No. 861,404. PATENTED JULY 30, 1907.

H. R. STACKS.

VARIABLE SPEED MECHANISM.

APPLICATION FILED MAY 19, 1904.

4 SHEETS—SHEET 1.

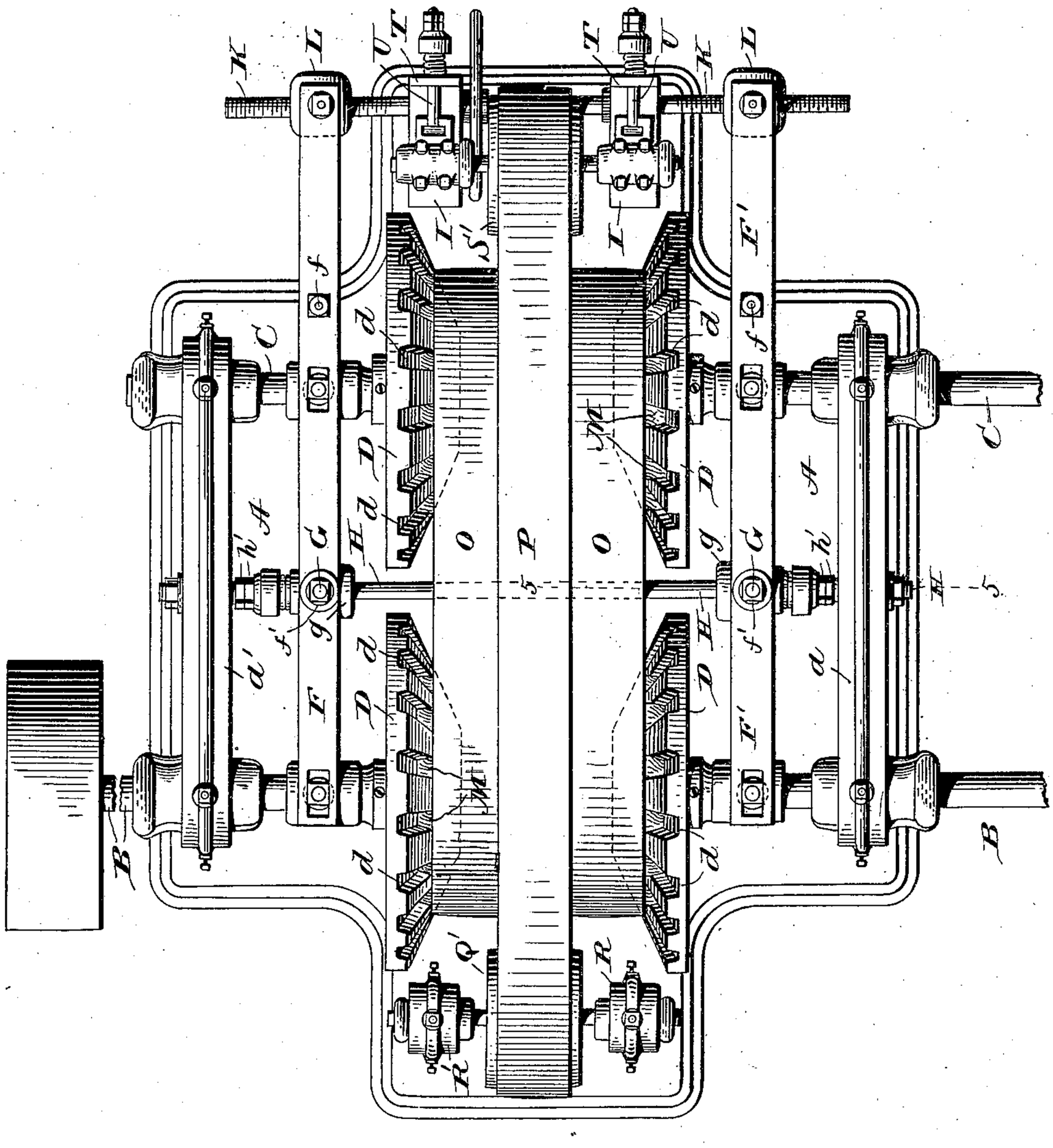

Fig. 1.

Witnesses
Jas. E. Hutchinson
J. L. Lawlor

Inventor
Howard Roy Stacks,
by Prindle and Williamson.
Attorneys

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4 SHEETS—SHEET 2.

Fig. 2.

