F. S. RAND.

VARIABLE SPEED MECHANISM.

APPLICATION FILED NOV. 10, 1909.

955,201.

Patented Apr. 19, 1910.

2 SHEETS—SHEET 1.

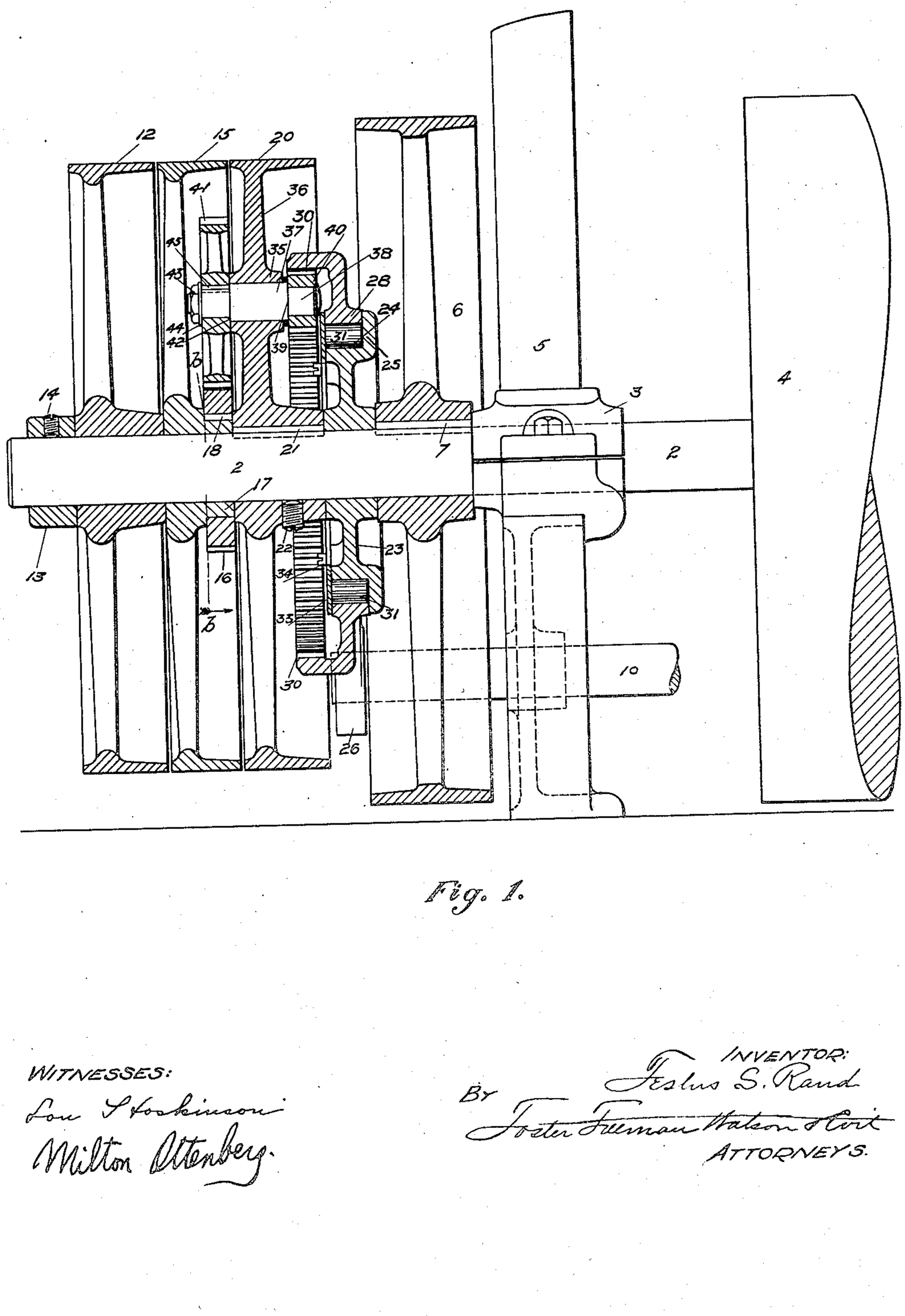

Fig. 1.

