

March 17, 1936.

T. B. KOHLER

2,034,302

TRANSMISSION

Filed July 17, 1933

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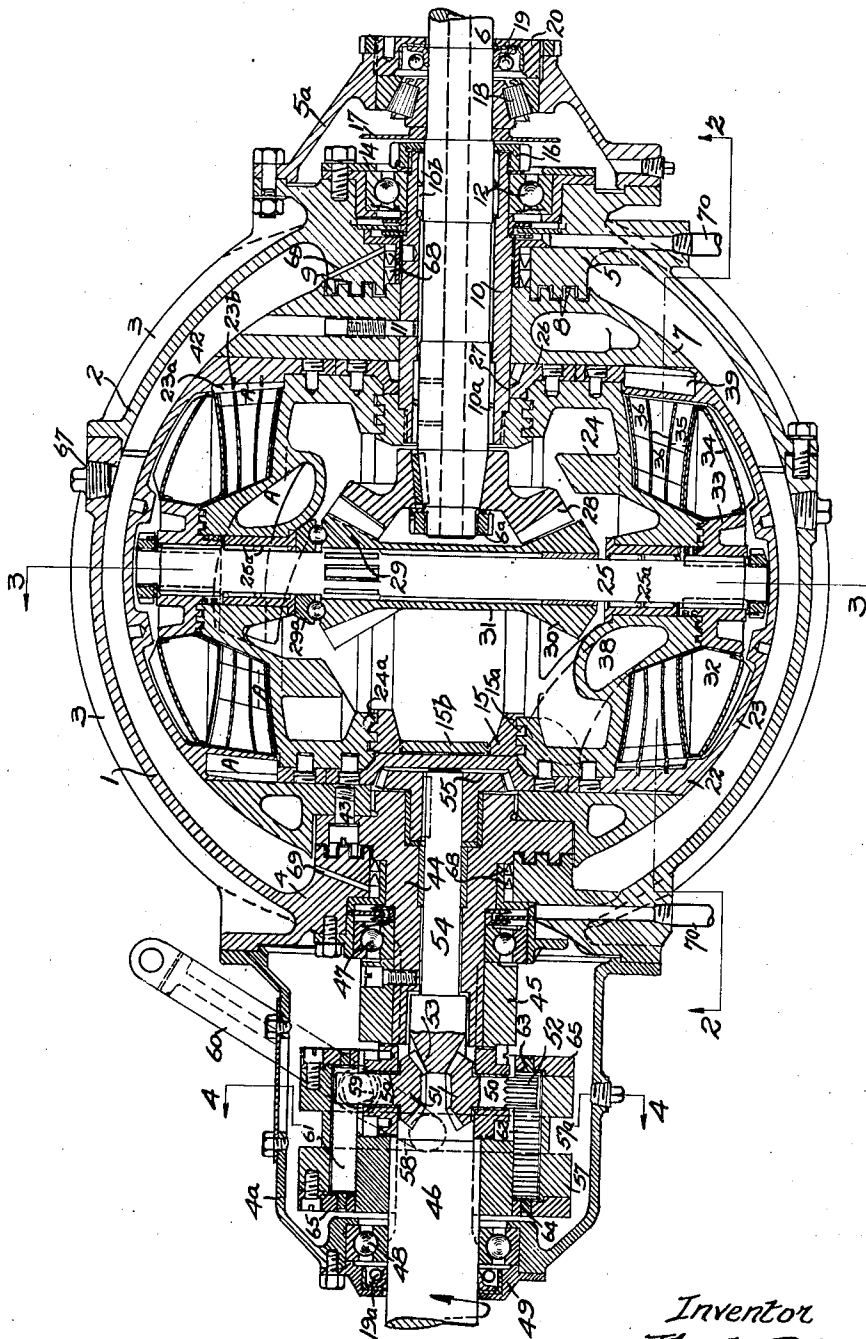


FIG. 1.

