J. STURGESS.

VARIABLE SPEED GEAR.

APPLICATION FILED AUG. 14, 1905.

949,782.

Patented Feb. 22, 1910.

6 SHEETS—SHEET 1.

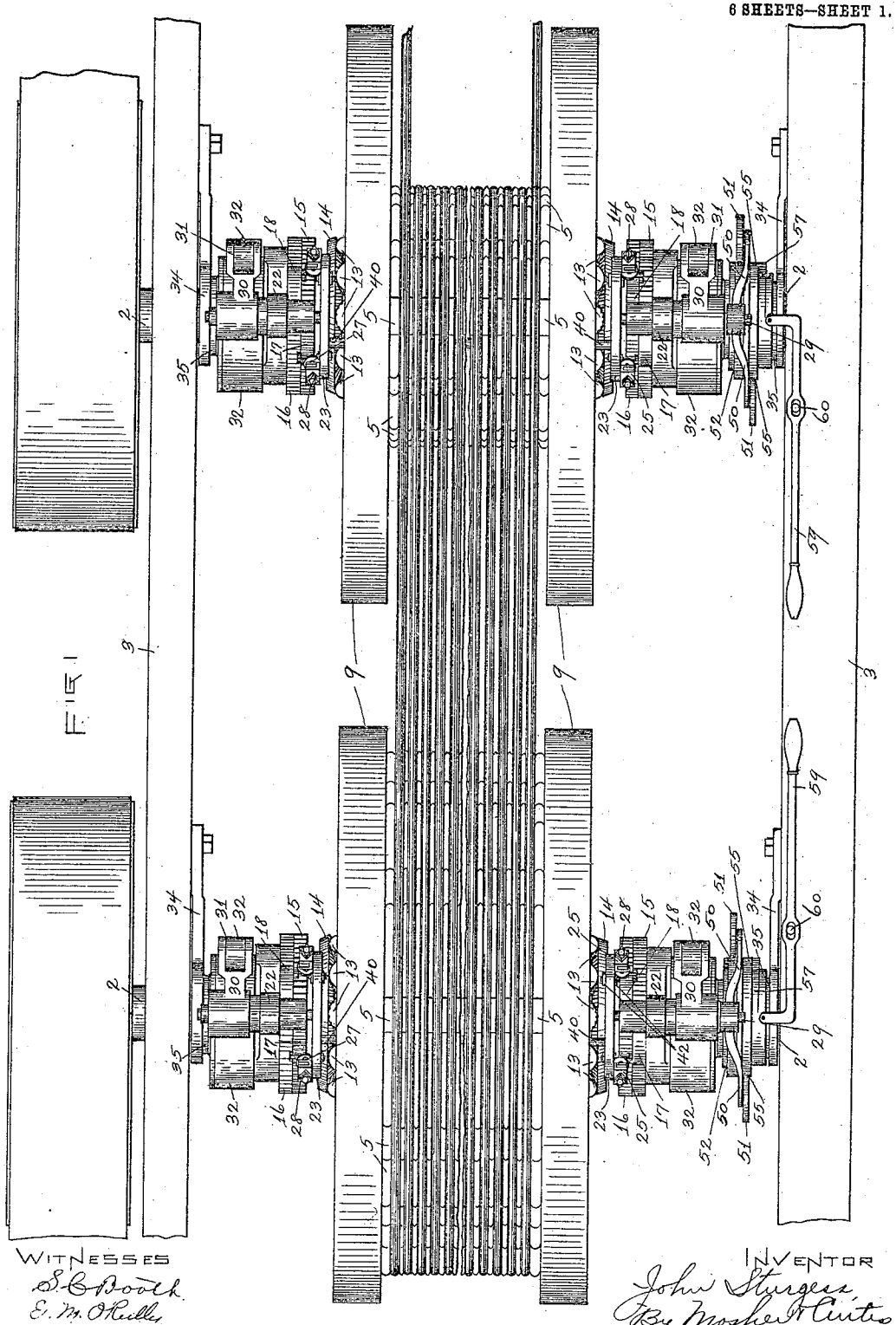

FIG. 1

WITNESSES

S. B. Boock

E. M. O'Reilly

INVENTOR

John Sturgess

By Mosher & Curtis

Attys

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6 SHEETS—SHEET 2.