WITNESSES:

Lou S Hoskinson

Milton Attenberg.

INVENTOR:

Festus S. Rand

By Foster Freeman Watson & Coit

ATTORNEYS.

F. S. RAND.

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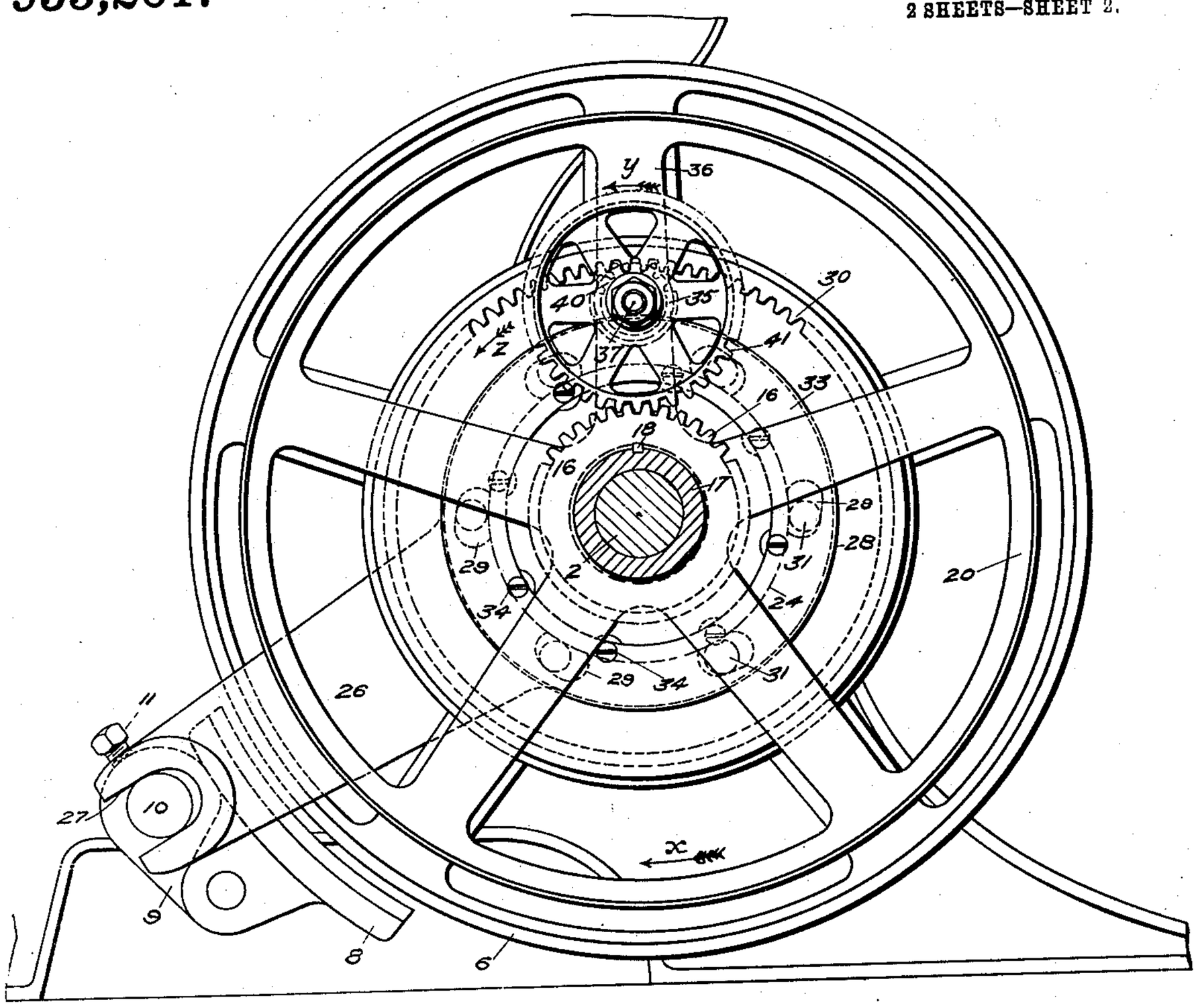

Fig. 2.

