No. 843,874. PATENTED FEB. 12, 1907.

G. L. M. DÖRWALD.

HYDRAULIC POWER TRANSMISSION APPARATUS.

APPLICATION FILED JULY 2, 1906.

2 SHEETS—SHEET 1.

Fig. 1

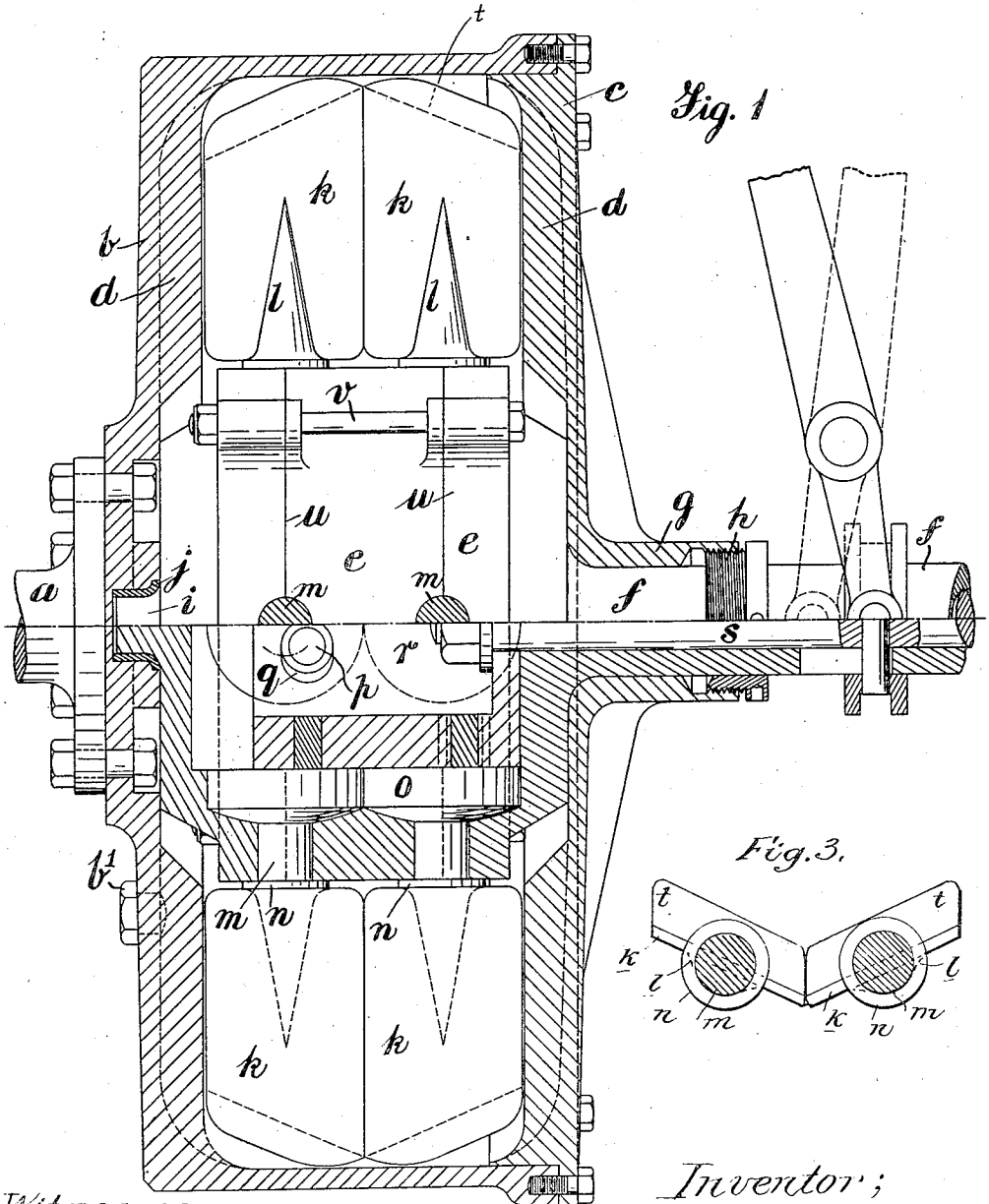



Fig. 3.




