No. 702,930 Patented June 24, 1902.

T. A. DICKS.

CHANGEABLE SPEED AND REVERSING GEAR.

(Application filed Sept. 25, 1901.)

(No Model.) 3 Sheets—Sheet 1.

Fig. 3.

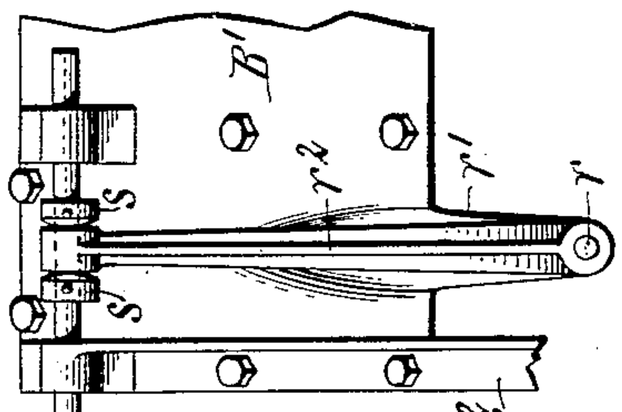


Fig. 2.

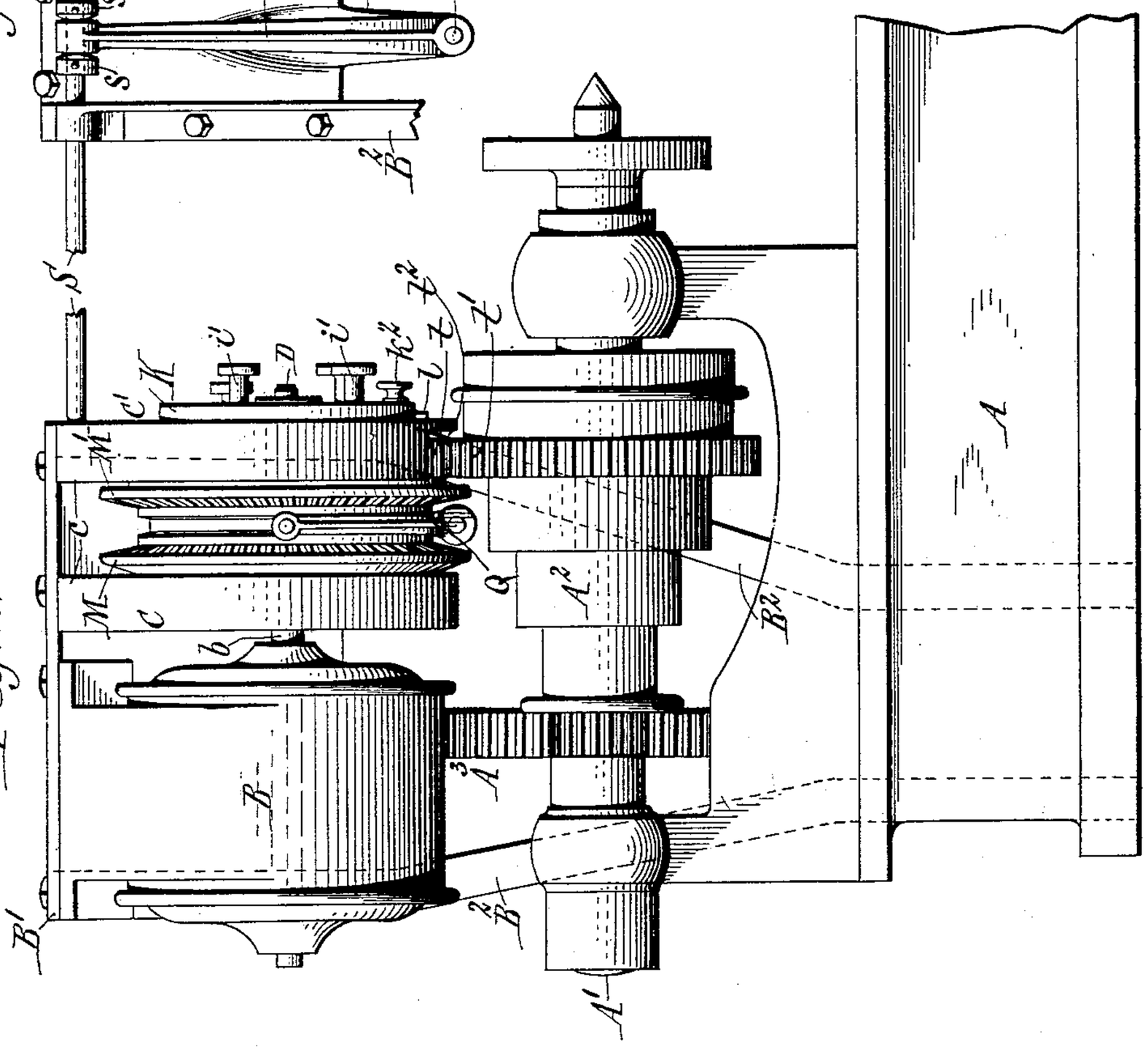
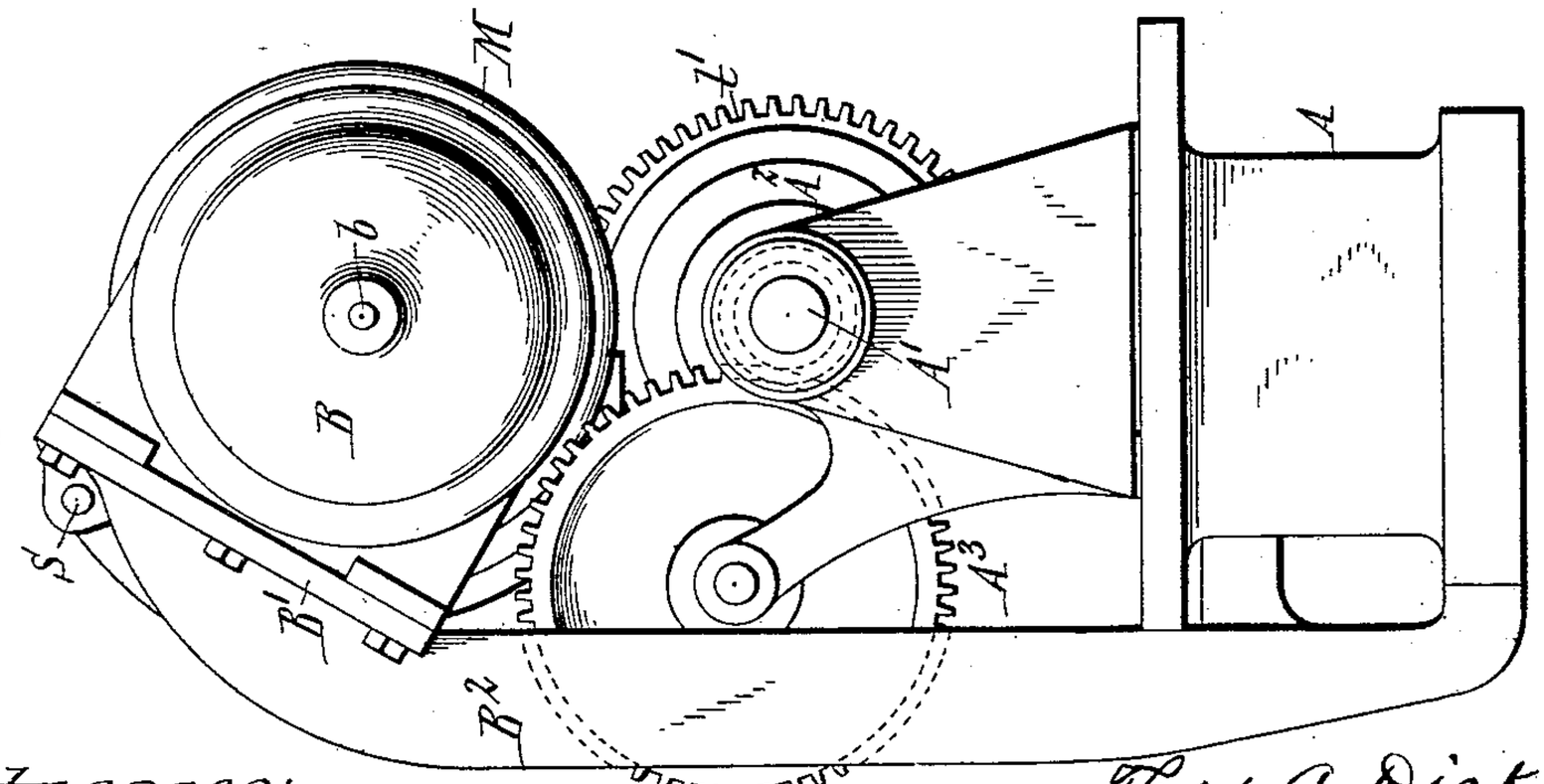


Fig. 1.



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(No Model.) 3 Sheets—Sheet 2.

