

Oct. 9, 1923.

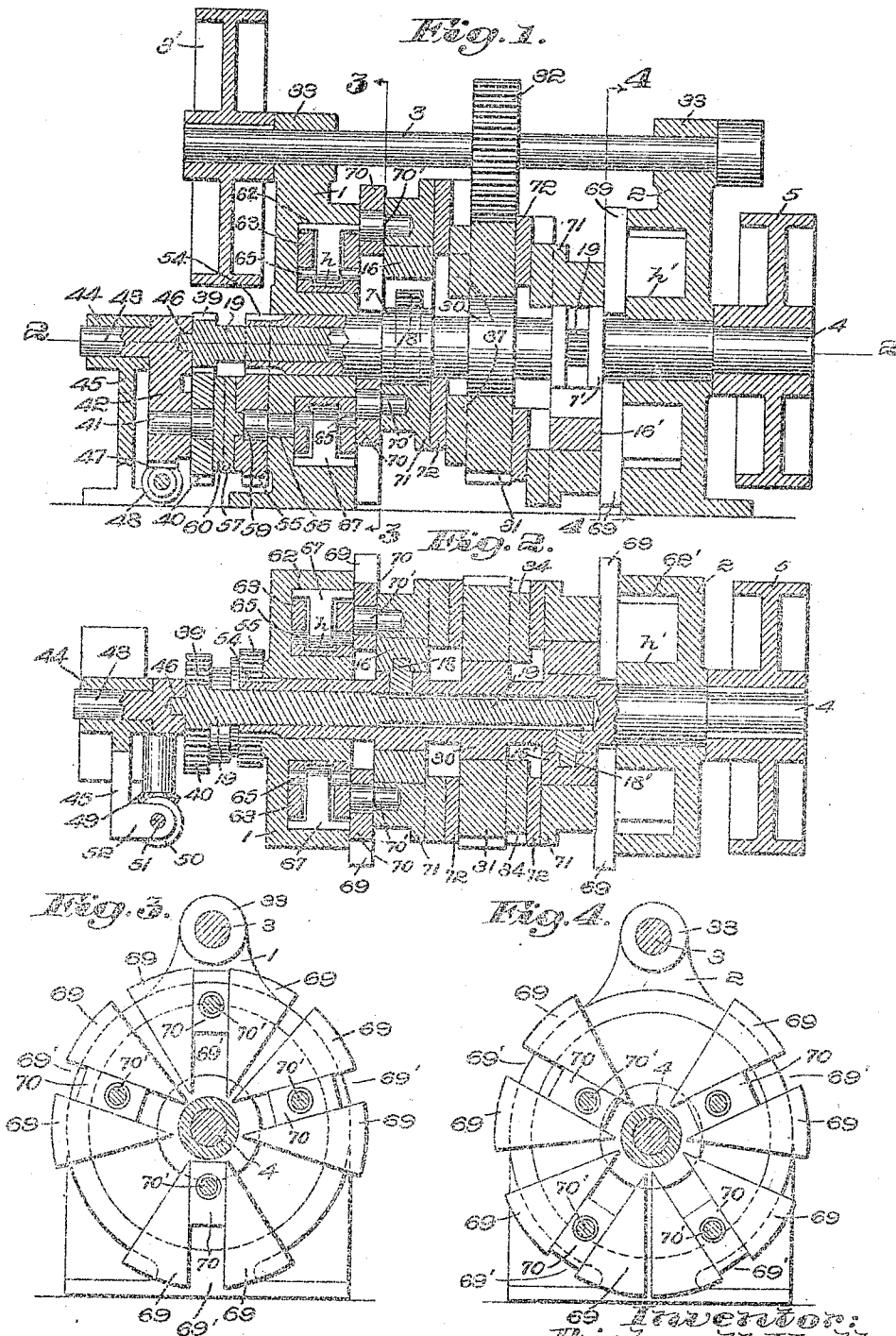
B. HALL

1,470,561

VARIABLE SPEED MECHANISM

Original Filed Sept. 29, 1917

2 Sheets-Sheet 1



By *Inventor:*
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Fig. 5.

