

Oct. 30, 1928.

1,689,587

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PRESSURE FLUID MOTOR

Original Filed June 27, 1918

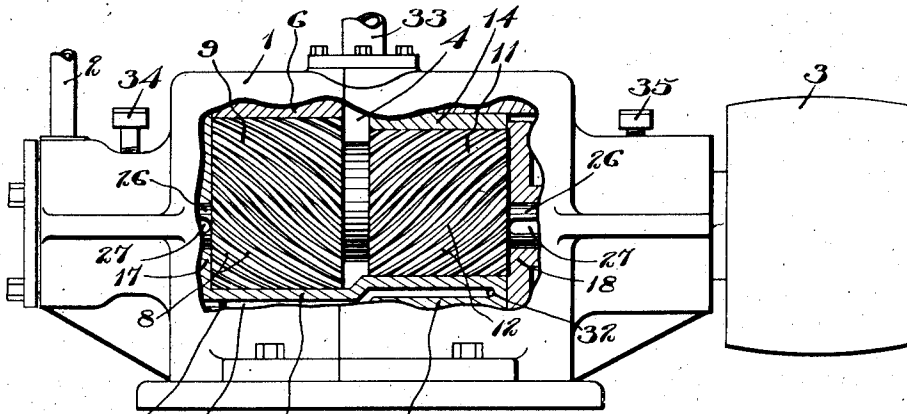


Fig. 1.

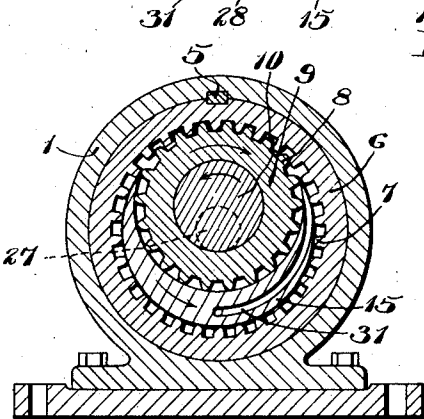


Fig. 3.

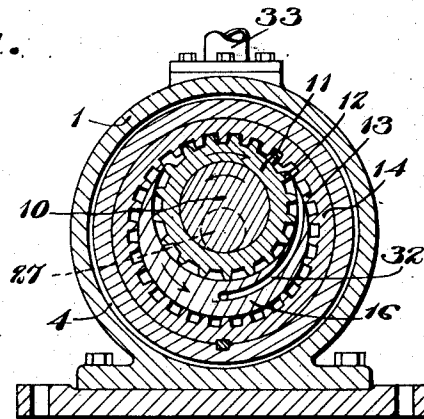
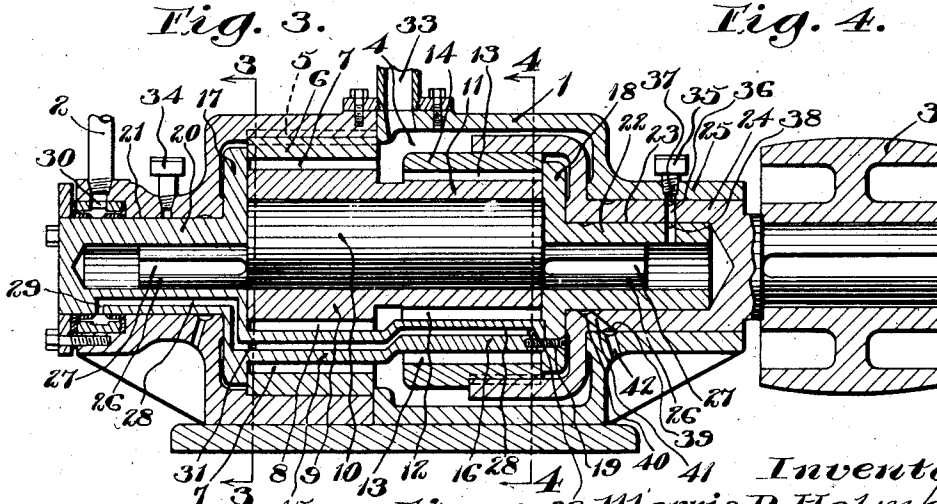


Fig. 4.



