No. 881,987. PATENTED MAR. 17, 1908.

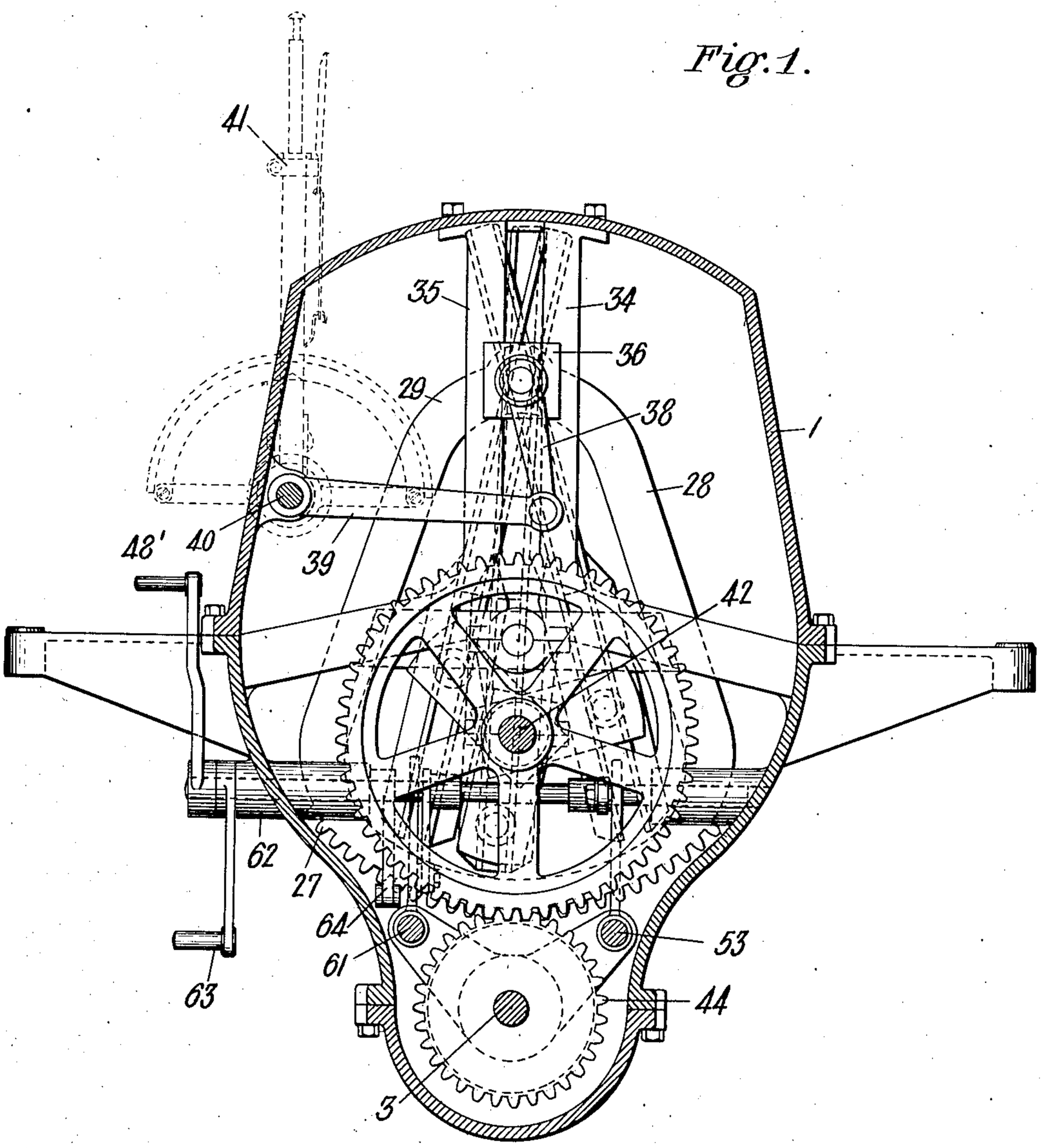
H. I. WILBER.

VARIABLE SPEED MECHANISM.

APPLICATION FILED APR. 9, 1907.

5 SHEETS—SHEET 1.

Fig. 1.



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5 SHEETS—SHEET 2.

Fig. 3.

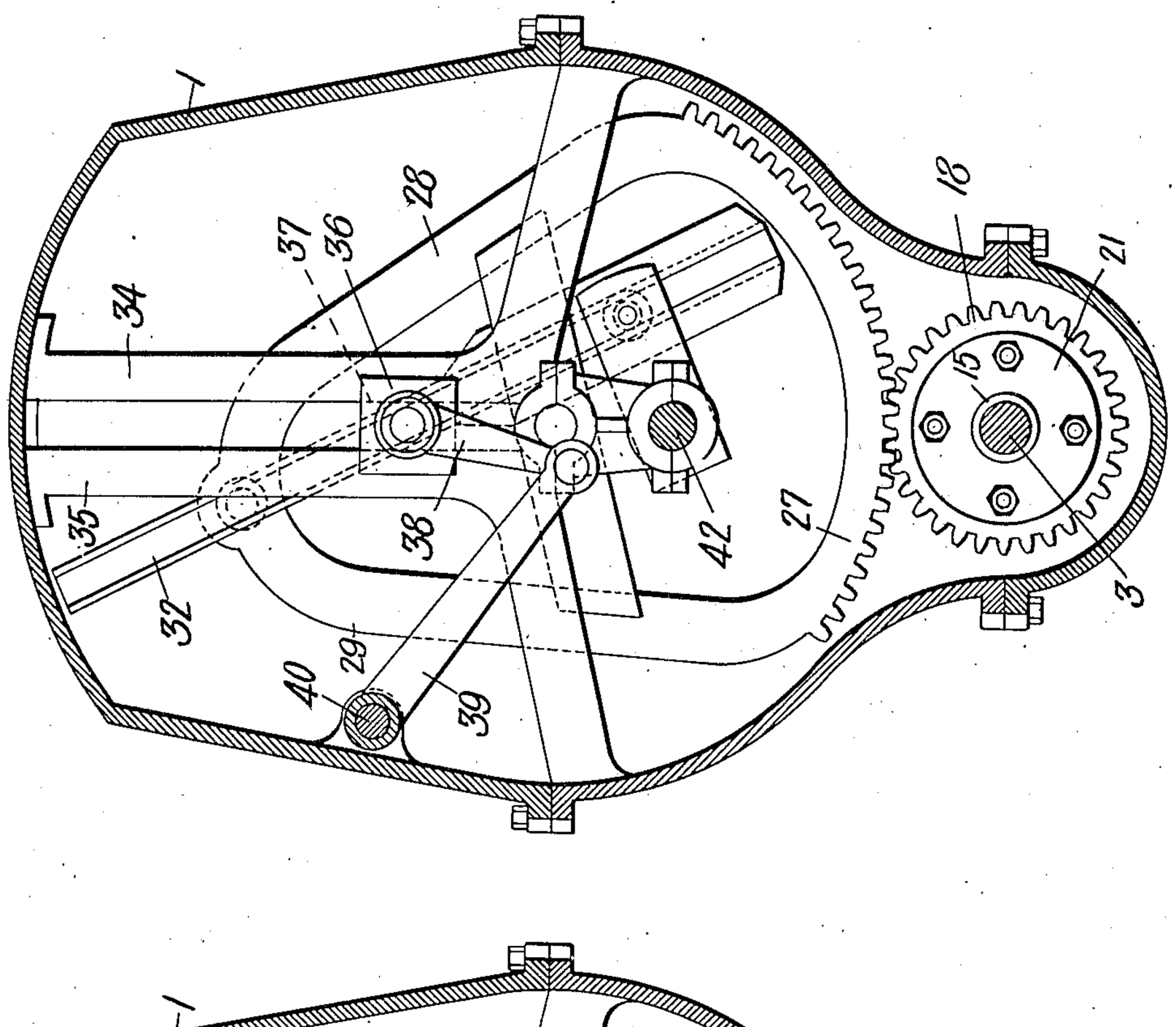
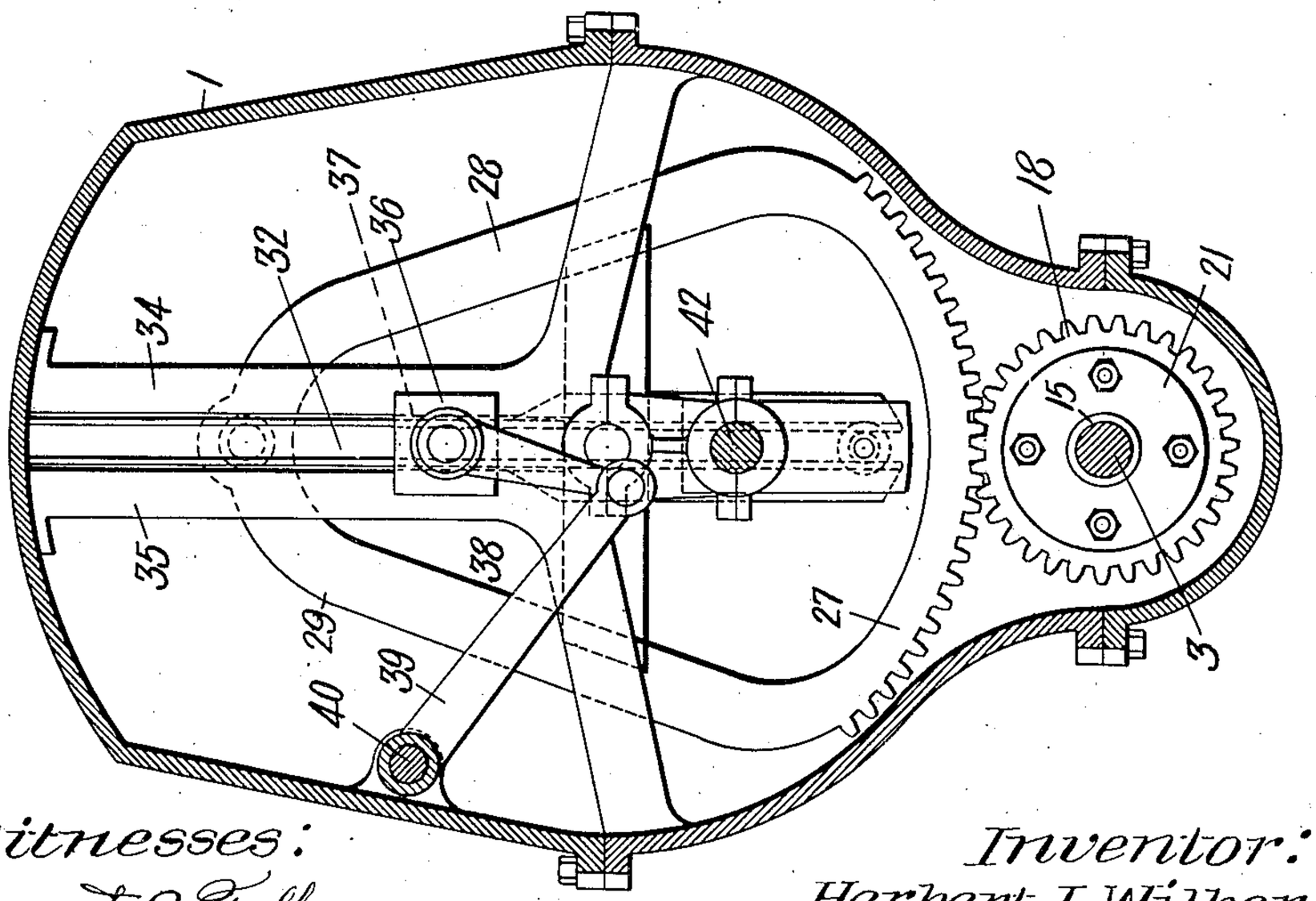