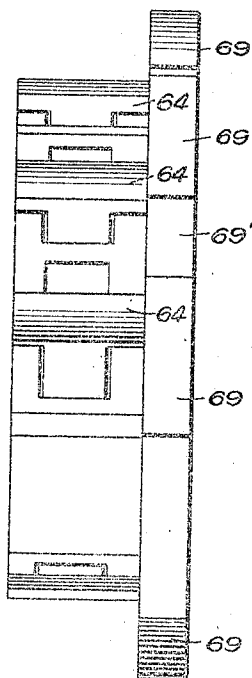


Fig. 6.

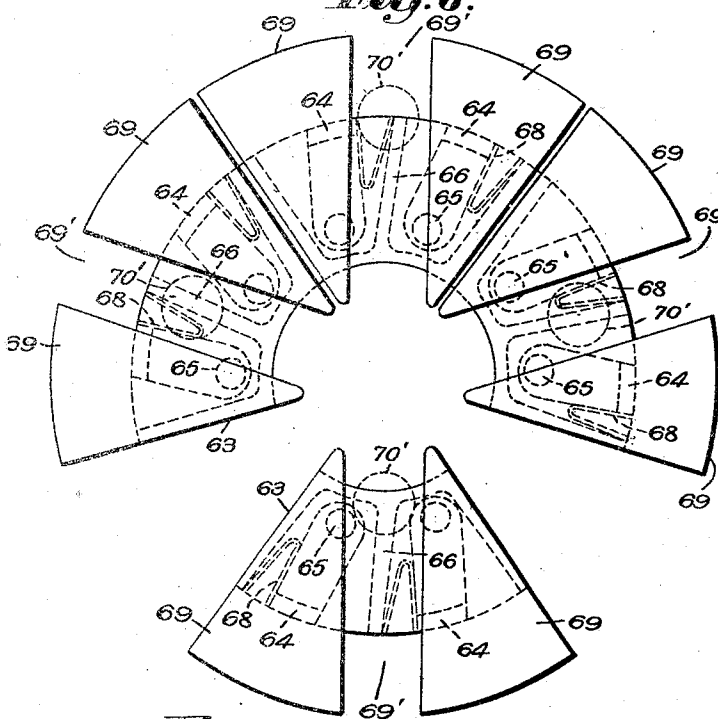


Fig. 7.

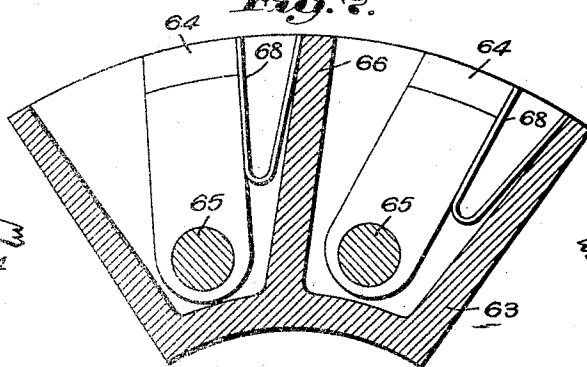


Fig. 9.

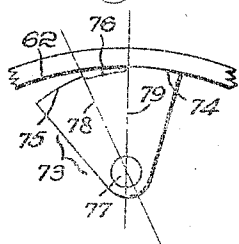


Fig. 10.

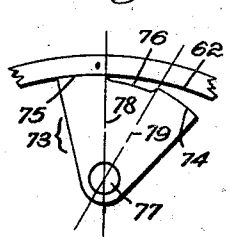
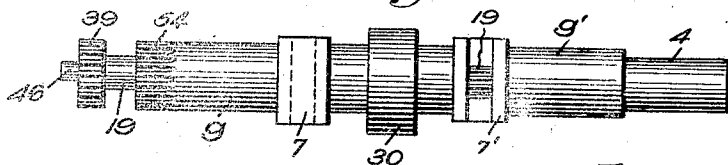


Fig. 8.



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UNITED STATES PATENT OFFICE.

