No. 844,748. PATENTED FEB. 19, 1907.

J. RIDDELL.

SPEED CHANGING DEVICE.

APPLICATION FILED JULY 9, 1904.

3 SHEETS—SHEET 1.

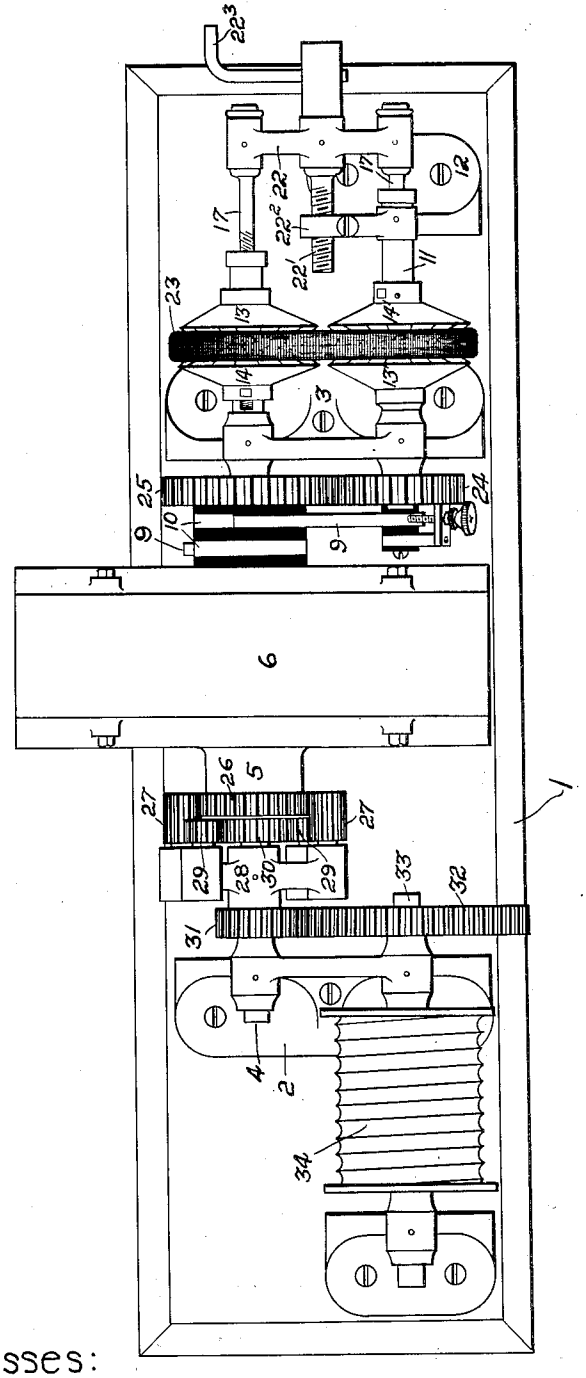

Fig. 1.

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3 SHEETS—SHEET 2.

Fig. 5.

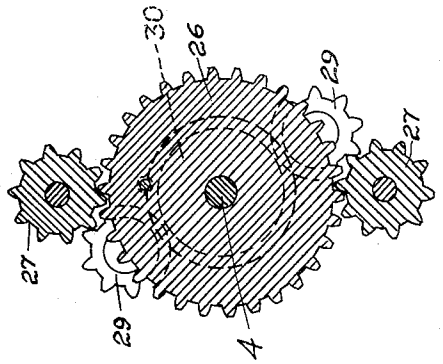

Fig. 2.

