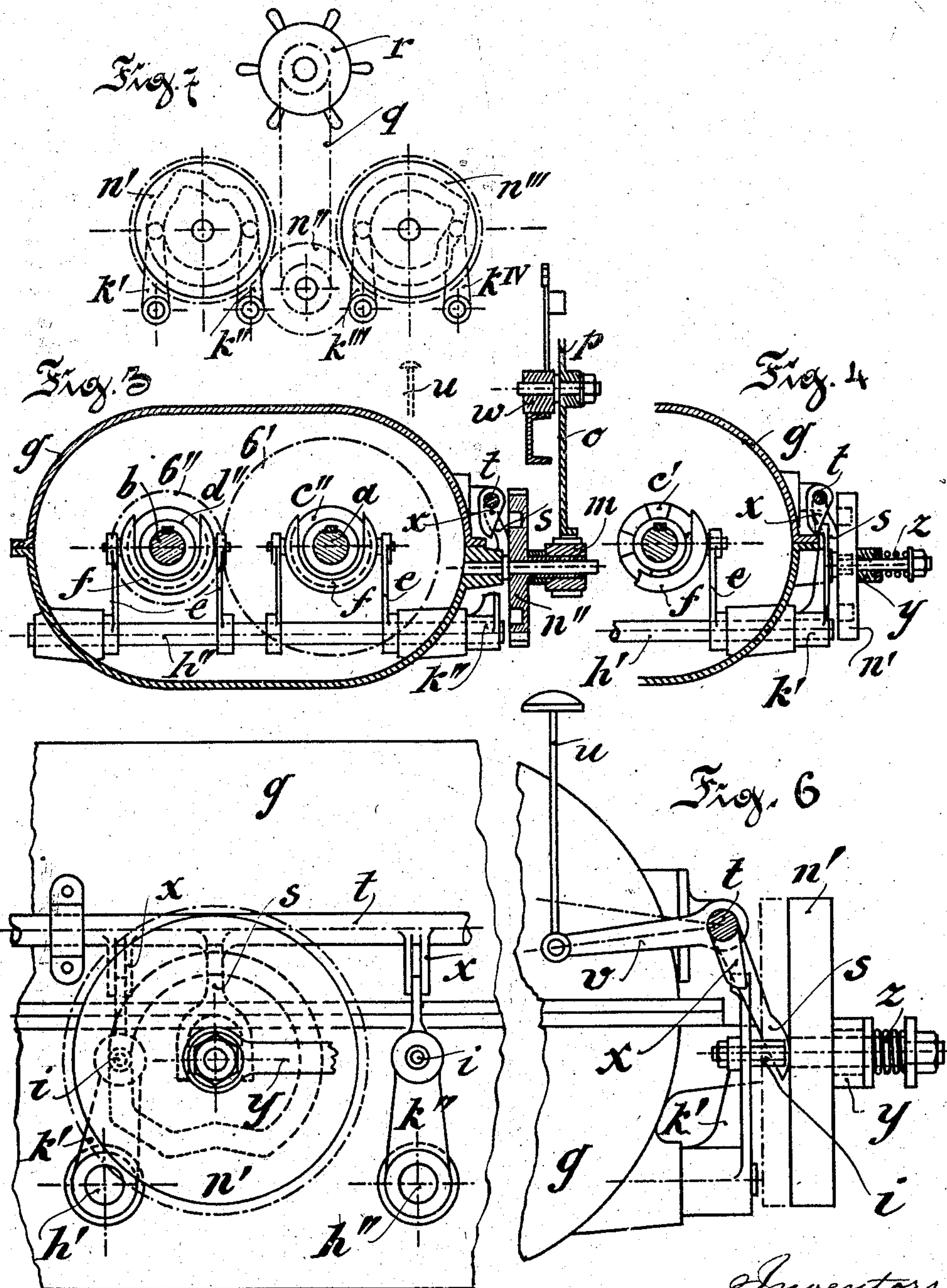
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W. K. Boulter

Attorney

Fig. 5

Inventors:
Eugen Soller,
Friedrich Hottinger,
By W. K. Boulter, attorney

UNITED STATES PATENT OFFICE.