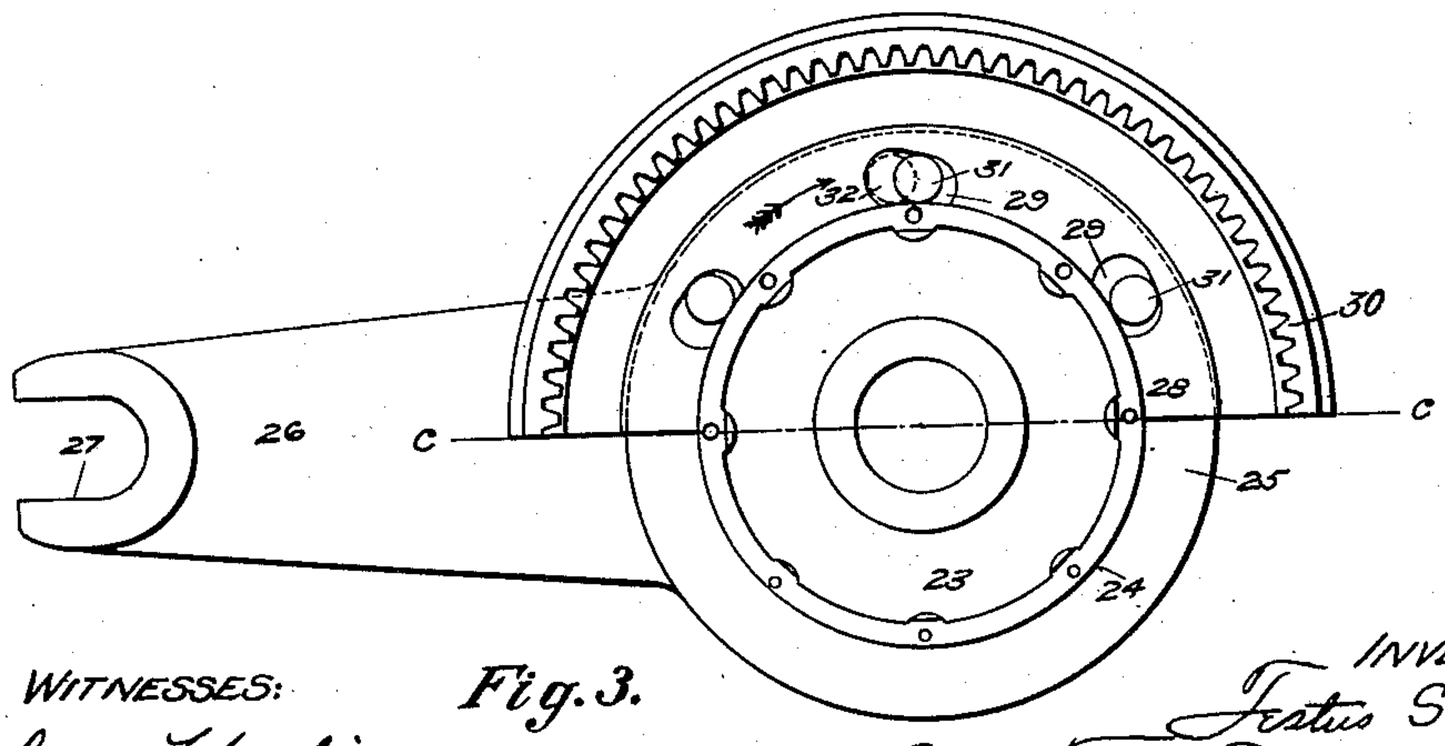

Fig. 3.

WITNESSES:

Lou T. Hoskinson

Milton Ottenberg.

INVENTOR:

Festus S. Rand

BY Foster Freeman Watson & Coit

ATTORNEYS.

UNITED STATES PATENT OFFICE.

FESTUS S. RAND, OF PROVIDENCE, RHODE ISLAND, ASSIGNOR TO UNIVERSAL WINDING COMPANY, OF PORTLAND, MAINE, A CORPORATION OF MAINE.

VARIABLE-SPEED MECHANISM.

955,201. Specification of Letters Patent. Patented Apr. 19, 1910.