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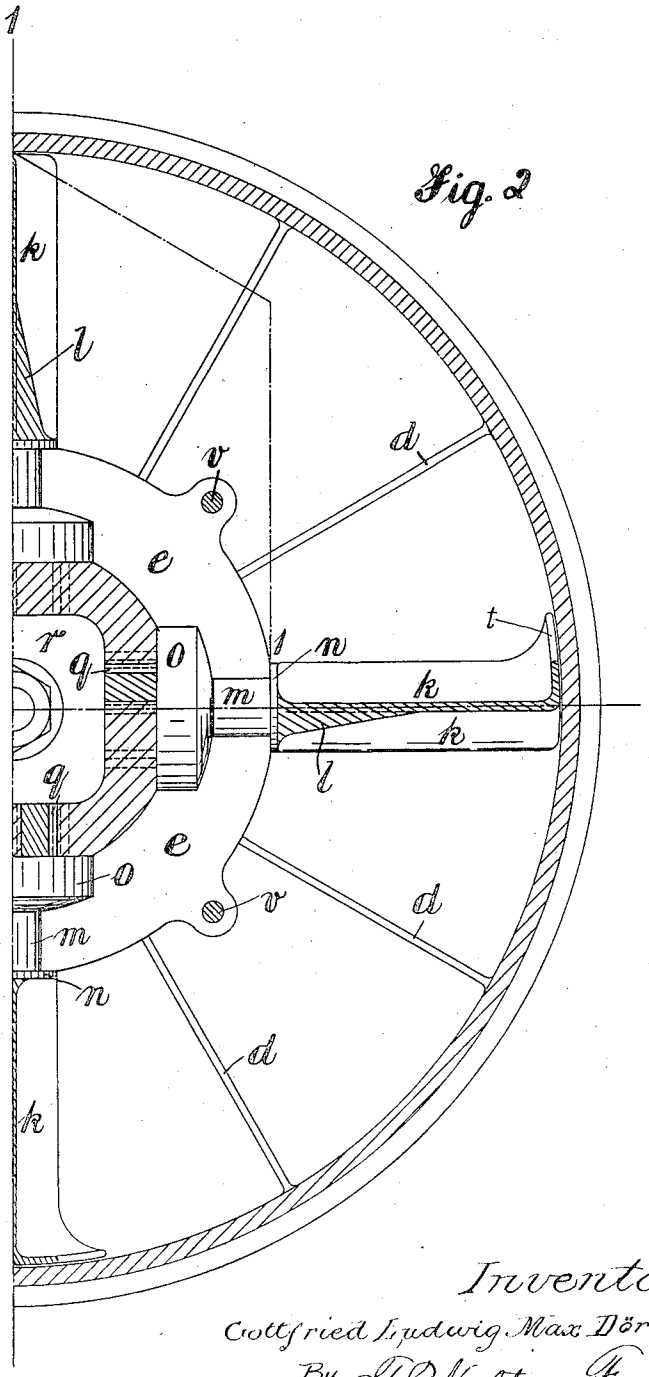
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HYDRAULIC POWER TRANSMISSION APPARATUS.

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2 SHEETS—SHEET 2.

Fig. 2




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# UNITED STATES PATENT OFFICE.

GOTTFRIED LUDWIG MAX DÖRWALD, OF EAST PUTNEY, LONDON, ENGLAND, ASSIGNOR OF ONE-HALF TO JOSECELINE CHARLES HENRY GRANT, OF LONDON, ENGLAND.

## HYDRAULIC POWER-TRANSMISSION APPARATUS.

No. 843,874. Specification of Letters Patent. Patented Feb. 12, 1907.

Application filed July 2, 1906. Serial No. 324,459.

*To all whom it may concern:*

Be it known that I, GOTTFRIED LUDWIG MAX DÖRWALD, engineer, a subject of the German Emperor, and residing at 28 Mexfield road, East Putney, London, S. W., England, have invented a certain new and useful Improvement in Hydraulic Power-Transmission Apparatus, of which the following is a full, clear, and exact description.

This invention relates to hydraulic power-transmission apparatus by which any portion of the driving power or any speed from zero to the maximum available can be transmitted to any load or resistance.

The present invention relates to that class of apparatus in which power is transmitted from one shaft to another by the action of a liquid contained in a revoluble drum, the said drum being mounted on one shaft, and a casing or hub fitted with adjustable radial blades is fitted within the drum and upon the second shaft.

The invention consists in so arranging the blades that they can be set in planes cutting the plane of the axis of the drum at right angles or in a plane passing through the axis or in planes cutting the axis at opposite or similar angles to one another. The invention also has reference to the construction of the apparatus and to combinations of parts as hereinafter set forth.