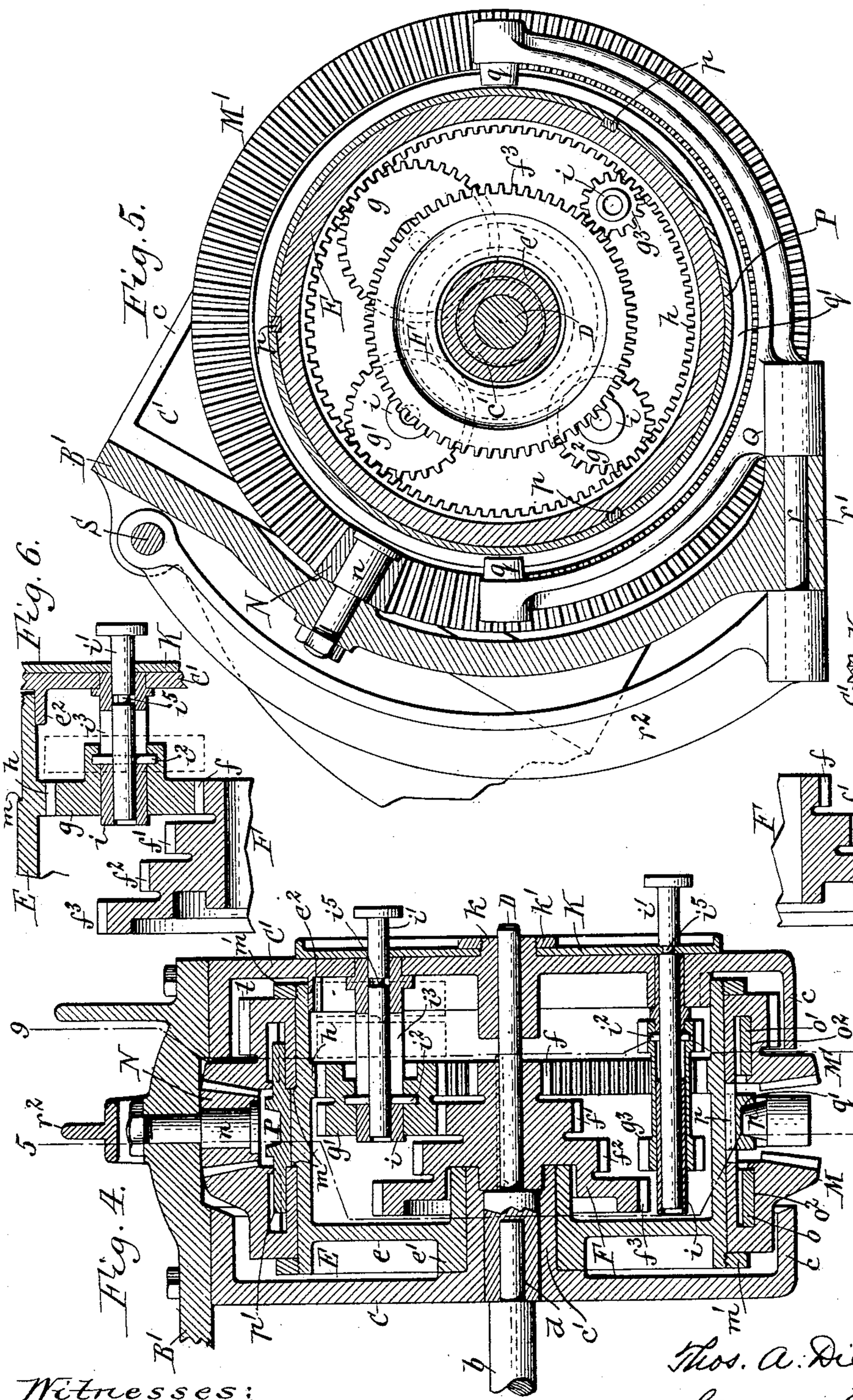

Fig. 5.

Fig. 6.

Fig. 7.

Fig. 4.