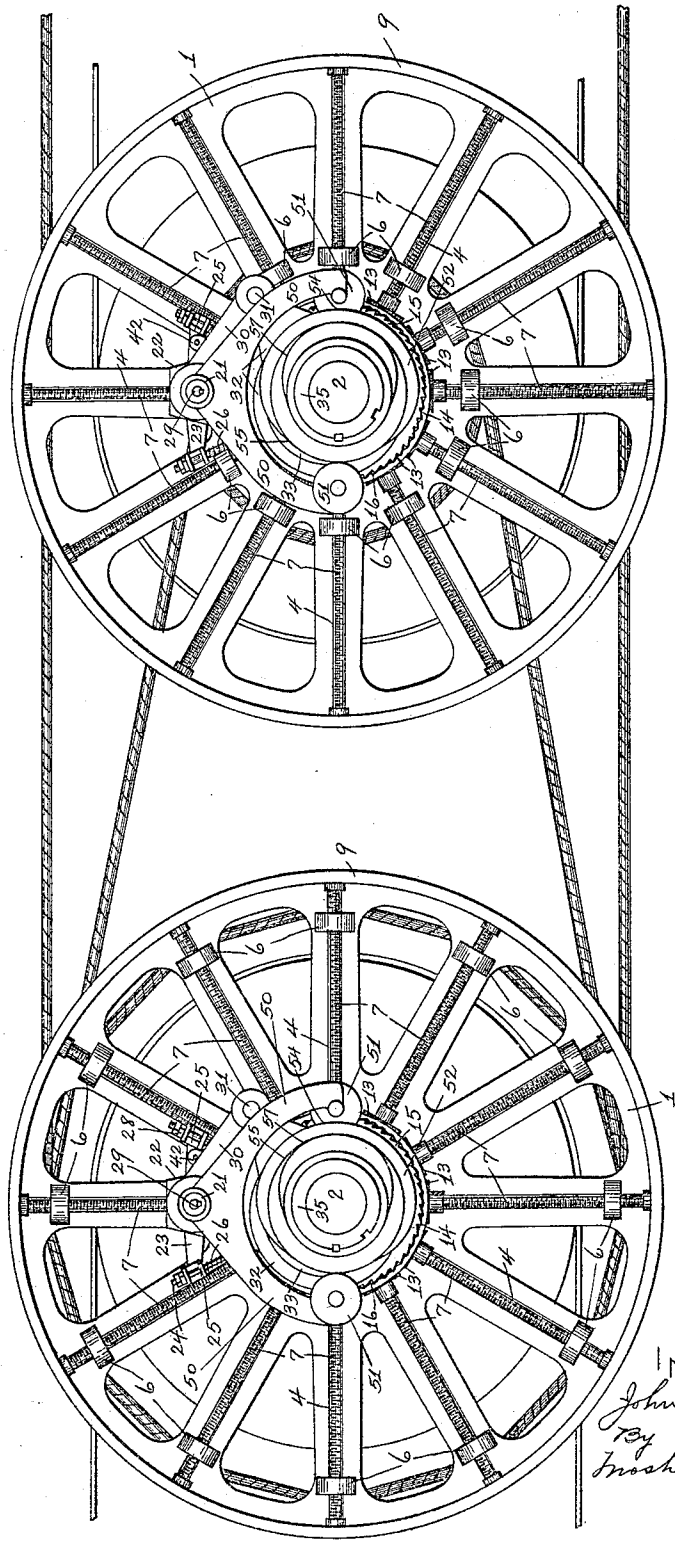

FIG 2

WITNESSES
S. B. Booth
E. M. O'Reilly

INVENTOR
John Sturgess,
By Mosher & Curtis,
Attys.

J. STURGESS.

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6 SHEETS—SHEET 3.