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PRESSURE-FLUID MOTOR.

Application filed June 27, 1918, Serial No. 242,175. Renewed October 31, 1921. Serial No. 511,842.

My invention relates to pressure fluid motors.

It has for its object to provide an improved pressure fluid motor. A further object of my invention is to provide an improved combined driving and speed reducing mechanism which is adapted to deliver the power required at the desired speed. A still further object of my invention is to provide an improved combined motor and speed reduction mechanism wherein one or more elements of the motor act simultaneously as elements of the speed reduction mechanism and thereby enable a compact and powerful unit to be provided adapted to a wide range of useful purposes. These and other objects and advantages of my improved construction will, however, hereinafter more fully appear.

In the accompanying drawings I have shown for purposes of illustration one embodiment which my invention may assume in practice.

In these drawings,—

Fig. 1 is a side elevation of my improved motor, a portion of the casing being broken away to show the rotors.

Fig. 2 is a central vertical longitudinal section of the construction shown in Fig. 1.

Fig. 3 is a transverse sectional view taken on line 3—3 of Fig. 2.

Fig. 4 is a similar transverse sectional view taken on line 4—4 of Fig. 2.

In this illustrative construction I have shown a motor of the pressure fluid type enclosed in a suitable casing 1 and adapted to be driven by any suitable pressure fluid, herein air, receivable through a suitable inlet, as 2, and operatively connected to rotate any desired element, herein shown for example as a pulley 3.

In my improved construction it will be observed that the casing 1 has a suitable rotor housing chamber 4 formed therein. This chamber, as shown, also has fixed therein at one end, as by a suitable spline 5, an internal gear 6 having spirally disposed teeth 7 adapted to mesh with cooperating spiral teeth 8 formed on the outer periphery of a rotor 9 which, as shown, is journaled on an eccentric 10. As illustrated, this eccentric 10 also carries a longitudinally spaced coaxially disposed smaller rotor 11, preferably rotatable

with the rotor 9 and herein integral therewith, having a smaller number of teeth 12 thereon similar to the teeth 8 and meshing with corresponding teeth 13 on the inner periphery of an internally toothed gear 14. Here it will also be noted that intermediate, rotary, longitudinally spaced fluid pressure supplying members 15 and 16, herein integrally united, are disposed between the rotor 9 and the gear 6, and between the rotor 11 and the gear 13. Herein, it will also be noted that these members 15 and 16 are of substantially crescent shaped cross section so that they substantially fill the interval between their respective rotors and gears. It will also be noted that the same are attached, respectively, to head members 17 and 18, the member 17 in a preferred form being integral with the member 15, while the member 18 is removably attached to the member 16 by any suitable means, such as one or more screws 19. These head members 17 and 18, as shown herein, in turn each also serve to close or seal the ends of one set of spiral teeth. As shown, one of the same, i. e. the member 17, is provided with a sleeve 20 journaled in suitable bearings 21 formed in one end of the casing 1, while the other is provided with a sleeve 22 journaled in a suitable bearing 23 formed in the sleeve 24, which last is secured, by a spline 24', on the gear 14, the sleeve 24 in turn being journaled in bearings 25 at the opposite end of the casing and having the rotated element, herein the pulley 3, rotatable therewith. Attention is also directed to the fact that the eccentric 10 is provided on its opposite ends with coaxial stub shafts 26 keyed at 27 to the sleeves 20 and 22. It will also be noted that the sleeve 20 and the members 15 and 16 are herein provided with a longitudinally disposed passage 28 communicating through a lateral port 29 and a suitably packed annular passage 30, with the inlet 2, and through cooperating lateral passages 31 and 32 with the tip of each of the members 15 and 16, so that the fluid is discharged between the teeth on the adjacent elements 9, 6, and 11, 14. As shown, it will be noted that a single exhaust pipe 33 is also provided intermediate the ends of the casing 1 to conduct away the exhaust from both ends of the motor. In order to provide for lubricating the parts, it will also

be observed that a suitable oil cup 34 is provided for the bearing 21, and that a corresponding oil cup 35 is provided for the bearings 25 and 23, the latter oil cup communicating with these bearings through suitable registering ports 36 and annular grooves 37 and 38 formed in the members 24 and 22, respectively. In order to prevent the blowing out of the lubricant around the end of the casing, it will also be noted that suitable annular grooves 39 and 40 are provided in these same members 24 and 22, and that a passage 41 is provided in the member 24 leading from the groove 40 to the groove 39 so that any air escaping from the chamber 4 may pass to the latter groove and out through a registering passage 42 formed in the casing.