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VARIABLE-SPEED MECHANISM

Original application filed September 29, 1917, Serial No. 194,012. Divided and this application filed August 30, 1923. Serial No. 660,244

To all whom it may concern:

Be it known that I, BICKNELL HALL, a citizen of the United States, and a resident of Abington, in the county of Plymouth and State of Massachusetts, have invented an Improvement in Variable-Speed Mechanism, of which the following description, in connection with the accompanying drawings, is a specification, like characters on the drawings representing like parts.

This application is a division of my co-pending application Serial No. 194,012 filed Sept. 29, 1917, originally filed as Serial No. 610,295 on February 23, 1911.

This invention relates to variable speed mechanism, the object thereof being to provide an improved, simplified and compact construction. The nature of my invention will best appear from a description of an embodiment thereof selected for illustrative purposes and shown in the accompanying drawings wherein—

Fig. 1 is a vertical, longitudinal central section of a speed varying mechanism embodying my invention;

Fig. 2 is a longitudinal, central, horizontal section taken at right angles to Fig. 1 and upon the line 2—2 of said figure;

Figs. 3 and 4 are transverse, sectional views upon the lines 3—3 and 4—4 of Fig. 1 and looking respectively to the left and to the right in said Fig. 1;

Fig. 5 is a side elevation of one of the sets of segments;

Fig. 6 is a front elevation thereof;

Fig. 7 is a transverse section taken through one of the segments;

Fig. 8 is a side elevation of the drive shaft preferably embodied in this form of my invention; and

Figs. 9 and 10 represent two positions of double dogs which may be employed in the present form of my invention.

Referring first to Figs. 1 and 2, upon a suitable base (not shown) are erected two end standards 1 and 2, constituting, it may be, a partial casing and here shown as having loosely mounted in the upper part thereof a horizontal shaft 3 having fast thereon a pulley 3' from which power may be taken. If desired, the mechanism may be substantially wholly enclosed. Within bearings in said standard is mounted a shaft 4 herein a driving element, and having fixed thereon

a pulley 5 to which power may be applied from any suitable source whereby the shaft may be driven at a constant speed in a given direction.

As shown most clearly in Fig. 8, the drive shaft has formed with, or fast thereon, preferably rectangular eccentric seats 7, 7', here shown as oppositely protruding from the shaft, or which may be formed or mounted thereon in any suitable manner. Intermediate said rectangular eccentric seats 7, 7', the drive shaft is provided with a hub 30. Said seats are here shown as of opposite eccentricity with respect to the drive shaft 4 and thus provide a running balance.

Inasmuch as in this embodiment of the invention various parts are duplicated, it will be necessary to describe in detail but one set of parts, excepting insofar as it is essential to make clear the different circumferential positions of certain of the members of said set of parts. I shall describe in detail the parts shown at the left in Figs. 1 and 2.

Upon the rectangular seat 7, as shown most clearly in Fig. 1, is positioned a slotted disk bearing 16, the diametral slot thereof being of such length as to permit the shifting of the disk bearing 16 so as to vary its eccentricity with reference to the drive shaft 4. While any suitable means may be employed to vary the eccentricity thereof thereby to vary the radius of its gyration, preferably I form with or attach to one of the walls of the slot a rack 18 meshing with an elongated pinion 19 mounted within the drive shaft 4, which for that purpose is made hollow for a portion of its length, as represented in Fig. 2. Inasmuch as the eccentricity of the slotted disk bearing 16, and of the corresponding slotted disk bearing 16', mounted upon the rectangular seat 7', may be varied or eliminated, as desired, I shall term said bearings 16 and 16' adjustable disk bearings. The shaft 4 and said bearings 16, 16' constitute herein the driving element, or any one of them may be so considered.

In the present form of the invention I provide upon the drive shaft 4 concentric portions g, g' , which are mounted in sockets 62, 62' formed in annular members, herein shown as portions of the standards 1, 2, said sockets having circular hubs h, h' as

represented in Figs. 1 and 2, the outer faces of said hubs being concentric with the shaft 4.

