June 14, 1932. A. I. POPE 1,862,802

SPEED CONTROL MECHANISM

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Fig. 1.

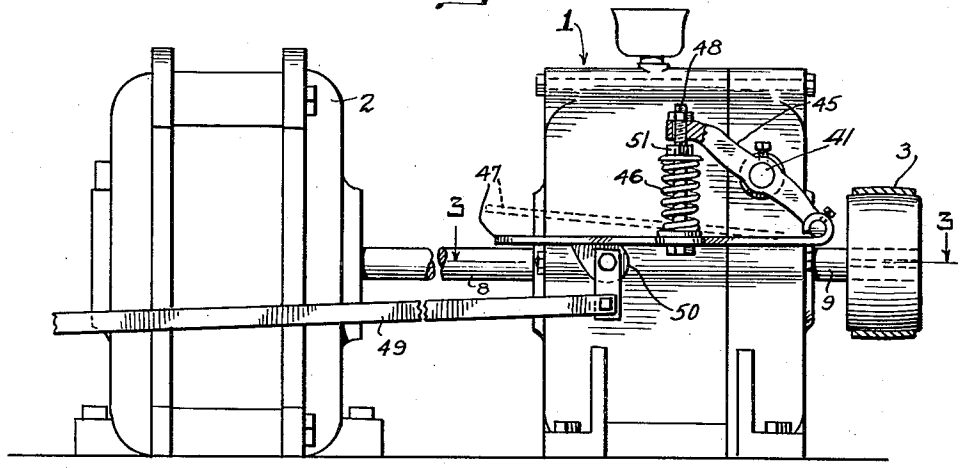


Fig. 2.

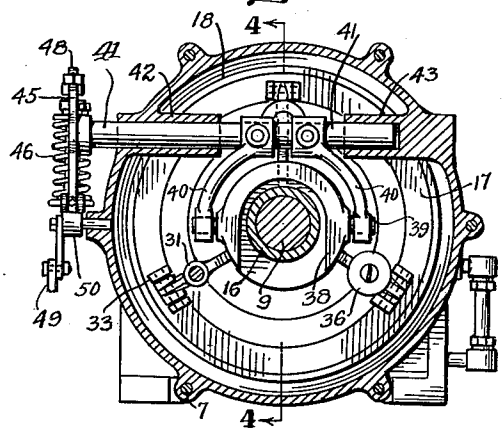


Fig. 3.

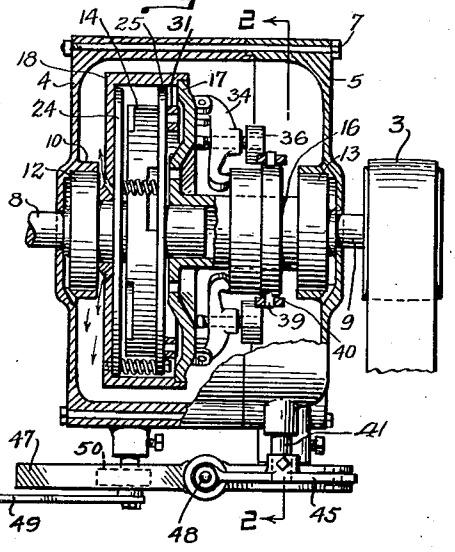


Fig. 10.

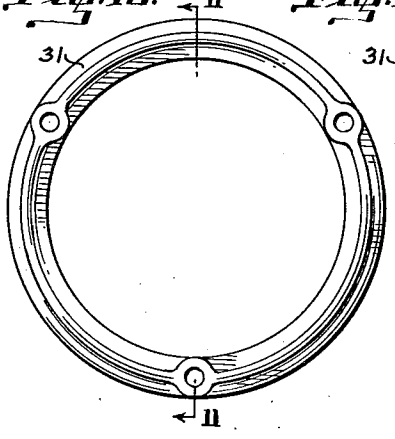


Fig. 11.