In the operation of my improved construction, it will be observed that when a suitable pressure fluid, such, for example, as air, is supplied through the supply pipe 2, the same enters the annular passage 30, and from the latter is delivered through the lateral port 29 continuously into the longitudinal passage 28. From this passage 28 the fluid is supplied through the lateral passages 31 and 32 to the tips of the members 15 and 16. Here, we will first consider the action of the pressure fluid in the larger of the elements, i. e. in that including the larger rotor 9. Obviously, due to the fact that the internal gear 6 is fixed, the pressure fluid passing into the space between the spiral teeth 7 and 8, will cause the rotor 9 to be rotated clockwise, as shown in Fig. 3, relative to the teeth 7. Obviously, during this movement the member 15 will rotate in an opposite direction to the member 9 and with the eccentric 10 to which it is fixed, will move in a counter-clockwise direction. In other words, it will be observed that as pressure fluid is supplied through the passage 31 rotation will be imparted to the rotor 9, and the supply means delivering the pressure fluid thereto will rotate therewith in such a manner that a constant supply of fluid is delivered to the teeth as the rotor moves about the inner periphery of the internal gear 6. Obviously, due to the supply of pressure fluid through the passage 32, a similar action will then also be taking place in the smaller element, i. e. that including the smaller rotor 11. However, in this instance since the outer gear 14 is not fixed but is instead free to rotate, it will be noted that this gear will rotate relative to the rotor. The rotation of the gear 14 will of course be at a much smaller angular velocity than that of the other rotating gears and its speed may be determined from the formula: 14's velocity equals the product of the velocity of the ec-

centric $10 \times (1 - \frac{fm}{sn})$ where f equals the number of teeth on the gear 6, m the number of

teeth on the gear 11, s the number of teeth on the gear 9, and n the number of teeth on the gear 14. In other words, it will be noted that while the elements of the compound gearing herein shown act as driving elements, the same also simultaneously act as a compound gear reduction operating upon the principle of a compound epicyclic train utilizing two internal gears. It will of course be evident that this operation will continue as long as pressure fluid is supplied from the inlet 2, and that the exhaust from the two sets of rotors will pass out of the chamber 4 into the common exhaust pipe 33. It will also be evident that during the operation of my improved mechanism, oil will be supplied from the oil cups to the bearings and that the air from the chamber 4 will be prevented from blowing out the oil at one end of the casing, due to the action of my improved means 39, 40, and 41 above described.

In the use of my improved motor, it will be evident that a very wide variation in reduction may be obtained by a simple variation in the number of teeth employed upon either of the rotors 9 and 11, or the gears 6 and 14. In practice, it has been found that any desired reduction may be obtained ranging on either side of two hundred or more to one. Thus, obviously, any desired speed of rotation of the sleeve 24 and the illustrative rotated element 3 may be obtained enabling my improved combined driving and reduction mechanism to be adapted to a wide range of uses. It will further be observed that through my improved construction wherein the driving and reducing mechanism are formed in one and cooperate simultaneously to perform their separate functions, it is possible to produce an exceedingly compact construction which readily lends itself to a wide range of uses. Attention is also directed to the fact that elements of any desired power or size may be readily provided utilizing gears of different sizes or gears having different numbers of teeth, and that if desired the principle of my invention may be embodied in a single driving rotor, as distinguished from the plural driving rotors described in this illustrative construction. These and other advantages of my improved construction will, however, be clearly apparent to those skilled in the art.

While I have in this application specifically described one embodiment which my invention may assume in practice, it will be understood that this form is used for purposes of illustration only, and that the invention may be modified and embodied in various other forms without departing from the spirit or scope of the appended claims.

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

1. In combination, a compound epicyclic

gear reduction including a plurality of pairs of intermeshing gears, means cooperating with the teeth of the gears of each pair to form pressure fluid receiving pockets increasing in volume on relative movement between said gears, and means for supplying motive fluid to the pockets formed between the teeth of each pair.