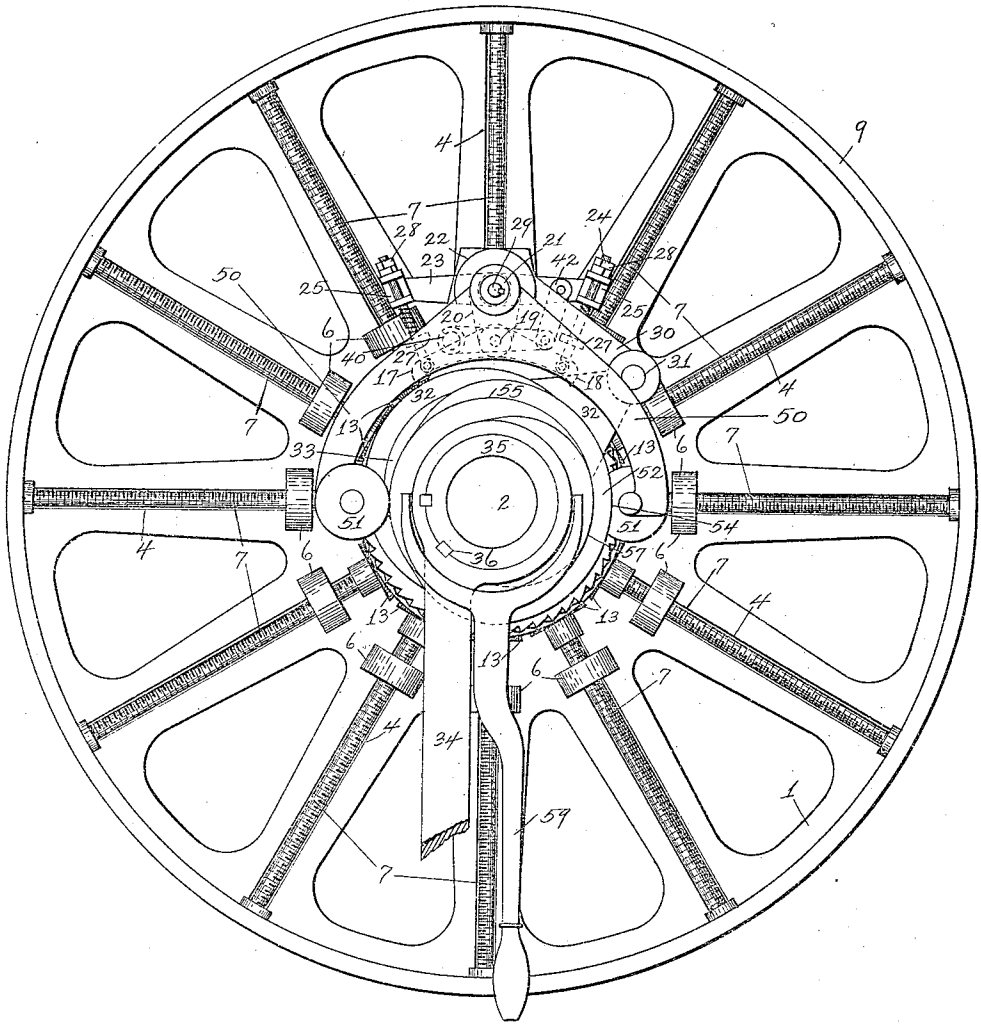

FIG 3

WITNESSES

S. C. Booth

E. M. O'Reilly

INVENTOR

John Sturgess,

By Mosher & Curtis

Attys.

J. STURGESS.

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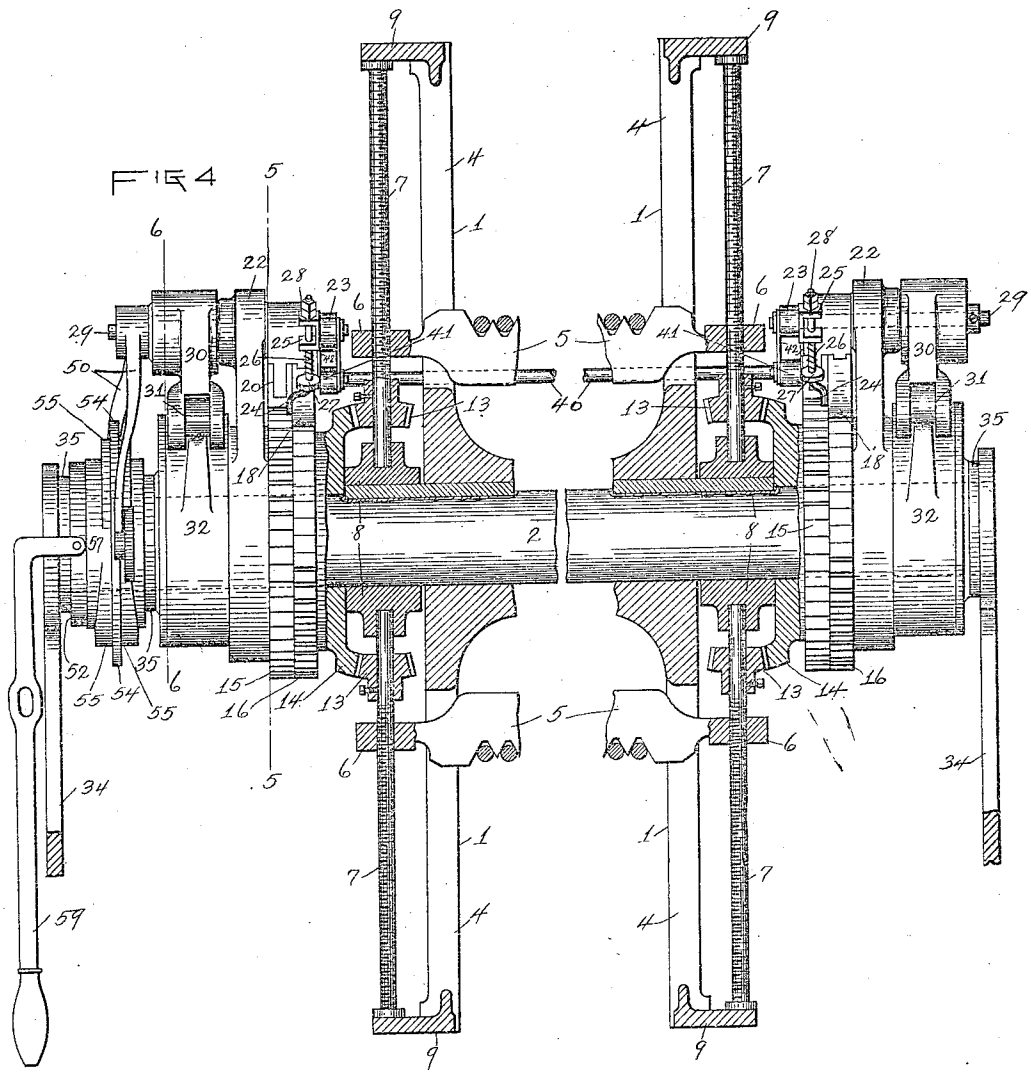
6 SHEETS—SHEET 4.