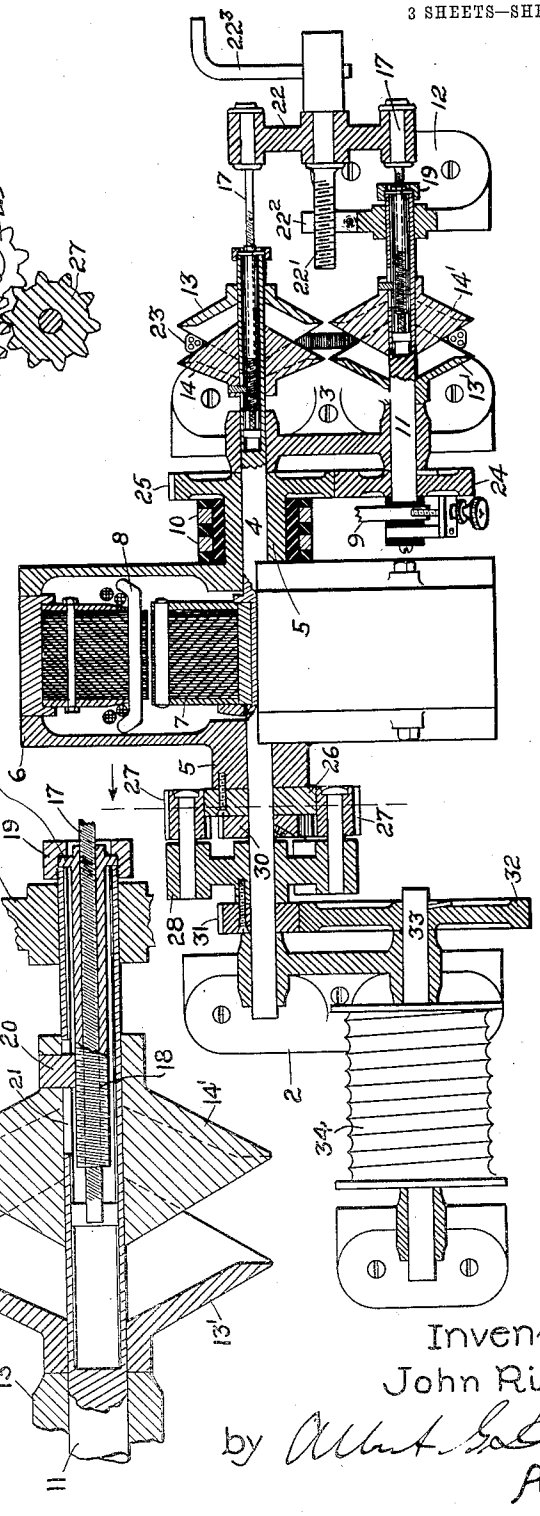

Fig. 4.

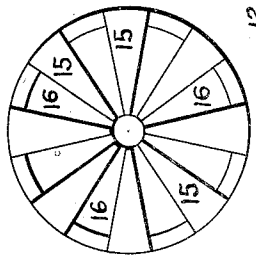

Fig. 3.

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3 SHEETS—SHEET 3.

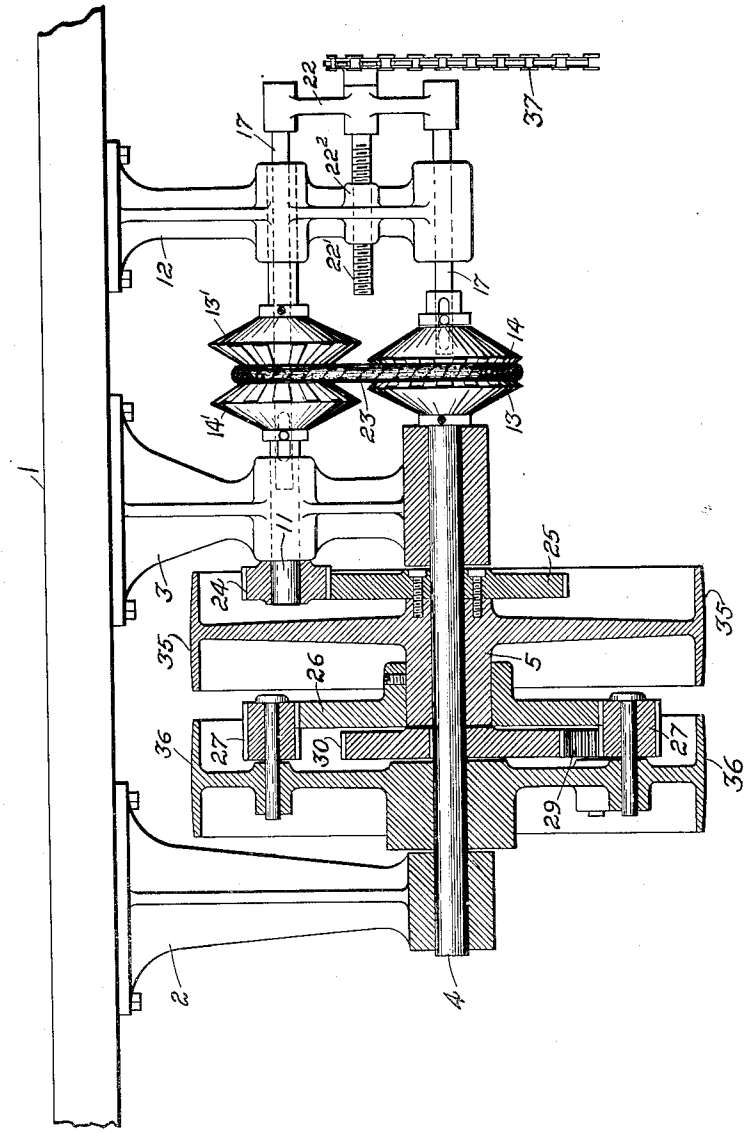

Fig. 6.