Although in this specification it will be assumed that the invention is applied to a motor-car, to which purpose it is particularly adapted, nevertheless I do not confine it to that one use.

In carrying the invention into effect for the purpose mentioned I proceed in or in about the following manner, making reference now to the accompanying drawings, wherein—

Figure 1 is a sectional elevation, the lower part being a vertical section and the upper part a section on line 1 1 of Fig. 2. Fig. 2 is a part side elevation in section on the center line of one set of the blades. Fig. 3 is an end view of a pair of blades on section-line 1 1 of Fig. 2, but looking in the opposite direction to that of Fig. 1.

In the subsequent description I am referring to a drum as the driver and a casing or hub as the follower; but it is obvious that the hub or casing may be the driver and the drum the follower.

I attach to the driving-shaft *a* a drum *b*, having a cover *c* at one end or otherwise made so that access may be had to the interior. On the inside of each end of the drum *b* are radial ribs *d*, the inner edge of each of which is preferably at right angles to the axis of the shaft *a* and drum *b*. Inside the drum *b* is a casing or hub *e*, having six or any other suitable number of sides, the said casing being attached to or formed integrally with the tubular transmission-shaft *f*, free to turn in a tubular extension *g* of the cover *c*. A stuffing-box *h* is provided at the outer end of the said extension *g*.

If desired, the inner end of hub *e* may have a projecting lug *i* free to run in a bearing *j* in the adjacent inner end of *b*.

Attached to each side of the casing or hub *e* are radial blades *k*, arranged in pairs and carried by arms *l*, having circular stems *m*, which pass through, so as to turn easily in holes provided for them in the thickness of the material of the casing or hub *e*. The stems *m* are provided with a shoulder *n* outside the casing and with an enlarged base *o* inside the casing, which serve to maintain the twin blades *k* in position. I provide any suitable means to enable the stems *m* to be rotated from the outside of the drum.

In the drawings I have shown a spindle outside the drum and conveniently connected to the enlarged bases *o*.

Projecting from each enlarged base *o* is an eccentrically-placed pin *p*, and these pins are free to turn in elongated and bushed holes *q* in a slide *r*, which can be moved to and fro within the hub *e* by moving in or out the spindle *s*, passing through the tubular transmission-shaft *f* and actuated by a lever or other means. The extent to which *r* can move within the casing *e* is such that when drawn fully in one direction the action of the holes *q* on the pins *p* will turn the blades *k* so that they will stand across the space between the ribs *d* at one end of the drum *b* and those at the other end, and when pushed as far as possible in the opposite direction the blades *k* will be "edge on" in the direction of rotation of the drum *b*. The blades *k* when in position across the drum *b* may be so arranged as

to be in a plane at an angle to the axis of *b* or in a plane passing through or obliquely to the axis, and in any case the outer half or more or less of the top of each blade may "oversail," as at *t*.

In the drawings the blades are shown as arranged obliquely to the plane of the axis at opposite angles to one another and forming an obtuse angle between themselves, and it will be noticed that by turning the stems of the blades the width of the opening between each pair of blades may be varied.

For convenience in putting in the stems *m* of the blades the casing *e* may be divided on the centers of the stems, as at *u*, and be held together by cross-bolts *v*.

In use any suitable liquid is put into the drum *b*, and in the example illustrated a plug *b'* is shown for this purpose. When the drum is rotated centrifugal force will cause the liquid to take a cylindrical shape, and while the blades *k* are edge on no energy or practically no energy will be conveyed to them, but when they are turned so as to stand to a greater or lesser extent across the axis of *b* the liquid being forced through the opening between their inner edges will have its kinetic energy absorbed and an impulse will be given to the blades *k* and the driven shaft *f*.

By operating the spindle *s* the opening between the inner edges of the blades *k* can be varied. The greater the opening the less will be the absorption of the kinetic energy of the rotating liquid, and vice versa.

The impulse on the blades *k*, and consequently the speed of the shaft *f*, will thus vary directly as to the impulse from zero when the blades are placed so as to be edge on to the maximum when there is no opening between the inner edges of the blades.

The blades *k* may be of any suitable shape and made of rigid or of yielding material, and there may be several sets of blades in one drum or in a series of drums.