FIG 4



WITNESSES

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E. M. O'Reilly.

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By Mosher & Curtis,

Attys.

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6 SHEETS—SHEET 5.

FIG 5

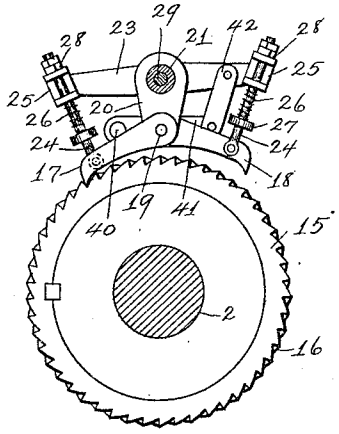
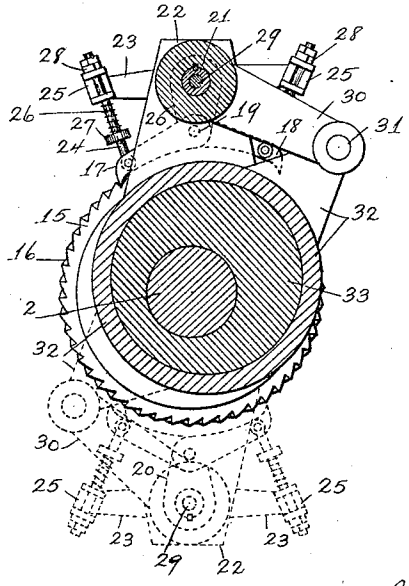


FIG 6



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E. M. O'Reilly.

INVENTOR

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By Mosher & Curtis.

Attys.

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6 SHEETS—SHEET 6.