Application filed November 10, 1909. Serial No. 527,270.

To all whom it may concern:

Be it known that I, FESTUS S. RAND, a citizen of the United States, residing at Providence, in the county of Providence and State of Rhode Island, have invented certain new and useful Improvements in Variable-Speed Mechanisms, of which the following is a specification.

My invention relates to improvements in variable-speed mechanisms for regulating the rotative speed of a driving shaft or other power element.

The purpose of my invention is to provide a device for communicating rotation to a shaft from belt-driven pulleys or other transmission devices with means to change the speed of the shaft from slow to fast or vice versa.

The object of my improvement is to simplify the arrangement and structure of such an apparatus and to provide that the intermediate connections between the driving element and the shaft shall remain at rest when the shaft is being rotated at the maximum speed, so that the wear on these parts will be reduced to a minimum and the mechanism rendered more durable.

My invention is fully set forth in the following specification, illustrated by the accompanying drawings, in which:

Figure 1 is a longitudinal sectional view of the device; Fig. 2, an end view looking in the direction indicated by the arrow in Fig. 1, part sectional on the line *b*—*b*, and with the parts at the left of this line removed; Fig. 3, a face view of the locking device or clutch-mechanism with the lower portion of the internal gear removed below the line *c*—*c*.

My invention is here shown as applied to a warping or beaming machine in which the main driving shaft 2 carries a cylinder or driving drum 4 adapted to bear on the beam on which the material is wound to rotate the latter by frictional contact. In machines of this class a large number of strands is usually wound on to the beam and it is necessary to start the rotation of the latter at a relatively slow speed so that fine yarns will not be strained or broken by a too sudden tension. Furthermore, when the beam is nearly filled with yarn it is very heavy and considerable power is required to overcome its inertia in starting it to rotate. Obviously, it is much easier to start the rotation of the beam at a comparatively slow speed, and then accelerate its speed after the inertia is overcome, than to start the rotation at high speed. For this reason it will be evident that the use of my device results in the advantages of saving power and relieving the mechanism of abnormal strain or shock. My invention is not restricted solely to the use here described and illustrated, however, as it might be applied to any machine or mechanism in which it is required to impart rotation to a driving element and to change the speed of the same from low to high or vice versa.

In Fig. 1 I have shown a portion of a warping machine with the driving shaft 2 adapted to rotate in bearings 3 on the frame of the machine. The shaft 2 carries a driving roll or friction drum 4 which extends between the frame upright 5 and a similar upright at the opposite side of the machine, the latter not here shown. On the outside of the bearing 3 is a brake-wheel 6 held fast on the shaft 2 by the key 7. A brake-shoe 8, see Fig. 2, is adapted to bear on the periphery of the brake-wheel 6, and is operated by an arm 9 secured to a rocker-shaft 10 by the set-screw 11. The rocker-shaft 10 is operated by any suitable means, such as a treadle or lever, not here shown, as this part of the mechanism is not essential to the present invention.

The means for imparting rotation to the shaft 2, as here illustrated, consists of a series of pulleys driven from a suitable belt with the belt arranged to be shifted from one pulley to another. Preferably there are three pulleys in the series arranged as follows: The outer pulley 12 is an idler, free to rotate on the shaft 2 and held in place by the collar 13 secured at the end of the shaft by the set screw 14. Adjacent the pulley 12 is a second pulley 15, of the same diameter as the pulley 12, and also free to rotate on the shaft 2. The pulley 15 carries a gear 16 on its hub 17, the gear being secured to rotate with the pulley by means of the key 18. The third pulley 20 is also of the same diameter as the idler pulley 12, but is fast on the shaft 2, being secured rotatively by the key 21 and held longitudinally by the set-screw 22. The hub of the pulley 20 and the collar 13 hold the pulleys 12 and 15 from longitudinal displacement on the shaft 2.