Having thus described my invention, what I claim as such, and desire to secure by Letters Patent, is—

1. In a power-transmission apparatus, the combination of a driving-shaft, a driven shaft, a drum revoluble with one of said shafts, a hub revoluble with the other shaft and within said drum, radial blades mounted upon said hub and arranged in pairs with one blade cooperating with the other one of a pair, and radial ribs upon the interior of the drum, said blades having stems and being rotatably adjustable upon the stems so that they may be turned to vary the resistance offered to liquid within the drum.

2. In a power-transmission apparatus, a drum revoluble with a shaft, a hub revoluble with a second shaft and within said drum, said hub being fitted with a number of twin blades, said blades being arranged in pairs with one blade of a pair coöperating with the other blade of same pair, and said blades, being adjustable to vary the width of opening between each pair.

3. In a power-transmission apparatus, a drum revoluble with a driving-shaft, a hub revoluble with a second shaft, said hub being provided with radial twin blades and said hub and blades being inclosed within said drum, radial ribs upon the interior of said drum and means for turning said blades about their axes so that the width of opening between each pair of blades may be varied from zero to the maximum available.

4. In a power-transmission apparatus, a liquid-containing driver-drum, a follower-hub, radial blades mounted in pairs upon said hub, said blades being rotatable on their radial axes, and means for adjusting the position of said blades so that each pair may be set more or less obliquely to the axis of the drum and the impelling effect of the liquid on the said blades varied accordingly.

5. In a power-transmission device of the character described, the combination of a liquid-containing driver-drum, a hub therefor, twin blades axially mounted on the hub, and means operated from without the drum to rotate the blades on their own axes to vary the width of the opening between the blades of each pair.

6. In a power-transmission device of the character described, the combination of a liquid-containing driver-drum, a hub therefor, a plurality of twin blades mounted radially on said hub and partly revoluble about their own axes said blades being arranged in pairs with one blade of a pair coöperating with the other blade of the same pair, crank-pins on the axis of the blades, and connections from said crank-pins to outside of the drum whereby the blades may be axially turned and adjusted as to position.

7. In a power-transmission device of the character described, the combination of a driving-shaft, a driven shaft, a liquid-containing driver-drum, a plurality of blades arranged obliquely to the axis of said driving-shaft, said blades being arranged in pairs with one blade of a pair coöperating with the other blade of the same pair, and means connecting the blades with the driven shaft whereby their obliquity to the axis of the drum can be varied.

8. In a power-transmission device of the character described, the combination of a liquid-containing driver-drum, a follower-hub, a plurality of blades arranged obliquely to the axis of the driver and pivotally connected with the follower, said blades being arranged in pairs and provided with means controlled from outside the drum whereby the obliquity of the blades may be varied and the angle between each pair of blades may be simultaneously varied.

9. In a power-transmission device of the character described, the combination with a liquid-containing driver-drum and a shaft therefor, and a follower, of a plurality of blades arranged obliquely to said shaft and pivotally connected with the follower, said blades being arranged in pairs and provided with means operated from the outside of the drum whereby the obliquity of all the blades may be synchronously altered.

10. In a power-transmission device of the character described, the combination of a rotatable driver, a follower, a plurality of blades arranged obliquely to the axis of the driver and radially mounted on the follower so as to be rotatable at right angles thereto, said blades being arranged in pairs and provided with crank-arms, an operating-slide, said slide having elongated holes engaging said crank-arms, and a controlling device actuated from the outside of the apparatus to control the position and obliquity of said blades.

11. In a power-transmission device of the character described, the combination with a driver and a follower, of a plurality of blades arranged in pairs radially of the follower, said blades having stems seated in the casing of the follower and said stems having enlarged bases within said casing, eccentrically-placed pins upon said stem-bases, a slide having slots engaging said pins, and a reciprocable spindle connected to said slide whereby the blades may be turned to vary the opening between the inner edges of each pair.

12. In a power-transmission device of the character described, the combination with a driver, an operating-spindle, a tubular transmission-shaft, an actuating-lever, and a follower-hub, of a plurality of blades having stems mounted radially upon the follower, said stems being retained in said hub, eccentrically-placed pins upon said stems, bushes to said pins, and a slide having an elongated hole engaging said pins, said slide being fast to the operating-spindle, and said spindle passing through the tubular transmission-shaft and connected to the actuating-lever.

In testimony whereof I affix my signature in presence of two witnesses.

GOTTFRIED LUDWIG MAX DÖRWALD.

Witnesses:

VICTOR F. FEENY,

GEO. W. WHITTON.