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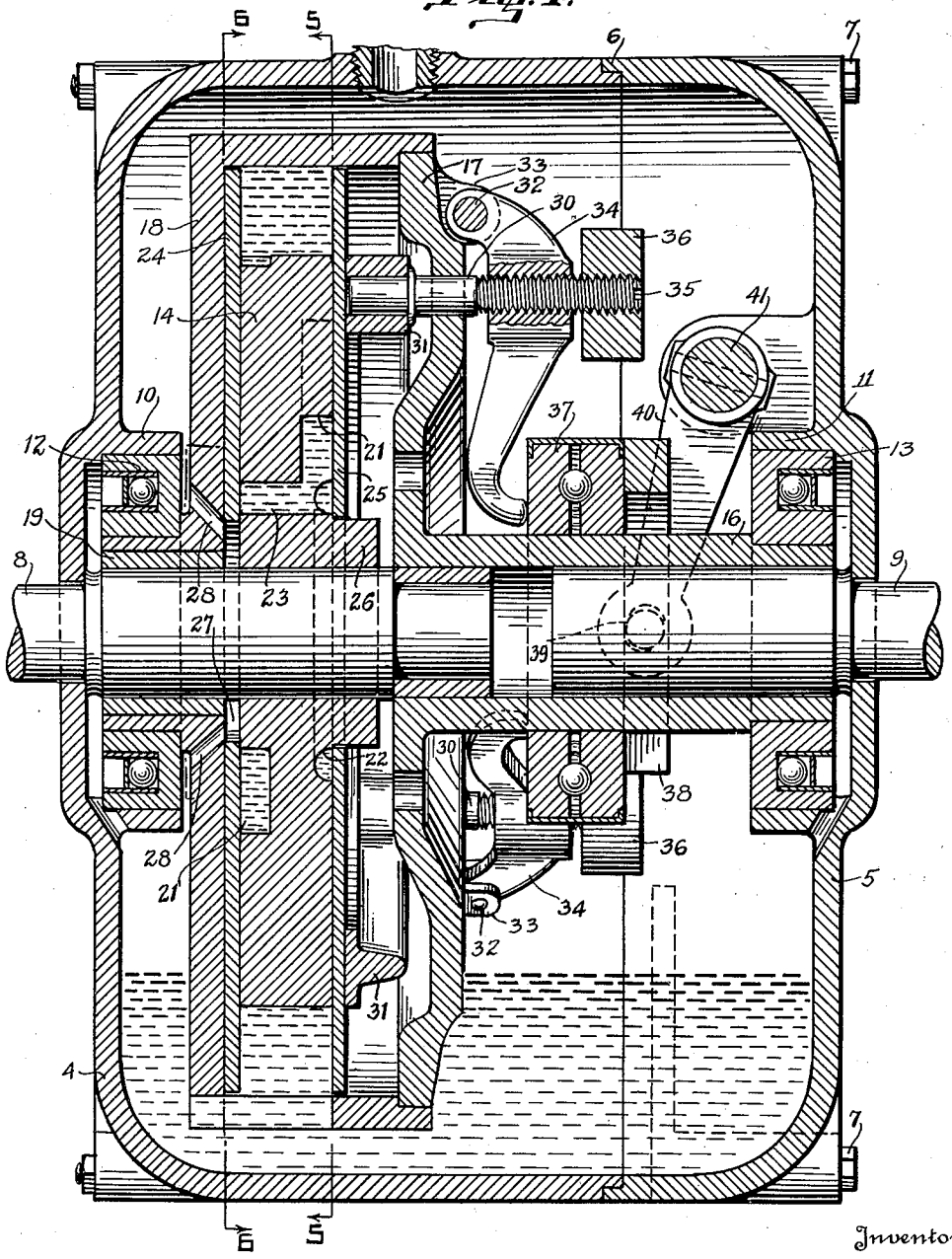
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SPEED CONTROL MECHANISM

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Fig. 4.



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SPEED CONTROL MECHANISM

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Fig. 5.