Fig. 2.



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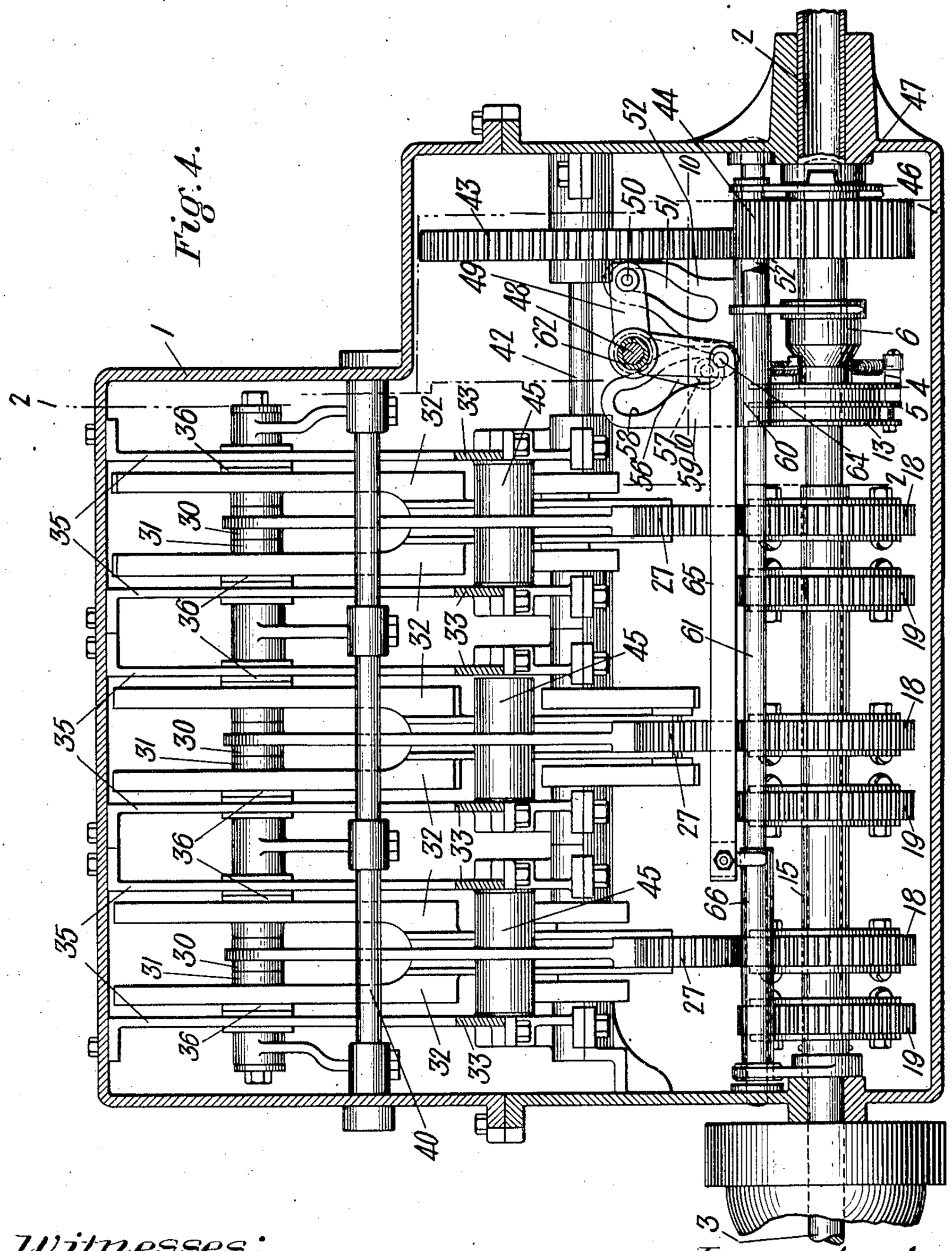
5 SHEETS—SHEET 3.

Fig. 4.



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5 SHEETS—SHEET 4.

Fig. 5.