The pulley 20 acts as a positive element for rotating the shaft 2 at the maximum speed, and the rotation of the pulley 15 is imparted to the shaft 2 at a slower speed by a novel arrangement of planetary gearing acting through the fast pulley 20, as now described: Between the hub of the pulley 20 and the hub of the brake-wheel 6 is a clutch-member 23 mounted on the shaft 2 with the shaft free to rotate therein. The clutch-member 23 has a form similar to that of a car wheel with a flat rim 24 and a flange 25, as shown in Fig. 1. Extending from the flange 25 is an arm 26, see Figs. 2 and 3, which is secured to the frame 5 of the machine to hold the clutch member from turning with or on the shaft 2. The arm 26 extends beyond the periphery of the brake-wheel 6 and the rocker-shaft 10 serves as a convenient means of securing it to the frame, the end of the arm being forked at 27 to straddle the shaft. Fitted to the rim of the clutch-member 23 is a ring 28 formed with pockets 29, 29, etc. and having integral therewith an overhanging rim formed as an internal gear 30. The pockets 29, 29, etc. are of wedge-shape and adapted to receive rolls 31, 31, etc. which ride on the rim 24 of the clutch member 23. The rolls 31 are of a diameter to adapt them to fit loosely in the large ends of the pockets 29, as indicated by dotted lines at 32, Fig. 3; but at the small ends of the pockets they bind tightly to lock the ring 28 against the rim 24. This arrangement is a familiar principle in clutch mechanisms and it will be seen that when the internal gear 30 is turned in the direction indicated by the arrow in Fig. 3 the rolls 31 are carried into the large ends of the pockets and the ring 28 rotates freely on the clutch-member 23. When the gear 30 is turned in the opposite direction, however, the rolls 31 will be carried to the small ends of the pockets and will wedge between the ring 28 and the rim 24 to lock the gear 30 from rotation on the clutch-member 23. A thin ring or washer 33 is secured on the face of the rim 24 by the screws 34, 34, etc. and abuts the ends of the rolls 31 and the face of the ring 28 to retain the rolls in their pockets and hold the ring in place against the flange 25.

The pulley 20 has a hub or boss 35 on one of its arms 36 which serves as a bearing for a stud 37. One end of the stud 37 is turned down at 38, and riveted thereon against the shoulder 39 is a pinion 40 adapted to mesh with the internal gear 30. The opposite end of the stud 37 is also reduced in diameter and carries a gear 41 held against the shoulder 42 by the nut 43 and a suitable washer 44, and secured rotatively on the stud by the key 45. The gear 41 meshes with the gear 16 on the hub 17 of the pulley 15.

Having now described the structure and arrangement of my improved device in detail, its mode of operation will next be explained: A driving belt, not here shown, connects the device with the source of power, which may be a countershaft, motor or other prime-mover, and normally the belt runs on the idler pulley 12 when the machine is at rest. The device as here shown is arranged to start the rotation of the driving-shaft 2 at a relatively slow speed and to accomplish this the driving belt is shifted from the idler pulley 12 on to the second pulley 15. The belt may be shifted by manual means or through the use of a suitable belt-shipper, the latter not being here shown as it is not essential to the present invention. The belt is arranged to rotate the pulley 15 in the direction indicated by the arrow *x*, Fig. 2, and the gear 16, fast on its hub 17, turns the gear 41 in the direction indicated by the arrow *y*. The gear 41 being keyed on the stud 37 and the stud being fast in the pinion 40 the latter will be turned in the same direction to tend to rotate the internal gear 30 in the opposite direction, as indicated by the arrow *z*. The tendency of rotation imparted to the internal gear 30 is therefore in the opposite direction to that of the pulley 15 and reference to Fig. 3 will show that only a slight movement of the gear 30 in this direction (opposite to that indicated by the arrow, Fig. 3) is permitted before the rolls 31 will lock the ring portion 28 of the gear on the clutch-member 23. In other words, when the pulley 15 is rotated in the direction indicated by arrow *x* in Fig. 2 the operation of the train of gearing between this pulley and the gear 30 will cause the latter to move in the direction of the arrow *z* until the rolls lock it on the clutch-member 23. As the clutch-member 23 is prevented from rotating by its arm 26 fastened to the machine frame, the gear 30 will be held from rotation under influence of the pinion 40 and therefore the pinion will travel around the gear with a planetary motion in the direction of the arrow *x*. Since the pinion 40 is mounted on an arm of the pulley 20 the latter will be carried around in the same direction as the pulley 15, but at a slower speed on account of the difference in ratios between the gear 41, pinion 40 and gear 30. The pulley 20 being keyed to the shaft 2, the latter is rotated thereby at the same speed and it will be seen that by changing the proportions of the gears in the train the speed of the shaft may be regulated within certain limits. As before specified, the present arrangement provides for a relatively slow speed of the shaft 2 when the belt is driving on the pulley 15, but after the inertia of the moving parts of the machine has been overcome it is desirable to accelerate this speed and to accomplish this the belt