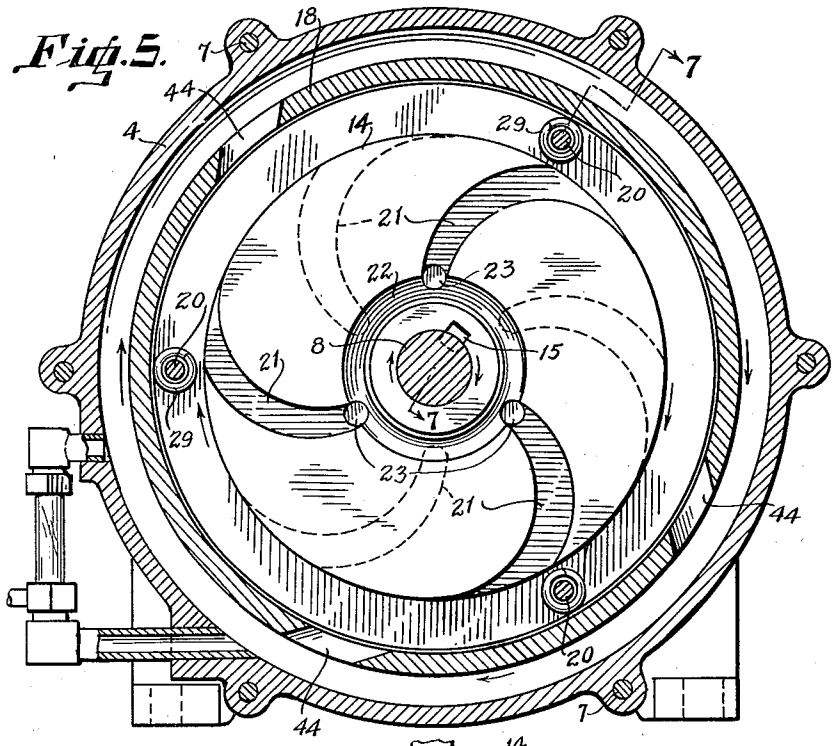
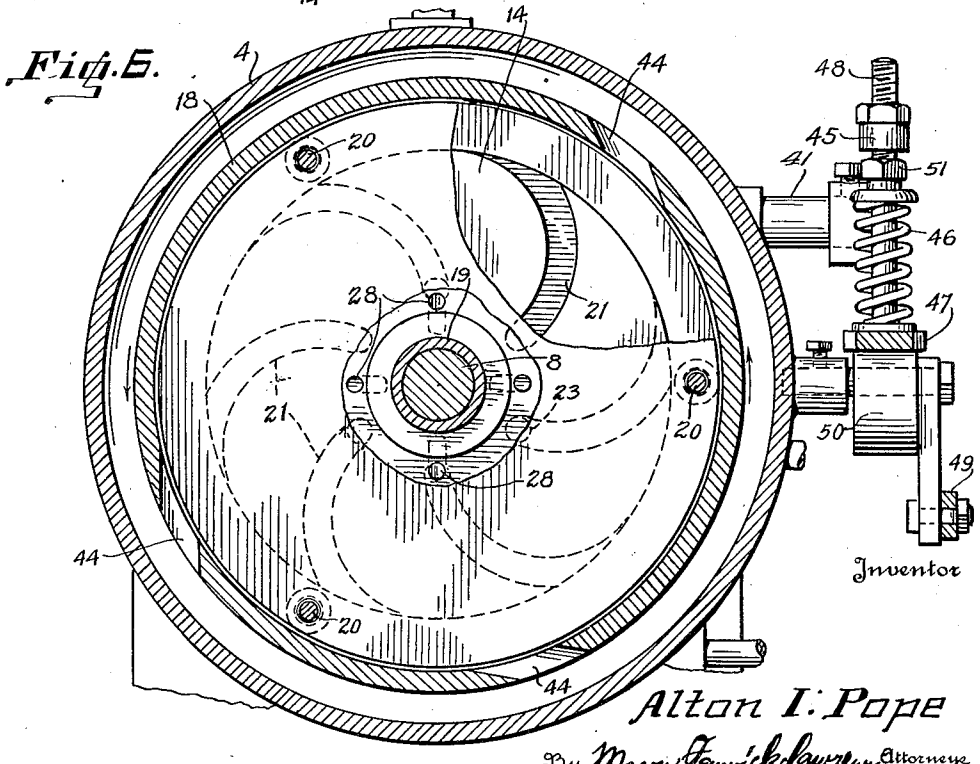


Fig. 6.



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SPEED CONTROL MECHANISM

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Fig. 7.

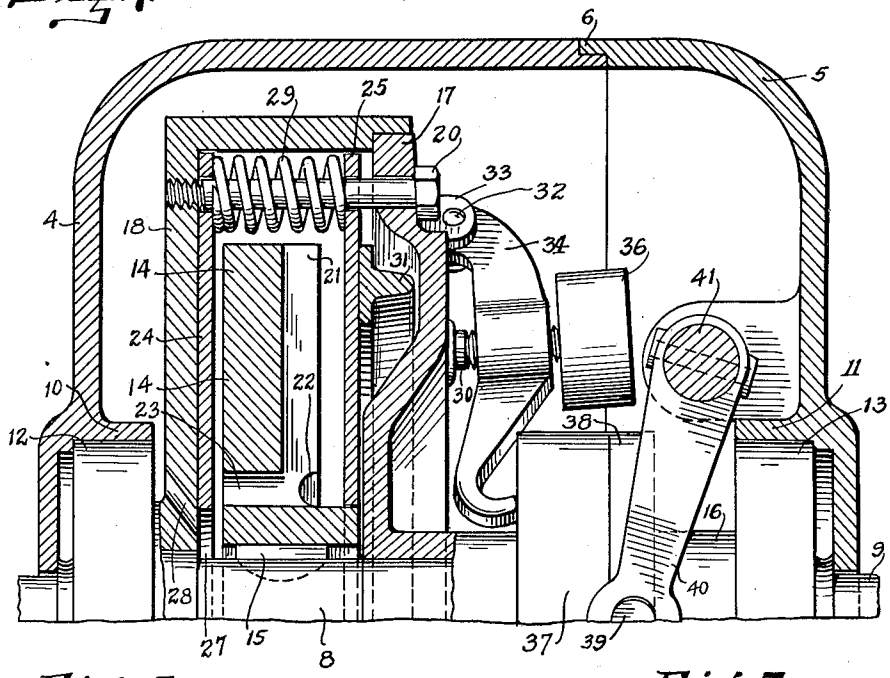


Fig. 8.