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4 Sheets-Sheet 2

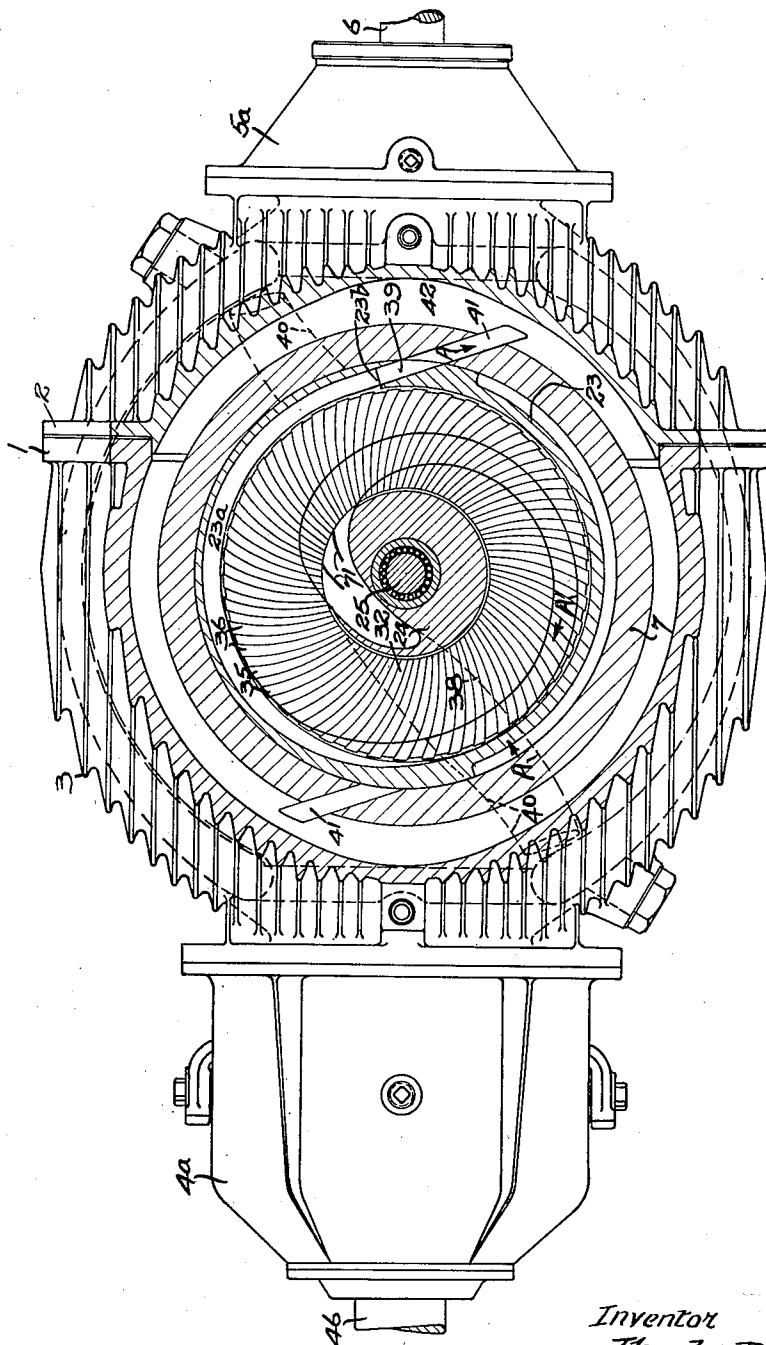


Fig. 2.

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4 Sheets-Sheet 3

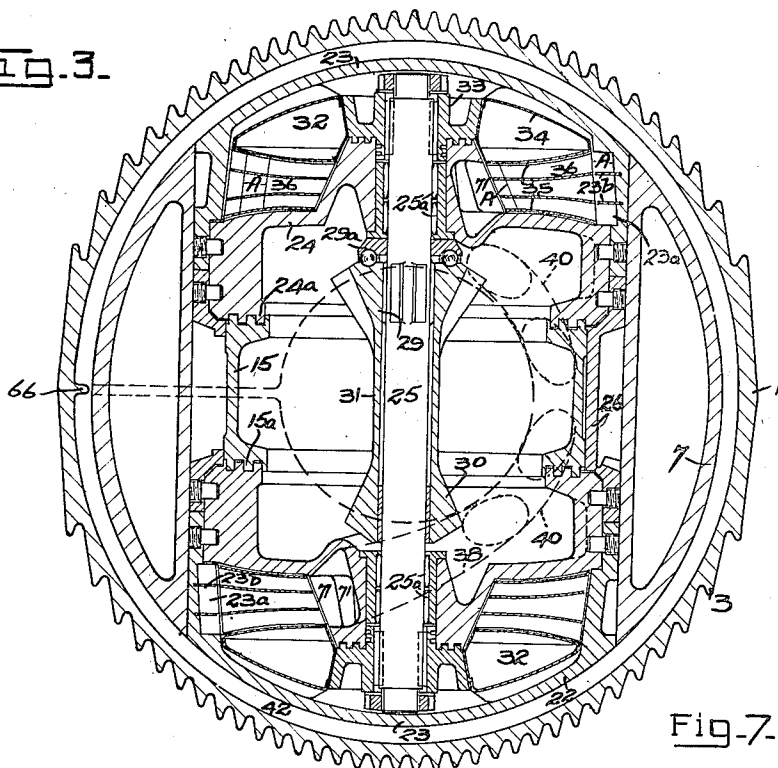
Fig. 3.