2. In combination, a compound epicyclic gear reduction including a plurality of pairs of intermeshing gears having helically disposed teeth, means cooperating with the teeth of the gears of each pair to form pressure fluid receiving pockets increasing in volume on relative movement between said gears, and valveless means for supplying motive fluid to the pockets formed between the teeth of each pair.

3. In combination, a compound epicyclic gear reduction including a plurality of pairs of intermeshing gears, one of the gears of each pair being an internal gear and said internal gears being coaxially disposed with respect to each other, means cooperating with the teeth of each pair to form pressure fluid receiving pockets increasing in volume on relative movement between said gears, and means for supplying motive fluid to the pockets formed between the teeth of each pair.

4. In combination, a compound epicyclic gear reduction including a plurality of pairs of intermeshing gears having helically disposed teeth, one of the gears of each pair being an internal gear and said internal gears being coaxially disposed with respect to each other, means cooperating with the teeth of each pair to form pressure fluid receiving pockets increasing in volume on relative movement between said gears, and valveless means for supplying motive fluid to the pockets formed between the teeth of each pair.

5. In combination, a compound epicyclic gear reduction including a plurality of pairs of intermeshing gears, corresponding gears of each pair being coaxial with each other and two of said corresponding gears moving orbitally and rotating at equiangular rates, means cooperating with the teeth of each pair to form pressure fluid receiving pockets increasing in volume on relative movement between the gears, and means for supplying motive fluid to the pockets formed between the teeth of each pair.

6. In combination, a compound reduction gearing including a fixed internal gear and a rotatable internal gear and coaxial rotors meshing respectively with said fixed and with said rotatable internal gears, means cooperating with the teeth of the gears to form pressure fluid receiving pockets increasing in volume on relative movement between the gears, and means for supplying motive fluid to the pockets formed between the teeth of each pair of meshing gears.

7. In combination, a compound epicyclic internal gear train, and means for supplying motive fluid to a plurality of the rotors thereof.

8. In combination, a compound epicyclic internal gear train having spiral teeth, and means for supplying motive fluid to a plurality of the rotors thereof.

9. In combination, a gear reduction including a fixed internal gear and an eccentrically mounted rotor meshing therewith, and motive fluid supply means rotatable relative to said rotor for supplying fluid to the teeth thereof.

10. A pressure fluid motor comprising combined motor and reduction compound gearing units, and pressure fluid connections therefor comprising supply and exhaust connections to each of said units.

11. In combination, compound reduction gearing including a fixed internal gear and a rotatable internal gear and a plurality of rotors meshing therewith, and means for supplying motive fluid to the meshing teeth of each of said rotors and its gear.

12. In combination, compound reduction mechanism comprising a plurality of elements, means for supplying motive fluid between the teeth of each of said elements, and means for sealing one end of the teeth of each of said elements.

13. In combination, compound reduction mechanism comprising a plurality of elements, means for supplying motive fluid between the teeth of each of said elements, means for sealing one end of the teeth of each of said elements, and a single means for conducting away the exhaust from each of said elements.

14. In combination, compound reduction gearing including a fixed internal gear and a rotatable internal gear, a plurality of rotors meshing therewith, an eccentric carrying each of said rotors, and means for supplying motive fluid to the meshing teeth of each of said rotors and its gear.

15. In combination, compound reduction gearing including a fixed internal gear and a rotatable internal gear and a plurality of rotors meshing therewith, an eccentric carrying each of said rotors, and means for supplying fluid parallel to the axis of one of said rotors and laterally to the teeth thereof.

16. In combination, a casing, an internal gear fixed therein, an internal gear rotatable therein, simultaneously rotatable rotors meshing with said gears, an eccentric on which said rotors are rotatably mounted, and fluid supply means fixed to said eccentric and having a portion disposed between each rotor and its gear and supplying fluid to the teeth of each rotor.

17. A pressure fluid motor comprising substantially coaxially arranged sets of motor and reduction gearing, one including a fixed gear and the other a rotatable gear and

each including cooperating rotating gearing, and means for supplying pressure fluid to and exhausting the same from each of said sets.