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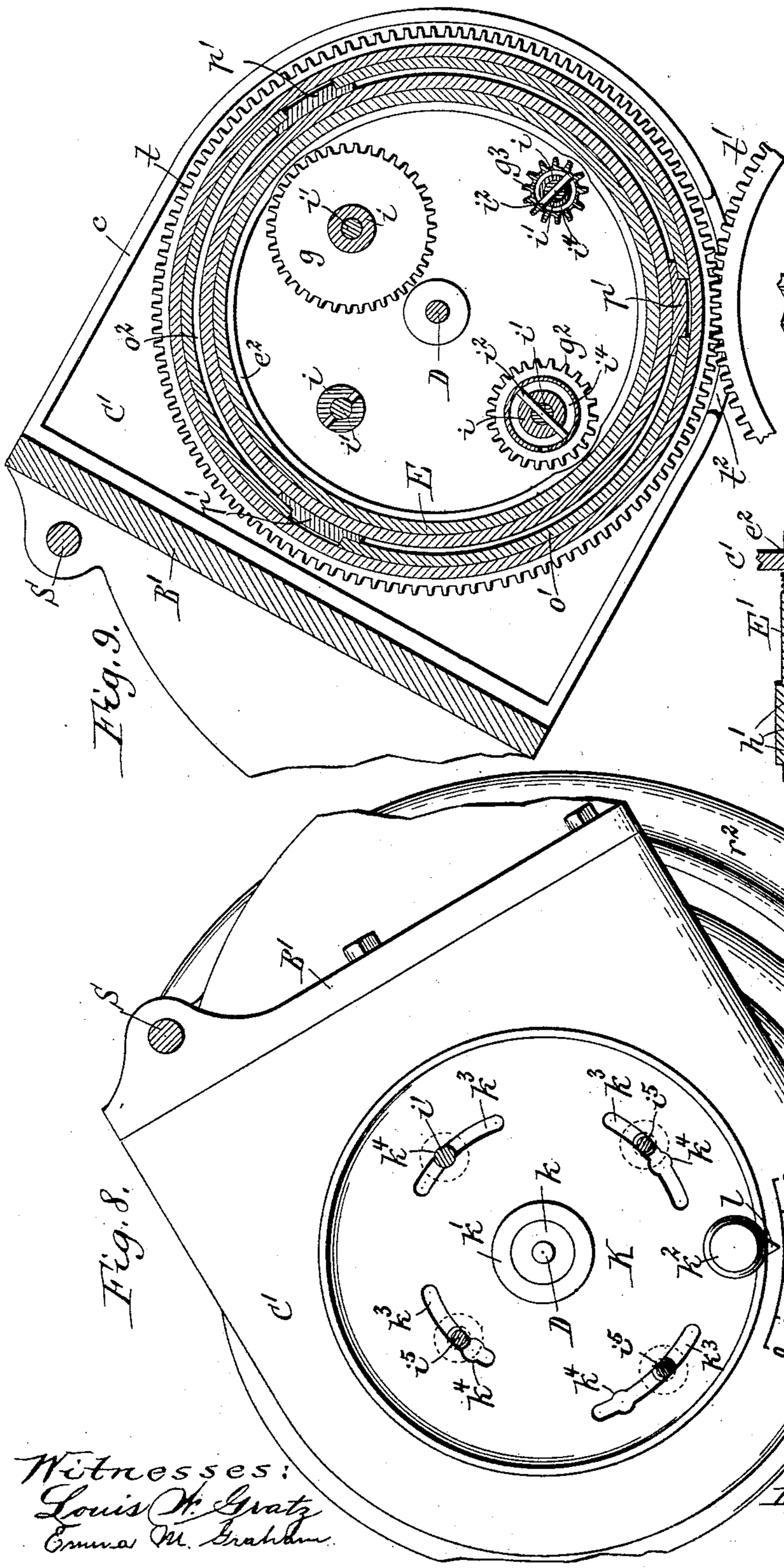

Fig. 9.

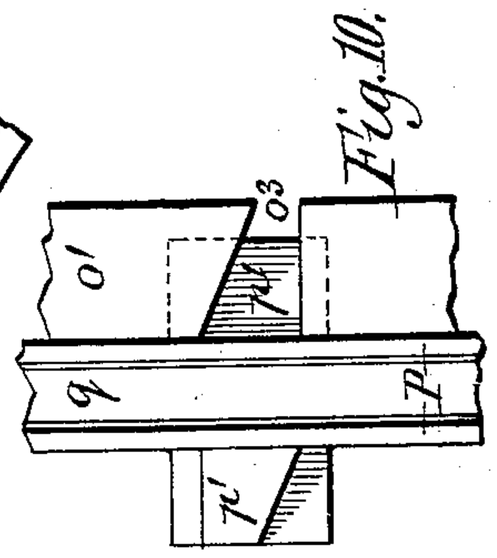

Fig. 10.

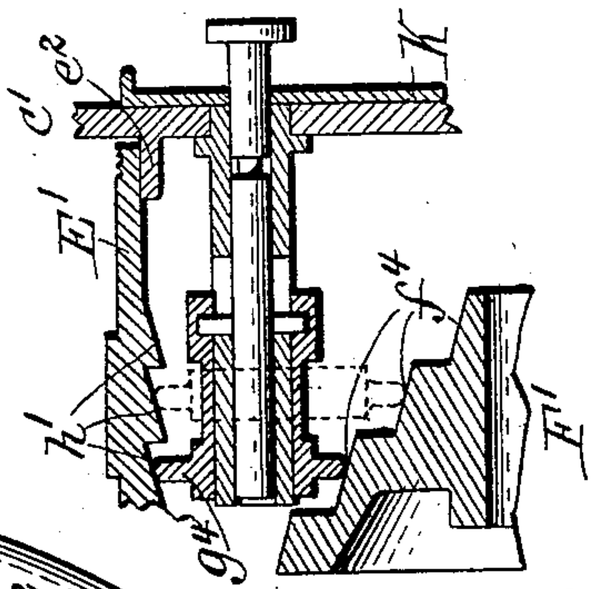

Fig. 11.

Fig. 8.

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UNITED STATES PATENT OFFICE.

THOMAS A. DICKS, OF WILKINSBURG, PENNSYLVANIA.

CHANGEABLE-SPEED AND REVERSING GEAR.

SPECIFICATION forming part of Letters Patent No. 702,930, dated June 24, 1902.