Fig-7.

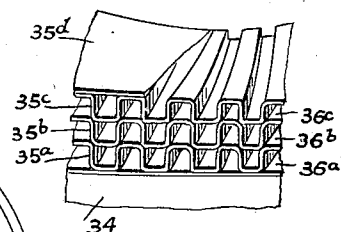


Fig. 6.

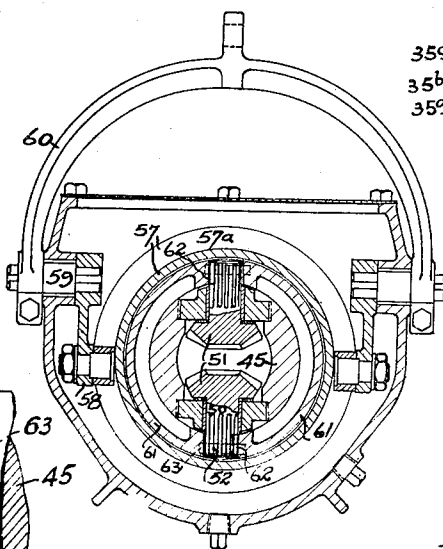
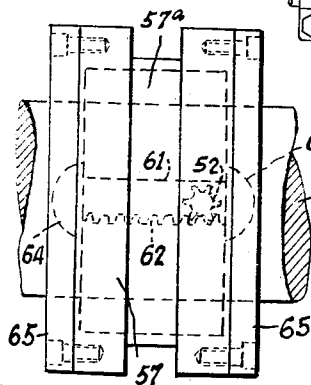


Fig 4

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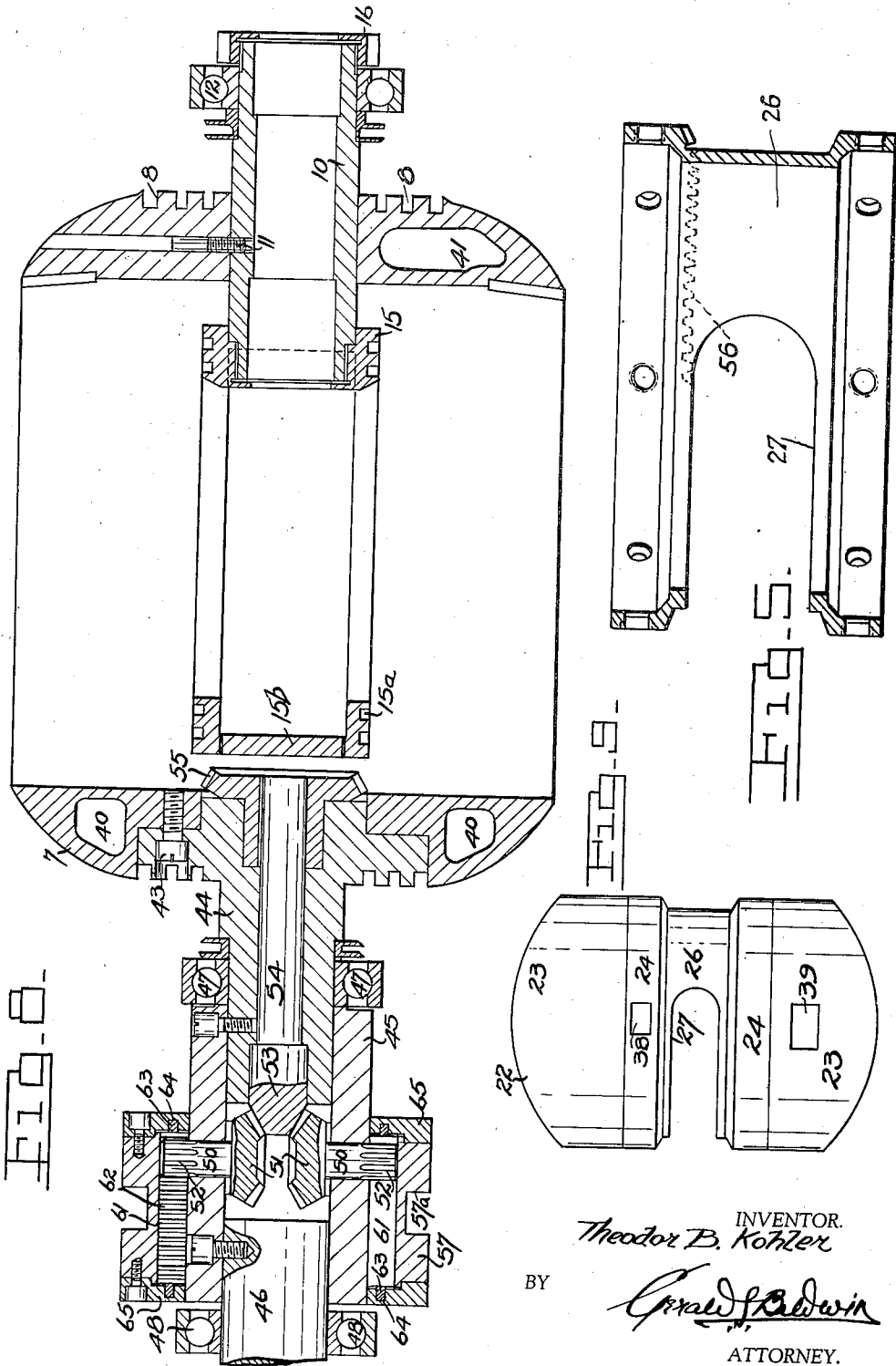
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4 Sheets-Sheet 4