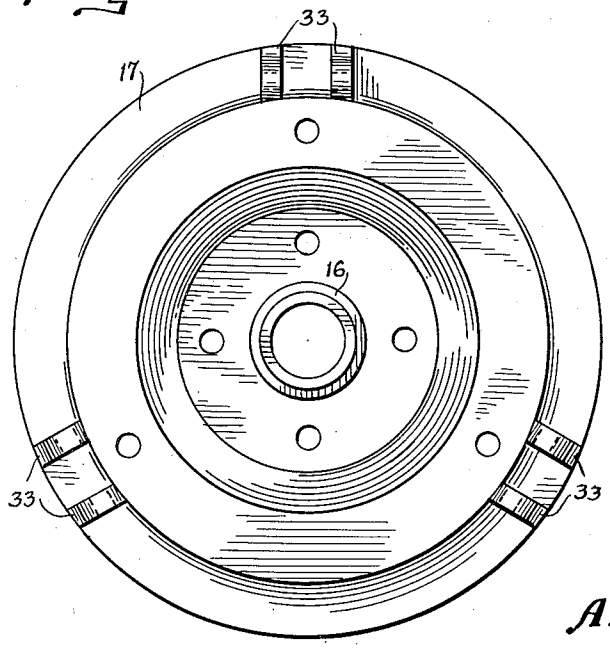
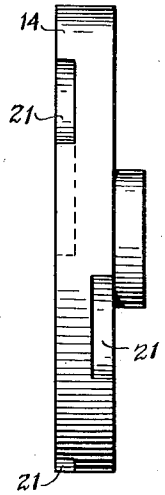


Fig. 9.



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Patented June 14, 1932 1,862,802

UNITED STATES PATENT OFFICE

ALTON I. POPE, OF FORT WORTH, TEXAS

SPEED CONTROL MECHANISM

Application filed March 11, 1930. Serial No. 435,012.

This invention relates to speed control mechanisms for power transmission, and has for its principal object the provision of means by which power from a source operating at a constant speed may be transmitted to an apparatus or machine operating at variable ranges of speed, not exceeding and generally below that of the prime mover, or other source of power.

Another object of the invention is to provide a centrifugally governed speed control responsive to the speed of the driven member, in which a suitable liquid, preferably oil, is employed as the controlling medium.

A further object of the invention is the provision of control means of the class described which automatically supplies itself while running, with the controlling medium, through inertia.

Still another object of the invention is to provide adjustable means correlated with the centrifugal governing mechanism for inhibiting the action of the latter until the attainment of a determined speed of the driven member at which speed, through the action of the centrifugal governing mechanism, the liquid control is brought into operation.

Other objects of the invention will appear as the following description of a preferred and practical embodiment thereof proceeds.

In the drawings in which the same characters of reference have been used throughout the several figures to denote identical parts:

Figure 1 is a side elevation of the apparatus embodying the invention including the source of power at constant speed and the power take-off;

Figure 2 is a section taken along the line 2—2 of Figure 3;

Figure 3 is a section taken along the line 3—3 of Figure 1;

Figure 4 is a section taken along the line 4—4 of Figure 2, on an enlarged scale;

Figure 5 is a section taken along the line 5—5 of Figure 4;

Figure 6 is a section taken along the line 6—6 of Figure 4;

Figure 7 is a section taken along the line 7—7 of Figure 5;

Figure 8 is a front elevation of the front plate of the casing, forming part of the driven element;

Figure 9 is an end elevation of the impeller;

Figure 10 is a front elevation of the push ring; and

Figure 11 is a section taken along the line 11—11 of Figure 10.

Referring now to the several figures, and first adverting to the lay-out shown in Figure 1, the numeral 1 represents in general, the speed control, 2 being an electric motor of the constant speed type, and 3 the pulley from which power is taken off from the driven shaft. Said pulley is capable of operating at variable speed ranges equal to or lower than the constant speed of the driving motor.

It is to be understood, of course, that the electric motor forms no part of the invention, that any prime mover could be substituted therefor and that the pulley 3 is only an example of any common and equivalent form of power take-off.