Upon each of said hubs h , h' and within the sockets 62, 62', I loosely mount segments or segmental members 63 of the general form shown in Fig. 7 and herein four in number, though it is evident that any suitable number of such segments may be provided. These segments are loose upon said hubs and are here shown as of general shell-like form.

I provide means whereby each segment may be temporarily and fixedly held against the inner concentric and herein friction-engaging surface of the sockets 62, 62', so that rotation of the driven parts of the mechanism may be obtained, said rotation being herein in a direction opposite to that of the shaft when holding means such as shown in Fig. 7 is employed. To that end, in this form of my invention, I mount within each segment one or more dogs 64, here shown as two in number and pivoted at their lower ends upon studs 65. If desired, a web 66 may be employed to divide the shell into two parts. The said dogs 64 may, if desired, be T-shaped and are here so shown in the several figures wherein the T heads are represented at 67 in Figs. 1 and 2. These T heads provide an increased friction surface to engage the inner concentric surface of the sockets 62, 62'. Springs 68 may be provided to force the dogs in the direction of the arrows in Fig. 7 and to maintain them in gripping relation with the interior surface of the sockets 62, 62' but permitting the dogs to yield in one direction.

Each segment 63 has formed therewith and positioned outside of the sockets 62, 62', a pair of preferably, generally wedge shaped wings 69 spaced from each other as represented at 69' to form a series of radial slots or guide ways. Positioned in each slot 69' is a rectangular block 70 having a stud 70' socketed into the adjoining preferably one-piece, transmission ring 71, loose upon the adjustable eccentric bearing 16; a similar ring 71 and connections are mounted upon eccentric bearing 16'. Said segmental members and dogs constitute one form of what I may term engaging units, said units being radially variably connected to the rings 71 in the manner described. Said rings 71 are caused to rotate about their own axes and by means of the segmental members herein shown, and said rings therefore constitute driven elements.

Between and operatively connecting each transmission ring 71 and the driven gear 31 or ultimately driven element loose upon the hub 30 of the drive shaft, is a unison ring 72, herein shown as of the Oldham coupling type, whereby said rings 71 and

gear 31 are caused to rotate in unison. The eccentric disk bearings 16, 16' employed in this embodiment of my invention may be adjusted in any preferred manner, but desirably as hereinafter described, whereby the axes of the driven rings 71 may be varied transversely of and relatively to the shaft 4 or driving element.

Upon rotation of the drive shaft 4, for example, in a clockwise direction, viewing Fig. 3, the bearings 16, 16' are rotated in the same direction, because seated upon the preferably rectangular seats 7, 7'. Said bearings 16, 16' as already stated, may be rendered concentric with or eccentric to the drive shaft 4. If they are concentric with the drive shaft 4, then the rotation of said drive shaft 4 does not result in the driving of said gear 31. The rings 71 then remain stationary and the bearings merely rotate within them without gyrating. If, however, said bearings be positioned eccentrically to the axis of said shaft 4 by adjusting them outward from the axis of the shaft upon said seats 7, 7', then in the rotation of the shaft 4 the said bearings 16, 16' gyrate or move eccentrically about the axis of said shaft 4 causing also the rings 71 to gyrate in the manner of eccentric straps.

The gyratory movement of each eccentric bearing 16 or 16' in a clockwise direction, acting through the blocks 70 mounted on the transmission rings 71, and which are confined in the slots 69' of the restrained segments 63, compels movement in a contra-clockwise direction of the adjacent transmission ring 71, its unison ring 72 and the driven gear 31. In that operation of the mechanism which I have selected for illustration and description, the eccentric bearings 16, 16' and shaft 4 are moved in a clockwise direction. Therefore, the center of each eccentric bearing travels in a circular orbit and in a clockwise direction about the axis of rotation of the shaft 4.