EUGEN SOLLER, OF BASEL, AND FRIEDRICH HOTTINGER, OF BERNE,
SWITZERLAND.

CHANGE-SPEED GEARING.

No. 815,386.

Specification of Letters Patent.

Patented March 20, 1906.

Application filed April 29, 1904. Serial No. 205,614.

To all whom it may concern:

Be it known that we, EUGEN SOLLER, residing at Basel, and FRIEDRICH HOTTINGER, residing at Berne, Switzerland, citizens of the Republic of Switzerland, have invented certain new and useful Improvements in Change-Speed Gearing, of which the following is a specification.

This invention relates to a change-speed gear, more particularly for use with motor-cars, comprising a number of spur-wheels loosely mounted on the driving and driven spindles and capable of being secured to them by means of adjustable clutches, the number and sizes of the said wheels depending upon the number of speeds desired, as well as upon the speed ratios. Each spur-wheel on the driving-spindle always engages with a spur-wheel on the driven spindle, so that the speed ratio of each pair of engaging wheels is constant. The corresponding coupling clutches or sleeves on the driving-spindle and on the driven spindle are actuated by means of cranks engaging with cam-grooves of a cam. Said grooves are closed in themselves, and at least half of them are concentric, the non-concentric portion being partly formed as a projecting and partly as a reëntering angle.

The accompanying drawings illustrate, by way of example, a construction of the apparatus according to this invention, together with a modified construction thereof.

Figure 1 shows a front elevation; Fig. 2, a partly-sectional plan view; Fig. 3, a cross-section on line A B C D, and Fig. 4 a cross-section on line G H E F of Fig. 2. Fig. 5 shows part of the front elevation, and Fig. 6 part of the side elevation on an enlarged scale. Fig. 7 is a diagrammatic view showing a modified arrangement of part of the mechanism.

In the front walls of a casing *g* are mounted two parallel driving and driven shafts *a* and *b*, respectively. On each of these two shafts are mounted loose six spur-wheels 1' to 6' and 1'' to 6'' of varying sizes, the spur-wheel of one shaft being always in engagement with that of the other shaft having the same index—that is to say, the wheel 2' engages with 2'', 5' with 5'', and so on. The hubs of all the twelve wheels are provided on one side with projections, forming parts of clutches, said projections being on one wheel on the right-

hand side and on the next one on the same shaft on the left-hand side, on the third one again on the right-hand side, and so on. The other side of the hub is plain. Between the projections of each two adjoining spur-wheels are mounted coupling-clutches *c'* *c''* *c'''* and *d'* *d''* *d'''*, provided with corresponding projections on both sides and mounted on the shaft so that they cannot rotate, but are longitudinally movable on it. The clutches *c* are slightly wider than the clutches *d*, or the projections of the former are slightly longer than those of the latter. Each clutch is engaged by a fork *f*, pivoted on two arms *e*. The four arms *e* for the clutches *c'* and *d'* or *c''* and *d''* or *c'''* and *d'''* are secured to one and the same crank-shaft *h'* or *h''* or *h'''*—that is to say, (see Fig. 3,) the clutches, say *c''* and *d''*, are secured to *h''*—so that the corresponding clutches are thus operated simultaneously, the coupling-clutches *c*, owing to their longer projections, engaging with one or the other of the spur-wheels slightly earlier than the clutches *d*.

To the outer ends of the crank-shafts *h'* *h''* *h'''* are secured cranks *k'* *k''* *k'''*, which are provided near their free ends with roller-carrying pins *i*. The rollers in question engage in grooves of toothed cams *n'* *n''* *n'''* of the same size which engage always with one another. The grooves of the three cams *n'* *n''* *n'''* are endless, being circular along two-thirds of the circumference, (two hundred and forty degrees,) while on one-sixth of the circumference (sixty degrees) they form a projecting angle, and on the remaining sixth a reëntering angle, as can be seen in Fig. 1. The three cams are so arranged with reference to their different direction of rotation, that during a complete revolution in the direction of the arrow, Fig. 1, all the three cranks are in turn moved first from the central position into the left-hand-end position and then into the right-hand-end position, the corresponding pairs of clutches being shifted in turn first also to the left hand and then to the right hand—that is to say, only one clutch on the shaft *a* and one on the shaft *b* are operated, but never several pairs of clutches together.