Application filed September 25, 1901. Serial No. 76,546. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. DICKS, a subject of the King of Great Britain, residing at Wilkinsburg, in the county of Allegheny and State of Pennsylvania, have invented new and useful Improvements in Changeable-Speed and Reversing Gears, of which the following is a specification.

This invention relates to a changeable-speed and reversing gear designed more especially for use in connection with an electric motor or a gas or other engine for individually driving various kinds of machinery, such as lathes and screw-machines; but the same is also desirable for driving automobiles, &c.

The object of my invention is the provision of a light, compact, and durable speed-gearing in which noise and wear of the parts are reduced to a minimum and which can be quickly and conveniently adjusted for driving a lathe or other machine at any of the several speeds afforded by the range or capacity of the gearing.

In the accompanying drawings, consisting of three sheets, Figure 1 is an end elevation of a lathe equipped with my changeable-speed gearing. Fig. 2 is a fragmentary front elevation thereof. Fig. 3 is a fragmentary rear view showing the shipper-rod and yoke of the clutch. Fig. 4 is a longitudinal central section of the speed-changing and reversing gearing. Fig. 5 is a transverse section in line 5 5, Fig. 4. Figs. 6 and 7 are fragmentary longitudinal sections showing different pinions in gear with the main gear-cone and the drum of the speed-changer. Fig. 8 is a sectional elevation of the speed-changer viewed from its adjusting side. Fig. 9 is a transverse section in line 9 9, Fig. 4. Fig. 10 is a fragmentary face view of the laterally-movable clutch-ring and one of the sectional clutch-bands. Fig. 11 is a fragmentary longitudinal section showing a modified construction of the gearing.

Like letters of reference refer to like parts in the several figures.

A indicates the bed of any ordinary lathe, A′ the rotary spindle, carrying the usual cone-pulley A^2, and A^3 one of the gear-wheels of the customary rear gearing.

B is an electric or other suitable motor, preferably supported above the lathe-spindle, as shown in Fig. 1, and *b* is its main shaft, from which the lathe or other machine is indirectly driven by my improved speed-gearing. In the construction shown in the drawings the motor is carried by a fixed longitudinal plate or bracket B′, overhanging the rear portion of the lathe and mounted on standards B^2, suitably secured to the lathe-bed.

The changeable-speed gearing is inclosed by a casing composed of fixed side plates or heads C C′, secured at their upper rear portions to the carrying-plate B′ by bolts or other means and provided with inwardly-extending marginal flanges or rims *c*. Located axially in this casing and journaled in suitable bearings in the side plates thereof is the main shaft D of the speed-gearing. This shaft is arranged in alinement with the motor-shaft *b* and connected therewith by any suitable coupling or socket *d*, which compels the two shafts to turn together.

E indicates a rotary driving-drum journaled within the casing C C′ in such manner as to be capable of turning independently of the main shaft D. As shown in Fig. 4, this drum is open at one end and provided at its other end with a head *e*, having a hub *e*′, which is mounted loosely on a stationary hub or hollow arbor *c*′, projecting inwardly from the plate C. The open end of the drum is loosely supported upon an annular rim or flange e^2, projecting inwardly from the adjacent side plate C′ of the casing.

F indicates a stepped or cone gear secured to the main shaft D of the speed-changer within the drum E, the cone shown in the drawings furnishing four changes of speed, and its gear-wheels or rims being designated by the letters $f\ f'\ f^2\ f^3$. Motion is transmitted from this cone-gear to the driving-drum E by one of a number of laterally-movable gear-pinions $g\ g'\ g^2\ g^3$, arranged within the drum E and adapted to mesh with one of the wheels of the cone-gear F and an internal annular gear-rim *h* of said drum. Each of these gear-pinions is of the proper diameter to enter between the gear-rim *h* and one of the gear-wheels of the cone-gear, so that upon shifting one of these pinions laterally into gear with said rim and its companion wheel

of the cone-gear and moving the remaining pinions out of gear, as shown in Fig. 4, the drum E will be driven at a speed proportional to the relative diameters of the active transmitting-pinion and the active wheel of the cone-gear. As shown in the drawings, the internal gear-rim h of the drum is preferably located opposite the smallest wheel of the cone-gear F, and owing to this arrangement the companion transmitting-pinion g requires but a single row of teeth. As the remaining gear-wheels of the cone-gear are progressively farther removed from the plane of the gear-rim h, it is necessary to provide the remaining pinions g' g^2 g^3 with two rows of teeth, which rows are spaced at the proper distance apart to simultaneously mesh with the companion wheel of the cone-gear F and the gear-rim h when one of such pinions is thrown into gear. Each of these transmitting-pinions is mounted on a fixed horizontal stud or arbor i, which projects inwardly from the head C′ of the stationary casing and upon which it is free to rotate, as well as slide laterally or endwise. These studs are arranged between the main shaft D and the rim of the drum E and are made of varying lengths, as shown, according to the extent of the lateral travel of the respective pinions. The pinions are individually shifted by sliding rods or bolts i', attached at their inner ends to the pinions and extending outwardly through the hollow studs i, the bolts projecting beyond the adjacent head C′ of the casing and terminating in suitable heads or knobs for manipulating them, as shown. In the preferred construction shown in the drawings each of these shifting-bolts is connected with the corresponding pinion by a transverse pin i^2, which passes through the bolt and a longitudinal slot i^3 of the hollow arbor and enters an annular groove i^4, formed in the bore of the pinion, thereby interlocking the pinion with its shifting-bolt and at the same time permitting the pinion to turn on its arbor.