Referring now to Figure 4, it will be noted that there is a stationary casing comprising parts 4 and 5, suitably joined in known manner, as shown at 6, and secured together by means such as the bolts 7. Said casing forms an enclosure for the operating mechanism of the speed control, and at the same time constitutes a reservoir for the body of oil from which the controlling fluid is drawn by the speed control in its operation. The oil level is clearly indicated in this figure.

The opposite ends of the casing are suitably apertured for the passage of the drive and driven shafts, 8 and 9, respectively, the casing being formed with interior flanges 10 and 11 forming seats for bearings 12 and 13 by which the respective shafts are supported. An impeller 14, of which more will presently be said, is secured to the drive shaft 8 by suitable means such as the spline 15, said impeller having a slight longitudinal play on said shaft.

A sleeve 16 is suitably keyed to the driven shaft, said sleeve projecting inwardly beyond the end of the driving shaft, and freely receiving the inner end of the driving shaft, acting as an inner bearing therefor. The

sleeve is expanded at its inner end to form, or is otherwise provided with, a plate 17, said plate forming the closure for a casing 18, the latter having a suitably bushed hub 19 which encircles the adjacent portion of the driving shaft and is supported thereby. The plate 17 and casing 18 are secured together by through bolts 20, one of which is shown in Figure 7.

It is apparent from the structure so far described, that the casing secured to the driven shaft encloses the impeller which is carried by the driving shaft. It will be noted from Figure 4 that the impeller is smaller in diameter than the internal diameter of the casing 18, so as to form an annular peripheral space surrounding said impeller.

It will be seen from Figures 5 and 6 that the impeller is formed on its opposite sides with curved channels 21, the channels on one side communicating at their outer ends with the peripheral annular space, and at their inner ends with an annular groove 22 adjacent the center of the impeller. The channels 21 on the opposite side likewise communicate at their outer ends with the peripheral space, while at their inner ends they communicate with cross-channels 23 extending from one side of the impeller to the other.

Thus the inner ends of the curved channels 21 are in inter-communication. The impeller 14 is flanked on opposite sides by disks 24 and 25. Said disks are mounted to rotate with the casing 18 and make sliding contact with the cylindrical inner wall of the casing 18, the disk 25 being seated on the hub 26 of the impeller and the disk 24 having a central aperture 27 communicating with discharge passages 28 formed in the adjacent wall of the casing 18, the central aperture being normally closed to the cross-passages 23, but communicating with said cross-passages when the disk 24 becomes spaced apart from the impeller. The discharge passages 28 drain into the outer stationary casing.

The disks 24 and 25 are normally biased by the springs 29, one of which is shown in Figure 7 so that they will move away from the impeller when free to do so, but said disks are, in one phase of the operation of the speed control held in contact with the opposite faces of the impeller against the tension of the springs 29, by means of governor pins 30, Figure 4, acting against the push ring 31 which bears against the disk 25. In the present embodiment of the invention, there are three units of the centrifugal governing mechanism, all units being similar. These units are pivotally supported on the outer plate 17. The pivots 32 are mounted in pairs of lugs 33, Figure 8, formed on the plate 17 at equal circumferential intervals.

The pivots each carry a lever 34, said lever having a threaded aperture in which is threaded a pin 35. Said pin 35 fits normally against the governor pin 30 and presses the control ring 31 against the disk 25, the pressure being derived from a heavy nut 36 threaded on the outer end of the pin 35. The pin itself can be adjusted relatively to the lever 34 so as to determine the point in the position of said lever at which the pin 35 will touch the pin 30.

The inner ends of the levers 34 make contact with an end thrust bearing 37 mounted on the sleeve 16. Said bearing abuts a collar 38 loosely surrounding the sleeve 16 and having trunnions 39 at its opposite sides which, in turn engage with suitable lost motion, in the apertured ends of a yoke 40 fixed to a lay shaft 41, the latter extending into the stationary casing and being carried in suitable bearings 42 and 43 as shown in Figure 2.

From what has now been described, it is obvious that when the driven member attains a proper speed, the weighted nuts 36 tend to fly toward the cylindrical periphery of the casing, rocking the levers 34 upon the pivotal mounting, pushing the inner ends of said levers against the end thrust bearing, and pushing said bearing against the yoke 40 rocking the lay shaft 41.

At the same time, the pins 35 tend to recede from the governor pins 30, permitting the springs 29 which are confined between the disks 24 and 25, to expand, enlarging the space between said disks and thus separating said disks from contact with the impeller 14, which they normally closely embrace. The lay shaft is associated exteriorly of the stationary casing, with the mechanism that determines the speed at which the centrifugal governor will operate and which mechanism will be later described.