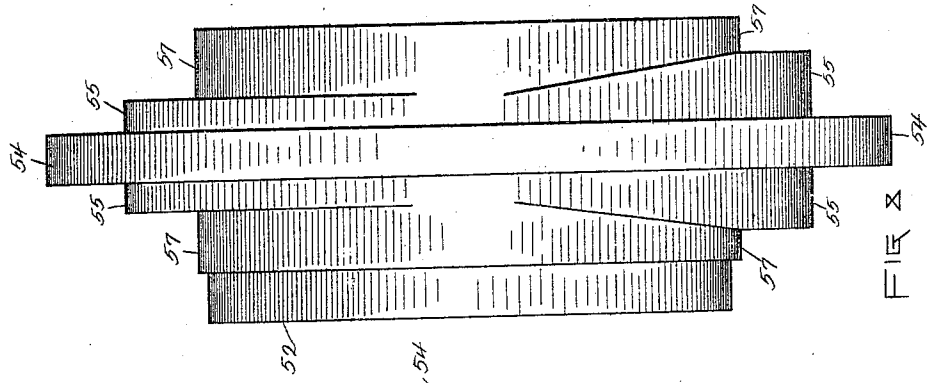

FIG 8

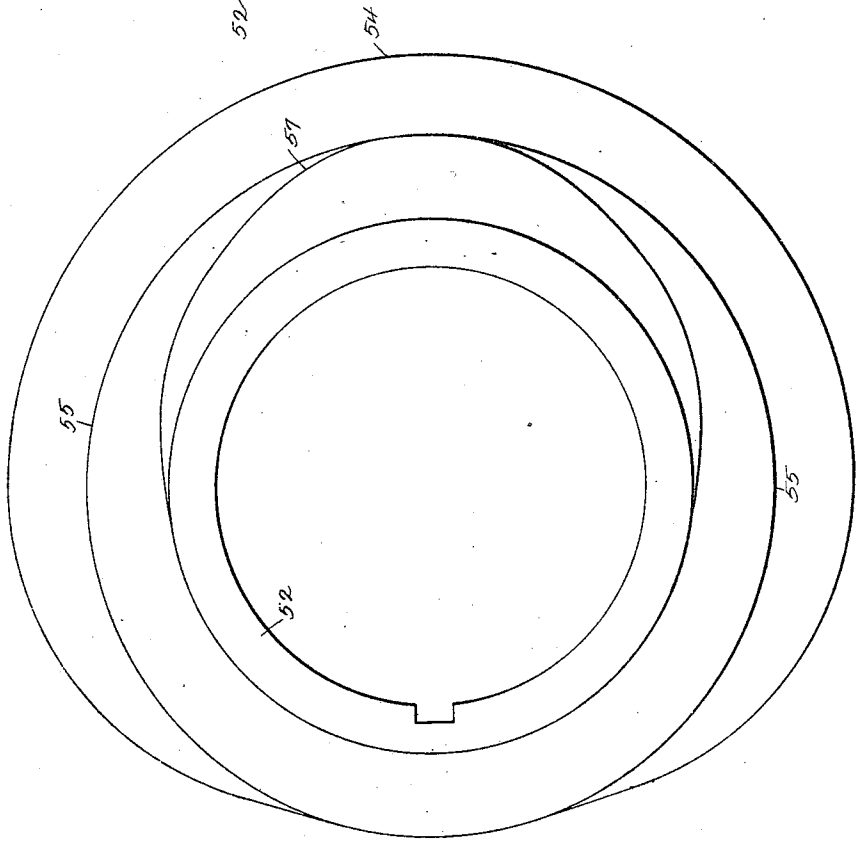

FIG 7

WITNESSES

S. L. Booth.

E. M. O'Reilly.

INVENTOR

John Sturgess.

By Mosher & Curtis.

Attys.

UNITED STATES PATENT OFFICE.

JOHN STURGESS, OF TROY, NEW YORK, ASSIGNOR TO STURGESS GOVERNOR ENGINEERING COMPANY, OF TROY, NEW YORK, A CORPORATION OF NEW YORK.

VARIABLE-SPEED GEAR.

949,782. Specification of Letters Patent. Patented Feb. 22, 1910.

Application filed August 14, 1905. Serial No. 274,042.

To all whom it may concern:

Be it known that I, JOHN STURGESS, a subject of Great Britain, residing at Troy, county of Rensselaer, and State of New York, have invented certain new and useful Improvements in Variable-Speed Gears, of which the following is a specification.

The invention relates to such improvements and consists of the novel construction and combination of parts hereinafter described and subsequently claimed.

Reference may be had to the accompanying drawings, and the reference characters marked thereon, which form a part of this specification. Similar characters refer to similar parts in the several figures therein.

Figure 1 of the drawings is a top plan view of my improved variable speed gear. Fig. 2 is a side elevation of the same with the supporting frame removed. Fig. 3 is a view in side elevation on an enlarged scale of one of the pulleys of variable diameter with its supporting shaft and the mechanism for expanding and contracting the same. Fig. 4 is a side view of the same partly broken away and partly in section. Fig. 5 is a vertical cross-section of the same taken on the broken line 5—5 in Fig. 4. Fig. 6 is a vertical cross-section of the same taken on the broken line 6—6 in Fig. 4. Fig. 7 is a view in side elevation of the cam which controls the automatic expansion and contraction of the pulley. Fig. 8 is an edge view of the same.

My invention relates to variable speed gear wherein a rope or other form of transmission belt passes over a pulley the effective diameter of which can be varied from time to time as desired to accomplish variations in speed of the same or a shaft connected therewith.

The principal object of the invention is to facilitate the operation of changing the effective diameter of the variable pulley as desired from time to time, and more specifically to automatically accomplish such change in diameter of the variable pulley.

Other objects of the invention will appear in connection with the following description.

The invention contemplates the use of a belt pulley, the working diameter of which can be varied by varying its actual diameter, or in any other known manner, whereby under different conditions of adjustment the belt is caused to engage the pulley at different distances from its axis of rotation.

In the variable speed gear of the type to which this invention relates it is customary to provide means for changing the effective or working diameters of both of the belt connected pulleys, and in Figs. 1 and 2, I have shown my invention applied to a variable speed gear in this manner. For certain purposes of the invention, however, it is sufficient that only one of the belt-connected pulleys be made variable. As the construction and manner of operation of both pulleys are substantially the same, a detailed description of one will suffice for both.

The pulley comprises in part a pair of disks, 1, 1, mounted in parallel planes upon the shaft, 2, or otherwise mounted to rotate in unison with each other. The shaft, 2, is rotatively mounted in bearings in the frame 3. Each of the disks, 1, is provided with a plurality of radial slots, 4, at equal distances from each other, the slots in one disk being directly opposite the respective slots in the other. Each oppositely located pair of radial slots, 4, in the respective disks is adapted to receive and form slideways for the opposite ends of a belt-supporting segment, 5, which may be of any known form adapted to support a power transmission belt of any known kind. As shown in the drawings the segments, 5, are grooved to receive a rope transmission belt. The ends, 6, of the segments, 5, which project exteriorly beyond the respective disks are severally provided with a screw-threaded aperture adapted to receive and fit a screw-threaded shaft, 7, rotatively mounted upon the neighboring disk 1. The inner ends of the respective screw-shafts, 7, are mounted in step-bearings in the hub, 8, of the pulley, and their outer ends upon the rim-plate or ring, 9, mounted upon the lugs, 10, outwardly offset from the disk intermediately of the respective slots, 4, therein. The rim-plate or ring, 9, may be an integral structure, as shown in Fig. 3 or a segmental structure. The screw-shafts are thus rotatively mounted substantially opposite and in line with the respective radial slots, 4, in the disks. A rotative movement of a screw-shaft, 7, in one direction will cause the end of the segment mounted thereon to travel inwardly, and a rotative movement of

said shaft in the opposite direction will cause said end of said segment to travel outwardly along said shaft. It is thus possible, by imparting to all the screw-shafts, 7, simultaneously, similar rotative movements, to accomplish a variation of either enlargement or diminution in the effective size or working diameter of the pulley, while retaining a symmetrical disposition of the belt-supporting segments.