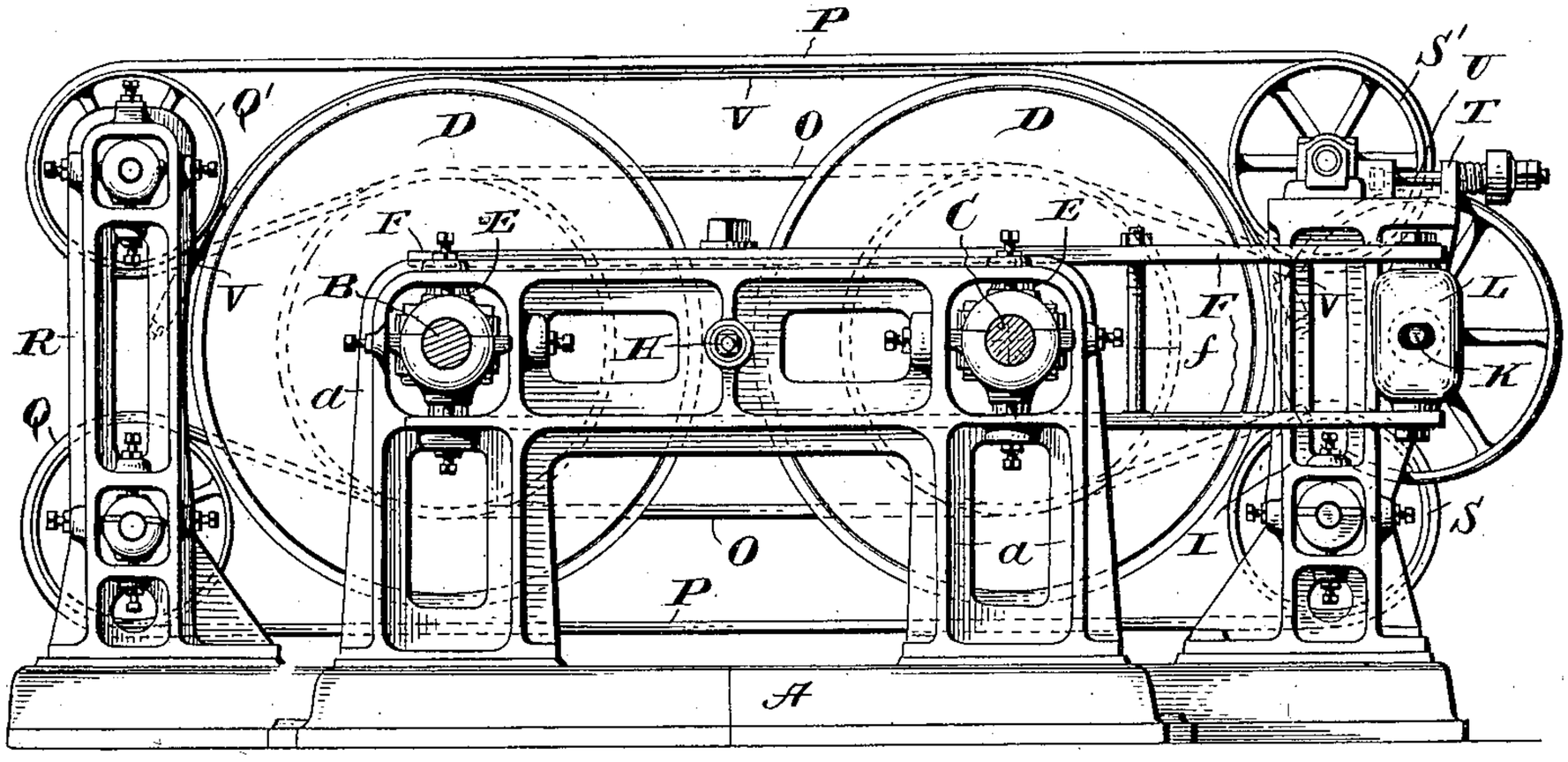
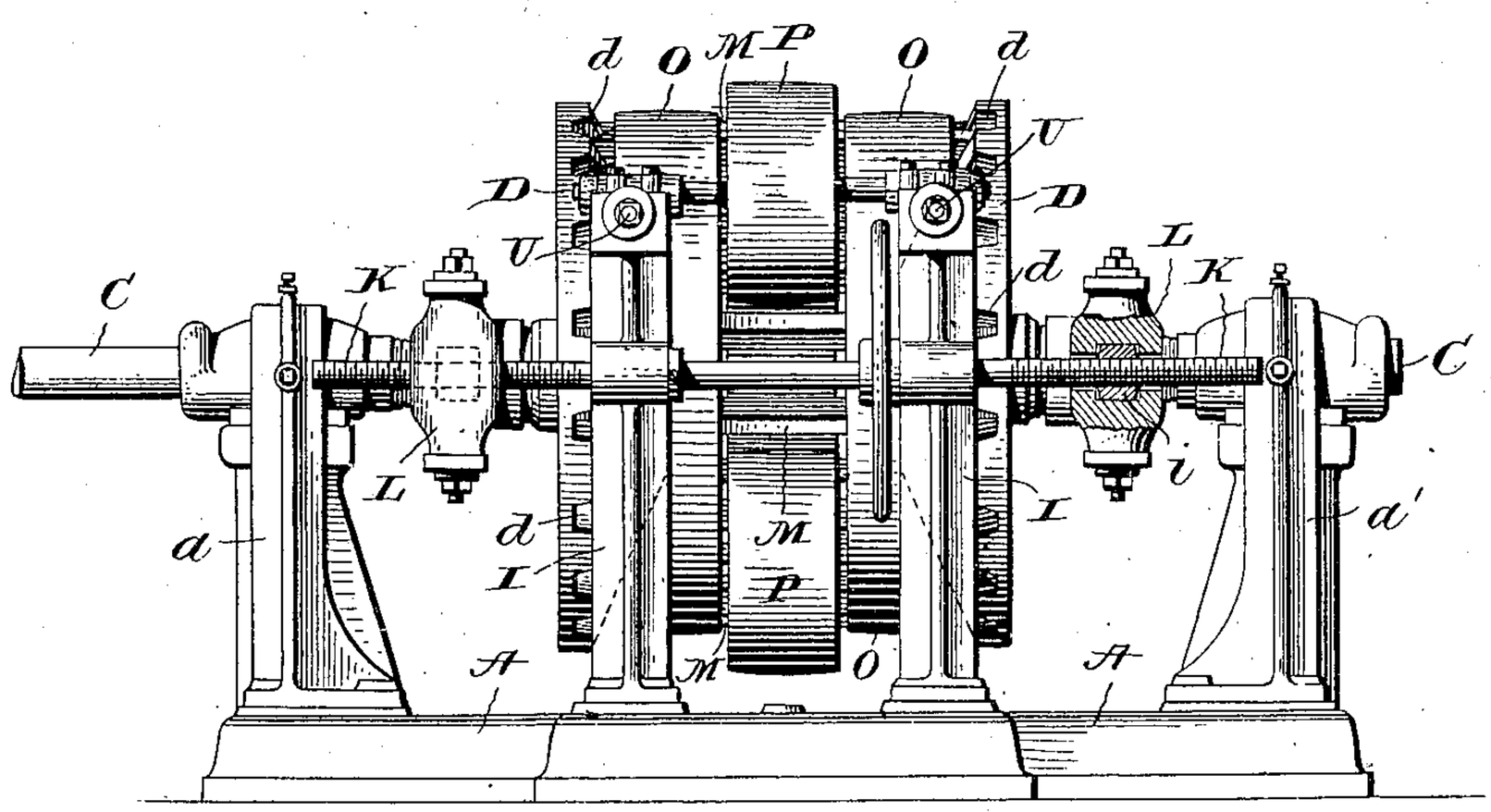