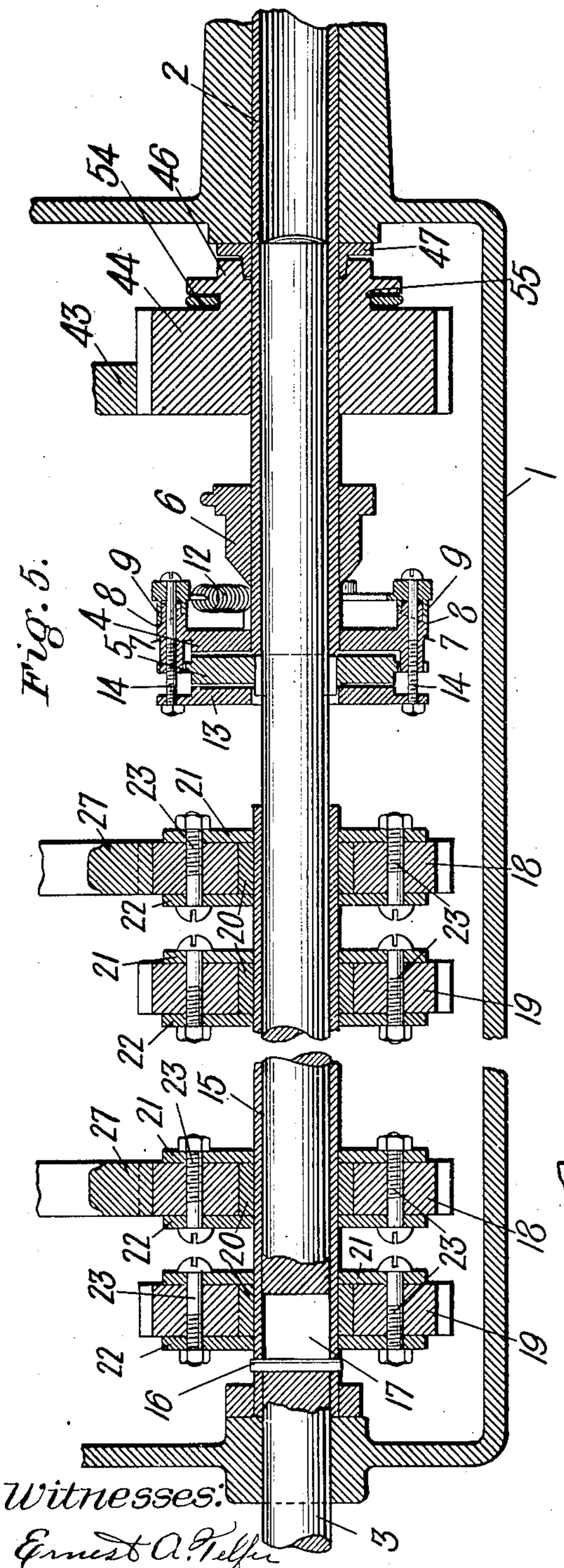
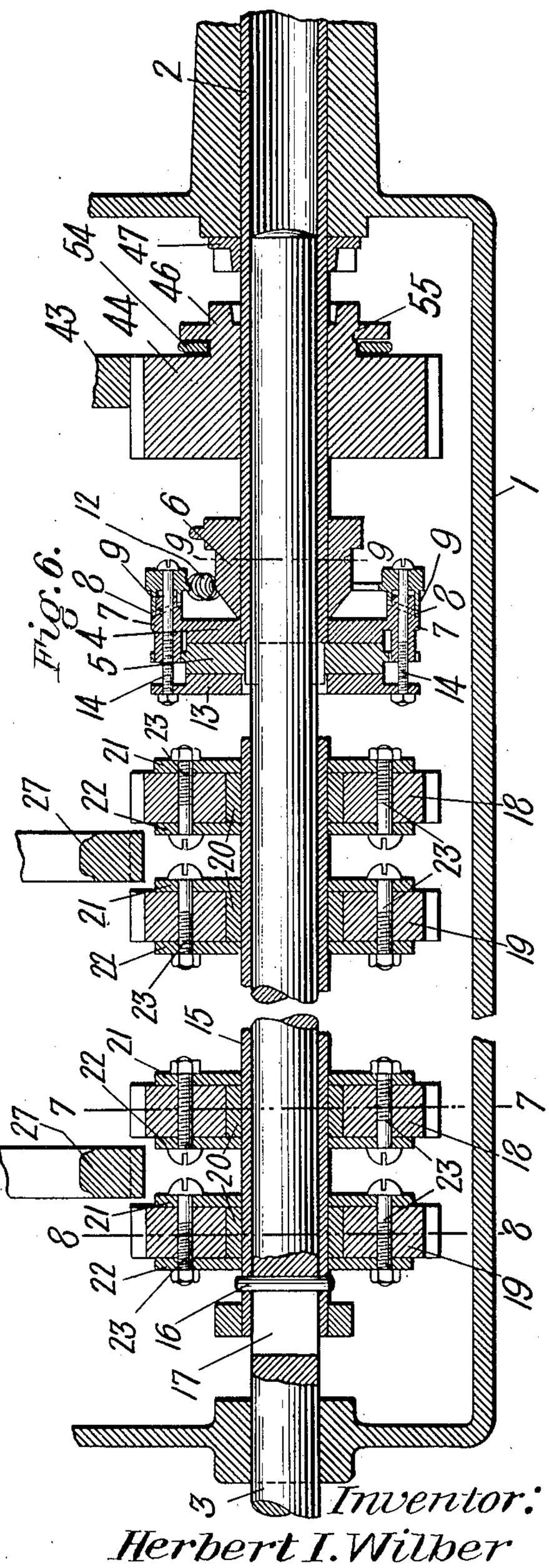


Fig. 6.



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5 SHEETS—SHEET 5.

Fig. 7.

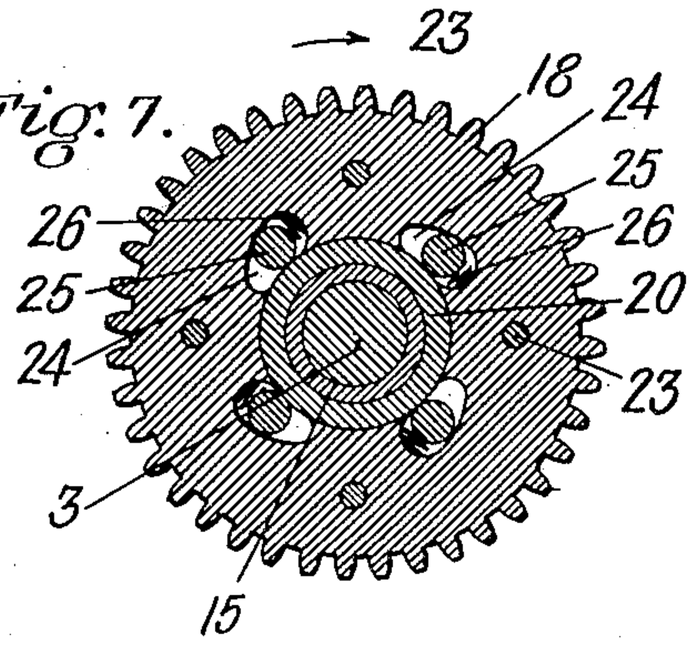


Fig. 8.

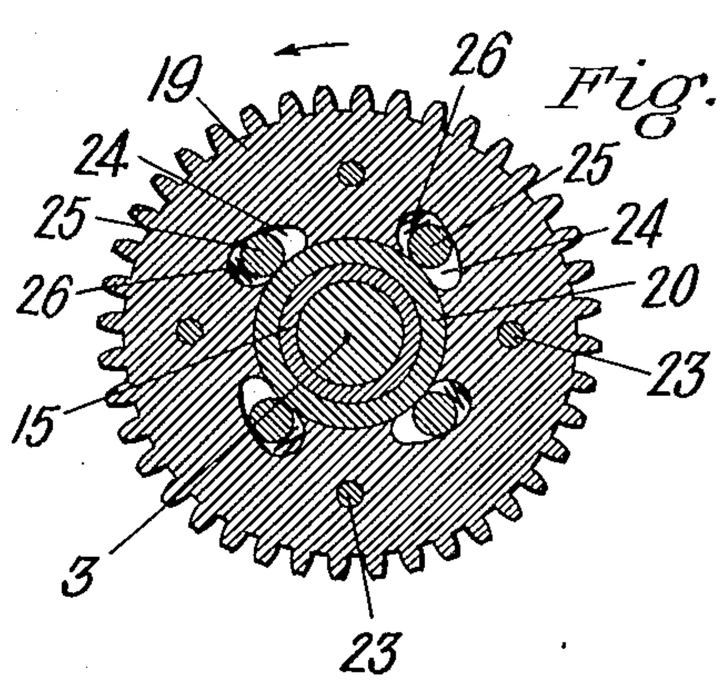


Fig. 9.

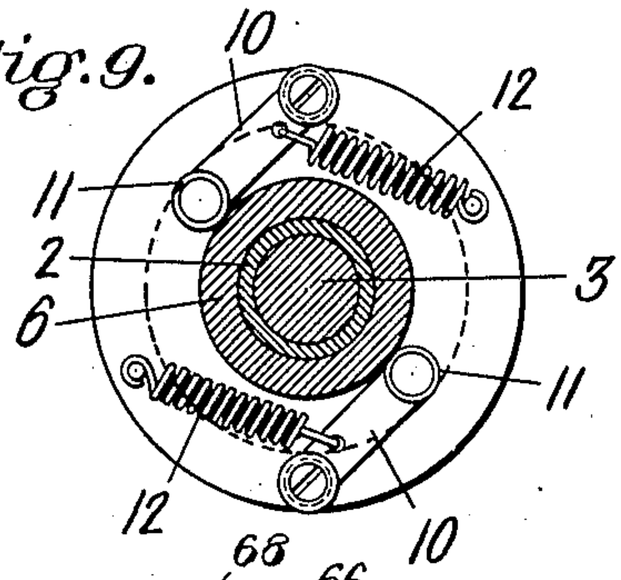
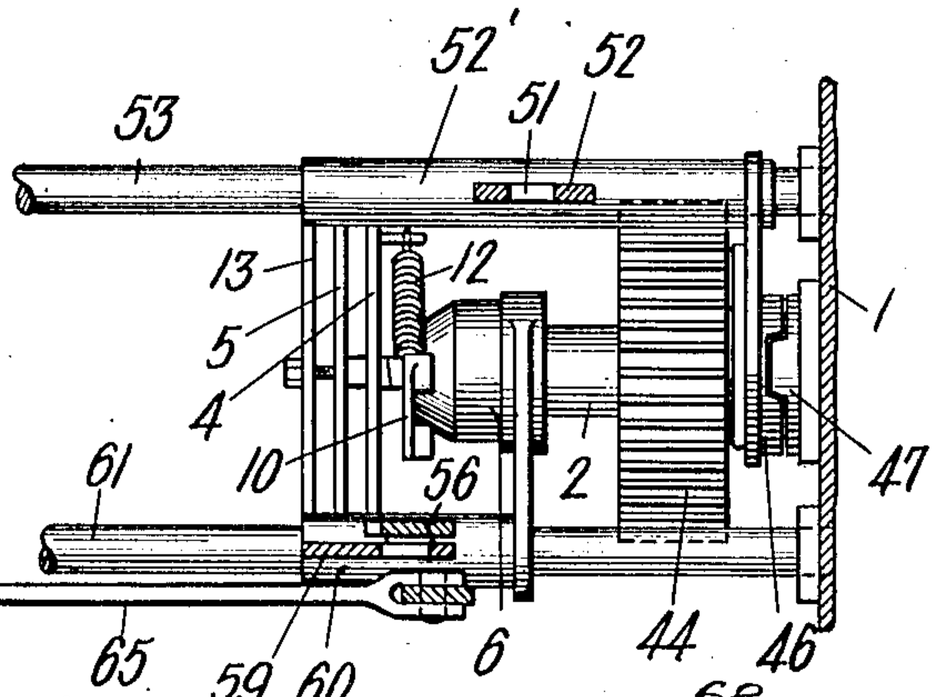


Fig. 10.