Assuming the center of one of said bearings to have been moved slightly in a clockwise direction, the effect of such movement is to compel an inward radial movement of that block 70 whose segment 63 is nearest the center of the said eccentric ring. Inasmuch as said block is limited to a radial movement in its slot 69' of its segment 63, and inasmuch as said segment cannot move in a clockwise direction because its dogs 64, 64 bind against the inner surface of the sockets 62 or 62', the necessary result of such inward radial movement of the block 70 is a contra-clockwise movement of rotation about its own axis upon the part of the transmission ring wherein the said block 70 is mounted, and therefore of the adjacent unison ring and the gear or member 31.

As each segment 63 becomes effective to

secure this contra-clockwise movement of the transmission ring by being held fixedly against the inner surface of the socket 62 or 62' the other segments may move concentrically about and upon the hubs h or h' . As the movement of the eccentric bearing continues, each segment 63 in turn becomes progressively intermittently fixedly held against the inner surface of its socket, and the other segments are free to move concentrically about and upon said hub h or h' . The said segments 63 are at all times concentric with the shaft 4 and their dogs 64 are at all times in contact with the inner surface of the sockets 62, 62', but the binding action of each segment against the socket 62, 62' occurs progressively and in sequence with the other segments.

The rate of rotation of the transmission rings 71, the unison rings 72 and the driven gear 31 depends upon the degree of eccentricity to which the bearings 16, 16' are adjusted, or in other words, upon the relative eccentricity of the driving and driven elements. Inasmuch as such adjustment may be varied to any extent, and since the engaging units or segmental members are engageable to hold at points infinitely variable by increments of any desired extent and universally circumferentially about the engaged surface of the annular member, it is evident that the rate of rotation of the gear or member 31 may be any desired rate between the minimum and the maximum speed.

If the bearings 16, 16' be adjusted until their centers are at the opposite side of the axis of the shaft 4 from that herein illustrated:—that is, if they be adjusted until their centers are below the axis of the shaft 4, viewing Figs. 6,—it is evident that while the direction of gyration of the rings 71 remains the same, the direction of the rotation of said rings and of the gear or member 31 would continue to be the reverse thereof, with the dogs arranged to hold in the same manner and as above described. With the eccentric bearings adjusted to either side of the shaft however I may obtain a drive in either the same or the opposite direction as that in which the shaft 4 rotates by providing a reversible engaging unit or adjustment means such as hereinafter described, shown in Figs. 9 and 10 and whereby the rings are held at one or the opposite side and accordingly caused to rotate in one or the opposite direction, the dog at one side of the rings being inactive, while the dog diametrically opposed to it is holding.

Any suitable reversible engaging means may be provided so to effect the rotation of the gear or member 31 in a clock-wise direction from the shaft 4 while still driving said shaft 4 in a clock-wise direction. In Figs. 9 and 10 I have represented the grip-

ping dogs at 73 and as each having gripping faces 74, 75 spaced from each other by a part 76 of less radial extent. The dogs are therefore each provided with two gripping surfaces, either of which may be made effective by swinging the dogs upon their centers 77, it being noted that the inner or adjacent edges of the gripping faces 74, 75, do not extend toward each other beyond radial lines 78, 79. If now the dogs 73 be swung to the right or clockwise viewing Fig. 9, then the gripping surfaces 74 are removed from contact with the surface 62 and the gripping surfaces 75 are brought into gripping relation therewith as represented in Fig. 10, which therefore prevent the segments from free rotation in the opposite direction.

The pinion or pinions 19 may be rotated in any suitable manner to adjust the disk bearings 16, 16'; that is, to vary their eccentricity. Herein as shown in Fig. 2, a single elongated pinion 19 is employed to adjust both disk bearings 16, 16'. In order rotatively to adjust said pinion 19, I have herein represented it as having formed therewith on its outer end a pinion 39, as shown most clearly in Figs. 1 and 2, meshing with a gear 40 loose upon a stud 41 carried by a gear segment 42, the upper end whereof has an angularly extending stud 43 mounted in a bearing 44 in a suitable standard 45. The end 46 of said pinion 39 is shown as extending into said gear segment 42 coaxially with the pivotal stud 43 of the latter. The lower end of said gear segment 42 is provided with teeth 47 meshing with a horizontally positioned worm 48 upon the outer end whereof is a bevelled pinion 49, Fig. 2, meshing with a similar pinion 50 on a short shaft 51 mounted in bearings 52 of the frame and having at its upper end any suitable operating means such as an adjusting hand wheel (not shown).