As a means for simultaneously and similarly operating all the screw-shafts mounted upon one of the disks, 1, I provide each of the screw-shafts mounted upon said disk with a beveled pinion, 13, fixed thereupon, all of which pinions are adapted to engage a common beveled gear, 14, loosely mounted upon the shaft, 2, and capable of a rotative movement independently of, or relatively to, that of said disk, whereby a differential rotative movement between said disk and beveled gear will cause the beveled pinions and their respective screw-shafts, 7, to be rotated in accordance with the direction of such differential movement.

For rotating each of the beveled gears, 14, relatively to the neighboring disk, 1, to accomplish a differential rotative movement between said disk and beveled gear I have provided a pawl-and-ratchet mechanism adapted to automatically cause, under the control of the operator, a rotative movement of the beveled gears in either direction relatively to the pulley disk.

Fixed upon the hub of each beveled gear, 14, are a pair of ratchets, 15 and 16, the teeth of which respectively face in opposite directions. The respective ratchets, 15 and 16, are adapted to be engaged at certain times by the respective pawls, 17 and 18, pivotally mounted at, 19, upon an arm, 20, fixed upon a hollow-shaft, 21, rotatively mounted in a bearing in an arm or bracket, 22, fixed upon the main shaft 2. The pawls are controlled as to their working and idle positions by the lever, 23, the opposite ends of which are connected with the respective pawls by means of rods, 24, one end of each rod being pivotally connected with a pawl, and its other end adapted to reciprocate through a slideway, 25, pivotally mounted upon one end of said lever, a coil spring, 26, being interposed between the slideway and a shoulder, 27, on said rod. A stop-nut, 28, is applied to the outer end of the rod, 24, adapted to engage the slideway, 25, to limit the action of the spring 26. The lever, 23, is fixed upon a rock-shaft, 29, which extends through and is capable of rotative movement within the hollow shaft 21. When the lever, 23, is in mid-position both pawls are supported thereby in idle position withdrawn from engagement with their respective ratchets. When the lever, 23, is rocked in either direction one of said pawls will be caused to yieldingly engage its ratchet while the other pawl will be withdrawn from engagement with its ratchet by reason of the engagement of the slideway, 25, with the stop-nut, 28, on the rod connected therewith. The position of the lever, 23, may be controlled and varied in any known manner. As a means for rendering operative the pawl which is in engagement with one of said ratchets, I fix upon the hollow shaft, 21, upon which the pawl-carrying arm, 20, is fixed, a rocker-arm, 30, pivotally connected at, 31, with the strap, 32, of an eccentric, 33, said eccentric being maintained in stationary position by means of an arm, 34, fixed upon the frame of the machine and inclosing the hub, 35, of the eccentric which is keyed thereto as shown at 36. In the operation of the apparatus, the eccentric being thus maintained stationary, while the shaft, 2, rotates within the same and the eccentric strap turns around the same, the pulley disks and parts mounted thereon and the pawl mechanism mounted upon the arm, 22, all move in unison with the main shaft. The pivotal connection, 31, between the eccentric strap and the arm, 30, whereby the pawls are operated will, during each rotation of the shaft, 2, be caused to reciprocate toward and from said shaft, thus causing a rocking movement of said arm, 30, which movement is transmitted through the hollow-shaft, 21, and arm, 20, to the pawls, causing the pawl which is in engagement with a ratchet to reciprocate back and forth upon the ratchet, its movement in one direction serving to operate the ratchet, while during its movement in the opposite direction the pawl slips over the ratchet-teeth in the usual manner. The beveled-gear, 14, which is loosely mounted upon the shaft, 2, rotates with said shaft and the neighboring pulley-disk and parts mounted thereon, except when such movement is interfered with by the action of one or the other of said pawls. With either pawl in operation, however, a step-by-step rotative movement of said beveled gear is induced relatively to said main shaft and pulley-disk, which relative or differential rotative movement causes, through the beveled pinion, 13, operation of the several screw-shafts, 7, mounted upon the neighboring disk. By rendering one of said pawls operative a rotative movement of retardation, and by rendering the other of said pawls operative a rotative movement of acceleration, can be imparted to said beveled gear relatively to the neighboring pulley-disk, serving in one case to rotate the screw-shafts, 7, in a direction to expand the pulley and in the other case to contract the same.

