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Fig. 1.

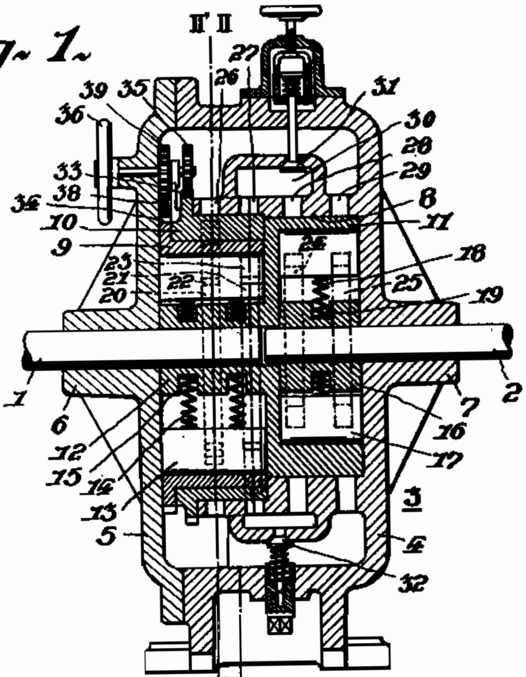

Fig. 2.

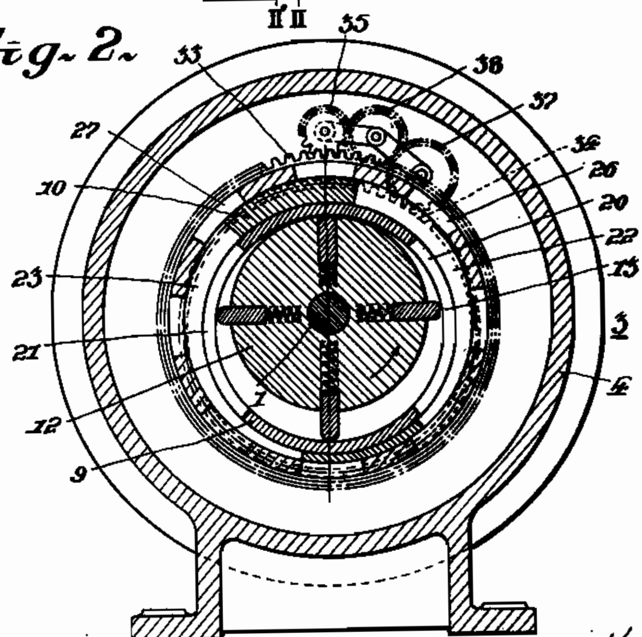

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Fig. 3.

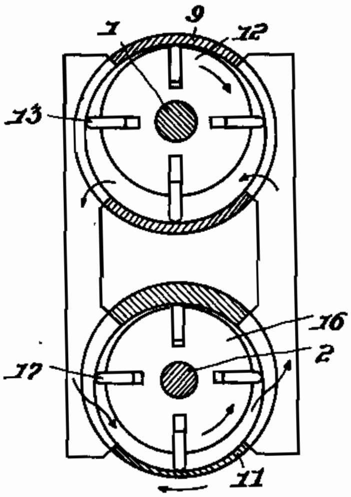


Fig. 4.

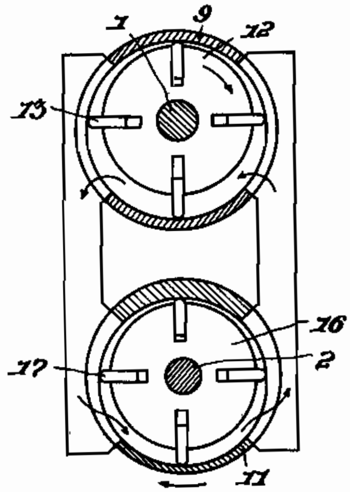


Fig. 5.