Fig. 3.



Witnesses:
Jas. E. Hutchinson.
J. L. Taylor.

Inventor:
Howard Roy Stacks,
by Pinkle and Williamson
Attorneys

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4 SHEETS—SHEET 3.

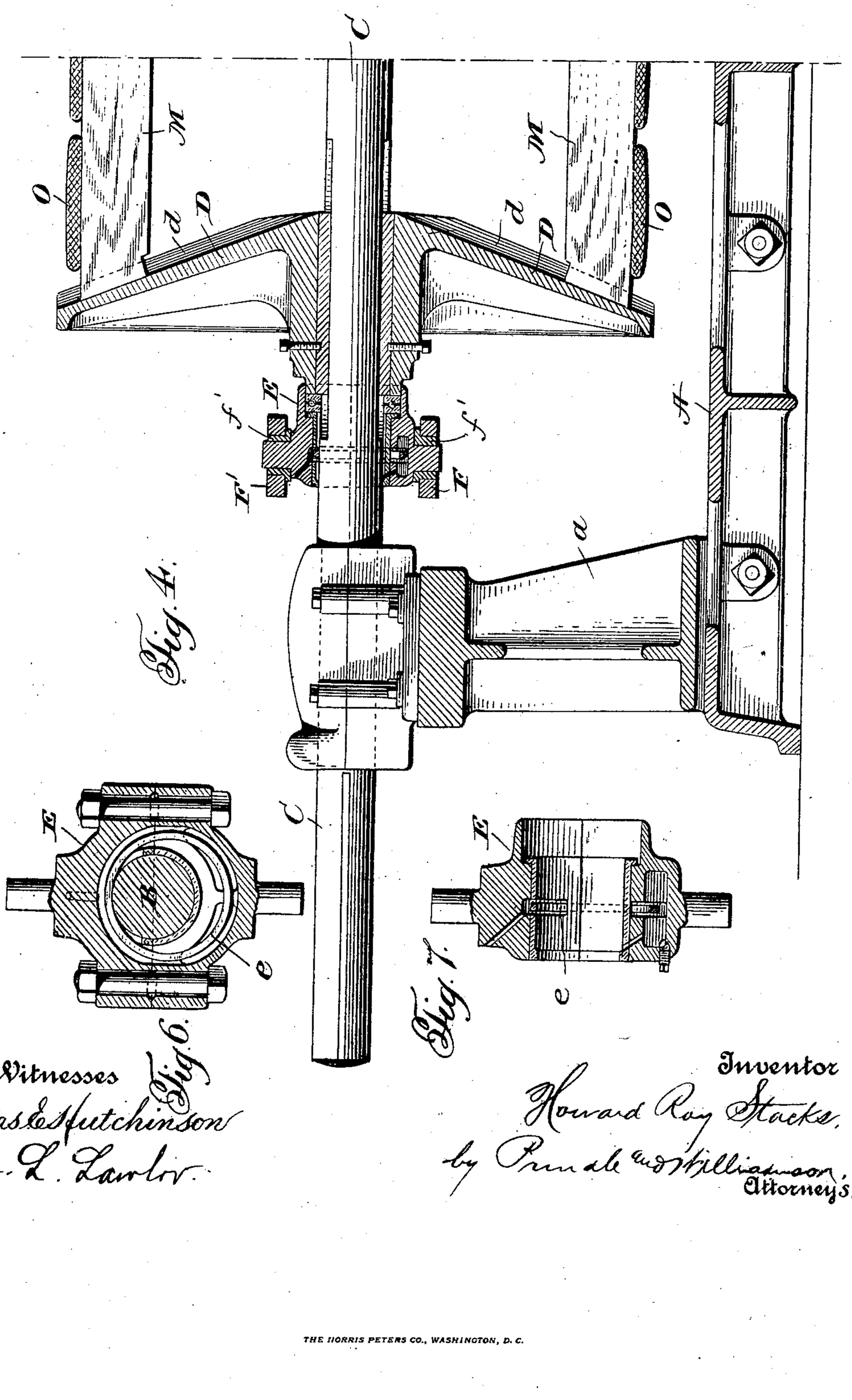

Fig. 4.

Fig. 6.

Fig. 5.

Witnesses