To the extension of the hub of the cam *n''* is secured a toothed wheel *m*, with which engages a toothed segment *o*, which can be rotated by means of a hand-lever *p*, adapted to

be fixed, by means of a pawl, in twelve positions on a bracket w , provided with a corresponding number of recesses or notches of unequal depth. The distance between each
 5 two recesses or notches I II-VI for the pawl and the ratio between the toothed segment o and the toothed wheel m are calculated so that when the hand-lever p is turned through a portion corresponding to the said distance
 10 the cams are turned through an angle of sixty degrees. The shallower projections on the bracket w serve for fixing the lever in positions corresponding to those positions of the three cams in which the rollers on all the three
 15 cranks k' k'' k''' are in the circular portion of the cam-grooves or at a point situated at the same distance from the center as the grooves in question.

In order to effect the change of a high to a
 20 much lower speed, or vice versa, leaving out those in between—say from the second speed on to the fifth—the three cam-disks are mounted so as to be longitudinally adjustable on their journals. Against the centers
 25 of the inner sides of the two outer cams rest forks s , mounted on a spindle t , which can be actuated by means of a pedal u and lever v . On the said spindle are also mounted three
 30 pairs of lugs x for the purpose of fixing between them the free ends of the cranks k' k'' k''' , so as to prevent them from swinging laterally while the rollers are out of engagement with the grooves of the cam-disks. The hubs
 35 of the three cams are connected together by a cross-bar y in such manner that they can only be moved all together and in such manner as to always remain parallel to their normal position and all in one plane. On the
 40 journals of the two outer cams n' and n''' are mounted helical springs z for the purpose of always returning the cross-bar y and the cams to their normal position.

The manipulation and the working of the
 45 change-speed gear described during driving are as follows: After disengaging the pawl the hand-lever p is swung to the right—say so far as to bring it to engage with the notch marked I of the quadrant w . In this swinging
 50 movement the toothed segment o participates engaging with the toothed wheel m . The result is that the cam-disks are turned to a corresponding extent in the direction indicated by the arrow, Fig. 1. During this
 55 movement the crank k' , the roller of which engages with the groove of the cam n' , will be operated first, for the rollers of the cranks k'' and k''' are still in the circular portion of the grooves of the cams n'' and n''' . The crank
 60 k' therefore will only be slightly moved to the left, the result being that first the clutch c' will engage with the projection of the spur-wheel $1'$, and a moment later the clutch d' will come into engagement with the projections
 65 of the spur-wheel $1''$. As soon as the clutch c' has been thrown into gear, $1'$, and there-

fore $1''$, also will begin to participate in the rotation, and at the next moment the projections of the latter can be engaged by those of the clutch d'' . After the coupling has been
 70 effected the rotation of the shaft a will be transmitted to the shaft b , which will have a speed in proportion to the ratio between the spur-wheels $1'$ and $1''$. If it is desired to
 75 throw into gear the next highest speed, then the hand-lever after its pawl has been disengaged is moved farther to the right until the pawl engages with the notch II. This movement causes the cams n to again turn through
 80 an angle of sixty degrees; but again only the movement of n' results in its couplings being thrown into gear. Owing to the shape of the groove of n' the roller engaging with it will pass over a point at the same distance from
 85 the center as the circular portion of the groove into a position situated nearer to the center, the result of this being that the crank k' will pass from its left-hand-end position over the central position to the right-hand-end position, which again results in the shifting
 90 of the clutches c' and d' to the right. For one moment the coupling is thrown completely out of gear, and then first the clutch c' will come into engagement with $2'$ and immediately afterward d' with $2''$. If it be desired
 95 to change, say, from the second speed direct to the sixth, the hand-lever p is first turned until the pawl first engages with the shallower notch immediately following that on which it was before. Then the pedal u is
 100 depressed and the shaft t turned to such an extent that the pairs of lugs x , mounted on it, fix between them the free end of all the three cranks k , and the forks s press the cams connected by the cross-bar y outward against
 105 the action of the helical springs z to such an extent that the rollers of the cranks k' k'' k''' become disengaged from the grooves of the cam-disks, so that the latter become freely rotatable. Then, and not until then, the
 110 hand-lever p is turned farther to the right until the pawl engages with the last of the shallow notches, whereupon the pedal u is again released, thus releasing the cranks, and the cams will return under the influence
 115 of the action of the springs z to their normal position. The hand-lever p is now finally turned into its outermost position, the pawl being brought into the notch VI, the crank k'' alone being operated during that movement, which will result in the clutches c'' and
 120 d'' being shifted to the right, so that the ratio between the speeds of the shafts a and b will then be the same as that between the wheels $6'$ and $6''$.