In order to render it impossible to shift more than one transmitting-pinion into gear at a time, and thus prevent injury to the parts, a locking device is combined with the shifting-bolts i', which is so constructed that when one of the shifting-bolts is unlocked all of the remaining bolts are locked against endwise movement. This device preferably consists of a rotary locking plate or disk K, applied to the outer side of the outer casing-head C′ and turning upon an arbor k, which projects axially from said head. The plate is retained on its arbor by suitable means, such as a nut k', and provided with a knob k^2 for turning it. This locking-plate is provided with slots k^3, through which the shifting-bolts i' pass, respectively, and which are curved concentrically with the main shaft D, as seen in Fig. 8. The shifting-bolts are annularly grooved to form necks or reduced portions i^5, and the slots of the locking-plate K are just wide enough to receive these necks, as shown in Fig. 8 and in the lower portion of Fig. 4, thereby locking the bolts against endwise movement when their necks are thus interlocked with the slots. Each of these slots is provided with an enlargement k^4 of sufficient size to admit the ungrooved body portion of the corresponding shifting-bolt, as shown in Figs. 6 and 7 and the upper right-hand portion of Fig. 8, so that when the locking-plate is turned to bring such an enlargement in register with the companion bolt the bolt is unlocked and can be shifted inwardly into gear with the cone-gear F and the gear-rim h of the drum E, as shown in the upper portion of Fig. 4 and in Figs. 6 and 7. The locking-necks i^5 of the bolts are so arranged that when they are interlocked with the locking-plate K the corresponding pinions are out of gear. The enlargements k^4 of the several locking-slots are arranged unsymmetrically relatively to one another, so that when any one of the enlargements is brought into register with its companion shifting-bolt the register between all of the remaining enlargements and the corresponding bolts is broken. All of the bolts except the one desired to be released thus remain positively locked, and but a single pinion can be thrown into gear with the drum E and the cone-gear F at a time, thereby effectually guarding against breakage of the gears or other parts, which would result if more than one pinion were thrown into gear at the same time.

To permit the locking-plate K to be readily shifted to the proper predetermined position for unlocking the desired transmitting-pinion, said plate is provided with a pointer l, which traverses a graduated scale l', arranged on the adjacent head C′ of the casing, as shown in Fig. 8. This scale has suitable designations, as the numerals "1, 2, 3, 4," which indicate the four speeds at which the driven machine may be run, and the enlargements k^4 of the locking-slots k^3 are arranged to correspond to the designations of this scale. These slots are preferably of such a length and their enlargements are so arranged that when the locking-plate is turned to either extremity of its movement all of the transmitting-pinions are locked in their inoperative position, in which position the electric or other motor runs idle and the lathe or other machine is allowed to remain at rest. As shown in Fig. 8, the scale l' begins and ends with ciphers or other suitable designations, which indicate the last-named position of the pinions.

In cases where a machine is to be driven at different speeds, but always in the same direction, motion may be transmitted from the drum E directly to the machine by a belt or other suitable means. Where, however, it is desired to reverse the motion of the driven part or machine as well as change its speed of rotation, I combine with the drum E a reversing-gear, which is preferably constructed as follows:

M M′ indicate a pair of bevel gears or rims mounted loosely upon the drum E and arranged to face each other, but separated by an intervening space. These wheels, while free to turn on the drum, are held against lateral displacement between external annular shoulders *m* of the drum and screw-nuts *m′* applied to the screw-threaded ends of the drum, as shown in Fig. 4. The bevel-wheels M M′ are geared together by a bevel-pinion N, which is journaled on a fixed arbor *n*, secured to the carrying-plate B′, as shown in Figs. 4 and 5, and which causes one of such bevel-gears to be turned from the other, but in the reverse direction. One or the other of these loose bevel-gears is compelled to turn with the drum E by a clutch of any ordinary or suitable construction. The preferred clutch (shown in the drawings) consists of a pair of expansible clamping-bands *o o′*, seated loosely in annular grooves or recesses o^2, formed in the opposing sides of the bevel-gears M M′, and a laterally-movable clutch-ring P, surrounding the drum E between said clamping-bands. These bands are divided transversely into a number of sections, and one or both of the opposing ends of the sections are cut off obliquely to form wedge-shaped spaces o^3 between adjoining sections, as shown in Fig. 10. The clutch-ring P is splined to the drum E by keys *p* to compel the ring to turn with the drum, but permit it to slide laterally thereon. The clutch-ring is provided at each edge opposite the wedge-shaped intervals o^3 of the clamping-bands *o o′* with a set of laterally-projecting wedges or wedge-shaped lugs *p′*, which enter the corresponding spaces o^3 of the clamping-ring, toward which the clutch-ring is shifted, thereby expanding the sectional clamping-ring against the surrounding bevel-gear M or M′ and clutching said gear to the drum E.