The drive shaft 4 has upon its end opposite the pulley 5 a circumferential series of teeth 54 with which mesh the teeth of a gear 55 loose upon a stud 56 mounted in the standard 1. Between the gear 55 and the gear 40 is a unison or other transmission ring 57 generally similar to the unison rings 72 in Figs. 1 and 2. The gear 55 is provided with a diametral groove to receive a corresponding rib 59 (Fig. 1) upon the unison ring 57 and the opposite face of said unison ring is provided with a diametral rib 60 preferably positioned at right angles to the rib 59 to enter the corresponding groove 61 of the gear 40. The pinions 39 and 54 are of the same size and normally rotate together and at the same speed, since the elongated pinion 19 is within and rotating with the shaft 4 carrying pinion 54. Also the gears 40 and 55 are of the same size and are normally idly driven about

their own axes and at the same speed by the pinions 39 and 54.

When it is desired to adjust the pinion 19 so as to change the eccentricity of the eccentrics 16, 16', the gear segment 42 is swung in an arc about its stud 43 as a pivot, through the worm 48, as by means of a hand wheel. This arcuate movement of the segment 42 compels a bodily movement of the gear 40 carried thereby about the center of said gear segment, and of the pinion 39, said movement permitted by the unison ring 57. Said gear 40 constantly meshes with said pinion 39 and is constantly rotating therewith at a speed proportional to that of said pinion and also at the same speed as that of gear 55 with which it is connected through said unison ring. Said bodily movement of gear 40, which latter is prevented from turning relatively to the gear 55 by said unison ring, therefore gives to the pinion 39, fast on elongated pinion 19, a relative movement in one direction or the other, the said pinion 19 thereby being angularly adjusted within and relatively to the shaft 4 in one direction or the other depending upon the direction of turning of the handwheel 53, worm 48 and segment 42. Said relative movement of the elongated pinion 19 moves the racks 18, 18' thereby to adjust eccentrically the bearings 16, 16'. From the foregoing it will be clear that said adjustment with resulting speed variation may be made while the transmission mechanism is in operation, or while stationary, it being unnecessary to interrupt the turning of shaft 4 to make any desired shift in speed transmitted.

It will be evident from the foregoing description that in accordance with the described embodiment of my invention I may from a drive shaft constantly rotated in one direction, obtain any desired speed of a driven gear or member, and in either direction. The segmental members preferably employed in effecting this result are herein concentrically mounted with respect to the driving shaft or member.

Having thus described one illustrative embodiment of my invention, I desire it to be understood that although specific terms are employed, they are used in a generic and descriptive sense and not for purposes of limitation, the scope of the invention being set forth in the following claims.

What I claim is:—

1. Speed varying mechanism comprising in combination, a drive shaft, a normally stationary element surrounding the axis of said shaft, a gyratable and also rotatable member, means upon said shaft variably to gyrate said member, and a circumferential series of intermittently effective engaging members co-operating with said stationary

element at any point circumferentially of the same and with said gyratable member whereby said member is forced to rotate about its own axis when caused to gyrate.

2. Variable speed transmission mechanism comprising in combination a plurality of elements relatively rotatable in fixed planes, one of said elements being movable in a circular orbit of variable radius about the axis of the other element, driving means to impart said orbital movement, means to vary the radius thereof and operable during movement of the parts, a series of engaging members connected to said orbitally movable element and having sequential functioning engagement with said other element universally circumferentially about the axis thereof to effect the relative rotation of said elements as a consequence of said orbital movement and at a speed proportionate to the radius thereof.

3. Variable speed transmission mechanism comprising in combination a plurality of relatively rotatable elements the axes of which are relatively movable into and out of concentricity with each other, means for gyrating one of said elements at a constant speed about the axis of the other, gear means to vary the radius of said gyration, and means connected with one of said elements and having driving engagement with the other element in any relative position of the axes of said elements to produce relative rotation of one element as a consequence of and simultaneously with said gyratory movement.

