June 4, 1929. A. HUGUENIN 1,716,134

MOVABLE WHEEL FOR REVERSIBLE ROTARY MACHINES AND PARTICULARLY FOR HYDRAULIC TURBINES

Filed March 21, 1927 2 Sheets-Sheet 1

Fig. 1

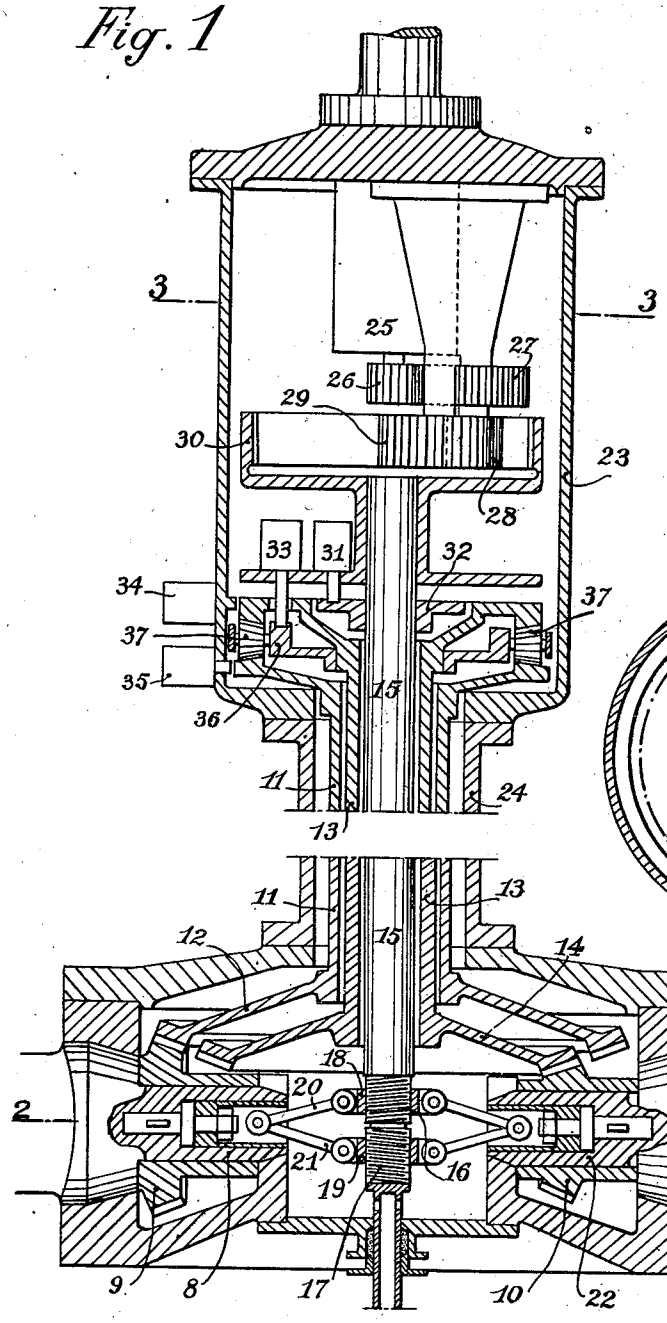
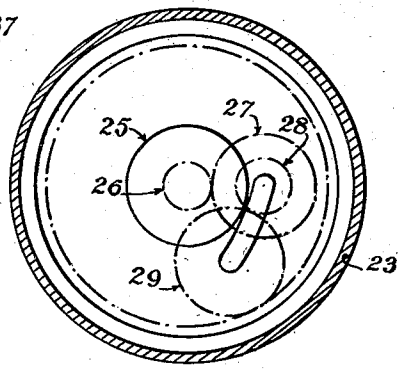