The clutch-ring P is shifted in one or the other direction for clutching either bevel-gear M M′ to the drum by a suitable shipper device. The device shown in the drawings consists of an oscillating yoke Q, having studs *q*, which engage in an annular groove *q′* in the face of the clutch-ring. This yoke is rigidly secured to a short rock-shaft *r*, arranged transversely below the casing of the speed-changer and journaled in a bearing *r′*, depending from the carrying-plate B′, as shown in Figs. 3, 5, and 8. Secured to the rear end of the rock-shaft *r* is an actuating arm or lever r^2, the upper end of which embraces a shipper-rod S between a pair of collars *s*, secured to the latter. This shipper-rod extends lengthwise of the lathe and slides in suitable guides on the carrying-plate B′ or other support.

One of the bevel-gears M M′ is provided with a spur-gear *t*, which meshes with a similar gear *t′*, which may be secured to the lathe-spindle or to one of the steps of the usual cone-pulley, as shown in the drawings. As shown in Figs. 2 and 9, the casing is provided with an opening t^2 for the passage of the gear-wheel *t′*.

The lathe-spindle is driven in one direction by clutching the right-hand bevel-gear M′ to the drum E and in the reverse direction by clutching the other bevel-gear M to the drum. When the right-hand bevel-gear is clutched to the drum, the lathe-spindle is driven directly from the drum and the bevel-pinion N and the other bevel-gear M are inoperative and turn idly. When the left-hand bevel-gear M is clutched to the drum, the lathe-spindle is driven indirectly and in the reverse direction from said bevel-gear through the medium of the bevel-pinion N and the other bevel-gear M′, which latter turns loosely on the drum E under these conditions.

In the normal condition of the changeable-speed gear all of the transmitting-pinions *g* g^3 are withdrawn from engagement with the main cone-gear F and the gear-rim *h* of the drum E, and they are all positively locked in this position by the locking-plate K when the pointer of the plate is brought opposite either zero of the scale *l′*. When the lathe or other machine is to be driven, the locking-plate K is turned to the proper position for unlocking the bolt *i′* of that transmitting-pinion which provides the desired speed, and this pinion is then pushed laterally into mesh with the drum E and the cone-gear F by means of its bolt, as shown, for example, in the upper portion of Fig. 4. All of the other transmitting-pinions remain locked in their inoperative position, as hereinbefore described. To change the speed of the driven machine, the operative transmitting-pinion is withdrawn to its inoperative position, the locking-plate K is turned to the proper position to release the bolt of the pinion which affords the desired speed, and this last-named pinion is then pushed into engagement with the drum E and the cone-gear F. These operations can be conveniently and quickly performed.

In my improved speed-gear only the single pinion which is for the time being required to transmit motion from the main shaft D to the drum E is in gear, all of the remaining transmitting-pinions being entirely clear of the gear-rim *h* of the drum and the corresponding gear-wheel of the cone-gear F, as shown by dotted lines in Figs. 4 and 6. The noise incident to the running of the gears is thus minimized, the wear of the same is correspondingly lessened, and the durability of the gearing increased in the same measure.

As the speed-changing gears are all inclosed within the driving-drum E, the construction of the device is exceedingly compact. This advantage, combined with the lightness of the speed-gearing, renders the same especially desirable for driving automobiles and other apparatus where lightness and compactness are important considerations.

While spur-gears are herein shown and described for transmitting motion from the main

shaft D to the drum E at different speeds, I do not wish to limit myself to the use of such gearing, as the same result may be attained by the employment of equivalent gearing—such, for instance, as frictional cone-gearing. A construction showing such gearing is illustrated in Fig. 11, in which F′ indicates a cone-gear having smooth beveled faces f^4; h', conical or beveled rims arranged on the inner side of the drum E′ opposite the steps of the cone-gear, respectively, and g^4 one of the laterally-movable transmitting-pinions, having a comparatively narrow edge adapted to bear against the corresponding rim of the drum and the companion step of said cone-gear.

In the construction shown in Figs. 1 to 10 of the drawings four transmitting-pinions are employed, furnishing four changes of speed; but the number of changes may obviously be reduced or increased within certain limits by employing a corresponding number of transmitting-pinions and a corresponding number of gear-wheels on the cone-gear F.