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2,034,302

TRANSMISSION

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Application July 17, 1933, Serial No. 680,794

14 Claims. (Cl. 60—54)

This invention relates to improvements in transmissions, and refers to a transmission constructed somewhat along the lines of that shown in my co-pending application Serial #575,862, now Patent #2,010,401.

This invention aims, among other things, to provide a transmission wherein: Means are provided for maintaining the hydraulic liquid entirely separate from the lubricant; built up impellers are employed having a plurality of superimposed radial passages from which liquid is thrown into cavities formed within the casing in the direction valve covers, and wherein the cavities are circumferentially divided to increase the efficiency of the device, and wherein deflector vanes are arranged in the inlet passages to the impellers to cause the liquid to break up into separate streams and insure its entering the passages at the most efficient angle; to provide a simplified form of direction valve; and to provide manually operable means for turning the direction valve, by which the direction of rotation of the driven shaft is controlled, so that the latter may be shifted when the drive shaft is stationary.

Yet another object of the invention is to provide such a transmission which is efficient in operation, and which is relatively simple to construct and easy to operate.

With these and other objects and advantages in view which will become apparent as the specification proceeds, the invention is hereinafter more fully described with the aid of the accompanying drawings, in which:

Figure 1 illustrates a cross section of my transmission.

Figures 2, 3 and 4 are sections on the lines 2—2, 3—3 and 4—4 of Figure 1.

Figure 5 is an enlarged detail of the central portion of the direction valve.

Figure 6 is an enlarged detail showing a portion of the manually operated mechanism for moving the direction valve.

Figure 7 is an enlarged detail showing a partial cross section of one of the impellers.

Figure 8 is a sectional view showing the parts rotatable with the driven shaft, and

Figure 9 shows an elevation of the direction valve on a reduced scale.

Referring to the drawings, 1 designates a housing on which a cover 2 is secured so that these two parts together form a hollow body of substantially spherical shape. The outer face of both the housing and cover are preferably provided with radiating fins 3. The housing 1 and

cover 2 are each provided with opposed inwardly and outwardly projecting bosses 4 and 5 respectively, and secured to, and projecting outwardly from, each of the latter is a bearing member 4a and 5a. Through the bearing member 5a a drive shaft 6 extends which is preferably hollow so that a lubricant may be injected therethrough.

Mounted within the housing is a circular casing 7 having sealing grooves 8, preferably of the conventional labyrinth type, formed in its periphery which engage corresponding grooves 9 formed in the inner face of the bosses 4 and 5 of the housing 1 and cover 2. Extending through the inner casing 7 in alignment with the axis of the bearing member 5a is a bushing 10 which is fixed to the said casing 7 as by a set screw 11 so as to turn about its axis the said casing. The bushing 10 is provided with bearings, preferably needle bearings 10a and 10b in which the shaft 6 is rotatably supported. Around the bushing 10 adjacent its outer extremity is a ball bearing 12 the outer race of which is held to the outwardly projecting portion of the boss 5; this bearing is supported against axial movement by a retaining collar 14 secured to the said boss 5. The outer extremity of the bushing 10 is threaded for a nut 16, and outwardly beyond the latter the diameter of the shaft 6 is reduced to form a shoulder against which a throw ring 17 rests, which is held by the shoulder spaced from the nut 16. Against the outer face of the throw ring a roller bearing 18 rests which supports the outer extremity of the drive shaft 6 within the bearing member 5a; and 19 denotes a conventional sealing ring arranged around the shaft 6 and held in position by a nut 20 in threaded engagement with the said member 5a.