Fig. 3



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Fig. 2

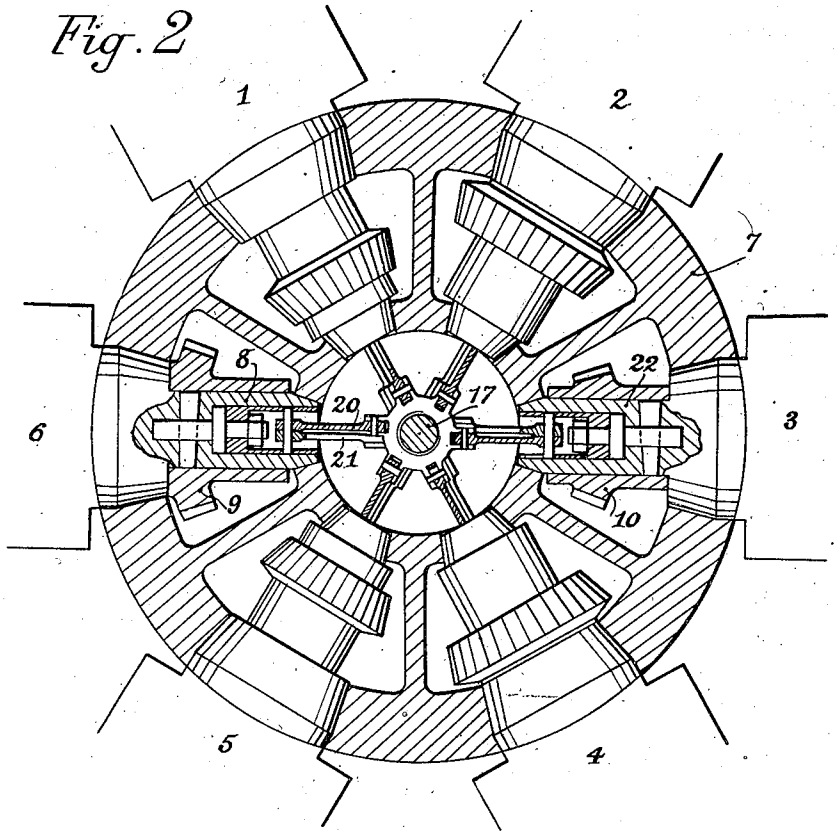
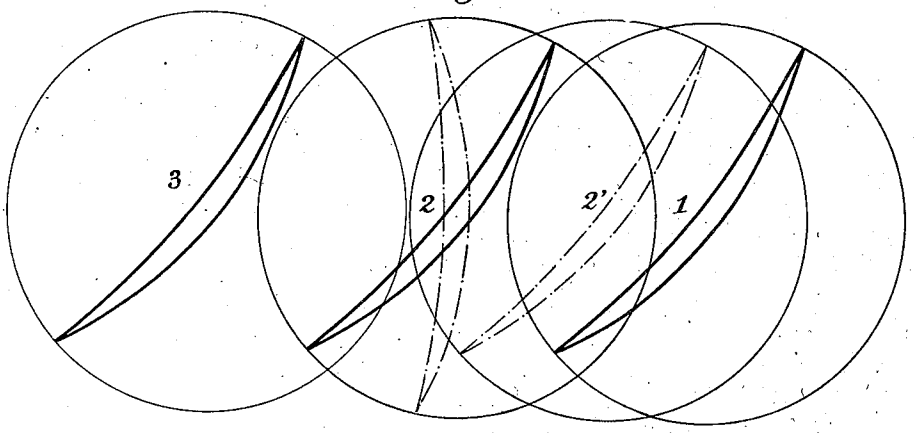


Fig. 4



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UNITED STATES PATENT OFFICE.

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MOVABLE WHEEL FOR REVERSIBLE ROTARY MACHINES AND PARTICULARLY FOR HYDRAULIC TURBINES.

Application filed March 21, 1927, Serial No. 177,168, and in France March 25, 1926.

There are, as known, movable wheels for reversible rotary machines in which all the vanes are pivotally mounted and are secured at their hub in such manner that the fastening can be, when needed, loosened and subsequently reestablished for any angular position of the vanes relatively to the wheel shaft. In an arrangement of this kind, all the vanes of the wheel are driven or controlled simultaneously, this control being moreover effected in a room which is situated outside the turbine properly called.

It results therefrom that it is necessary to choose an evolvent of the vanes in a circumferential direction which is smaller for a same diameter than the pitch between two consecutive vanes, so that the said motion can be effectively possible.

The fact of controlling the pivoting of the vanes from an operating chamber or room situated outside the turbine is moreover not suitable for all applications.

The present invention has for its object a device in which the pivotal movement of the vanes is not produced simultaneously for all the vanes but for only one half of the latter, either for example by the even or odd vanes. In first turning for example the even vanes until they are in their middle position, in then causing the odd vanes to entirely pivot and in achieving then as a third operation the pivoting of the even vanes, it will be possible to obtain the complete reversibility of the wheel while having the possibility of sensibly decreasing the pitch of the vanes for the same evolvent of these latter in the circumferential direction.

The control of this pivoting motion of vanes by a mechanism which is located in the shaft itself transmitting the torque of the turbine allows to place this mechanism in a more suitable place, for instance, in the case of vertical turbine, above the turbine, while the controlling or driving chamber located outside the latter will be situated below the turbine.

The accompanying drawing shows by way of example a mode of carrying out the object of the invention.

Fig. 1 is a vertical section made by the axis of the turbine.