I claim as my invention—

1. In a speed-changing mechanism, the combination of a driving-shaft, a gear-wheel mounted on the shaft, a drum loosely surrounding said shaft, and independent, laterally-movable gear-pinions of different diameters capable of being individually shifted into and out of engagement with said gear-wheel and said drum, substantially as set forth.

2. In a speed-changing mechanism, the combination of a driving-shaft, a stepped gear-wheel mounted on said shaft, a rotary drum loosely surrounding said shaft, and laterally-movable transmitting-pinions of different diameters interposed between the drum and the steps of said gear-wheel, substantially as set forth.

3. The combination of a driving-shaft, a toothed cone-gear turning with said shaft, a rotary drum loosely surrounding said shaft and provided with an internal annular gear-rim, and laterally-sliding toothed pinions of different diameters arranged to enter between the gear-rim of said drum and one of the wheels of said cone-gear, a casing inclosing said shaft and drum, and shifting devices for said pinions extending through the wall of said casing, substantially as set forth.

4. The combination of a stationary casing, a driving-shaft arranged therein, a cone-gear mounted on said shaft, a drum surrounding said shaft and arranged within the casing, studs extending inwardly from one of the walls of the casing and arranged parallel with said driving-shaft, laterally-sliding transmitting-pinions of different diameters mounted on said studs, and shifting devices for said pinions extending through the wall of the casing, substantially as set forth.

5. The combination of a stationary casing, a driving-shaft arranged therein, a cone-gear mounted on said shaft, a drum surrounding said shaft and arranged within the casing, hollow studs projecting inwardly from one of the walls of the casing, transmitting-pinions of different diameters mounted to slide laterally on said hollow studs, and shifting-bolts for said pinions sliding in said studs and extending through the wall of said casing, substantially as set forth.

6. The combination of a casing, a driving-shaft arranged therein, a gear-wheel mounted on said shaft, a drum loosely surrounding said shaft, a hollow stud extending inwardly from the wall of said casing and provided with a longitudinal slot, a transmitting-pinion slidably mounted on said stud and provided in its bore with an annular groove, and a shifting-bolt sliding in said hollow stud and provided with a transverse pin which passes through the slot of the stud and enters the groove of said pinion, substantially as set forth.

7. The combination of a driving-shaft, a gear-wheel mounted thereon, a drum loosely surrounding said shaft, a plurality of retractable transmitting-pinions interposed between the gear-wheel on the driving-shaft and said drum, and a locking device having individual locking means for said transmitting-pinions constructed and arranged to release but one of said pinions at a time, substantially as set forth.

8. The combination of a driving-shaft, a gear-wheel mounted thereon, a drum loosely surrounding said shaft, a plurality of retractable transmitting-pinions interposed between the gear-wheel on the driving-shaft and said drum, individual shifting-bolts for said pinions, and a movable locking-plate having slots constructed to interlock with said bolts in one position of said plate and to release the bolts in another position of the plate, substantially as set forth.

9. The combination of a driving-shaft, a gear-wheel mounted thereon, a drum loosely surrounding said shaft, laterally-sliding transmitting-pinions of different diameters interposed between said gear-wheel and the drum, shifting-bolts connected with said pinions and each having a contracted neck, and a rotary locking-plate having curved locking-slots which are wide enough to receive the contracted necks of said bolts but narrower than the bodies thereof, and which are provided with enlargements of sufficient size to receive the bodies of said bolts, substantially as set forth.

10. The combination of a driving-shaft, a gear-wheel mounted thereon, a drum loosely surrounding said shaft, a plurality of retractable transmitting-pinions interposed between the gear-wheel on the driving-shaft and said drum, individual shifting-bolts for said pinions, a movable locking-plate having slots constructed to interlock with said bolts in one position of said plate and to release the bolts in another position of the plate, a stationary scale arranged adjacent to said locking-plate,

and a pointer carried by said plate and cooperating with said scale, substantially as set forth.

11. The combination of a driving-shaft, a drum driven therefrom, a pair of gear-wheels mounted loosely on said drum and geared together to turn in opposite directions, one of said gear-wheels forming a driver, and a clutch for coupling either of said gear-wheels to said drum, substantially as set forth.

12. The combination of a driving-shaft, a hollow drum loosely surrounding the same, a changeable-speed gear arranged within said drum and constructed to transmit motion from said shaft to said drum, and a reversing-gear mounted on the periphery of said drum, substantially as set forth.

13. The combination of a driving-shaft, a hollow drum loosely surrounding the same, a changeable-speed gear constructed to transmit motion from said shaft to said drum and arranged within the drum, adjusting devices for said speed-changing gear projecting laterally from said drum, a pair of opposing bevel-gears journaled on the periphery of said drum, an intervening pinion connecting said bevel-gears, and a clutch for coupling either of said bevel-gears to said drum, substantially as set forth.

Witness my hand this 17th day of September, 1901.

THOMAS A. DICKS.

Witnesses:
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D. B. DOUTHETT.