The driving of the cam-disks could also be
 125 effected by means of a hand-wheel r , as shown dotted in Fig. 1, and a chain q , leading from it to a sprocket-wheel, mounted on the spindle of the cam-disk n'' .

If more than six—for instance, eight—dif- 130

ferent speeds are to be obtained with the present change-speed gear, the number of the spur-wheel pairs on the shafts *a b* must be increased by two and the number of the coupling-sleeve pairs *c d* by one, and consequently also the number of the cranks by one. However, two cam-disks *n* instead of three can be used, as shown in Fig. 7, by causing the pivots *i* of two adjacent cranks—for instance, *k'* and *k''*—to engage with the cam-groove of one and the same disk *n'*. In this case the groove of both disks *n'* and *n'''* would extend concentrically to three-quarters, equal to two hundred and seventy degrees of the circumference, and form a projecting angle for one-eighth, equal to forty-five degrees, and a re-entering angle for one-eighth of the circumference. For a whole revolution of the cam-disks all four cranks are operated, and the central disk *n''* need therefore have no groove, as it only serves the purpose of an intermediate gear-wheel.

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

1. In change-speed gearing, a driving and a driven shaft, a plurality of gear-wheels mounted loosely on said shafts and engaging together in pairs, a corresponding series of pairs of coupling-clutches longitudinally adjustable on both shafts, rotatable disks geared together and each provided with a partly-concentric and partly projecting and re-entering cam-groove with the projecting and re-entering parts arranged in a different part of the groove relatively to the other disks, and a series of clutch-operating cranks engaging in said cam-grooves, substantially as set forth.

2. In change-speed gearing, a driving and a driven shaft, a plurality of gear-wheels mounted loosely on said shafts and engaging together in pairs, a corresponding series of pairs of coupling-clutches longitudinally adjustable on both shafts, rotatable disks geared together and each provided with a partly-concentric and partly projecting and re-entering cam-groove with the projecting and re-entering parts arranged in a different part of the groove relatively to the other disks, a series of clutch-operating cranks engaging in said cam-grooves, and means for moving the rotatable disks axially on their spindles to cause the disengagement and reengagement of the cranks in the cam-grooves when it is desired to change from one speed to another, substantially as set forth.

3. In change-speed gearing, a driving and a driven shaft, a plurality of gear-wheels mounted loosely on said shafts and engaging together in pairs, a corresponding series of pairs of coupling-clutches longitudinally adjustable on both shafts, rotatable disks geared together and each provided with a partly-concentric and partly projecting and re-entering cam-groove with the projecting and re-

entering parts arranged in a different part of the groove relatively to the other disks, a series of clutch-operating cranks engaging in said cam-grooves, a pedal-operated shaft provided with engaging means for axially shifting the rotatable disks on their spindles and crank-holding lugs, attached to said shaft, substantially as set forth.

4. In change-speed gearing, a driving and a driven shaft, a plurality of gear-wheels mounted on said shafts and engaging together in pairs, a corresponding series of coupling-clutches arranged between each pair of gear-wheels on each shaft and longitudinally adjustable on the said shaft, each coupling-clutch being adapted to be engaged with the gear-wheel on either side of it or to be free of both, and the corresponding clutches on the driving and driven shafts being adapted for operation together, rotatable disks geared together and each provided with a partly-concentric and partly projecting and re-entering cam-groove with the projecting and re-entering parts arranged in a different part of the groove relatively to the other disks, and a series of clutch-operating cranks engaging in said cam-grooves, substantially as set forth.