Jas. E. Hutchinson
J. L. Lawlor.

Inventor
Howard Ray Stacks.
by Prindle and Williamson
Attorneys.

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4 SHEETS—SHEET 4.

Fig. 8.

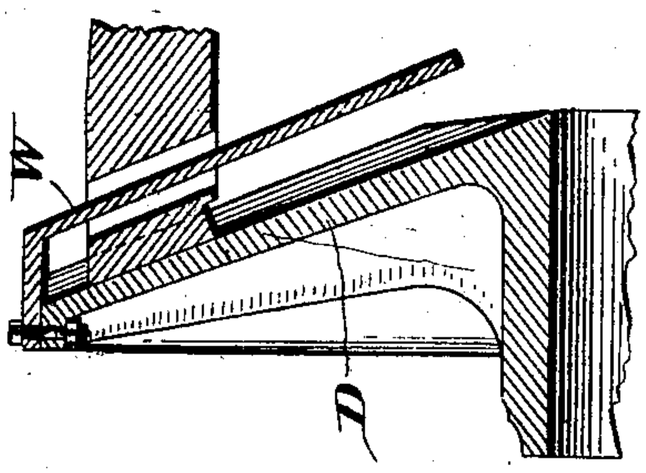
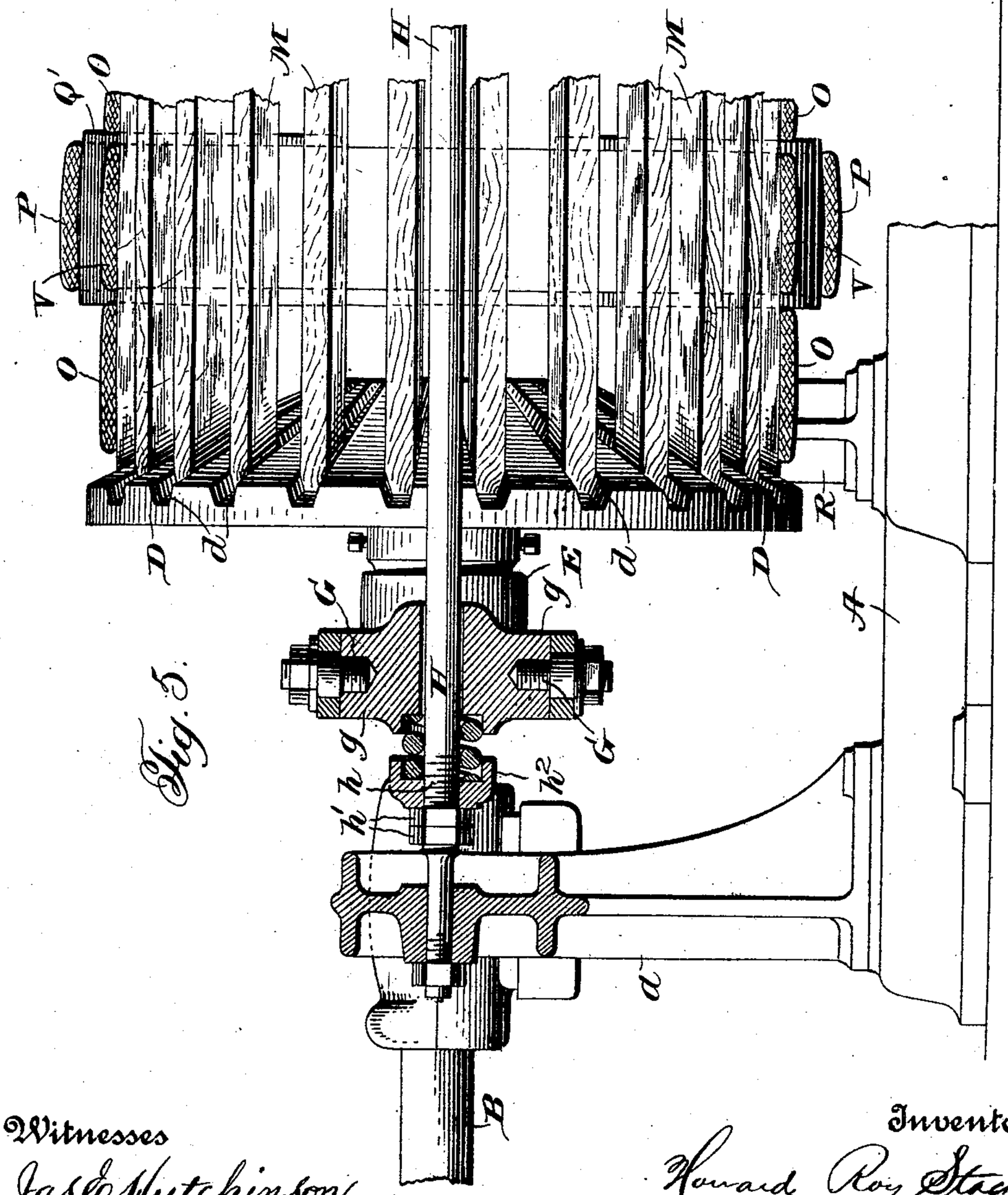