Rotatable about an axis substantially at right angles to the axis of the drive shaft 6, is a built-up direction valve 22. The latter consists of two circular outer covers 23 extending about the axis of a spindle 25; two annular bearing portions 24 in which the spindle 25 is rotatably supported adjacent its extremities in needle bearings 25a and substantially at right angles to the axis of the drive shaft 6; and an inner ring 26 which is segmentally slotted at 27 for the bushing 10 about the axis of the spindle 25 and through an angle somewhat greater than 180°, to permit the turning of the direction valve 22 about the axis of the said spindle. Extending around the latter centrally of its length and apertured for the passage of the bushing 10 is a sealing ring 15, having labyrinth seals 15a formed thereon which coact with similar seals formed around

- the bearing portions 24 of the direction valve 22. 15b denotes a plug inserted in the ring 15 to permit insertion and removal of the nut 6a on the inner extremity of the drive shaft 6. The function of this ring 15 is to prevent the escape of the lubricant within the direction valve which would otherwise pass through the segmental slot 27, and the dilution of the lubricant by hydraulic liquid hereinafter referred to.
- Mounted on the inner extremity of the drive shaft 6 is a gear 28 which meshes with a pinion 29 fixed on the spindle 25. 30 denotes a balance weight also mounted on the spindle 25 and in the present instance integral with the said pinion and connected thereto by a sleeve 31. The underside of the pinion 29 is preferably supported by a thrust ring 29a the opposite face of which bears against one of the bearing portions 24 of the direction valve 22.
- Mounted on each extremity of the spindle 25 is an impeller 32. Each of the latter consists of a hub 33 having a hollow circumscribing disc 34 thereon; and extending towards one another from adjacent faces of the discs 34 are blade portions 35 between which discharge passages 36 are formed. The construction of the blade portions and their passages will be readily seen from the detail view shown in Figure 7. Each impeller is provided with a plurality of blades 35a, 35b and 35c, each of which is annular and is corrugated so as to form a plurality of substantially radial though slightly curved passages 36a, 36b and 36c. Alternate radial parts of the blade portions 35a rest upon and are secured to the discs 34 while their other alternate portions are spaced from the said discs so as to form the passages 36a. The other blade portions 35b and 35c, which are similar to the portions 35a, are superimposed on the blade portions 35a and 35b respectively to form the passages 36b and 36c. 35d constitute bracing discs secured to the top of the corrugations of the blade portions 35c.
- Formed through the bearing portions 24 of the direction valve 22 and leading to each impeller 32 is an inlet passage 38, and extending from the periphery of the impellers outlet passages 39 are provided through the direction valve covers 23. Through the casing 7 two pair of diametrically opposed inlet and outlet ports 40 and 41 are formed in order that the direction of rotation of the driven shaft 46 may be reversed. By turning the direction valve in a manner hereinafter described either set of ports may be set to register with the inlet and outlet passages 38 and 39. The ports 40 and 41 are in communication with a reservoir 42 formed between the casing 7 and direction valve 22 and the housing 1 and its cover 2.
- Secured to the casing 7 as by screws 43 is a hollow driven stub shaft 44. Around the outer portion of the latter one extremity of a splined sleeve 45 is provided the opposite extremity of which encircles and is connected by splines to a driven shaft 46. Adjacent the boss 4 a ball bearing 47 is arranged to support the stub shaft 44; this bearing is held in position by the inner face of the sleeve 45. A second ball bearing 48 is retained in the outer extremity of the bearing member 4a by a cap 49 and supports the driven shaft 46. 19a denotes a conventional sealing ring within the cap 49.
- Extending radially through the sleeve 45 immediately of its length are two opposed spindles 50 which are rotatably supported therein. These spindles terminate at their inner extremities in bevel gears 51, while spur gears 52 are formed on their outer extremities. The bevel gears 51 both mesh with a pinion 53 on the outer extremity of a direction shaft 54 which extends axially through 5 and is rotatable in the hollow stub shaft 44. Mounted on the inner extremity of the direction shaft 54 and within the casing 7 is a bevel gear 55 which meshes with a partial ring gear 56, shown in Figure 5, which is formed integral with the inner ring 26 of the direction valve 22. Within the bearing member 4a is an axially slidable collar 57 which encircles the sleeve 45. This collar is annularly recessed at 57a intermediately of its length to receive the extremities of arms 58 which are secured to pivotal pins 59 to which the ends of a yoke 60 are also secured, so that movement of the latter moves the collar 57 axially along the sleeve 45.
- Within the collar 57 and between the latter 20 and the sleeve 45 are two segmental bushing sections 61 each of which has a rack 62 cut the full length of one of its radial faces, and co-operates with the adjacent spur gear 52. Thus each rack 62 cooperates with one of the gears 52 so that when the bushing portions 61 are moved axially in one direction the two spur gears turn in opposite directions thereby causing both the bevel gears 51 to supplement one another in imparting rotation to the pinion 53. The segmental bushing sections 61 are held substantially in alignment by Woodruff keys 63 and flat face of each of which bears against one extremity of both the said sections, while the curved faces of the keys are rockable in keyways 64 formed in annular flanges 65 secured to opposite extremities of the collar 57. Axial movement of the latter in either direction along the sleeve 45 therefore turns the direction valve 22 and when the collar 57 is at either limit of travel the direction valve 22 is so set that its intake and outlet passages 38 and 39 register with one set of casing ports 40 and 41 respectively.
- In order to prevent hydraulic liquid in the reservoir 42 turning with the casing 7 I provide a rib 66 integral with the inner face of the housing 1 which extends almost to the said casing and thereby prevents any appreciable rotary movement of the liquid.
- The lubricant used for the gears 28 and 29 and stored within the direction valve 22 is prevented from reaching the hydraulic liquid by the labyrinth seals 8 and 9, 15a and 24a, and other similar seals provided on the contiguous faces of the hubs 33 of the impellers and the bearing portions 24 of the direction valve.
- The reservoir and passages are partly, but not completely filled with liquid which is introduced into the reservoir 42 by removing the plug 67. As a slight pressure is exerted on the hydraulic liquid in the reservoir during operation of the transmission suitable expansive cup washers 68 are employed in the bosses 4 and 5 for preventing seepage of the liquid into the bearings from the passages 69 formed through the bosses. 70 denotes overflow pipes from the said bosses through which surplus liquid escapes if for some cause the pressure against the washers becomes excessive.
- In Figures 1 and 2 the letter A denotes the path of the hydraulic liquid into and through the impellers. Deflector vanes indicated at 71 are provided in the inlet passages 38 by which the liquid is diverted so as to enter the passages 36 at the 75