is shifted on to the pulley 20. As the pulley 20 turns under the impulse of the belt on its periphery the friction of the teeth on the pinion 40 meshing with the teeth of the internal gear 30 will cause the latter to move in the same direction, that is, as indicated by the arrow *x*. When the gear 30 is rotated in this direction, see arrow in Fig. 3, the rolls in the pockets of the ring 28 will be freed from their clutching contact and the gear and its ring will turn freely on the clutch-member 23. The friction between the engaging gears 41 and 16 is also sufficient to cause the pulley 15 to be carried around with the pulley 20 so that when the belt is driving on the fixed pulley the train of gearing between the two pulleys is carried around bodily but remains inactive. In this way the gearing is relieved of all unnecessary wear when the shaft is driven positively and the whole device is therefore rendered more durable. This is an important improvement over other devices in which the gears run constantly whether carrying a load or not, and besides materially reducing the wear on the parts the noise of the gears is eliminated.

It will be evident that certain modifications might be made in the structure and arrangement of the parts of my device without departing from the scope of the invention: For instance, in place of the belt pulleys, other forms of driving elements such as friction disks or gears might be substituted. Again, the invention is not limited to the use of the exact form of clutch mechanism here shown as other similar arrangements would be effective for the purpose intended. By changing the order of the pulleys the device could be arranged to drive first at the maximum speed and then at a slower speed and by varying the ratio of the gearing other speed relations could be arrived at.

I am aware that it is old in the art to make use of planetary gearing for varying the speed of a driven element from the constant speed of the transmission element, and I do not claim such an arrangement broadly. My invention, however, is an improvement over previously known devices, in that the mechanism is much simplified and the drive more direct and, furthermore, the parts are relieved of all unnecessary wear when the power is transmitted positively.

What I claim is:—

1. In a variable-speed mechanism, the combination with a rotatable shaft, of a power-transmission element fixed on said shaft, a second transmission element rotatable on the shaft, a gear 16 fast on the hub of said second element, a stud mounted rotatably on the first element, a gear 41 on said stud adapted to engage the gear 16, a pinion 40 on said stud, and a gear 30 engaged by said pinion 40 and adapted to rotate on the axis of the shaft in one direction, but held from rotation in the opposite direction to cause the pinion 40 to travel thereon with a planetary motion.

2. In a variable-speed mechanism, the combination with a rotatable shaft, of a power-transmission element fixed on said shaft, a second transmission element rotatable on the shaft, a gear 16 rotatable with said second element, a gear 41 mounted rotatably on the fixed element and engaging the gear 16, a pinion 40 driven by the gear 41, a gear 30 engaged by the pinion 40, and a clutch-member arranged to permit the gear 30 to rotate on the axis of the shaft in the direction of rotation of the transmission elements and to prevent the rotation of the gear 30 in the opposite direction to cause the pinion to travel on the gear 30 when the second transmission element is rotated from the source of power.

3. In a variable-speed mechanism, the combination with a rotatable shaft 2, of a driving-pulley 20 fixed on said shaft, a pulley 15 rotatable on the shaft, a gear 16 rotatable with the pulley 15, a gear 41 rotatable on an arm of the pulley 20 and engaging the gear 16, a pinion 40 rotated from the gear 41, a clutch-member 23 mounted on the shaft 2 but held from rotation, and a gear 30 adapted to rotate on the clutch-member 23 in one direction, but held from rotation in the opposite direction, with the pinion 40 engaging said gear to travel around the shaft with a planetary motion.