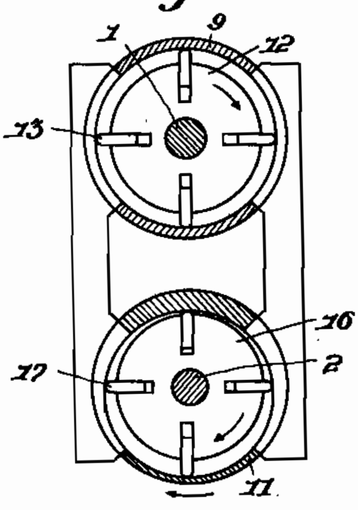
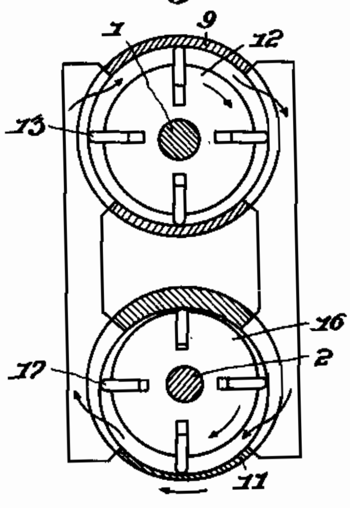


Fig. 6.



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ALIEN PROPERTY CUSTODIAN

VARIABLE SPEED HYDRAULIC COUPLINGS

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Application filed March 17, 1941

This invention relates to variable speed hydraulic couplings, and has for its object to provide an improved construction of this class, having eccentric rotary pumps, one of which may be adjusted in eccentricity to control the flow of fluid into the other pump, whereby the latter pump may be controlled in operation.

In the accompanying drawings:

Fig. 1 is a vertical sectional view of a hydraulic coupling embodying the invention;

Fig. 2 is a sectional view, the left half taken on the line II—II and the right half taken on the line II'—II' of Fig. 1;

Figs. 3–6 are diagrammatic views illustrating the operative relations between the eccentric rotary pumps on driving and driven sides.

Referring to the drawings, a driving shaft **1** and a driven shaft **2** extend in an allinement into a closed casing **3**, for example comprising a body **4** and a cover member **5**, through in a fluid-tight relation opposite hubs **6** and **7** provided in the cover member and the body respectively. The casing is provided with an internal cylindrical case member **8** integral with or secured to the casing, whereby the casing is divided into inner and outer chambers. A part of the inner wall of the internal cylindrical case member **6** is adapted to receive a cylinder **0** for an eccentric rotary pump associated with the driving shaft **1** in the casing **3**, through the intermediary of an adjusting ring **10** whereby the cylinder **9** may be adjusted to position in concentric or in various eccentric relation as desired to the driving shaft **1**, while the other part is adapted to receive a cylinder **11** for an eccentric rotary pump associated with the driving shaft **2** in the casing **3**.

The driving shaft **1** carries a rotor **12** for the eccentric rotary pump, secured to its inner end in the cylinder **9**. The rotor **12** has a smaller diameter than the inner diameter of the cylinder **9**, so as to leave a suitable space between the cylinder **9** and the rotor **12**, and is provided with a number of radial movable blades **13** supported by means of spiral springs **14** in slots **15** provided in the rotor **12** for that purpose.

The cylinder **11** for the eccentric rotary pump associated with the driven shaft **2** may be integral with as shown or secured to the rotator **12** for the eccentric rotary pump associated with the driving shaft **1**. The inner circumferential wall of the cylinder **11** is in an eccentric relation to the driven shaft **2**, while its external circumferential face is in a concentric relation to said driven shaft.

Similarly to the driving shaft **1**, the driven shaft **2** carries a rotor **16** for the eccentric rotary pump secured to its inner end in the cylinder **11**. The rotor **16** has a smaller diameter than the inner diameter of the cylinder **11**, so as to leave a suitable space between the cylinder **11** and the rotor **16**, and is provided with a number of radial movable blades **17** supported by means of spiral springs **18** in slots **19** provided in the rotor **16** for that purpose.

The cylinder **9** is provided with ports **20** and **21**, the adjusting ring **10** ports **22** and **23** adapted to communicate with the ports **20** and **21** respectively, and the cylinder **11** ports **24** and **25**. The internal cylindrical case member **8** is provided with circumferential series of ports **26**, **27**, **28** and **29** adapted to communicate with the ports **20**, **21**, **22** and **23** respectively, and is provided with a circumferential annular chamber **30** including the ports **27** and **28**. Spring loaded safety valves **31** and **32** are provided for limiting fluid pressure in the outside and the inside of the annular chamber **30** respectively.