most efficient angle, and to divide the stream as it enters the impeller.

In the inner faces of the direction valve covers 23 substantially semi-circular eccentric cavities 23a are formed which are divided by inwardly projecting circumferential fins 23b so arranged that the said cavities are divided into separate compartments one opposite each set of impeller passages 36.

It is believed that the operation of the transmission will be readily understood; briefly it is as follows: The drive shaft 6 causes rotation of the spindle 25 and its impellers 32. Liquid from the reservoir 42 passes through one or other set of casing inlet ports or passages 40, and, when the direction valve 22 is operatively positioned, into the direction valve inlet passages 38. As it leaves the latter the liquid is diverted by the deflector vanes 71 to enter the impeller passages 36 in separate streams and at the desired angle. From the impeller passages 36 the liquid is thrown in the compartments formed by the fins 23b in the eccentric cavities 23a and its reaction effect causes rotation of the valve 22, casing 7 and driven shaft 46 about the axis of the latter. The liquid then passes through the outlet passages 39 and the set of casing ports or passages 41 in registry with the latter to the reservoir 42. The rate of speed of the impellers 32 decreases as the speed of the driven shaft 46 approaches that of the drive shaft 6. In order to provide means for reversal of rotation of the driven shaft the direction valve 22 must be rotatable through 180° about its axis, and two substantially opposed sets of ports or passages 40 and 41 are therefore furnished through the casing 7 so that one set or the other will register with the valve passages 38 and 39 when the said valve is in one of its operative positions. The provision of the superimposed passages 36 and the circumferential fins 23b add to the operative efficiency of the device. The operation of the mechanism for turning the direction valve 22 has already been explained.

While in the foregoing the preferred embodiment of the invention has been described and shown, it is understood that the construction is susceptible to such alterations and modifications as fall within the scope of the appended claims.

What I claim is:

1. In a transmission, a substantially spherical housing, a drive shaft and a driven shaft projecting therefrom, a casing in the housing secured to the driven shaft, said casing being also substantially spherical and having its periphery spaced from the housing so that a reservoir is formed between them, inlet passages through the casing, a direction valve in the casing having passages therethrough with which the casing passages are adapted to register, a spindle rotatable in the direction valve, means turning the spindle with the drive shaft, impellers on the spindle rotatable in the direction valve, walls so formed in the direction valve that liquid thrown against them by the impellers causes rotation of the casing and driven shaft about the axis of the latter and means for turning the direction valve about the spindle axis to control the direction of rotation of the casing and driven shaft.