Figures 5 and 6 show that the casing 18, which for convenience may alternatively be referred to as the driven member is formed with slots 44 in its cylindrical periphery, inclined outwardly toward the direction of rotation of said driven member so that when the driven member rotates it picks up oil from the stationary casing transferring it to a position within the driven member where it will be accessible to be picked up by the curved channels of the impeller 14 which, for convenience, may alternatively be referred to as the driving member.

Referring to Figure 1, the lay shaft 41 will be seen projecting from one side of the casing of the speed control. A rocking lever 45 is secured to the extended end of said lay shaft and at the lower end of said lever is mounted a cam plate 47. An adjustable spring 46 is mounted on a bolt 48 which bridges the angle between said cam plate and the upper end of the rocking lever. The spring determines the amount to which the cam plate may be deflected before the deflection is communicated to the upper end of the

lever 45 rocking the same. A rod 49 which may be manually controlled or otherwise, actuates a cam 50 mounted in operative relation to the cam plate 47, to impart more or less deflection to the cam plate according to the range of speed which it is desired shall be maintained by the driven member of the speed control or the machine or apparatus connected to said driven member.

The tension of the spring 46 may be set by suitable means such as the nut 51 which may be threaded on the bolt 48 in such a manner so as to compress the spring 46 to any desired degree.

The speed control mechanism as above described, operates as follows:

Assume the parts to be in position shown in Figure 7, in which the spring 46, shown in Figure 1 is so reduced in tension that the springs 29 press the disks 24 and 25 apart. The driven member is now stationary and centrifugal force is of course, not acting upon the weighted nuts 36. The spaces between the impeller 14 and the disks, and the apertures 23 and 28 are now wide open. There is free passage for the oil which may be churned up by the rotation of the impeller, but there is absolutely no driving connection between the driving and driven members. Thus the motor may be started with no load.

As the tension of the spring 46 may be increased by screwing down upon the nut 51, the tension of the spring 46 opposing that of the springs 29, forces the disks to approach one another, gradually reducing the oil spaces between said disks and the impeller and thus confining the churned up oil which now acts as a film, the viscosity of which transmits power from the driving to the driven members so that the latter is started into rotation and will maintain such speed relative to the driving member, as the viscosity of the oil films, having a thickness determined by the amount of separation between the impeller and the disks 24 and 25 will permit.

When the driven member rotates, the centrifugal elements 36 are urged outwardly, opposing the tension of the spring 46 and thus tending to widen the spaces between the impeller disks whenever a certain speed limit is exceeded, thus keeping the driven member at a uniform speed. This speed limit may, of course, be changed by merely varying to a suitable degree, the tension of the spring 46.

The tension of the spring 46 may be so increased by adjustment that both centrifugal force and the tension of the springs 29 will be overcome and the disks 24 and 25 pressed against the faces of the impeller, squeezing out the oil films and closing communication between the apertures 23 and 28. When in this condition, the driving and driven members travel together and at the same speed so that the oil control is not now functioning. The oil will then stand at the level shown in Figure 4 and the parts be in the relative positions shown in this figure, the oil level being the same both in the outer casing and in the casing of the driven member. Rotation of the driven member causes it to pick up oil from the stationary casing and rotation of the driving member causes the oil to be driven against the centrifugal force through the curved channels to the central groove 22 and cross passages 23.

When these parts are full there can be no further pick up of oil except the slight amount incidental to what may fly out of such of the slots 44 as are uppermost at any time in the rotation of the driven member. If it be now assumed that the attained speed of the driven member is such as to cause the weighted nuts 36 to move outwardly against the tension of the spring 46, swinging the levers 34 so as to relieve the pressure on the governor pins 30, the springs 29 will then expand forcing apart the disks 24 and 25 and thus providing a circular space between the disks and the opposite faces of the impeller, into which the oil is driven by the impeller.

A flow of oil through the driven and driving members is thus set up, a part of the oil returning to the body of oil in the outer casing by way of the cross passages 23 and the discharge passages 28. The object of these passages is to return the oil to the outer casing so as to maintain a supply of oil for the driven member to pick up, since it is in picking up this oil that the driven member does work and thus slows down.

At the same time, the separation of the disks 24 and 25 from the impeller opens the outer faces of the curved channels so that a portion of the oil contained therein and continualy picked up by the driving member spreads in a film betwen said disks and driving member. When the movement of the centrifugal units is great, the disks separate to a comparatively wide distance so that a thick film of oil is formed and maintained between the disks and the impeller.