WITNESSES:
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UNITED STATES PATENT OFFICE.

JOHN RIDDELL, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

SPEED-CHANGING DEVICE.

No. 844,748. Specification of Letters Patent. Patented Feb. 19, 1907.

Application filed July 9, 1904. Serial No. 215,882.

To all whom it may concern:

Be it known that I, JOHN RIDDELL, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Speed-Changing Devices, of which the following is a specification.

This invention relates to variable-speed-reversing mechanism for connecting a power shaft or element with a driven shaft or element; and its object is to provide an efficient and simple piece of apparatus for this purpose.

The invention consists of two concentric rotatable members, the outer or tubular one being preferably the power element, gearing connecting said members and comprising two pulleys of variable diameters connected by an endless belt, means for varying the effective diameter of one pulley inversely as the other, and epicyclic gearing connecting both shafts with the driven element.

In the accompanying drawings, Figure 1 is a top plan view of one form of my variable-speed mechanism. Fig. 2 is a longitudinal section of the same. Fig. 3 is an enlarged section of one of the expanding pulleys. Fig. 4 is a face view of one portion of the same. Fig. 5 is an end elevation of the epicyclic gearing, and Fig. 6 shows a modified form of the mechanism.

On a suitable foundation 1 are secured two pillow-blocks 2 and 3, in which is journaled a shaft 4. A sleeve 5 is rotatable on the shaft and carries a circular concentric drum by which power is applied to said sleeve. In Figs. 1 and 2 this drum is the rotatable field-magnet frame 6 of an electric motor whose armature 7 is secured to the shaft 4. Current is conveyed to the field-coils 8 through the insulated brushes 9, suitably supported on the foundation and bearing on the collector-rings 10 on the sleeve 5, the motor shown being an induction-motor. The shaft 4 projects beyond the pillow-block 3, and parallel with this part of it is a counter-shaft 11, journaled at one end in the pillow-block 3 and at the other end in a standard 12. Secured to each shaft is an expanding pulley, which is composed of two similar parts 13 14, 13′ 14′, one fixed to the shaft and the other movable lengthwise thereof. Each half of each pulley has a substantially conical face consisting of alternating ribs 15 and slots 16, all radial to the shaft, the ribs on each half fitting into the slots of the other. The result is that each pulley has a circumferential V-shaped groove. The depth of this groove, and consequently the effective diameter of the pulley, can be varied by sliding the movable half of the pulley toward or away from the other half. The preferred means for accomplishing this consists in a screw 17 of long pitch, slidable lengthwise in a central longitudinal bore in the shaft and splined therein, so that it rotates therewith. A long nut 18 engages with the rod and is provided at one end with a flange 18′, which is held against the end of the shaft by a union 19. The nut is, however, freely rotatable in the bore of the shaft and can be thus rotated by a longitudinal movement of the rod 17. The outer surface of the nut is also cylindrical and is cut with screw-threads of fine pitch. A segment-nut 20 is secured to the hub of the movable half of the expanding pulley and projects through a longitudinal slot 21 in the shaft into engagement with the external screw-threads on the nut 18. It follows that a reciprocation of the rod 17 with reference to the shaft will cause the nut 18 to rotate, and this in turn will traverse the segment-nut 20 along the slot 21 and effect an expansion or contraction of the pulley. At its outer end the rod 17 is journaled in a cross-head 22, which can be reciprocated by any suitable device, such as a screw 22′, meshing with a stationary nut 22^2 and having a handle 22^3 for rotating it. In order that one pulley may be enlarged in diameter while the other one is diminished, the right-hand half of one pulley and the left-hand half of the other are the movable portions.

The pulleys are connected by an endless belt 23, preferably a triangular belt of peculiar construction, which forms the subject of a separate application. The counter-shaft 11 is geared to the sleeve by the spur-gears 24 25, the latter being preferably somewhat larger than the other. To the opposite end of the sleeve is secured the gear-wheel 26 which meshes with two long pinions 27, carried by a yoke 28, rotatably mounted on the shaft 4. The yoke also carries two other pinions 29, meshing with the long pinions 27 and also with a smaller spur-gear 30, secured to the shaft 4. The yoke also has a pinion

31 concentric with the shaft and meshing with a spur-gear 32 on the driven shaft—such, for example, as the shaft 33 of a hoisting-drum 34.