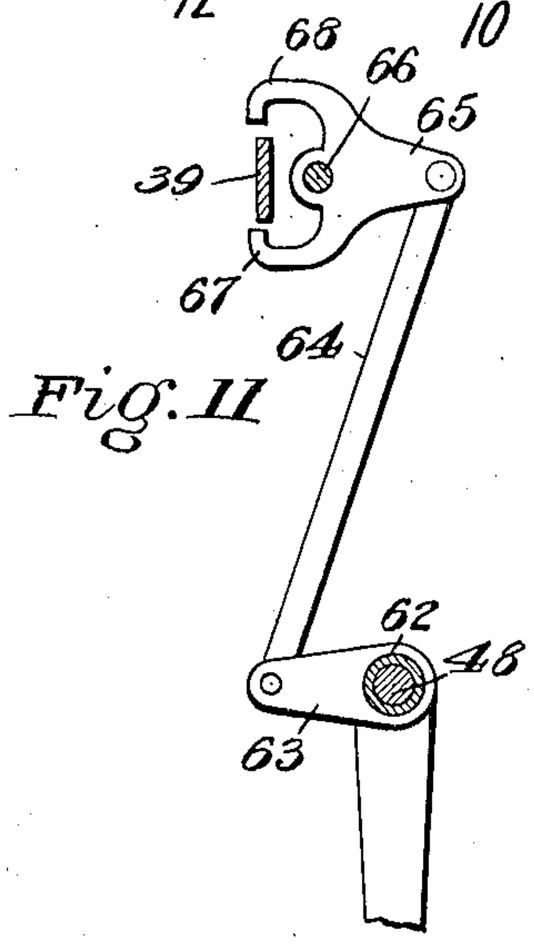


Fig. 11

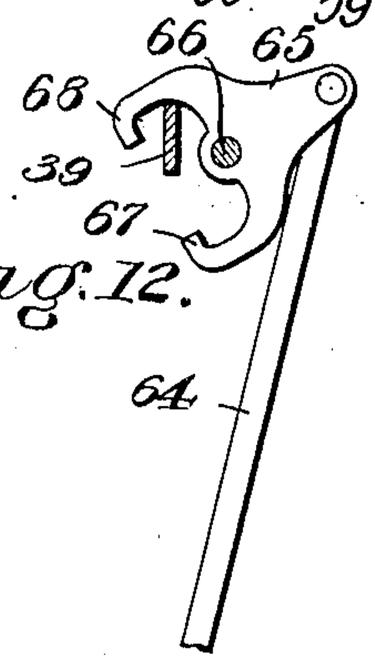


Fig. 12.

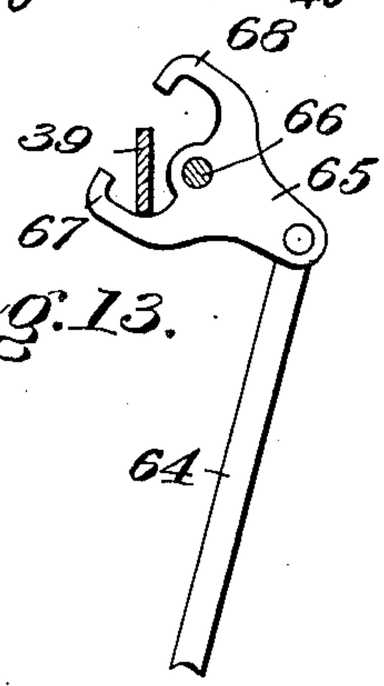


Fig. 13.

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UNITED STATES PATENT OFFICE.

HERBERT I. WILBER, OF DORCHESTER, MASSACHUSETTS.

VARIABLE-SPEED MECHANISM.

No. 881,987. Specification of Letters Patent. Patented March 17, 1908.

Application filed April 9, 1907. Serial No. 367,223.

To all whom it may concern:

Be it known that I, HERBERT I. WILBER, a citizen of the United States, residing at Dorchester, in the county of Suffolk 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 letters on the drawings representing like parts.

This invention relates to speed regulators which, while they may be of general application and used in various relations, are more particularly adapted for use in automobiles.

In order that the principles of the invention may be clearly understood I have disclosed a single type or embodiment of the invention in the accompanying drawings, wherein

Figure 1 is a transverse vertical section through the mechanism, as upon line 1—1 of Fig. 4; Fig. 2 is a transverse vertical section through the mechanism upon the line 2—2 of Fig. 4; Fig. 3 is a transverse vertical section of the parts represented in Fig. 2 but showing them differently positioned; Fig. 4 is a side elevation of the mechanism, the casing and a portion of the mechanism being in vertical section; Fig. 5 is a longitudinal vertical section of the driving and driven shafts represented as unclutched from each other and the gears and clutches associated with said shafts, the parts being positioned for the forward drive of the driven shaft; Fig. 6 is a view of the same parts but representing the driving and driven shafts as clutched for the direct drive of the driven shaft; Fig. 7 is a vertical transverse section upon the line 7—7 of Fig. 6 and representing the ratchet gear employed for the forward drive of the driven shaft through the speed changing gear; Fig. 8 is a similar section upon the line 8—8 of Fig. 6 showing the ratchet gear for imparting a reverse drive to the driven shaft from the driving shaft through the speed changing gearing; Fig. 9 is a vertical transverse section upon the line 9—9 of Fig. 6 representing a form of clutch that may be employed to connect the driving and driven shafts, Fig. 10 is a detail showing in plan a portion of the mechanism for operating the clutches, and Figs. 11, 12 and 13 are details in side elevation and vertical section showing mechanism in different positions of operation, said mechanism connecting the reverse and forward drives and the means for varying the speed of movement of the segmental gears.

Referring to that single type or embodiment of the invention herein selected for illustration and more particularly to Figs. 1 to 6 inclusive, the casing that may be employed for the mechanism is represented at 1, it being of any suitable form and material and being adapted in this type of the invention to be suitably positioned upon or in connection with an automobile.

Within the scope of my invention, such casing may or may not be employed as is found desirable. Suitably mounted in the casing, and as indicated in Fig. 4 and in this type of the invention, in the lower portion thereof is mounted a driving shaft 2, herein represented as a sleeve (see also Figs. 5 and 6), to which power may be applied in any desired manner as from the engine of the automobile. Likewise mounted in the casing 1 co-axially with the driving shaft is a driven shaft 3 (see Figs. 4, 5 and 6) upon which the driving shaft is sleeved, as more clearly indicated in Figs. 5 and 6, for a portion of its length. Fast upon the driving shaft, and as indicated in Figs. 5 and 6, at the end thereof, is mounted a disk-like member 4 of a clutch adapted to be forced longitudinally into engagement with a similar disk member 5 splined upon the driven shaft 3 in any suitable manner. Herein for the purpose, I have represented a cone 6 (see Figs. 5 and 6) slidingly mounted upon the driving shaft 2 and adapted to be shifted longitudinally thereon in a manner to be more fully described to effect the engagement of the disk members 4 and 5 in the following manner. The disk member 4 has formed thereon at its outer edge a suitable number, and herein two, of lugs 7 laterally projecting from the edge of said disk and having cam faces 8 formed at the base of a portion of said lugs that is of reduced diameter. Sleeved upon said reduced portions of each of said lugs is a cam sleeve 9 having extending therefrom, as indicated in Fig. 9, arms 10—10 provided at the outer free ends thereof with rolls 11—11. Preferably springs 12—12 are employed connected at one end to the arms 10 and at the other end in any suitable manner to a face of the disk 4, as by pins extending therefrom and acting yieldingly to hold said rolls 11 in engagement with the cone 6 when the same is longi-

tudinally projected as shown in Fig. 6. When the cone 6 is projected as shown in Fig. 6, the arms 10—10 are forced outwardly, thereby relatively rotating the cam sleeve 9 with respect to the cam surface 8 of the lug 7. Disposed upon the opposite face of the disk member 5 is a third disk member 13 having ears through which project bolts 14 passing loosely and axially through the lugs 7 and receiving upon their outer ends the sleeved cams 9, thereby to support them and the arms 10. When in the described manner the sleeved cams 9 are partially rotated with respect to the cam surfaces 8, the disk member 4 is forced axially of the driving shaft 2 into engagement with the disk member 5, which, being splined upon the driven shaft, may be thereby forced into driving engagement with the disk member 15. Any other suitable form of clutch may be employed for the purpose of connecting the driving and driven shafts 2 and 3.