4. Speed varying mechanism comprising in combination a plurality of elements one of which is gyratable in an orbit of variable radius about the axis of the other and also rotatable relative to said other, means to gyrate said gyratable element, means operatively connected with one of said elements and having effective engagement with the other of said elements during said gyratory movement at one or more points variable by intervals of any desired extent circumferentially about the axis of gyration thereby to rotate said gyratory element at a speed dependent upon the radius of gyration.

5. Speed varying mechanism comprising in combination a drive shaft, a normally stationary element surrounding the axis of said shaft and provided with an annular guideway concentric with said shaft, a transversely adjustable bearing upon said shaft, a driven element rotatable upon said bearing, one or more segmental engaging units slidable in said guideway and operatively connected with said driven element in any adjusted position thereof, said units provided with means engageable with a wall of said guideway to prevent movement of said units in one direction thereby to cause

said gyratory element to rotate while gyrating and at a speed dependent upon the adjusted position of said element.

6. Speed varying mechanism comprising in combination a drive shaft, a normally stationary element surrounding the axis of said shaft, a rotatable element gyratable in a path of variable radius about said shaft, means upon said shaft variably to gyrate said element, one or more units engageable with said stationary element at any point circumferentially thereof the by to prevent relative movement in one or the other direction between said units and said stationary element, and means radially variably connecting said units and said rotatable gyratory element to compel the latter to rotate while gyrating.

7. Speed varying mechanism comprising in combination a drive shaft, an annular member concentric with said shaft and having a circumferential engaging surface, an eccentrically adjustable bearing upon said shaft, means operable during movement of the parts to adjust said bearing, a driven element rotatable upon said bearing, a plurality of segmental members engageable at any point circumferentially upon said surface and adapted progressively intermittently to be restrained from movement relatively thereto in one direction, and means radially variably connecting said segmental members and said driven element in any eccentric position of the latter to cause them intermittently to be restrained and thereby to compel said element to rotate upon its own axis.

8. Speed varying mechanism comprising in combination a drive shaft, a plurality of annular members concentric with said shaft and each having a circumferential engaging surface, a corresponding number of bearings upon said shaft and oppositely adjustable into greater or less eccentricity relative to said shaft, means simultaneously to adjust said bearings, driven elements rotatable upon said bearings respectively, a group of segmental members having holding means to co-operate with said engaging surfaces, and radially variable connecting means between said members and the respective driven elements to cause the segmental members of each group progressively to be held against

the cooperating engaging surface thereby to cause rotation of said driven elements upon their respective axes.

9. Speed varying mechanism comprising in combination a drive shaft, a plurality of annular members concentric with said shaft and each having a circumferential engaging surface, a corresponding number of bearings upon said shaft and oppositely adjustable into greater or less eccentricity relative to said shaft, means simultaneously to adjust said bearings, gyratory members rotatable upon said bearings respectively, an ultimately driven element rotatable about said shaft intermediate said gyratory members and connected to them for rotation in unison therewith, groups of segmental members having holding means to cooperate with said engaging surfaces, and radially variable connecting means between said members and the respective gyratory members to cause the segmental members of each group progressively to be held against the cooperating engaging surface thereby to cause rotation of said gyratory members and said ultimately driven element upon their respective axes.

10. Speed varying mechanism comprising in combination a drive shaft, a normally stationary member surrounding the axis of said shaft and having a circumferential engaging surface, a bearing upon said shaft adjustable eccentrically to either side thereof, a gyratory member rotatable upon said bearing, one or more members cooperating with said surface and having means to hold them from movement relatively thereto in one or the opposite direction as desired, and operating connections between said members and said gyratory member whereby the latter causes said members to be held against said surface thereby to compel said gyratory member to rotate upon its own axis in a direction opposite to or the same as the direction of rotation of the drive shaft respectively as said means is effective to hold in one or the opposite direction and at a speed depending upon the extent of said eccentricity.

In witness whereof, I have signed my name to this specification.

BICKNELL HALL.