18. A pressure fluid motor comprising cooperating sets of substantially coaxially disposed combined motor and reduction gearing, a casing enclosing said gearing and forming a journal therefor, means for supplying pressure fluid to one of said sets of gearing, means for exhausting pressure fluid therefrom through said casing, means for supplying lubricant to said gearing, and means for sealing one end of said casing against the discharge of lubricant while permitting the escape of exhaust pressure fluid therethrough.

19. In combination, a circular rotatable power driven member and driving means therefor comprising intermeshing toothed rotatable driving members one of which rotates upon a fixed axis and the other of which rotates upon an axis which travels around said first mentioned axis, and means for conducting motive fluid to said driving members and exhausting it therefrom including an admission port constantly communicating with the teeth of said driving members adjacent their line of mesh.

20. In combination, a driven member, and driving means therefor comprising cooperating members constituting a motor, one of said members rotating in the same direction and at the same angular speed as said driven member, and means for supplying motive fluid to the space between said members to effect operation of said motor, said last mentioned means including a continuously acting fluid pressure supply port rotating about the axis of rotation of said driven member.

21. In combination, a driven member, and driving means therefor comprising cooperating members constituting a motor, one of said members being rigidly connected to said driven member and rotating therewith, and means for supplying motive fluid to the space between said members to effect operation of said motor, including port means whose orifice bears a fixed space relation to a plane including the axes of said members, the peripheral and angular speeds of one of said members cooperating to constitute a motor being greater than those of said driven member.

22. In a fluid pressure motor, a circular rotatable power transmission member having a gear attached thereto which is operative on rotation to rotate said circular member, a second gear meshing with said first mentioned gear and traversing an orbit such that its axis moves around the axis of said first mentioned gear, means for supplying fluid pressure to said gears to effect relative rotation thereof, and means including a station-

ary member and a member cooperating therewith and rotatable on rotation of one of said first mentioned gears to effect rotation of said annular member at a rate less than the product of the rate of rotation of said second mentioned gear and the ratio of the teeth of the second mentioned gear to the first mentioned.

23. In combination, a rotatable power driven member circular in cross section, and driving means therefor comprising cooperating intermeshing toothed members, one of which rotates upon its axis and simultaneously traverses a path such that its axis traces a surface of revolution surrounding the axis of said rotatable member, gearing connecting said last mentioned toothed member in driving relation with said power driven member, and means for supplying motive fluid to and exhausting it from said toothed members, said motive fluid supplying means including a port opening adjacent the mesh line between said toothed members through which motive fluid is constantly supplied during their rotation.

24. In combination, a rotatable power driven member circular in cross section, and driving means therefor comprising cooperating intermeshing toothed members, one of which rotates upon its axis and simultaneously traverses a path such that its axis traces a surface of revolution surrounding the axis of said rotatable member, gearing connecting said last mentioned toothed member in driving relation with said power driven member, including a pinion rotatable coaxially with and at the same angular speed as said toothed member, and means for supplying motive fluid to and exhausting it from said toothed member, said motive fluid supplying means including a port opening adjacent the mesh line between said toothed members through which motive fluid is constantly supplied during their rotation.

25. In combination, a power driven member circular in cross section, and driving means therefor comprising an expansible chamber motor which comprises a toothed, motor rotor member rotatable upon its own axis and simultaneously traversing a path such that its axis traces a surface of revolution surrounding the axis of said rotatable member, and means for causing rotation of said toothed member to effect rotation of said power driven member including a fixed gear and a gear meshing therewith and movable bodily about the axis of rotation of said power driven member at an angular speed equal to the angular speed of movement of the axis of said toothed member in tracing said surface of revolution.

26. In combination, a combined valveless motor and gear reduction including a fixed internal gear and a meshing rotatable ele-

ment, and means for supplying motive fluid to the meshing teeth thereof.

27. In combination, a combined valveless motor and gear reduction including a fixed internal gear and a meshing rotatable element, and means for constantly supplying motive fluid to the meshing teeth thereof.

28. In combination, a combined valveless

motor and gear reduction including a fixed internal gear and an eccentrically mounted rotor meshing therewith, and motive fluid supply means supplying fluid to the meshing teeth thereof. 10

In testimony whereof I affix my signature.

MORRIS P. HOLMES.