The operation of the invention is as follows: When current is supplied to the motor, the armature and field-frame begin to revolve in opposite directions. The ratio of rotation is governed by the relative effective sizes of the expanding pulleys. If their diameters are substantially the same as shown in the drawings, the armature will make several more rotations per minute than the field-frame, because of the difference in the diameters of the spur-gears 24 25. By making the gears 30 and 26 of the same relative difference as the gears 24 25 the yoke 28 will remain stationary when the diameters of the expanding pulleys are the same, so that no movement will be imparted to the hoisting-drum by the motor. If now one of the pulleys is enlarged and the other diminished in effective diameter, the effect of the epicyclic gearing will be to cause the yoke to revolve in one direction or the other, depending on which one of the expanding pulleys is enlarged—that is to say, if the pulley 13 14 be enlarged, so that the counter-shaft is driven faster than the main shaft 4, and the speed of the sleeve 5 and gear 26 is correspondingly increased then the yoke 28 will revolve in the same direction as said sleeve and gear, and vice versa. In other words, the yoke always revolves in the same direction with that one of the two gears 26 and 30 having the faster peripheral speed; but since the travel of the yoke is measured on the circumference of that gear which moves the slower and since they differ in diameter it follows that the angular movement of the yoke in one direction is greater than it is in the other for the same increment of change in size of the pulley 13 14 from the medium size shown in the drawings. This is a feature of especial importance when the yoke is geared to a hoisting-drum 34, since the hoisting speeds and power can be varied considerably, while the lowering speeds do not need so much variation.

It will thus be seen that my invention provides for reversing the direction of rotation of a driven shaft, for driving it at varying speeds in either direction and with a greater range of variation in one direction than in the other, and for stopping it without stopping the driving-shaft or varying its speed. The invention is thus of peculiar advantage in machinery driven by an induction-motor whose greatest efficiency is developed when running at full speed.

The mechanism employed for expanding and contracting the belt-pulleys is so designed that the wedging action of the belt which tends to force the halves of the pulleys apart is sustained entirely by the shafts and not by the rods 17, one half being secured directly to the shaft and the other half exerting its thrust on the nut 18, whose flange is coupled to the shaft by the union 19.

Fig. 6 shows the application of the invention to a pair of belt-pulleys 35 36, the former receiving power from any suitable source and the latter transmitting it to a machine. It will be seen that the pulley 35 takes the place of the field-frame 6 in Figs. 1 and 2 and that the pulley 36 acts on the yoke of the epicyclic gear. The pillow-blocks are inverted to serve as shaft-hangers, and the screw 22′ may be rotated by a sprocket and chain 37, if too high to be easily reached.

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

1. In combination, a power-driven shaft, an oppositely power driven sleeve concentric therewith, means for regulating the relative movements of said shaft and said sleeve gears connected respectively to said shaft and sleeve, and planetary gears operatively engaging said gears.

2. In combination, a power-driven shaft, an oppositely power driven sleeve concentric therewith, a counter-shaft positively geared to said sleeve, speed-changing means connecting said shafts, gears connected respectively to said power-shaft and sleeve, and planetary gears operatively engaging said gears.

3. The combination with a main shaft, of the armature of an induction-motor secured thereto, a sleeve concentric with said shaft carrying the rotatable field-magnet of said induction-motor, a counter-shaft geared to said sleeve, inversely-expansible pulleys on the main shaft and counter-shaft, a belt connecting said pulleys, a rotatable driven element, and epicyclic gearing connecting said element with the main shaft and the sleeve.

4. The combination with a main shaft, of the armature of an induction-motor secured thereto, a sleeve concentric with said shaft and carrying the rotatable field magnet of said motor, a counter-shaft parallel with said sleeve, spur-gears connecting said sleeve and counter-shaft, the gear on the sleeve being the larger, expanding pulleys on said main shaft and said counter-shaft, means for varying the effective diameters of said pulleys inversely, a belt connecting said pulleys, a driven element, and epicyclic gearing connecting said element and the main shaft and sleeve and comprising two gears having the same ratio as the gears connecting the sleeve and the counter-shaft.

In witness whereof I have hereunto set my hand this 8th day of July, 1904.

JOHN RIDDELL.

Witnesses:
BENJAMIN B. HULL,
HELEN ORFORD.