4. In a variable-speed mechanism, the combination with a rotatable transmission element 20, of a second transmission element 15 rotatable on the same axis, a gear 16 rotatable with the element 15, a gear 41 engaging the gear 16 and pivoted on the element 20 to revolve about its axis, a pinion 40 rotated by the gear 41, a gear 30 meshing with the pinion 40, and means to prevent the rotation of the gear 30 in one direction, while allowing it to rotate in the opposite direction with the element 20.

5. In a variable-speed mechanism, the combination with a rotatable transmission element 20, of a second transmission element 15 rotatable on the same axis, a gear 16 rotatable with the element 15, a stud 37 pivoted in the member 20 and revoluble about its axis, a gear 41 fast on said stud 37 and engaging the gear 16, a pinion 40 also fast on the stud 37, a gear 30 in mesh with said pinion and adapted to rotate with the member 20 in one direction, and means to prevent the gear 30 from rotating in the opposite direction so that the pinion 40 will travel thereon with a planetary movement when driven by the gear on the member 15.

6. In a variable-speed mechanism, the combination with a rotatable shaft 2, of a transmission element 20 fixed on the shaft,

a second transmission element 15 rotatable on the shaft, a gear 16 rotatable with the element 15, a gear 41 pivoted on the element 20 to revolve about the axis of the latter, a pinion 40 rotated by the gear 41, a clutch-member 23 mounted on the shaft 2 but held from rotation, an internal gear 30 engaging the pinion 40 and adapted to rotate on the member 23 in the direction of rotation of the element 20, and means on the clutch-member 23 to prevent the rotation of the gear 30 in the opposite direction so that the pinion 40 will be caused to travel around the gear 30 with a planetary motion.

7. In a variable-speed mechanism the combination with a rotatable shaft, of a driving pulley 20 fixed on said shaft, a pulley 15 rotatable on the shaft, a gear 16 fast on the hub of said pulley 15, a stud 37 rotatable in an arm of the pulley 20, a gear 41 fast on said stud and adapted to mesh with the gear 16, a pinion 40 fast on the opposite end of the stud 37, a clutch-member 23 mounted on the shaft and held from turning, an internal gear 30 engaging the pinion 40 and formed with a ring 28 rotatable on the member 23, said ring formed with wedge-shaped pockets 29, and rolls 31 arranged in said pockets to allow the gear 30 to rotate on the member 23 in one direction and to prevent the rotation of the gear in the opposite direction.

8. In a variable-speed mechanism the combination with a rotatable shaft 2, of a clutch-member 23 mounted on said shaft 2, with means to prevent the clutch-member from turning, said clutch-member formed with a flanged rim 24, a gear 30 formed with a ring 28 fitted to the rim 24 and having wedge-shaped pockets, rolls 31 in said pockets between the ring 28 and the rim 24, a ring 33 secured to the face of the member 23 and abutting the ends of the rolls 31 and the side of the ring 28 to keep them in place on the rim 24, a pulley 20 fast on the shaft 2, a stud 37 rotatable in an arm of the pulley 20, a pinion 40 fast on said stud 37 and adapted to engage the gear 30, a gear 41 fast on the opposite end of the stud 37, a pulley 15 rotatable on the shaft 2, and a gear 16 fast on the hub of the pulley 15 and adapted to mesh with the gear 41.

9. In a variable-speed mechanism for warping machines, the combination with a shaft rotatable in bearings in the frame of the machine, a driving-drum 4 on said shaft, a power-transmission element 20 fast on the shaft 2, a second transmission element 15 rotatable on the shaft 2, a gear 16 rotatable with the element 15, a gear 41 rotatable on the element 20 and revoluble about the axis of the shaft 2, said gear meshing with the gear 16, a pinion 40 rotated by the gear 41, a gear 30 engaged by the pinion 40, a clutch-member 23 mounted on the shaft 2 and secured to the frame of the machine to prevent it from turning, and means between the clutch-member 23 and the gear 30 to check the rotation of the latter in one direction but adapted to allow the rotation of the gear in the opposite direction.

In testimony whereof I affix my signature in presence of two witnesses.

FESTUS S. RAND.

Witnesses:
ARTHUR M. HOWE,
EUGENE H. VAUGHN.