5. In change-speed gearing, a driving and a driven shaft, a plurality of gear-wheels mounted on said shafts and engaging together in pairs, a corresponding series of coupling-clutches arranged between each pair of gear-wheels on each shaft and longitudinally adjustable on the said shaft, each coupling-clutch being adapted to be engaged with the gear-wheel on either side of it or to be clear of both, and the corresponding clutches on the driving and driven shafts being adapted for operation together, rotatable disks geared together and each provided with a partly-concentric and partly projecting and re-entering cam-groove with the projecting and re-entering parts arranged in a different part of the groove relatively to the other disks, a series of clutch-operating cranks engaging in said cam-grooves, and means for moving the rotatable disks axially on their spindles to cause the disengagement and reengagement of the cranks in the cam-grooves when it is desired to change from one speed to another, substantially as set forth.

6. In change-speed gearing a driving and a driven shaft, a plurality of gear-wheels mounted on said shafts, and engaging together in pairs, a corresponding series of coupling-clutches arranged between each pair of gear-wheels on each shaft and longitudinally adjustable on the said shaft, each coupling-clutch being adapted to be engaged with the gear-wheel on either side of it or to be free of both, and the corresponding clutches on the driving and driven shafts being adapted for operation together, rotatable disks geared together and each provided

with a partly-concentric and partly projecting and reëntering cam-groove with the projecting and reëntering parts arranged in a different part of the groove relatively to the other disks, a series of clutch-operating cranks engaging in said cam-grooves, a pedal-operated shaft provided with engaging means for axially shifting the rotatable disks on their spindles, and crank-holding lugs attached to said shaft, substantially as set forth.

7. In change-speed gearing, a driving and a driven shaft, a plurality of gear-wheels mounted loosely on said shafts, and engaging together in pairs, a corresponding series of pairs of coupling-clutches longitudinally adjustable on both shafts, rotatable disks geared together and each provided with a partly-concentric and partly projecting and reëntering cam-groove with the projecting and reëntering parts arranged in a different part of the groove relatively to the other disks, a series of clutch-operating cranks engaging in said cam-grooves, and means for rotating the cam-disks to cause the cams to operate the cranks consecutively whereby during a complete revolution of the cam-disks all the cranks, and therefore all the clutches, are operated in turn substantially as set forth.

8. In change-speed gearing, a driving and a driven shaft, a plurality of gear-wheels mounted on said shafts, and engaging together in pairs, a corresponding series of coupling-clutches arranged between each pair of gear-wheels on each shaft, and longitudinally adjustable on the said shaft, each coupling-clutch being adapted to be engaged with the gear-wheel on either side of it or to be free of both and the corresponding clutches on the driving and driven shafts being adapted for operation together, rotatable disks geared together and each provided with a partly-concentric and partly projecting and reëntering cam-groove with the projecting and reëntering parts arranged in a different part of the groove relatively to the other disks, a series of clutch-operating cranks engaging in said cam-grooves, and means for rotating the cam-disks to cause the cams to operate the cranks consecutively whereby during a complete revolution of the cam-disks all the cranks, and therefore all the clutches, are operated in turn, substantially as set forth.

9. In change-speed gearing, a driving and a driven shaft, a plurality of gear-wheels mounted loosely on said shafts and engaging together in pairs, a corresponding series of pairs of coupling-clutches longitudinally adjustable on both shafts, the clutches on one shaft having long projections and the clutches of the other shaft having shorter projections, rotatable disks geared together and each provided with a partly-concentric and partly projecting and reëntering cam-groove with the projecting and reëntering parts arranged in a different part of the groove relatively to

the other disks, and a series of clutch-operating cranks engaging in said cam-grooves, substantially as set forth.