Fig. 5.



Witnesses

Jas. E. Hutchinson.

J. L. Lawlor.

Inventor

Howard Roy Stacks

by Prindle and Williamson

Attorneys.

UNITED STATES PATENT OFFICE.

HOWARD ROY STACKS, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR TO GEO. V. CRESSON COMPANY, OF PHILADELPHIA, PENNSYLVANIA.

VARIABLE-SPEED MECHANISM.

No. 861,404. Specification of Letters Patent. Patented July 30, 1907.

Application filed May 19, 1904. Serial No. 208,680.

To all whom it may concern:

Be it known that I, HOWARD ROY STACKS, of Philadelphia, in the county of Philadelphia and in the State of Pennsylvania, have invented a certain new and useful Improvement in Variable-Speed Mechanisms, and do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, in which—

Figure 1 is a perspective view of a variable speed mechanism embodying my invention; Figs. 2 and 3 are, respectively, side and end elevations; Fig. 4 is a partial transverse sectional view showing one of the conical disks, together with the thrust bearing and trunnions thereof in section. Fig. 5 is a transverse sectional view taken on the line 5—5 of Fig. 1; Figs. 6 and 7 are detail views, in section, of one of the split or divided collars for transmitting motion from the levers to the cones; Fig. 8 is a partial, sectional view of a cone and a slat, showing a retaining device for the slat.

The object of my invention has been to provide a mechanism by which any desired speed of rotation can be transmitted from one shaft to another shaft, and to do this by means which are highly efficient, simple and durable, and to such ends, my invention consists in the variable speed mechanism hereinafter specified.

In carrying my invention into practice, as illustrated in the specific instance chosen, I provide a base A, having side frames *a* and *a'*, respectively, in which side frames are journaled the driving shaft B preferably having a constant rate of rotation, and the driven or variable speed shaft C, to which it is desired to transmit rotation at various speeds. The said shafts may be journaled in any form of boxes. The boxes which have been found most convenient are those illustrated in the patent to A. C. Pessano, #654,276, granted July 24th, 1900. Upon each of the said shafts is mounted a pair of disks D, whose opposing faces are conical, and are provided with radial grooves *d*. The grooves are preferably formed, as illustrated, with flat bottoms and flaring side walls. Each disk is splined upon its shaft and has a hub that is journaled within a collar E mounted upon the shaft, between the disk and the frame of the machine, so that, by the movement of the collar along the shaft, the pairs of disks can be shifted toward or from each other. The said collars are shifted by means of levers F and F' which are fulcrumed at a point intermediate of the shafts in a manner presently to be described, and are journaled upon studs formed upon the upper and lower sides of the said collars, and preferably in a plane passing through the axes of the respective shafts. The pairs of levers are, or may be, connected by bolts *f*, so as to give them rigidity. Inasmuch as great strain falls upon the collars E, so that they are subjected to wear, it is, therefore, important to have them readily removable from the shaft C for repair or replacement, and for this reason each collar is made in halves, as clearly shown in Figs. 6 and 7, which are united by nuts and bolts. With the collars made solid, the only way to get them from the shaft is to move the latter endwise through them, a proceeding that is very objectionable, since it involves dismantling. Another advantage in making the collars in separable halves is that they can be provided with a ring oiler *e*. If they are made solid an expensive oil-cup is required. In view of the strains and wear to which the collar E is subjected, it is, of course, very important that they be well oiled. Preferably, the studs upon the collars E do not directly engage the levers F and F', but a bushing *f'* is employed, of brass or other suitable metal, so that the sliding movement of the parts may be as easy and free from friction as possible. The fulcrums of the levers are, as shown in Fig. 5, formed by screws G which are threaded into the fulcrum block *g*, the latter being loosely mounted upon a tie-rod H, extending from side frame to side frame, between the two pairs of disks. The tie-rod is bolted to the side frames, and is provided with threaded portions *h*, upon which are mounted pairs of nuts *h'* that serve to adjust collars h^2, toward and from the fulcrum block, the adjacent faces of the collars and fulcrum block being preferably recessed, and springs being interposed between the collars and fulcrum block, so that the fulcrum block may be yieldingly forced toward each other and the pairs of levers consequently yieldingly forced toward the disks which they operate.