The mechanism above described for rotating the beveled gear, 14, relatively to the neighboring disk is duplicated on opposite sides of the pulley; and, to secure simul-

taneous and similar operation of both beveled gears, 14, on opposite sides of the pulley, I extend through the pulley parallel with its axis a rock-shaft, 40, rotatively mounted in bearings in the respective pulley-disks, said shaft passing between two neighboring screw-shafts, 7, on each disk. On the opposite ends of this rock-shaft, 40, are fixed rocker-arms, 41, connected by links, 42, with the respective pawl-controlling levers, 23, on opposite sides of the pulley, whereby said levers, 23, are caused to operate in unison with each other. It will thus be seen that in the operation of the apparatus a rocking movement imparted to the rock-shaft, 29, on either side of the pulley will cause both of the beveled gears, 14, on opposite sides of the pulley to be simultaneously and similarly operated whereby similar and equal movements will be imparted to the opposite ends of the respective pulley segments.

It is desirable in the operation of the apparatus that a pawl should not be thrown into action during its forward stroke because of the possibility of the point of the pawl striking and glancing off from the point of one of the ratchet-teeth. I have therefore provided means whereby said pawls can be separately thrown into action, each during its return stroke only.

Fixed upon the outer end of the rock-shaft, 29, are a pair of rocker arms, 50, each provided on its end with a cam-follower roller, 51, engageable at different times with different portions of the cam-wheel, 52, which cam-wheel is mounted upon the hub of the eccentric, being free to slide longitudinally thereon, but keyed thereto to prevent rotative movement. In the operation of the apparatus the cam-followers, 51, are caused to travel around the periphery of the stationary cam-wheel. The cam-follower rollers, 51, occupy different vertical planes perpendicular to the axis of the pulley and pulley-shaft, and the cam-wheel, 52, is provided on opposite sides of the central cam flange, 54, with a pair of cylindrical surfaces, 55, concentric with the main shaft, 2, and adapted when the cam-shaft is in mid-position (referring to its slide movement) to be engaged at diametrically opposite points by the respective cam-follower rollers, 51, whereby the pawl-controlling lever and pawls are maintained in mid-position with both pawls disengaged from the ratchets. When it is desired to throw one of the pawls into action, the position of the cam-wheel is shifted by a sliding movement thereof until its central cam-flange, 54, is brought into line with that one of the cam-follower rollers, 51, the outward movement of which will produce the desired rocking movement of the pawl-controlling lever 23. The cam-flange, 54, begins and ends in a cylindrical surface continuous with the cylindrical surfaces, 55, and a shifting movement of the cam-wheel is possible only when the low point of said cam, 54, where it terminates in said cylindrical surface, is opposite one of the cam-follower rollers, 51, and then it can only be shifted in a direction away from the other of said cam-follower rollers, other shifting movements of the cam-wheel being prevented by the engagement of the respective cam-follower rollers with the side of said cam-flange 54. The cam-flange, 54, is so located circumferentially upon the cam-wheel relatively to the eccentric that the forward movement of each pawl does not commence until just after the cam-follower roller, by outward movement of which said pawl can be thrown into action, has reached a point opposite the high part of the cam-flange, 54, so that when either of the cam-follower rollers is brought into line with the cam-flange, 54, it is caused to ride upon the higher part of said flange and freely actuate the rock-shaft, 29, and rock-lever, 23, to throw the pawl into action before the forward movement of the pawl begins. When the cam-wheel is shifted to bring one of the cam-follower rollers into line with the cam-flange, 54, the other cam-follower roller is brought opposite one of the cam-surfaces, 57, located on opposite sides of the cam-wheel just outside the respective cylindrical surfaces 55. These cam-surfaces, 57, are each so shaped as to engage one of the cam-follower rollers while the other is engaged by the cam-flange, 54, so that lost motion is prevented, and the high point of said cam-surface, 57, is caused to coincide with the neighboring cylindrical surface, 55, at the point diametrically opposite the low point of the cam-flange 54. When the cam-wheel is in mid-position, both pawls are held out of operative position. The shifting movement of the cam-wheel in one direction causes one of the pawls to be thrown into action, while a shifting movement in the opposite direction causes the other pawl to be thrown into action. Shifting movements of the cam-wheel can be caused by a hand-lever, 59, fulcrumed at, 60, upon the stationary frame, 3, one end of said lever being connected with said cam-wheel.

What I claim as new and desire to secure by Letters Patent is—

1. In a variable speed mechanism the combination with a variable pulley mechanism having a movable element whereby the capacity of the pulley can be varied, a pair of rotatory members capable of rotary movements at relatively different speeds, and connections whereby said movable element is operated by said rotatory members; of pawl and ratchet mechanism for inducing at certain times movement of said rotatory members at relatively different speeds.

2. In a variable speed mechanism the combination with a variable pulley mechanism having a plurality of movable elements whereby the capacity of the pulley can be varied, rotatory members certain of which are capable of rotary movements at relatively different speeds, and connections whereby said movable elements are operated by said rotatory members; of pawl and ratchet mechanism for inducing at certain times rotary movements of said rotatory members at relatively different speeds.