In the position of the parts indicated in Fig. 6, the driving and driven shafts being clutched together in the manner described, when power is applied to the driving shaft 2 the driven shaft 3 is directly driven thereby, that is to say, without the interposition of the gearing hereinafter described for changing the speed of the driven shaft.

Viewing Figs. 4, 5 and 6, there is mounted upon the driven shaft 3 for longitudinal movement thereon, a sleeve 15 connected thereto in any suitable manner to prevent relative rotation, as by means of a pin 16 (Figs. 5 and 6) adapted to pass through an elongated slot 17 formed in said driven shaft 3 whereby in any suitable manner the said sleeve may be axially or longitudinally moved upon the driven shaft. Suitably carried upon the sleeve 15 are any desired number of pairs of driving gears 18 and 19. As shown in Fig. 4, in this type of the invention, I employ three pairs of such gears. Each of said gears is, in the present type of the invention, connected to the sleeve 15 by a ball ratchet device, whereby each gear is effective in one direction of rotation thereof to rotate said sleeve and in the opposite direction merely to move idly thereover.

Viewing Figs. 5, 6, 7 and 8 it will be observed that the gears 18 are provided with ball ratchet devices effective in one direction of rotation of said gears and that the gears 19 are provided with similar ball ratchet devices effective in the opposite direction. Thus, when the gears 18 are driven in the manner to be hereinafter described they act to drive the driven shaft 3 in one direction. When the gears 18 are disengaged and the gears 19 are driven, then the driven shaft 3 is rotated in the opposite direction.

While the gears 18 and 19 may be suitably connected in any desired manner so as to be effective in one direction of movement thereof and ineffective in the other, I herein employ ball ratchet devices more clearly indicated in Figs. 7 and 8, wherein a collar or enlargement 20 is provided upon the sleeve 15. At opposite extremities of each of said collars or enlargements 20 is mounted a pair of disks 21, 22, between which is mounted the gear 18, bolts 23 passing through said disks 21 and 22 and said gear. Each of said gears 18 and 19 is provided at the surface thereof that contacts with the collar 20 with pockets 24 of gradually increasing diameter from end to end. Disposed within said pockets are balls 25 suitably spring pressed, if desired, as indicated by coil springs 26. Viewing Figs. 7 and 8, it will be observed that the pockets 24 are oppositely formed in said gears 18 and 19, so that each gear is effective in the direction of rotation of the arrow adjacent thereto to operatively engage the face of the collar 20 in such manner as to drive the same and the sleeve 15, and thereby the driven shaft 3 in the direction of said arrow. When the said gears are rotated respectively in the direction opposite to that of the arrow associated therewith, then the said gears move idly with respect to the collars 20 and sleeves 15, and hence the shaft 3 is not driven thereby during such stroke.

While I have thus described the gearing whereby the driven shaft 3 may be driven in opposite directions, my invention is not limited thereto, although in practice suitable mechanism is employed to drive the shaft 3 in opposite directions which may be of the type indicated or any other preferred type.

If I employ gearing or other mechanism to drive the driven shaft 3 in opposite directions, I employ suitable speed changing mechanism adapted to engage with said gearing, which speed changing mechanism is interposed between the driving shaft 2 and the driven shaft 3, whereby with a constant speed of the driving shaft any desired speed of the driven shaft may be secured.

In the type of the invention herein disclosed, I employ segmental gears 27, more clearly indicated in Figs. 1 to 4 inclusive, adapted to mesh with either member of said sets of gears 18 and 19 or to be out of mesh with either member of said pairs when the parts are positioned for direct driving of the driving shaft as indicated in Fig. 6. I employ, in this type of the invention, as many segmental gears 27 as there are pairs of ratchet gears 18 and 19. In the present type of the invention, three such segmental gears are indicated in Fig. 4. When the gears 18 and 19 are so positioned that the segmental gears 27 are in mesh with the respective gears 18, then the driven shaft 3 is driven in the direction of rotation of the driving shaft 2. When, however, the gears 19 are thrown into mesh with the segmental

gears 27, the driven shaft 3 is oppositely driven.

The segmental gears 27 may be operated in any suitable manner to drive the gears 18 or 19. Herein, said segmental gears are represented as operating in different phases, whereby the shaft 3 is continuously rotated in the desired direction. As more clearly indicated in Figs. 1, 2 and 3, the segments 27 have upwardly extending arms 28 and 29 suitably connected at their upper ends and there provided with sleeves 30 mounted upon bearing studs 31 projecting inwardly from and connecting for simultaneous movement lever arms 32, two of such arms being provided for each segment 27.

Projecting upwardly from any suitable portion of the frame or casing 1 as from cross bars 33 shown in Fig. 4, are pairs of guides 34 and 35 indicated more clearly in Figs. 1, 2 and 3. Each pair of guides 34, 35, is adapted to receive therein for vertically sliding movement, bearing blocks 36 shaped in any suitable manner as by grooved edges to operatively engage the guides 34 and 35. Carried by said bearing blocks 36 are projections or portions 37 (see Fig. 4) adapted to be received by the lever arms 32 which for the purpose are provided with flanged sides between which flanges the said projections 37 are received for sliding movement.

The bearing blocks 36 are mounted upon links 38 (see more particularly Figs. 1, 2 and 3) pivotally connected to said bearing blocks and pivotally connected to lever arms 39 projecting from a rock shaft 40 (see Fig. 1) suitably disposed in the casing 1 parallel to the driving and driven shafts 2 and 3. The shaft 40 may be rocked in any suitable manner as by quadrant and arm mechanism 41 indicated in Fig. 1, thereby to move said lever arms 39 through any desired arc and thus to reciprocate the bearing blocks 36 in said guides 34 and 35. It will thus be apparent that the bearing blocks 36 may be so positioned that the projections 37 thereof are coincident or alined with the bearing studs 31 upon which the sleeves 30 of the segments 27 are mounted for oscillation, or said bearing blocks may be moved to any suitable distance above or below said bearing studs 31.

The lever arms are adapted to be oscillated in any suitable manner. Herein for the purpose I employ a countershaft 42 having a gear 43 thereon in mesh with a gear 44 upon the driving shaft as indicated in Figs. 5 and 6. Suitably formed upon said countershaft 42 are cranks 45, one crank being provided for and suitably engaging each pair of lever arms 32, said cranks being disposed in different phases.

If the bearing blocks 36 be positioned so that the projections thereon that engage the lever arms 32 are axially alined with the bearing portions of the segmental gears 27, then when a rocking movement is imparted to said lever arms by the cranks 45, no movement is imparted to the segmental gears 27, inasmuch as said lever arms rock about an axis of movement coincident with the point of pivotal support of the segmental gears 27. This relation of the parts is indicated in Fig. 1. If, however, the bearing blocks 36 be depressed below the position of the parts indicated in Fig. 1, as, for example, to the position indicated in Figs. 2 and 3, then a rocking or oscillatory movement is imparted to the segmental gears 27 by reason of the effective leverage of the lever arms 32 between such position of the bearing blocks 36 and the point of pivotal support of said segmental gears. That is to say, when said lever arms 32 are oscillated by the cranks 45 about the bearing blocks 36 when depressed into the position shown in Figs. 2 and 3, then said segmental gears 27 are rocked about said bearing blocks 36 as a center, which bearing blocks are connected with the point of pivotal support of said segmental gears by a portion of said lever arms 32 which is variable in length. Thus, as the bearing blocks 36 are removed in either direction from axial alinement with the point of axial support of the segmental gears, the greater becomes the length of stroke of the said segmental gears. If said bearing blocks be depressed below such point of support of said segmental gears 27, then the direction of stroke of the said segmental gears is in the direction of movement of said lever arms 32. If, however, said bearing blocks be elevated above said axial point of support of the segmental gears, then the direction of stroke of said gears is contrary to the direction of stroke of said lever arms. Thus, not only may the length of stroke of said segmental gears be varied from zero to any desired extreme, but the stroke may be made in the same direction as or contrary to the direction of rotation of the countershaft 42.

It will thus be apparent that with a uniform rate of rotation of the driving shaft 2 in one direction, movement may be imparted to the segmental gears 27, which movement may be in the same direction or contrary to the direction of rotation of the countershaft 42, and the length of stroke of said segmental gears as well as the speed of movement thereof may be varied as desired, such speed of movement varying in accordance with the length of effective leverage of said lever arms 32. If, therefore, the segmental gears 27 be in driving engagement with the gears 18, then the driven shaft 3 will be forwardly rotated at a speed dependent upon the position of the bearing blocks 36. Such rotation of said driven

shaft 3 will be uniform because of the different phases of movement of the cranks 45 and consequently of the segmental gears 27. If the gears 19 be brought into mesh with the segmental gears 27, then the driven shaft 3 will be driven in a reverse or backward direction at any desired speed. If, as previously stated, both gears 18 and 19 are out of mesh with the segmental gears 27, then the driven shaft 3 is directly driven by the driving shaft 2 at the same speed.