2. In a transmission, a housing, a drive shaft and a driven shaft projecting therefrom, a casing within the housing connected to the driven shaft so as to rotate therewith, said casing being spaced from the housing bore so that a reservoir is formed between them, a bushing supporting the drive shaft in the housing, said bushing being connected

to the casing and rotating therewith, a spindle at right angles to said drive shaft and rotatable in the casing, means turning the spindle with the drive shaft, impellers on the spindle rotatable in the casing, and walls formed within the casing against which liquid is thrown by the impellers to cause rotation of the casing about the driven shaft axis, said casing having inlet and outlet passages formed therethrough.

3. In a transmission, a housing, a drive shaft and a driven shaft projecting therefrom, a casing in the housing having inlet and outlet passages therethrough and being connected to the driven shaft so that they turn together about the driven shaft axis, said casing being so shaped that a reservoir is formed between it and the interior of the housing, a direction valve in said casing having inlet and outlet passages therethrough adapted to register with the casing passages, a spindle rotatable in the direction valve, impellers on the spindle, means turning the spindle with the drive shaft, walls formed in the direction valve against which liquid is thrown by the impellers to cause rotation of the valve, casing and driven shaft about the axis of the latter, said impellers having a plurality of substantially radial superimposed passages formed therethrough outwardly through which liquid is thrown against said walls and means for turning the direction valve about the spindle axis to reverse the direction of rotation of the casing and driven shaft.

4. In a transmission, a housing, a drive shaft and a driven shaft projecting therefrom, a casing rotatably connected to the driven shaft so as to turn with the latter, said casing having inlet and outlet ports therethrough, and being so shaped that a reservoir is formed around it between it and the housing, a spindle at an angle to said drive shaft and rotatably supported within the casing, impellers spaced on the spindle, means turning the spindle with the drive shaft, walls formed within the casing so that liquid thrown against them by the impellers causes rotation of the casing and driven shaft, said impellers having a plurality of substantially radial superimposed passages formed therethrough outwardly through which liquid is thrown against said walls, deflector vanes within the casing to break up the liquid into separate streams before it enters the impeller passages, and circumferential fins extending from said walls towards said impellers, said fins dividing the walls into circumferential compartments one of which is in radial alignment with each set of superimposed passages so that liquid thrown from the latter strikes the compartment opposite to it.

5. In a transmission, a housing, a drive shaft and a driven shaft projecting therefrom, a casing in the housing secured to the driven shaft and having inlet and outlet passages therethrough, a direction valve rotatable in the casing and having inlet and outlet passages therethrough adapted to register with the casing passages, a spindle rotatable in the direction valve about the axis of the latter, means turning the spindle with the drive shaft, impellers on the spindle within the direction valve, the latter having walls so formed therein that liquid thrown against them by the impellers causes rotation of the casing and driven shaft about the axis of the latter, and manually operable means for turning the direction valve when the drive shaft is either running or stationary.

6. In a transmission, a housing, a drive shaft and a driven shaft projecting therefrom, a casing

in the housing having inlet and outlet passages therethrough, said casing being connected to the driven shaft so as to turn with the latter, a direction valve rotatable in the casing and slotted radially for the passage of the drive shaft therethrough, a spindle rotatable in the direction valve, means turning the spindle with the drive shaft, impellers on the spindle, said direction valve having passages therethrough adapted to register with the casing passages, said valve also having walls therein against which liquid thrown by the impellers strikes to cause rotation of the direction valve, casing and driven shaft about the axis of the latter, a sealing ring around the interior of the direction valve to cover the slot, said ring turning with the driven shaft, the drive shaft extending through the sealing ring, said casing being spaced from the housing to form a reservoir therebetween, and means for turning the direction valve about its axis.

7. In a transmission, a housing having a drive shaft and a driven shaft projecting therefrom, a casing in the housing, a direction valve rotatable in the casing, said casing and valve both having inlet and outlet passages formed therethrough, a spindle rotatable in the valve about the axis of the latter, impellers on the spindle rotatable within the valve, means turning the spindle with the drive shaft, walls so formed in the valve that liquid thrown against them by the impellers causes rotation of the casing and driven shaft, a hollow stub shaft secured to the casing in alignment with the driven shaft, a sleeve connecting the stub shaft and the driven shaft, a direction shaft rotatable in the stub shaft, means turning the direction valve about its axis when the direction shaft is turned, spindles extending through the sleeve, means turning the direction shaft when the spindles rotate, gears on the spindles, segmental bushing sections around the sleeve, a rack on one radial face of each bushing section, each rack meshing with one of the gears, a collar around the bushing sections, means on the ends of said collar for causing the bushing sections to move axially with the collar, other means equalizing the rotary pressure exerted by the racks on their gears, and means for moving the collar axially.