At the forward end of the base, are mounted a pair of end frames I, in which is journaled a screw rod K having a collar and a hand-wheel thereon to prevent endwise movement, and having a hand-wheel for turning the rod. The screw rod is oppositely threaded at points outside of the end frames I, and such threaded portions engage blocks *i*, which are preferably elliptical in horizontal cross-section, and which are received within preferably rectangular chambers formed in blocks L, that are journaled between the forward ends of the pairs of levers. By turning the hand-wheel, the blocks L can be made to travel in and out on the threaded portions of the screw rod, and to draw the ends of the pairs of levers together or spread them apart so that the disks upon one shaft shall be forced together, while at the same time, the disks on the opposite shaft will be spread apart. The corresponding grooves in each pair of disks are occupied by slats M, the said slats being preferably formed of wood, and

preferably, although not necessarily, having their ends which engage the grooves shod with metal, the preferred metal being brass, or a similar composition.

The two cylinders formed by the slats are embraced by a belt or belts O, there being, preferably, two of such belts located near the outer ends of the slats. These belts are open belts. In order to retain the slats in position during the portion of their revolution when they are not engaged by the driving belts O, I provide a retaining belt P, which is guided upon four idlers, two of which, Q and Q′, are mounted in brackets R and R′ secured upon the rear end of the base A, and two of which S and S′, are mounted on the brackets I, at the forward end of the frame. The retaining belt passes from the upper surface of the idler Q′, around such idler, over the upper surface of the adjacent cylinder of slats, thence around such cylinder of slats, and over the upper surface of the lower idler Q′, around such idler, and straightforward to the under surface of the lower idler S, over such idler and around the adjacent cylinder of slats to the under surface of the idler S, around such idler and rearward again. It will be seen that the two cylinders of slats are thus completely inclosed in their belts, so that the slats are at all times pressed toward the shafts and down into the grooves in the disks, and no motion of the slats relative to the disks in a given adjustment of the disks is possible. The retaining belt preferably runs between the driving belts. In order to insure that the retaining belt shall be under tension, the journal boxes of the upper idler S are formed on slides T, that are movable upon guideways formed on the upper ends of the brackets I, the said slides being engaged by the heads of bolts U that are dropped into recesses formed in said slides, the said bolts passing through flanges formed on the brackets I, and having coiled springs thereon, outside of said brackets, there being collars on said bolts and nuts for adjusting the position of said collars, so that the tension of said spring is applied to the shaft of the idler to draw it forward. It will thus be seen that the driving belts are kept under tension by means of the springs applied to the fulcrums of the pairs of levers, and the retaining belt is kept under tension by means of the springs on the bolts U.

In order to prevent the slats being thrown out of the machine and causing injury in case the belts or any of them should break, I provide a strap V which is supported on the frame at its ends, and is extended over the space between the two pairs of disks. An alternative construction is illustrated in Fig. 8 in which rods W are secured to the peripheries of the disks and extend parallel to the conical faces thereof, the slats being provided with holes to permit the passage of said rods. The slats are preferably crowned, or made of increased height under each belt to keep each belt away from the neighboring belts or the disks. This saves wear on the edge of the belt. The journal boxes for the idlers, with the exception of the idler S, are preferably of the same form as that illustrated in the Pessano patent, before referred to. I find the use of boxes of this type of great advantage, since they are not only self-lubricating, but I can place the base of my speed-controller either on the floor or on the ceiling, or in a vertical position, and yet can adjust the journal boxes so that the oil receptacle shall always be underneath, and thus proper lubrication be provided for. The boxes, it will be observed, are supported between two vertical and two horizontal set screws, and by the use of such set screws the tension of the belts can be regulated, if desired.

In the operation of the above-illustrated speed mechanism, power may be applied to either shaft, but the shaft B will be designated as the driving shaft. When such shaft is rotated, it causes its disks to revolve and carries the slats around with them, causing the driving belts, and also the retaining belt, to rotate the opposite cylinder of slats, and with it the disks and their shaft. The speed which is transmitted to the drive shaft will depend upon the relative diameters of the two cylinders of slats, and these diameters depend upon the positions of the pairs of levers. When the levers are moved to increase or decrease the driving pulley formed by the cylinder of slats upon the driving shaft, they, at the same time, cause an increase or decrease in the diameter of the driven pulley formed by the cylinder of slats upon the driven shaft. This results in the length of the driving belts, and also of the retaining belt being maintained practically constant, any slight variation which may occur being taken up by the two sets of springs. I find in actual practice that it is feasible to vary the diameters of the cylinders of slats, so that the ratio of the speeds of the two shafts may be varied from unity to that of one to ten. The above-illustrated construction has the great advantage that the driving belts are open belts. This saves wear upon the belts, since they are bent always in one direction, and it enables the mechanism to be run either backward or forward. All of the belts employed on the machine are driving belts, it being found that the retaining belt transmits a large percentage of power. It is not necessary to use endless belts in my mechanism, and laced belts can be used, if desired. All of the belts can be of the same width. Practically the whole length of the slats is occupied by belts. Since laced belts can be used, new belts can be placed upon the machine without dismantling the machine. The belt tension is practically constant. The tension rod upon which the fulcrums of the levers are mounted, takes the strains from the lever off the frame. The idler pulleys are all in exposed positions, where they can be oiled and watched, and easily adjusted and repaired. Moreover, they can be provided with self-oiling boxes, which has not been feasible in some previous variable speed mechanisms, because of the cramped space in which they had to be located. The ratio of the diameters of the cylinders of slats can be varied by lengthening or shortening the belts. The shifting of the levers by means of the screw shaft is simple and efficient.