The cohesion of the oil in a thick film is less thin in a thin film, for in a thick film particles of oil will be readily displaced by bending the oil as well as by shearing the oil. In a thin film there is not room for the displacement of the oil particles by bending, this being possible only by shearing strain upon the oil. Consequently, when the centrifugal units permit the disks to open to a wide extent, there is but little cohesion between the driving and driven members and the driven member quickly slows down. The films of oil between the disks and impeller are reduced in thickness, the coefficient of cohesion raises and the driving element again takes up gradually the acceleration in the speed of the driven element. Thus the use of oil as a control agent has two effects or functions. One is to cause the driven element to do work

when the oil can flow through said driven element and secondly, to create films of various coefficients of cohesiveness between the driven and driving means for varying the rate of slippage between said members at different relative speeds. If there were no oil in the speed control and the centrifugal units were relied upon merely to produce an air gap between the disks and impeller, there would be an abrupt parting and engagement of the speed control members creating an excessive "hunting" of the centrifugal governor so that the driven member would be a long time settling down to any desired determined range of speed.

The rocking lever 45 and its appurtenant parts have been described in detail in order to explain that feature of the invention which covers the adjustable control of the governor mechanism from the exterior of the casing of the speed control. It is to be understood, however, that there are many equivalent devices, any one of which might be substituted for the adjusting mechanism here shown without affecting the entity of the invention.

What I claim is:

1. In a speed control mechanism, driving and driven members, means for maintaining a supply of liquid in said members in readiness to be introduced as a power transmission element between said members, means for normally inhibiting the said introduction of said liquid, and means responsive to increase in the speed of said driven members for countering the action of said inhibiting means.

2. In a speed control mechanism, driving and driven members, means for maintaining a supply of liquid in said members in readiness to be introduced as a power transmission element between said members, means for normally inhibiting the said introduction of said liquid, means responsive to increase in the speed of said driven member for countering the action of said inhibiting means, said inhibiting means being adjustable for determining the speed value at which said countering means shall begin to act.

3. In a speed control mechanism, driving and driven members, means for maintaining a supply of liquid in said members in readiness to be introduced as a power transmission element between said members, means for normally inhibiting the said introduction of said liquid, means for biasing said members in the direction of separation, a governor responsive to increase in the speed of said driven member for countering the action of said inhibiting means, said inhibiting means being adjustable for determining the speed value at which said countering means shall begin to act.

4. In a speed control mechanism, driving and driven members, means for maintaining a supply of liquid in said members in readiness to be introduced as a power transmission element between said members, means for biasing said members toward a position of separation, means for normally inhibiting the action of said biasing means, means responsive to the increase of speed of said driven member for countering the action of said inhibiting means, and means for providing a by-pass for some of the liquid from the point where it is held in readiness back to the supply, to promote a circulation of liquid between said members and through said by-pass.

5. A speed control mechanism comprising driving and driven members, means affording a source of supply of liquid, said driving and driven members being constructed to conduct liquid from said supply through said members to a point adjacent the center of said driven member for holding said liquid in readiness to be circulated as a power transmission element between said driving and driven elements, means for normally inhibiting the circulation of said liquid, means responsive to increase in the speed of said driven member for countering the action of said inhibiting means, and means for bypassing some of said liquid through to said supply at times when said inhibiting means is counteracted, to promote a circulation of liquid through and between said driving and driven members and through said by-pass when said members are rotating.

6. A speed control mechanism comprising driving and driven members, the former including an impeller having channels leading from its periphery toward the center and inclined in the direction of rotation of said driving member, the latter including a casing enclosing said impeller and having slots, a plate within said casing forming a reservoir for liquid maintained at a depth to be picked up by the slots in said casing and in turn by the channels of said impeller, the latter being formed with a passage adjacent its middle, communicating with said channels and opening in the face of said impeller contacted by said plate the latter acting as a valve to said passage, means for biasing said plate to a position of separation with respect to said impeller, means for normally inhibiting the action of said biasing means, and means operating responsive to the speed of said driven member to permit said biasing means to move said plate away from said impeller, promoting the flow of liquid in a film between said plate and said impeller.

7. In a speed control mechanism driving and driven members, the former comprising an impeller having channels leading from its periphery toward the center and inclined in the direction of rotation of said driving member, the latter including a casing enclosing said impeller and having slots, a plate within said casing and rotatable therewith, said casing

forming a reservoir for liquid maintained at a depth to be picked up by the slots in said casing and in turn by the channels in said impeller, the latter being provided with a passage adjacent its middle communicating with said channels and opening in the face of the impeller contacted by said plate, the latter acting as a valve to said passage, a by-pass for returning liquid direct to said outer casing also controlled by said plate, means for biasing said plate toward a position of separation with respect to said impeller, means for normally inhibiting the action of said biasing means, and means operating responsive to the speed of the driven member for countering the action of said inhibiting means, permitting said biasing means to separate said plate and impeller.