As previously described, the driving shaft 2 and driven shaft 3 are adapted to be connected by the clutch mechanism shown in Figs. 5, 6 and 9. I also provide mechanism whereby the gear 44 (see Figs. 4, 5 and 6) may be unclutched from the driving shaft 2, thereby to throw the countershaft 42 and the parts carried thereby out of action. For this purpose, I form the gear 44 as a wide gear and mount it for sliding movement upon the driving shaft 2. Formed upon one face of said gear 44 is a clutch member 46 adapted to be engaged with a corresponding clutch member 47 formed upon the driving shaft 2. In Fig. 5 the gear 44 is shown as in driving relation with the driving shaft 2 and in Figs. 6 as in non-driving relation. The gear 44 may be longitudinally moved upon the driving shaft 2 in any suitable manner. Herein for the purpose, I have provided (see Fig. 4) a rock shaft 48 mounted in any suitable manner in the casing 1, and herein transversely to and above the driving and driven shafts. Any suitable operating means may be provided as a crank handle 48′ upon said rock shaft 48 and preferably at one end thereof, there being at the opposite end of said rock shaft 48 a lever arm 49 having a roll 50 thereon adapted to engage a cam slot 51 in an arm or projection 52 extending from a suitable sleeve 52′ mounted upon a rod 53 (see Fig. 1), suitably mounted in the frame work or casing and alined with the driving or driven shafts 2 and 3. Said sleeve has projecting therefrom a forked arm 54 (see Figs. 5 and 6) adapted to engage the annular recessed portion 55 of the gear 44, whereby when the sleeve is longitudinally slid upon said rod 53 said gear 44 may be clutched to or unclutched from the driving shaft 2. Also mounted upon the rock shaft 48 is a lever arm 56 having a roll 57 at the end thereof adapted to engage a cam slot 58 formed in an arm or projection 59 extending from a sleeve 60 mounted upon a rod 61 (see also Fig. 1) that is disposed in parallelism with the rod 53. Said sleeve 60 has extending therefrom a member 61 adapted to engage the cone 6 in any suitable manner as indicated in Fig. 4, thereby to shift said cone longitudinally of the driving shaft 2 and thus clutch or unclutch the driving shaft. Thus, by rocking the shaft 48 by means of the handle 48′ the two clutches may be engaged or disengaged. It is apparent that the operative connections from the rock shaft 48 to the two clutches may be such that said clutches are operated simultaneously but oppositely, but preferably the connections are such that the cone 6 is moved to move the disk members 4, 5 and 13 into operative or clutching relation just prior to the movement of the gear 44 in a direction to disengage it from the driving shaft 2. In the reverse direction of movement of the rock shaft 48 the gear 44 is clutched to the driving shaft 2 just prior to the withdrawal of the cone 6 from clutching relation to its clutch. Thus, by a single movement of the rock shaft, the driving and counter shafts may be clutched or unclutched and the driving and driven shafts unclutched or clutched.

Any suitable means may be employed to shift the gears 18 and 19 longitudinally of the driven shaft 3. Herein for the purpose I employ (see Figs. 1 and 4) a rocking sleeve 62 mounted upon the rock shaft 48. As indicated in Fig. 1, said sleeve is provided with a handle 63. Depending from said rock sleeve is a lever arm 64 (shown in Figs. 1 and 4) pivotally connected to a longitudinally disposed bar 65, the opposite end whereof is connected to a sleeve 66 mounted upon the rod 61. In this manner merely by rocking the rock sleeve 62 in the proper direction either gear 18 or 19 of each set may be brought into engagement with the corresponding segmental gear 27.

Rotation of the driven shaft 3 may be stopped by disengaging the clutch between the driving and driven shafts 2 and 3 and so shifting the gears 18 and 19 that they are removed from mesh with the segmental gears 27, which therefore may be oscillated at any desired speed, or the rotation of the driven shaft may be stopped while maintaining either gear 18 or 19 in mesh with its segmental gear 27 by positioning the bearing block 36 in axial coincidence with the axis of rotation of said segmental gears. It will be observed that without the employment of clutches I am enabled to change or vary the speed of rotation of the driven shaft 3 and that moreover I am enabled to obtain any desired rate of rotation between zero and the highest speed at which the shaft 3 may be driven.

Although the speed of rotation of the driving shaft 2 and the counter shaft 42 remains unchanged, yet the speed of stroke as well as the length of stroke of the segmental gears 27 are variable, owing to the described variability in the length of the lever arms 32 between their centers of oscillation and their points of pivotal connection with the said segmental gears 27, the speed of stroke and length of stroke increasing as the distance increases between said two points. The bearing block 36 becomes in effect the center

of movement of the segmental gears 27 and as their length of radius increases, that is, as the distance increases between said bearing block and the point of connection of said levers to their respective gears, the speed of stroke and length of stroke of said segmental gears increase.

In practice I may form each crank as a two part member connected by a roll or other portion to engage the respective levers. If desired, such roll or portion may be formed of two telescoping or suitably connecting parts to facilitate assembling. Any desired construction accomplishing this end may be employed. When the segmental gears 27 are in engagement with the gears 18 so that the shaft 3 is driven in a forward direction, the bearing blocks 36 are positioned by the lever arms 39 below the point of pivotal connection of the arms 28 and 29, as shown in Figs. 2 and 3. In this manner, a slow forward motion is imparted to the said gears 18 and a quick return owing to the ratchet construction. In reversing the mechanism, in which event the gears 19 are thrown into mesh with the segmental gears 27, preferably the bearing blocks 36 are elevated above the said pivotal point of support of the arms 28 and 29, so that a slow, even, driving motion is imparted to the said pinions 19 during the reverse and a quick return movement. By this construction, the driven shaft is smoothly and evenly operated during both the forward and the reverse movements. I may employ suitable mechanism operatively connecting the reversing mechanism and one of the arms 39 or other parts associated therewith, whereby when the mechanism is reversed the bearing blocks 36 can be moved only above the said pivotal point of support of the segmental gears, and whereby when the parts are positioned for forward drive the bearing blocks 36 can be moved only below such pivotal point of support. While any suitable means may be employed accomplishing this end, I contemplate the provision of an arm 63 (see Figs. 11, 12 and 13) mounted upon the rocking sleeve 62 shown in Fig. 4 and extending therefrom at right angles and connected to a link 64, the upper end whereof may be pivotally connected to a yoke or other device 65 pivotally mounted at 66 upon the machine frame in any suitable way. Such yoke may have two arms 67, 68 extending therefrom, and either arm may, in the swinging motion of the yoke, be brought into the path of movement of the arm 39. If the lower arm 67 be brought into the path of movement of such arm 39, then the arms 39 and consequently the bearing blocks 36 can be moved only upwardly. This would be the action when the reverse is thrown in by the described swinging movement of the rocking sleeve 62. When, however, the forward drive is thrown into action, then the lower arm 67 of the yoke is removed from beneath the arm 39 and the upper arm 68 is thrown into action, whereby a downward motion can be imparted to the bearing blocks 36. Such arms 67 and 68 upon the yoke are constructed to permit the shifting of the bearing blocks and of the arms from one position to the other, but prevent the arms 39 from being further depressed when the reverse is thrown in and hence make it necessary that such arms be elevated. Any other suitable mechanism may be employed for this purpose. I, however, prefer, as illustrated in Figs. 11, 12 and 13 and as herein described, the employment of automatic means operatively connecting the reverse and forward drives and the means for varying the speed of movement of the segmental gears 27.

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

Claim.

1. A variable speed mechanism comprising a driving shaft, a driven shaft, one or more gears operatively connected to said driven shaft, a gear or gears operatively connected to said first mentioned gear or gears to drive the same, means intermediate the driving shaft and said last mentioned gears to drive the latter, and means to vary the speed of movement of said last mentioned gears without stopping the mechanism.

2. A variable speed mechanism comprising a driving shaft, a driven shaft, one or more gears operatively connected to said driven shaft, a gear or gears operatively connected to said first mentioned gear or gears to drive the same, means intermediate the driving shaft and said last mentioned gears to drive the latter, and non-clutching means to vary the speed of movement of said last mentioned gears without stopping the mechanism.

3. A variable speed mechanism comprising a driving shaft, a driven shaft, one or more gears operatively connected to the driven shaft, one or more segmental gears adapted to mesh with said first mentioned gear or gears respectively, operative driving connections between said segmental gear or gears and said driving shaft and means to vary the extent of stroke of said segmental gears.