It is obvious that various changes can be made in the above-illustrated construction, which will be within the scope of my invention. For instance, a separate retaining belt can be used for each cylinder of slats.

Having thus described my invention, what I claim is:—

1. In a variable speed mechanism, the combination of cylinders whose diameters can be varied, a belt engaging said cylinders by the inside of such belt, and a belt engaging the portions of said cylinders not engaged by said first mentioned belt, said last mentioned belt engaging said cylinders by the outside of said belt.

2. In a variable speed mechanism, the combination of

cylinders whose diameters can be varied, said cylinders consisting of loose parts, a belt inclosing said cylinders, and a belt having reëntrant loops, that engage the portions of said cylinders not engaged by said first mentioned belt.

3. In a variable speed mechanism, the combination of parallel shafts, expansible pulleys on said shafts, the surface of which pulleys is formed by loose parts, a belt inclosing said pulleys, and having a path consisting of two arcs of circles connected by straight lines, and a belt inclosing the portions of said cylinders not in contact with said first mentioned belt, said last mentioned belt having reëntrant loops to engage said cylinders.

4. In a variable speed mechanism, the combination of a pair of parallel shafts, expansible pulleys on said shafts, the surfaces of which pulleys consist of loose parts, a belt inclosing both of said pulleys and engaging the portions of their peripheries most removed from each other, and a belt engaging the portions of the peripheries of said pulleys nearest to each other, said last mentioned belt passing from one pulley to the other by a path farther from said pulleys than the path of said first mentioned belt.

5. In a variable speed mechanism, the combination of a pair of parallel shafts, conical disks mounted on said shafts and having flaring grooves formed in their conical surfaces, slats mounted in said grooves, open belts passing about the two cylinders of slats thus formed, two pairs of idlers, said pairs being on opposite sides of said shafts, and a retaining belt passing about said idlers and the portions of the peripheries of said cylinders not engaged by said driving belts.

6. In a variable speed mechanism, the combination of a pair of parallel shafts, a pair of opposing conical disks upon each of said shafts, slats engaging the conical surfaces of said disks and forming cylinders, a belt engaging the said cylinders, which belt travels only in straight lines in passing from one cylinder to the opposite cylinder, a retaining belt having two reëntrant loops, each loop being adapted to engage the inner portion of the periphery of one of said cylinders, and means for guiding said retaining belt.

7. In a variable speed mechanism, the combination of a pair of parallel shafts, a pair of opposing conical disks mounted upon each of said shafts, slats engaging the conical surfaces of said disks and forming cylinders, open driving belts engaging said cylinders, means for moving said disks toward and from each other to increase or decrease the diameters of said cylinders, a retaining belt whose path of travel forms substantially a letter **I**, the concave curves thereof embracing the opposing peripheries of the said cylinders and means for guiding said retaining belt.

8. In a variable speed mechanism, the combination of a pair of parallel shafts, a pair of disks mounted on each shaft and provided with opposing conical surfaces, slats mounted in grooves formed in said surfaces, said slats forming cylinders, levers fulcrumed between said disks and engaging said disks, whereby the disks of one of said pairs are caused to approach each other, while the disks of the other of said pairs are simultaneously caused to recede from each other, a belt embracing said cylinders of slats, which belt travels only in straight lines in passing from one cylinder to the opposing cylinder and a retaining belt having two reëntrant loops that are adapted to engage the opposing surfaces of said cylinders.

9. In a variable speed mechanism, the combination of two expansible pulleys, means for driving one of said pulleys from the other thereof, upper and lower levers fulcrumed between said pulleys and connected thereto, blocks swiveled between the ends of said upper and lower levers, nuts mounted in said blocks so that they can turn in the plane of said levers with reference thereto, and a screw-shaft engaging said nuts.

10. In a variable speed mechanism, the combination of two expansible pulleys, means for driving one of said pulleys from the other thereof, upper and lower levers fulcrumed between said pulleys and connected thereto, blocks swiveled between the ends of said upper and lower levers, nuts mounted in said blocks so that they can turn in the plane of said levers with reference thereto, said nuts being elliptical in section parallel to the plane of said levers, and being seated in rectangular chambers formed in said blocks, and a screw-shaft engaging said nuts.

11. In a variable speed mechanism, the combination of two expansible pulleys, means for driving one of said pulleys from the other thereof, upper and lower levers fulcrumed between said pulleys and connected thereto, blocks swiveled between the ends of said upper and lower levers, nuts mounted in said blocks so that they can turn in the plane of said levers with reference thereto, said nuts consisting of elliptical-shaped blocks, each mounted in an elongated chamber in a block that is swiveled to said levers, and a right and left screw-shaft engaging said nuts for moving said levers.