8. In a speed control mechanism, driving and driven members, the former including an impeller having channels formed in its opposite faces extending from its periphery toward the center and inclined in the direction of rotation of said driving member, the latter including a casing enclosing said impeller and having slots inclined in the direction of rotation of said driven member, plates within said casing and rotatable therewith engaging the opposite faces of said impeller to normally close the sides of said channels, an outer casing forming a reservoir for liquid maintained at such depth as to be picked up by the slots in said casing and in turn by the channels of said impeller, the latter being provided with passages adjacent its center communicating with the channels on both faces, said plates acting as valves to said passages, springs between said plates for normally biasing them to positions of separation with respect to said impeller, means for normally inhibiting the action of said biasing means, and means operating responsive to the speed of the driven member for countering the action of said inhibiting means, to permit said biasing means to move said plates away from the impeller faces, promoting a flow of liquid in film form between said plates and said impeller.

9. In a speed control mechanism driving and driven members, the former including an impeller having channels formed in its opposite faces extending from its periphery toward the center and inclined in the direction of rotation of said driving member, the latter including a casing enclosing said impeller and having slots, plates within said casing and rotatable therewith engaging the opposite faces of said impeller to normally close the sides of said channels, an outer casing forming a reservoir for liquid maintained at such depth as to be picked up by the slots in said casing and in turn by the channels of said impeller, the latter being provided with passages adjacent its center communicating with the channels on both faces, said plates acting as valves to said passages, said casing being formed on one side with a passage controlled by the adjacent plate for by-passing some of the liquid directly back to said reservoir when said plate and impeller are separated, means for biasing said plates to positions of separation with respect to said impeller, means for normally inhibiting the action of said biasing means, and means operating responsive to the speed of the driven member for countering the action of said inhibiting means to separate said plates and impeller, promoting a flow of liquid in film form between said plates and impeller and through said by-pass to said reservoir.

10. In a speed control mechanism, a member having fluid passages provided with an outlet, a driven member having means to control said outlet, a spring urging the disassociation of said driving and driven members, and means acting against the influence of said spring to urge the driving and driven members into motion transmitting association and having speed responsive means cooperating therewith.

11. In a speed control mechanism, a member having fluid passages provided with an outlet, a driven member having means to control said outlet, a spring urging the disassociation of said driving and driven members, and means acting against the influence of said spring to urge the driving and driven members into motion transmitting association and having speed responsive means cooperating therewith, said speed responsive means being carried by said driven member.

12. In a speed control mechanism, a member having fluid passages provided with an outlet, a driven member having means to control said outlet, a spring urging the disassociation of said driving and driven members, and means acting against the influence of said spring to urge the driving and driven members into motion transmitting association and having speed responsive means cooperating therewith, said driven member embodying a casing receiving said driving member.

13. In a speed control mechanism, a driving member having fluid passages having inlets and outlets, a driven member embodying a plate positioned at one side of said driving member and having means to control the discharge of fluid from said outlets, a spring urging the disassociation of said driving member and the plate of said driven member, and means acting against the influence of said spring to urge said driving member and said plate into motion transmitting association and having speed responsive means cooperating therewith.

14. In a speed control mechanism, a rotary driving member having fluid passages provided with inlet ends adjacent the periphery of the driving member to pick up fluid, a driven member having means to control the

flow of fluid through said passages, adjustable means urging said driving and driven members into motion transmitting association and having a speed responsive element.

15. In a speed control mechanism, a rotary driving member having fluid passages provided with inlet ends adjacent the periphery of the driving member to pick up fluid, a driven member having means to control the flow of fluid through said passages, adjustable means urging said driving and driven members into motion transmitting association and having a speed responsive element, and a spring acting against said adjustable means.

16. In a speed control mechanism, a rotary driving member having a fluid passage provided with an inlet adjacent the periphery of the driving member and having an outlet adjacent to the axis of the driving member, a driven member having means to close the said outlet, adjustable means urging said driving and driven members into motion transmitting association and having a speed responsive element constituting a governor, and a spring acting against said adjustable means.

17. In a speed control mechanism, driving and driven members, means for maintaining a supply of liquid in readiness to be employed as a power transmission element between said members, means for normally inhibiting the said employment of said liquid, and means responsive to a change in the speed of said driven member for countering the action of said inhibiting means.

In testimony whereof I affix my signature.

ALTON I. POPE.