10. In change-speed gearing, a driving and a driven shaft, a plurality of gear-wheels mounted on said shafts and engaging together in pairs, a corresponding series of coupling-clutches arranged between each pair of gear-wheels on each shaft and longitudinally adjustable on the said shaft, each coupling-clutch being adapted to be engaged with the gear-wheels on either side of it or to be free of both and the corresponding clutches on the driving and driven shafts being adapted for operation together, the clutches on one shaft having long projections and the clutches of the other shaft having shorter projections, rotatable disks geared together and each provided with a partly-concentric and partly projecting and reëntering cam-groove with the projecting and reëntering parts arranged in a different part of the groove relatively to the other disks and a series of clutch-operating cranks engaging in said cam-grooves, substantially as set forth.

11. In change-speed gearing, a driving and a driven shaft, a plurality of gear-wheels mounted loosely on said shafts and engaging together in pairs, a corresponding series of pairs of coupling-clutches longitudinally adjustable on both shafts, rotatable disks geared together and each provided with a partly-concentric and partly projecting and reëntering cam-groove with the projecting and reëntering parts arranged in a different part of the groove relatively to the other disks, and a series of clutch-operating cranks engaging in pairs with each cam-groove to operate both of them at different times, substantially as set forth.

12. In change-speed gearing, a driving and a driven shaft, a plurality of gear-wheels mounted loosely on said shafts and engaging together in pairs, a corresponding series of pairs of coupling-clutches longitudinally adjustable on both shafts, rotatable disks geared together and each provided with a partly-concentric and partly projecting and reëntering cam-groove with the projecting and reëntering parts arranged in a different part of the groove relatively to the other disks, a series of clutch-operating cranks engaging in pairs with each cam-groove to operate both of them at different times, and means for rotating the cam-disks to cause the cams to operate the cranks consecutively whereby during a complete revolution of the cam-disks all the cranks, and therefore all the coupling-clutches are operated in turn, substantially as set forth.

13. In change-speed gearing, a driving and a driven shaft, a plurality of gear-wheels mounted on said shafts and engaging together in pairs, a corresponding series of coupling-clutches arranged between each pair of

gear-wheels on each shaft and longitudinally adjustable on the said shaft, each coupling-clutch being adapted to be engaged with the gear-wheel on either side of it or to be free of both and the corresponding clutches on the driving and driven shafts being adapted for operation together, rotatable disks geared together and each provided with a partly-concentric and partly projecting and reëntering cam-groove with the projecting and reëntering parts arranged in a different part of the groove relatively to the other disks, and a series of clutch-operating cranks engaging in pairs with each cam-groove to operate both of them at different times, substantially as set forth.

14. In change-speed gearing, a driving and a driven shaft, a plurality of gear-wheels mounted on said shafts and engaging together in pairs, a corresponding series of coupling-clutches arranged between each pair of gear-wheels on each shaft, and longitudinally adjustable on the said shaft, each coupling-clutch being adapted to be engaged with the gear-wheel on either side of it or to be free of both and the corresponding clutches on the driving and driven shafts being adapted for operation together, rotatable disks geared together and each provided with a partly-concentric and partly projecting and reëntering cam-groove with the projecting and reëntering parts arranged in a different part of the groove relatively to the other disks, a series of clutch-operating cranks engaging in pairs

with each cam-groove to operate both of them at different times, and means for rotating the cam-disks to cause the cams to operate the cranks consecutively whereby during a complete revolution of the cam-disks all the cranks, and therefore all the coupling-clutches, are operated in turn substantially as set forth.

15. In change-speed gearing, a driving and a driven shaft, a plurality of gear-wheels mounted loosely on said shafts and engaging together in pairs, a corresponding series of pairs of coupling-clutches longitudinally adjustable on both shafts, rotatable disks geared together and each provided with a partly-concentric and partly projecting and reëntering cam-groove with the projecting and reëntering parts arranged in a different part of the groove relatively to the other disks, a series of clutch-operating cranks engaging in said cam-grooves, a gear-wheel on the shaft of one of the cam-disks and a toothed segment engaging therewith, a hand-lever therefor and a notched sector for said hand-lever substantially as set forth.

In testimony whereof we have hereunto set our hands to this specification in the presence of two subscribing witnesses.

EUGEN SOLLER.
FRIEDRICH HOTTINGER.

Witnesses:

ALBERT GRAETER,
GEO. GIFFORD.