3. In a variable speed mechanism, the combination with variable pulley mechanism comprising in part a pair of similarly slotted disks adapted to rotate in unison and belt-supporting segments mounted between and upon said disks and movable along the respective slots therein to vary the capacity of the pulley; of a member rotatory relatively to said disks; connections between said relatively rotatory member and the respective segments whereby said segments are operated; and pawl and ratchet mechanism for inducing at certain times rotative movements of said disks and said relatively rotatory member at relatively different speeds.

4. In a variable-speed mechanism and in combination a rotatively mounted pulley disk; belt-supporting segments movably mounted thereon; segment-operating screw-shafts rotatively mounted upon said disk; a member rotatory relatively to said disk; connections between said relatively rotatory member and the respective screw-shafts; a ratchet fixed upon said relatively rotatory member; a pawl engageable with said ratchet; and automatic mechanism for imparting reciprocating movements to said pawl in the operation of the device.

5. In a variable-speed mechanism the combination with a variable pulley mechanism having a movable element whereby the capacity of the pulley can be varied; a pair of rotatory members capable of rotary movements at relatively different speeds; and connections whereby said movable element is operated by said rotatory members; of a ratchet for operating one of said rotatory members; a pawl engageable with said ratchet; and automatic mechanism for reciprocating said pawl.

6. In a variable-speed mechanism, the combination with a variable pulley mechanism having a movable element whereby the capacity of the pulley can be varied, a pair of rotatory members capable of rotatory movements at relatively different speeds, and connections whereby said movable element is operated by said rotatory members; of a pair of ratchets for operating one of said rotatory members in opposite directions; a pair of pawls engageable with the respective ratchets; means for throwing a selected pawl into engagement with its ratchet; and automatic mechanism for reciprocating said pawls.

7. In a variable-speed mechanism, the combination with a variable pulley mechanism having a movable element whereby the capacity of the pulley can be varied, a pair of rotatory members capable of rotatory movements at relatively different speeds, and connections whereby said movable element is operated by said rotatory members; of a ratchet for operating one of said rotatory members; a bearing support in fixed relation to the other of said rotatory members; a rock-shaft mounted upon said bearing support; a rocker-arm on said rock-shaft; a pawl mounted upon said rocker-arm and engageable with said ratchet; a rotatory shaft upon which said pulley mechanism is mounted; a stationary eccentric; an eccentric strap movable around said eccentric in unison with the rotary movement of said shaft; a rocker-arm connected with said eccentric-strap and fixed upon said rock-shaft; and means for throwing said pawl into or out of engagement with its ratchet.

8. In a variable speed mechanism, the combination with a variable pulley mechanism having a movable element whereby the capacity of the pulley can be varied, a pair of rotatory members capable of rotatory movements at relatively different speeds, and connections whereby said movable element is operated by said rotatory members; of a pair of ratchets for operating one of said rotatory members in opposite directions; a bearing support in fixed relation to the other of said rotatory members; a rock-shaft mounted upon said bearing support; a rocker-arm on said rock-shaft; a pair of pawls mounted upon said rocker-arm engageable with the respective ratchets; a rotatory shaft upon which said pulley mechanism is mounted; a stationary eccentric; an eccentric strap movable around said eccentric in unison with the rotary movement of said shaft; a rocker-arm connected with said eccentric-strap and fixed upon said rock-shaft; and means for throwing the several pawls into or out of engagement with their respective ratchets.

9. In a variable-speed mechanism, the combination with a variable pulley mechanism having movably supported elements whereby the capacity of the pulley can be varied, and at opposite ends of said movable elements a pair of members rotatory relatively to the support for said movable elements; and connections between each of said relatively rotatory members and the neighboring ends of said movable elements; of a ratchet for operating each of said relatively rotatory members; pawls engageable with said ratchets respectively; means for imparting to said pawls similar reciprocating movements; pawl-controlling means for

throwing each of said pawls into operative position; and connections between the controlling mechanisms of both pawls whereby they are thrown into operative position simultaneously.

10. In a variable-speed mechanism, the combination with a variable pulley mechanism comprising a pulley body having belt supporting elements movably mounted thereupon whereby the capacity of the pulley can be varied, and, on opposite sides of said pulley body, a pair of members rotatory relatively thereto, and connections between each of said relatively rotatory members and the neighboring ends of said belt supporting elements; of a ratchet for operating each of said relatively rotatory members; a pair of pawl-supports on opposite sides of said pulley body; pawls mounted upon the respective pawl-supports engageable with the respective ratchets; means for moving said pawl-supports to reciprocate said ratchets; a pair of pawl-controllers on opposite sides of said pulley body, each having a spring-connection with its pawl; a rock-shaft extended through the body of said pulley; connections between the opposite ends of said rock-shaft and the respective pawl-controllers; and means for moving one of said pawl-controllers whereby both are simultaneously operated through said rock-shaft.

In testimony whereof, I have hereunto set my hand this 7th day of August, 1905.

JOHN STURGESS.

Witnesses:

FRANK C. CURTIS,

E. M. O'REILLY.