Fig. 2 is a section made according to line 2—2 of Fig. 1, and,

Fig. 3 is a section made according to line 3—3 of the same figure.

Fig. 4 shows a development of the positions of vanes.

The turbine shown is a turbine with six vanes numbered from 1 to 6.

These vanes are terminated by truncated parts engaged in a hub 7.

The even vanes, 6 for example, carry on their truncated part 8 a bevel gear 9 next to the periphery of the hub 7 and the odd vanes 3 for example, carry, on their truncated part 22, a bevel gear or wheel near the middle of this hub.

A hollow shaft 11 carries a ring 12 meshing with the gears or pinions 9 while a concentric shaft 13 carries a ring 14 meshing with the gears or pinions 10.

A central shaft 15 is provided with two reverse threads 16 and 17 respectively meshing with nuts 18 and 19 which are connected by links 20 and 21 with the truncated parts 8 and 22.

The result is that if this shaft turns in a certain direction, the vanes are freed while a revolution in the reverse direction of the said shaft, on the contrary fastens these vanes in the hub.

In Fig. 4 which shows a development of a section of the vanes over a cylindrical surface tangential to the movable wheel, it will be seen that when the vane 2 is brought to the position indicated in dotted lines, the vanes 3 and 1 can make a full revolution, while if all the vanes were revolving simultaneously, the pitch ought to be increased and the vane 2 should be removed from the vane 3 for example as shown in 2′, in such manner that the ends thereof would describe a circle tangent or external to the one described by the ends of the vane 3.

The shaft 15 projects at the upper part as far as the middle of a flaring part 23 of the motor shaft 24, the shaft 13 ending a little lower and the shaft 11 still lower.

A motor 25 drives through gear wheels 26, 27, 28, 29 a ring 30 with internal teeth which loosely revolves about the shaft 15.

The ring 30 can be coupled by means of an electro-magnet 31, with a disc or plate 32 connected with the shaft 15.

Through electro-magnets 33, 34 and 35, and the disc 36 the two hollow shafts 11 or 13 can

be set in motion either in one direction or in the other.

The connection between the disc 36 and the shafts 11 and 13 is effected through planetary wheels 37.

The whole of this mechanism can be easily constructed so that the center of gravity of the whole of the parts will be strictly situated on the axis of the shaft 24, this being required by the strict balancing of the revolving part.

The driving or controlling electric current is led to the motor 25 and to the electro-magnets 31, 33, 34 and 35 by means of rings secured to the external periphery of the flaring part 23.

Having thus described my apparatus, what I claim as new therein, and my own invention, is:—

1. In a runner with pivoting vanes for reversible turbines, the combination of two groups of pivoting vanes the pitch of which is smaller than their width, the vanes of the one group being adapted to alternate with the vanes of the other group, means for causing the vanes of the one group to pivot axially and means for causing the vanes of the other group to also pivot axially independently from the vanes of the first group.

2. In a runner with pivoting vanes for reversible turbines, the combination of two groups of pivoting vanes the pitch of which is smaller than their width, the vanes of the one group being adapted to alternate with the vanes of the other group, means for causing the vanes of the one group to pivot axially and means for causing the vanes of the other group to also pivot axially independently from the vanes of the first group, a truncated seat at the base of each vane, the hub of the said wheel being provided with a conical bore, means to fasten said truncated seat in the said conical bore after the pivoting of the vanes, means to loosen the said truncated seat before the pivoting of the said vanes, said means comprising a central shaft placed on the axis of the said runner and provided with two reverse threads at the end located in the hub of the runner, nuts adapted to mesh with each of said threads and links pivoted at one end upon the nuts and at the other end upon the conical seat of said vanes and means for rotating the said shaft.

3. In a runner with pivoting vanes for reversible turbines, the combination of two groups of pivoting vanes the pitch of which is smaller than their width, the vanes of the one group being adapted to alternate with the vanes of the other group, means for causing the vanes of the one group to pivot axially and means for causing the vanes of the other group to also pivot axially independently from the vanes of the first group, a truncated seat at the base of each vane, the hub of the said wheel being provided with a conical bore, said truncated seat being adapted to fit into the said conical bore and to rotate in said bore, bevel gears on the truncated seat of the vanes of the first group, bevel gears on the truncated seat of the vanes of the second group, a first gear wheel adapted to mesh with the bevel gears of the first group, a second gear wheel adapted to mesh with the bevel gears of the second group, a first hollow shaft upon which is mounted the first gear wheel, a second hollow shaft concentric to the first and upon which is mounted the second gear wheel and means for rotating said hollow shafts.

In testimony whereof I have hereunto affixed my signature.

ALBERT HUGUENIN.