8. In a transmission, a housing, a drive shaft and a driven shaft extending therefrom, a casing in the housing connected to the driven shaft so as to turn with it, a direction valve rotatable in the casing about an axis inclined to the driven shaft axis, a spindle in the valve rotatable about the valve axis, means turning the spindle with the drive shaft, impellers rotatable in the direction valve fixed on the spindle, said casing having two sets of inlet and outlet passages therethrough, said direction valve having inlet and outlet passages therethrough adapted to register with either set of casing passages, walls so formed in the valve that liquid thrown against them by the impellers causes rotation of the valve, casing and driven shaft about the axis of the latter, a direction shaft concentric with the driven shaft, means on the direction shaft for turning the valve about its axis, and manually operable mechanical means for turning the direction shaft.

9. In a transmission, a housing, a drive shaft and a driven shaft projecting therefrom, a casing in the housing connected to the driven shaft so as to turn with the latter, a direction valve rotatable in the casing, a spindle rotatable in the direction valve, means turning the spindle with the drive shaft, impellers on the spindle

rotatable in the valve, said casing having two sets of inlet and outlet passages therethrough, the valve having inlet and outlet passages therethrough adapted to register with either set of casing passages, the valve having walls so formed therein that liquid thrown against them by the impellers causes rotation of the casing and driven shaft, a direction shaft extending through the casing and housing, means on the direction shaft turning the direction valve when it is turned, and manually operable means for turning the direction shaft.

10. In a transmission, a substantially spherical housing, a drive shaft and a driven shaft extending therefrom, a substantially spherical casing in the housing spaced from the latter and connected to the driven shaft so as to rotate therewith, said casing having two sets of inlet and outlet passages therethrough, a circular direction valve rotatable in the casing, the valve consisting of two outer covers, two bearing portions and an inner ring, a spindle rotatable in the bearing portions, means turning the spindle with the drive shaft, impellers on the spindle housed between the outer covers and the bearing portions, inlet passages formed through the latter adapted to register with either set of casing inlets, outlet passages formed through the outer covers adapted to register with either set of casing outlets, walls so formed in the outer covers that liquid thrown by the impellers against them causes rotation of the driven shaft, and means for turning the direction valve.

11. In a transmission, a housing, a drive shaft and a driven shaft projecting therefrom, a substantially spherical casing within the housing connected to the driven shaft, a spindle rotatable in the casing inclined to the axis of the drive shaft, means turning the spindle from the drive shaft, impellers on both extremities of the spindle rotatable in cavities within the casing, inlet passages in the casing through which liquid passes to the impellers, outlet passages in the casing through which the liquid thrown by the impellers passes after generating kinetic energy against the walls of the passages to rotate the casing about the driven shaft axis, and means for permitting the liquid to flow back from the outlet passages to the inlet passages between the casing and the housing.

12. In a transmission, a housing, a drive shaft and a driven shaft projecting therefrom, a casing in the housing having inlet and outlet passages therethrough, said casing being connected to the driven shaft so as to turn with the latter, a direction valve rotatable in the casing and slotted radially for the passage of the drive shaft therethrough, a spindle rotatable in the direction valve, means turning the spindle from the drive shaft, impellers on the spindle, said direction valve having passages therethrough adapted to register with the casing passages, said valve having walls therein against which liquid thrown by the impellers strikes to cause rotation of the direction valve, casing and driven shaft about the axis of the latter, and means connecting the outlet with the inlet passages to permit the liquid from the former to re-enter the latter and manually operated means for turning the direction valve about the spindle axis to reverse the direction of rotation of the casing and driven shaft.

13. In a transmission, the combination as described in claim 11 wherein manually operable means are provided for reversing the direction of rotation of the casing.

14. In a transmission, a housing, a drive shaft
and a driven shaft extending therefrom, a casing
in the housing connected to the driven shaft to
turn with the latter, a direction valve rotatable
5 in the casing about an axis inclined to the driven
shaft axis, impellers within the direction valve
mounted about a common axis on opposite sides
of the driven shaft axis, means turning the im-
pellers from the drive shaft, said casing having
10 two sets of inlet and outlet passages therethrough
the direction valve having inlet and outlet pas-
sages therethrough adapted to register with either
set of passages in the casing, liquid being adapted

to pass through the inlet passages in the casing
and valve to the impellers, walls so formed in the
valve that the liquid thrown against them by the
impellers causes rotation of the casing about the
driven shaft axis, the thrown liquid passing 5
through the outlet passages, a direction shaft
extending through the housing, means cooperat-
ing with the direction shaft for turning the valve
about its axis, and means for turning the direc-
tion shaft when the drive shaft is either station- 10
ery or rotating.

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