For the operation of the adjusting ring **10** and the cylinder **9** to adjust the cylinder **9** in a concentric or various eccentric positions to the driving shaft **1**, the adjusting ring **10** is provided with a circumferential flange with teeth **33**, the cylinder **9** a circumferential flange with teeth **34**. The teeth **33** engaged with a toothed wheel **35** which may be driven by means of a handle **36**, and the teeth **34** is drivingly connected through idle wheels **37** and **38** to a toothed wheel **39** which may be driven by means of the said handle, so that the adjusting ring **10** and the cylinder **9** may be moved in a certain relation by means of the handle **39**.

All the contacting faces of the parts are made in fluid tight, and the space in the casing is filled with suitable fluid, such as oil and water.

In operation, when the driving shaft **1** and hence the rotor **12** are driven in a direction as indicated by an arrow in Fig. 2, fluid will be admitted from the annular chamber **30** through the ports **27**, **23** and **21** into the cylinder **9**, and thence the fluid will be forced through the ports **20**, **22**, and **26** into the space in the casing **3** on the outside of the internal cylindrical case **0**, and thence the fluid will be forced through the ports **20** and **25** into the cylinder **11** to drive the rotor **16** and hence the driven shaft **2** in a direction opposite to that of the driving shaft **1**, and thence the fluid will be forced through the ports **24** and **28** into the annular chamber **30**, the fluid being thus circulated.

In each cycle of the fluid, if the volume of the fluid leaving the cylinder 9 during one complete revolution of the rotor 12 is the same as the volume of the fluid leaving the cylinder 11 during one complete revolution of the rotor 16, the driven shaft 2 will remain still, as the cylinder 11 rotates with the driving shaft 1. In accordance with whether the former volume of the fluid is larger or smaller than the latter volume of the fluid, the driven shaft 2 will be apparently driven in a direction opposite to or the same direction as that of the driving shaft 1. By so making the cylinder 9 that it may contain larger volume of the fluid by a suitable volume than the volume of the fluid which may be filled in the cylinder 11, and by the regulation of the volume of the fluid forced from the cylinder 9 into the cylinder 11 by changing the relative position of the cylinder 9 to the rotor 12 by means of the adjusting ring 10, the driven shaft 2 may be apparently driven at variable speed, even smaller or larger than the speed of the driving shaft 1, in a direction opposite to or the same direction as that of the driving shaft 1.

This will be illustrated in detail with reference to Figs. 3–6.

With the cylinder 9 in the relative position to the rotor 12, as shown in Fig. 3, so that the volume of fluid discharged from the cylinder 9, during one complete revolution of the driving shaft 1 is larger than the volume of fluid to be admitted into the cylinder 11, during one complete revolution of the driven shaft 2 in such a direction as indicated by an arrow, the driven shaft 2 will be driven in the opposite direction to the direction of the driving shaft 1.

With the cylinder 9 in the relative position to the rotor 12, as shown in Fig. 4, so that the volume of fluid discharged from the cylinder 9, during one complete revolution of the driving shaft 1 is equal to the volume of fluid to be admitted into the cylinder 11, during one complete revolution of the driven shaft 2, the driven shaft 2 will remain still, as the cylinder 11 is driven with the shaft 1.

With the cylinder 9 in the relative position to the rotor 12, as shown in Fig. 5, so that the volume of fluid discharged from the cylinder 9, for one complete revolution of the driving shaft 1 and hence the rotor 12 is smaller than the volume of fluid to be admitted into the cylinder 11, for one complete revolution of the rotor 16 and hence the driven shaft 2, the fluid pressure in the space in the casing 3 on the outside of the internal cylindrical case 6 will become lower than that in the annular chamber 39, as the cylinder 11 rotates with the rotor 12 on the driving shaft. This pressure difference will apparently cause the rotor 16 to be driven in the same direction as that of the rotating cylinder 11. In this case, thus the driven shaft 2 will be driven in the same direction as the driving shaft 1, the cylinder 9 being concentrically positioned to the rotor 12.

Finally, with the cylinder 9 in the relative position to the rotor 12, as shown in Fig. 6, the fluid will apparently enter in the cylinder 9 through the port 20 instead of the port 21 and discharge through the port 21 instead of the port 20, and will apparently enter into the cylinder 11 through the port 24 instead of the port 25 and discharge through the port 25 instead of the port 24, in the opposite direction to the above cases. Thus, the rotor 16 and hence the driven shaft 2 will be apparently driven in the same direction as the driving shaft 1 and hence the cylinder 11, at a speed in accordance with the volume of fluid discharging from the cylinder 9.

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