4. A variable speed mechanism comprising a driving shaft, a driven shaft, one or more gears operatively connected to the driven shaft, one or more segmental gears in mesh with said first mentioned gear or gears respectively, operative driving connections between said segmental gear or gears and

said driving shaft and means to vary the speed of stroke of said segmental gear or gears.

5. A variable speed mechanism comprising a driving shaft, a driven shaft, one or more gears operatively connected to the driven shaft, one or more segmental gears in mesh with said first mentioned gear or gears respectively, operative driving connections between said segmental gear or gears and said driving shaft and means effective without stopping the operation of the mechanism to vary the speed and extent of stroke of said segmental gear or gears.

6. A variable speed mechanism comprising a driving shaft, a driven shaft, one or more gears having ratchet connection to said driven shaft, one or more segmental gears in mesh with said first mentioned gear or gears, operative driving connections between said segmental gear or gears and said driving shaft and means to vary the stroke of said segmental gear or gears.

7. A variable speed mechanism comprising a driving shaft, a driven shaft, one or more gears connected to the driven shaft so that in only one direction of rotation thereof is movement of rotation imparted thereby to the driven shaft, a gear or gears operatively connected to said first mentioned gear or gears to drive the same, operative driving connections between said last mentioned gear or gears and said driving shaft and non-clutching means to vary the movement of said last mentioned gear or gears without stopping the mechanism.

8. A variable speed mechanism comprising a driving shaft, a driven shaft, one or more gears having ball ratchet connection with said driven shaft, a segmental gear or gears adapted to mesh with said first mentioned gear or gears, operative driving connections between said segmental gear or gears and said driving shaft and means to vary the stroke of said segmental gears.

9. A variable speed mechanism comprising a driving shaft, a driven shaft, one or more pairs of gears upon said driven shaft, the members of said pair or pairs having oppositely effective driving connection with said shaft, a segmental gear or gears adapted to mesh with the members of said pair or pairs of gears, operative driving connections between said segmental gear or gears and said driving shaft and means relatively to shift said pair or pairs of gears and the respective segmental gears, whereby either gear of said pair or pairs may be operatively engaged with the respective segmental gear.

10. A variable speed mechanism comprising a driving shaft, a driven shaft, one or more pairs of gears upon said driven shaft, the members of said pair or pairs having oppositely effective driving connection with said shaft, a segmental gear or gears adapted to mesh with the members of said pair or pairs of gears, operative driving connections between said segmental gear or gears and said driving shaft and means relatively to shift said pair or pairs of gears and the respective segmental gears, whereby either gear of said pair or pairs may be operatively engaged with the respective segmental gear, and means to vary the stroke of said segmental gear or gears.

11. A variable speed mechanism comprising a driving shaft, a driven shaft, one or more pairs of gears upon said driven shaft, the members of said pair or pairs having oppositely effective driving connection with said shaft, a segmental gear or gears adapted to mesh with the members of said pair or pairs of gears, operative driving connections between said segmental gear or gears and said driving shaft and means relatively to shift said pair or pairs of gears and the respective segmental gear or gears, whereby either gear of said pair or pairs may be operatively engaged with the respective segmental gear, and means to vary the length and the speed of stroke of said segmental gear or gears without stopping the operation of the mechanism.

12. A variable speed mechanism comprising a driving shaft, a driven shaft in axial alinement therewith, a clutch interposed between said shafts a countershaft, gearing between said driving shaft and said countershaft, a clutch between said gearing and said driving shaft, one or more gears upon said driven shaft and having oppositely effective driving connections therewith, segmental gears in mesh with said first mentioned gears, and means upon said counter shaft to oscillate said segmental gears.

13. A variable speed mechanism comprising a driving shaft, a driven shaft in axial alinement therewith, a clutch interposed between said shafts, a countershaft, gearing between said driving shaft and said countershaft, a clutch between said gearing and said driving shaft, one or more gears upon said driven shaft and having oppositely effective driving connections therewith, a segmental gear or gears in mesh with said first mentioned gear or gears, means upon said countershaft to oscillate said segmental gear or gears, and means to vary the stroke of said segmental gear or gears.

14. A variable speed mechanism comprising a driving shaft, a driven shaft in axial alinement therewith, a clutch interposed between said shafts, a countershaft, gearing between said driving shaft and said countershaft, a clutch between said gearing and said driving shaft, one or more gears upon said driven shaft and having oppositely effective driving connections therewith, segmental gears in mesh with said first mentioned gears, means upon said countershaft to oscillate

said segmental gears, and means to vary the length and speed of stroke of said segmental gears without stopping the operation of the mechanism.

15. A variable speed mechanism comprising a driving shaft, a driven shaft in axial alinement therewith, a clutch interposed between said shafts, a countershaft, gearing between said driving shaft and said countershaft to drive the latter, a clutch upon said driving shaft to throw into or out of action said countershaft, one or more gears upon said driven shaft, a segmental gear or gears in mesh with said first mentioned gear or gears, means upon said countershaft to oscillate said segmental gear or gears, and means to vary the effective stroke of said segmental gear or gears.

16. A variable speed mechanism comprising a driving shaft, a driven shaft in axial alinement therewith, a clutch interposed between said shafts, a countershaft, gearing between said driving shaft and countershaft to drive the latter, a clutch upon said driving shaft and controlling said countershaft, a plurality of pairs of gears upon said driven shaft having oppositely effective ratchet connections therewith, segmental gears operatively connected to said countershaft and adapted to mesh with the members of each of the respective pairs of said gears, means relatively to shift said sets of pairs of gears and said segmental gears, and means to vary the effective stroke of said segmental gears.

17. A variable speed mechanism comprising a driving shaft, a driven shaft, one or more gears operatively connected to said driven shaft and having driving connections therewith effective only in one direction of rotation of said gears, one or more segmental gears meshing with said first mentioned gears, a lever arm whereto each segmental gear is pivotally connected, and means to move said lever arm.

18. A variable speed mechanism comprising a driving shaft, a driven shaft, one or more gears operatively connected to said driven shaft and having driving connections therewith effective only in one direction of rotation of said gears, one or more segmental gears meshing with said first mentioned gears, operative driving connections between said segmental gear or gears and said driving shaft, lever mechanism whereto said segmental gears are connected, and means to vary the point of pivotal support of said lever mechanism.

19. A variable speed mechanism comprising a driving shaft, a driven shaft, one or more gears operatively connected to said driven shaft and having driving connections therewith effective only in one direction of rotation of said gears, one or more segmental gears meshing with said first mentioned gears, operating mechanism for said segmental gears, and means to vary the point of pivotal support of said mechanism.

20. A variable speed mechanism comprising a driving shaft, a driven shaft, one or more gears operatively connected to said driven shaft and having driving connections therewith effective only in one direction of rotation of said gears, one or more segmental gears meshing with said first mentioned gears, means to rock said segmental gears about a center of oscillation, and means to shift said center of oscillation without stopping the operation of the mechanism.

21. A variable speed mechanism comprising a driving shaft, a driven shaft, one or more gears operatively connected to said driven shaft and having driving connections therewith effective only in one direction of rotation of said gears, one or more segmental gears meshing with said first mentioned gears operative driving connections between said segmental gear or gears and said driving shaft, and means to vary the stroke of said segmental gears from zero to an established maximum without stopping the operation of the mechanism.

22. A variable speed mechanism comprising a driving shaft, a driven shaft, one or more gears operatively connected to said driven shaft and having driving connections therewith effective only in one direction of rotation of said gears, one or more segmental gears meshing with said first mentioned gears operative driving connections between said segmental gear or gears and said driving shaft, and means to vary the stroke of said segmental gears from zero through any desired gradations to an established maximum.

23. A variable speed mechanism comprising a driving shaft, a driven shaft, one or more gears operatively connected to said driven shaft and having driving connections therewith effective only in one direction of rotation of said gears, one or more segmental gears meshing with said first mentioned gears operative driving connections between said segmental gear or gears and said driving shaft, lever mechanism for operating said segmental gears, a rock shaft, and connections from said rock shaft to said lever mechanism to vary the action of the latter.

24. A variable speed mechanism comprising a driving shaft, a driven shaft, one or more gears operatively connected to said driven shaft and having driving connections therewith effective only in one direction of rotation of said gears, one or more segmental gears meshing with said first mentioned gears operative driving connections between said segmental gear or gears and said driving shaft, a rock shaft, means to rock the same, lever arms extending from said rock shaft, lever mechanism for operating said segmental gears, and connections whereby

upon the oscillation of said rock shaft the effective point of pivotal support of said lever mechanism is varied.

25. A variable speed mechanism comprising a driving shaft, a driven shaft, a clutch interposed between said shafts, a countershaft, gearing between said driving shaft and counter shaft, a clutch between said gearing and said driving shaft, one or more gears upon said driven shaft and having oppositely effective connections thereto, segments in mesh with said gears, means upon said countershaft to oscillate said segments, a rock shaft, and means operatively connected thereto to operate said clutches.