12. In a variable speed mechanism, the combination of a pair of expansible pulleys, means for driving one of said pulleys from the other thereof, a pair of levers fulcrumed between and connecting one of each of said pairs of pulleys, each of said levers consisting of an upper bar and a lower bar braced together, a block swiveled on each lever between said upper and lower bars, each of said blocks having a chamber formed therein, and an elliptical-shaped nut seated in said chamber, said mechanism having a right and left screw rod engaging said nuts.

13. The combination of a pair of expansible pulleys, means for driving one of said pulleys from the other thereof, upper and lower levers connecting one of each of said pairs of pulleys, fulcrum blocks for said levers, said fulcrum blocks being mounted between said levers and between the shafts of said pulleys, a tie-rod connecting said fulcrum blocks shoulders on said tie-rod and springs interposed between said fulcrum blocks and said shoulders.

14. The combination of a pair of expansible pulleys, belts engaging said pulleys, levers engaging said pulleys for moving the pulleys of each pair toward and from each other, said levers being fulcrumed between the shafts of said pulleys, and springs tending to move said fulcra toward each other, whereby said belts are automatically kept taut.

15. The combination of two pairs of opposing conical disks, belts engaging said disks, levers engaging said disks for moving them toward and from each other, said levers being fulcrumed between the shafts of said disks, and springs tending to move said fulcra toward each other, whereby said belts are automatically kept taut.

16. The combination of two pairs of opposing conical disks, said disks having slats engaging their surfaces and forming cylinders of slats, levers engaging said disks for moving them toward and from each other, and a tie-rod connecting the fulcrums of said levers, collars mounted on said tie-rods outside of said fulcrums, and springs interposed between said fulcrums and said collars.

17. The combination of two pairs of opposing conical disks, said disks having slats engaging their surfaces and forming cylinders of slats, levers engaging said disks for moving them toward and from each other, and a tie-rod connecting the fulcrums of said levers, collars mounted on said tie-rods thereon outside of said fulcrums, and springs interposed between said fulcrums and said collars.

18. In a variable speed mechanism, the combination of a shaft, bearings for said shaft, an expansible pulley mounted on said shaft between said bearings, said pulley comprising a part movable longitudinally of said shaft for expanding said pulley, a collar on said shaft for moving said parts, said collar being provided with trunnions, and a lever engaging said trunnions for moving said collar, said collar being formed of separable parts to enable the removal of the collar without disturbing the other parts of the mechanism.

19. In a variable speed mechanism, the combination of a shaft, bearings for said shaft, an expansible pulley mounted on said shaft between said bearings, said pulley comprising parts movable longitudinally of said shaft for expanding said pulley, a collar on said shaft for moving one of said parts, said collar being provided with trunnions, a lever engaging said trunnions for moving said collar, said collar being formed of separable parts to enable the removal of the collar without disturbing the other

parts of the mechanism, said collar being provided with an oiler that is adapted to supply oil in any position of the collar.

20. The combination of conical disks, belts engaging said disks, a collar rotatably connected to each of said disks for moving the latter upon its shaft, said collars having upper and lower studs formed integrally therewith, upper and lower levers having slots for engaging said studs, and a bushing mounted upon each of said studs, and having parallel surfaces for engaging the walls of said slots.

21. In a variable speed mechanism, the combination of two pairs of opposing conical disks having slats engaging their conical surfaces and forming cylinders, open driving belts engaging said cylinders, a retaining belt engaging the inner opposed portions of the peripheries of said cylinders, and idlers for guiding said retaining belt, one of said idlers being journaled in boxes mounted upon guides, bolts engaging said boxes and passing through stationary portions of the frame, springs on said bolts and bearing against said stationary portions, and collars adjustably secured on said bolts at the opposite ends of said springs.

22. In a variable speed mechanism, the combination of two pairs of opposing conical disks having slats engaging their conical surfaces and forming cylinders; levers fulcrumed between said pairs of disks and engaging said disks for moving the disks of each pair toward or away from each other, a retaining belt engaging the inner opposed portions of said cylinders, springs bearing against the fulcrums of said levers, an idler for guiding said retaining belt, and springs for moving said idler, whereby both said driving belts and said retaining belt are maintained under tension.

23. In a variable speed mechanism, the combination of two pairs of opposing conical disks having slats engaging their conical surfaces and forming cylinders, levers fulcrumed between said pairs of disks and engaging said disks for moving the disks of each pair toward or away from each other, a retaining belt engaging the inner opposed portions of said cylinders, springs bearing against the fulcrums of said levers, an idler for guiding said retaining belt, and springs for moving said idler, whereby both said driving belts and said retaining belt are maintained under tension, and means for adjusting said springs.

24. In a variable speed mechanism, the combination of two pairs of opposing conical disks having slats engaging the conical surfaces thereof and forming cylinders, open driving belts engaging said cylinders, a retaining belt engaging said slats during the portion of their travel not engaged by said driving belts, and idlers for guiding said retaining belt, said idlers being entirely without the space between said pairs of disks, whereby ample space is provided for the bearings of said idlers, and access afforded thereto.

In testimony that I claim the foregoing I have hereunto set my hand.

HOWARD ROY STACKS.

Witnesses:
JOSEPH M. HEWLETT,
GALES CRESSON, Jr.