26. A variable speed mechanism comprising a driving shaft, a driven shaft, a clutch interposed between said shafts, a countershaft, gearing between said driving shaft and countershaft, a clutch between said gearing and said driving shaft, one or more gears upon said driven shaft and having oppositely effective connections thereto, segments in mesh with said gears, means upon said countershaft to oscillate said segments, and means to throw one of said clutches into action before the other is thrown out of action.

27. A variable speed mechanism comprising a driving shaft, a driven shaft, a clutch interposed between said shafts, a countershaft, gearing between said driving shaft and countershaft, a clutch between said gearing and said driving shaft, one or more gears upon said driven shaft and having oppositely effective connections thereto, segments in mesh with said gears, means upon said countershaft to oscillate said segments, and means to throw either clutch into action before the other clutch is thrown out of action.

28. A variable speed mechanism comprising a driving shaft, a driven shaft, a clutch interposed between said shafts, a countershaft, gearing between said driving shaft and countershaft, a clutch between said gearing and said driving shaft, one or more gears upon said driven shaft and having oppositely effective connections thereto, segments in mesh with said gears, means upon said countershaft to oscillate said segments, a rock shaft, lever arms extending therefrom and slidingly mounted members operated by said lever arms and operatively connected to said clutches respectively to operate the same.

29. A variable speed mechanism comprising a driving shaft, a driven shaft, a clutch interposed between said shafts, a plurality of pairs of gears upon said driven shaft and having oppositely effective rotative connections therewith, a countershaft, gearing between said driving shaft and said countershaft, a clutch controlling said gearing, segmental gears in mesh with said first mentioned gears, means upon said countershaft to oscillate said segmental gears, a rock shaft, a rocking member sleeved upon said rock shaft, and connections from said rock shaft and rocking member to operate said clutches and relatively to shift said pairs of gears and said segmental gears.

30. A variable speed mechanism comprising a driving shaft, a driven shaft, a clutch interposed between said shafts, a countershaft, clutch controlled gearing between said driving shaft and said countershaft, a plurality of pairs of gears mounted upon said driven shaft, longitudinally movable with respect thereto and having oppositely effective rotative connections thereto, segmental gears adapted to mesh with said first mentioned gears, means upon said countershaft to oscillate said segmental gears, a rock shaft, a rocking member sleeved thereon, connections from one of said rocking parts to said clutches, and connections from the other of said rocking parts to said gears to shift the latter.

31. A variable speed mechanism comprising a driving shaft, a driven shaft, a clutch interposed between said shafts, a countershaft, clutch controlled gearing between said driving shaft and said countershaft, a plurality of pairs of gears mounted upon said driven shaft, longitudinally movable with respect thereto and having oppositely effective rotative connections thereto, segmental gears adapted to mesh with said first mentioned gears, means upon said countershaft to oscillate said segmental gears, and concentrically disposed means to shift said gears and operate said clutches.

32. A variable speed mechanism comprising a driving shaft, a driven shaft, a clutch interposed between said shafts, a countershaft, clutch controlled gearing between said driving shaft and said countershaft, a plurality of pairs of gears mounted upon said driven shaft, longitudinally movable with respect thereto and having oppositely effective rotative connections thereto, segmental gears adapted to mesh with said first mentioned gears, means upon said countershaft to oscillate said segmental gears, and rocking means to shift said gears and operate said clutches.

33. A variable speed mechanism comprising a driving shaft, a driven shaft, a clutch between said shafts, a sleeve upon said driven shaft axially movable with respect thereto, a plurality of pairs of gears upon said sleeve and having oppositely effective rotative connections to said sleeve, a counter shaft, gearing between said countershaft and said driving shaft, a clutch controlling said gearing, segmental gears adapted to mesh with either member of said pairs of gears, means upon said countershaft to oscillate said segmental gears, means to move either gear of each set of gears into engagement with its respective

segmental gear, and means to operate said clutches.

34. A variable speed mechanism comprising a driving shaft, a driven shaft, a clutch interposed between said shafts, a countershaft, clutch controlled gearing between said driving shaft and said countershaft, a pair of gears upon said driven shaft and having oppositely effective rotative connections therewith, a segmental gear adapted to mesh with either of said gears, operative driving connections between said segmental gear and said countershaft means relatively to shift said gears and said segmental gear, one or more lever arms, said segmental gear having a point of pivotal connection to said arm or arms, a pivotal support for said lever arm or arms, and means to vary the position of said pivotal support.

35. A variable speed mechanism comprising a driving shaft, a driven shaft, a clutch interposed between said shafts, a countershaft, clutch controlled gearing between said driving shaft and said countershaft, a pair of gears upon said driven shaft and having oppositely effective rotative connections therewith, a segmental gear adapted to mesh with either of said gears, operative driving connections between said segmental gear and said countershaft means relatively to shift said gears and said segmental gear, a pair of lever arms to which said segmental gear is pivotally connected, a pivotal support for said lever arms, and means to position said pivotal support either concentrically or eccentrically with respect to the point of pivotal connection of said lever arms and said segmental gear.

36. A variable speed mechanism comprising a driving shaft, a driven shaft, a clutch interposed between said shafts, a countershaft, clutch controlled gearing between said driving shaft and said countershaft, a pair of gears upon said driven shaft and having oppositely effective rotative connections therewith, a segmental gear adapted to mesh with either of said gears, operative driving connections between said segmental gear and said countershaft, means relatively to shift said gears and said segmental gear, a lever arm to which the segmental gear is pivotally connected, a movable point of support for said lever arm, and means to concentrically or eccentrically dispose the point of pivotal support of the lever arm and the point of pivotal connection of said lever arm and said segmental gear.

37. A variable speed mechanism comprising a driving shaft, a driven shaft, a clutch interposed between said driving and driven shafts, a gear upon said driven shaft, a countershaft operatively connected to said driving shaft, a segmental gear in mesh with said gear upon said driven shaft, operative driving connections between said segmental gear and said countershaft lever mechanism to which said segmental gear is pivotally connected, a pivotal support for said lever mechanism, and means concentrically or eccentrically to dispose the pivotal support for said lever mechanism, and the point of pivotal connection between said lever mechanism and said segmental gear.

38. A variable speed mechanism comprising a driving shaft, a driven shaft, a clutch interposed between said shafts, a pair of gears upon said driven shaft longitudinally movable with respect thereto and having oppositely effective rotative connections therewith, a countershaft, clutch controlled gearing between said countershaft and said driving shaft, a segmental gear adapted to mesh with either of said gears upon said driven shaft, means to shift said gears whereby either of them may be brought into mesh with said segmental gear, a crank upon said shaft, and variable connections between said crank and said segmental gear.

39. A variable speed mechanism comprising a driving shaft, a driven shaft, a clutch interposed between said shafts, a pair of gears upon said driven shaft longitudinally movable with respect thereto and having oppositely effective rotative connections therewith, a countershaft, clutch controlled gearing between said countershaft and said driving shaft, a segmental gear adapted to mesh with either of said gears upon said driven shaft, means to shift said gears, whereby either of them may be brought into mesh with said segmental gear, a crank upon said countershaft, lever mechanism operated by said crank mechanism, and means to vary the point of pivotal support of said lever mechanism, said segmental gear and said lever mechanism being operatively connected.

40. A variable speed mechanism comprising a driving shaft, a driven shaft and means whereby the latter may be directly driven by the former, one or more pairs of gears operatively connected to said driven shaft, the members of said pair or pairs having oppositely effective driving connection with said shaft, whereby forward and reverse driving of said shaft may be effected, a gear or gears operatively connected to said pair or pairs of gears to drive the same, means intermediate the driving shaft and said last mentioned gear or gears to drive the latter, means to vary the speed of movement of said last mentioned gears without stopping the mechanism, and means adapted operatively to engage said speed varying means to control the direction of movement thereof.

41. A variable speed mechanism comprising a driving shaft, a driven shaft, one or more pairs of gears operatively connected to said driven shaft, the members of said pair or pairs having oppositely effective

driving connections with said shaft, whereby forward and reverse driving of said shaft may be effected, a gear or gears operatively connected to said pair or pairs of gears to drive the same, means intermediate the driving shaft and said last mentioned gear or gears to drive the latter, means to vary the speed of movement of said last mentioned gears without stopping the mechanism, and means adapted operatively to engage said speed varying means to control the direction of movement thereof.

42. A variable speed mechanism comprising a driving shaft, a driven shaft, one or more pairs of gears operatively connected to said driven shaft, the members of said pair or pairs having oppositely effective driving connections with said shaft, whereby forward and reverse driving of said shaft may be effected, a gear or gears operatively connected to said pair or pairs of gears to drive the same, means intermediate the driving shaft and said last mentioned gear or gears to drive the latter, means to vary the speed of movement of said last mentioned gears without stopping the mechanism, and means to determine the path of movement of the speed varying means dependent upon the forward or reverse driving of the driven shaft.

In testimony whereof, I have signed my name to this specification, in the presence of two subscribing witnesses.

HERBERT I. WILBER.

Witnesses:

IRVING U. TOWNSEND,

GEO. R. BLINN.