The green energy calculation of thirty-six square meters vane in different shape

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Article

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Abstract

We design a new tidal power station as Fig. 1, including one impeller with the vane length 6 meters and the vane width 6 meters,and the impeller shaft above the sea water surface 1 meter. When the sea water flow speed is 2(m/s),and the impeller speed is 1.3 (rpm),we can get the green energy of this power station 225.1(KW).When the sea water flow speed is 3(m/s),and the impeller speed is 2(rpm),we can get the green energy 766(KW).When the sea water flow speed is 4(m/s),and the impeller speed is 3 (rpm),we can get the green energy 1818(KW).We build a table as the following Table 1.

We design a new tidal power station as Fig. 1, including one impeller with the vane length 12 meters and the vane width 3 meters,and the impeller shaft above the sea water surface 1 meter.When the sea water flow speed is 2(m/s),and the impeller speed is 1.3 (rpm),we can get the green energy 32.9(KW).When the sea water flow speed is 3(m/s),and the impeller speed is 2(rpm),we can get the green energy 339(KW).When the sea water flow speed is 4(m/s),and we presume the impeller speed is 3 (rpm),we can get the green energy 853(KW).We are happy to see the value is considerable,and we can build a table as the following Table 2.

1. Introduction

Now, global warming is very serious. Some species die out; many insects disappear forever; corals bleach in many places. The temperature is still rising on the earth, waking up many viruses, such as corona virus and bird flu, etc. All these phenomena show that the disaster is getting closer and closer to mankind. Human beings should wake up, think it over, and take measures to prevent global warming immediately.

Although some wind power stations are used,the tidal power station is still in a short situation.If there is no wind,it will be disaster.Therefore,we must use our brains to do better,and try to build more tidal power stations.Tides are produced by the moon, which has a fixed timetable. If we can use the tide to generate electricity, we can know exactly when we can generate electricity.Sea water tide is much better than wind, it has a much more accurate timetable. When we build enough tidal power stations, we dare to cut down many coal power stations. Tide is one of the best resources to save our environment to save our future.We want to build more tidal power stations ,now we hope to calculate the tidal power stations energy.

According to Newton second law theory $\Sigma F = ma$, we can get the momentum theorem

$\Sigma F dt = m dV$ (1)

As Fig. 2,when we lift the shaft of the impeller above the sea water surface 1 meter, and design the length of the vanes 6 meters and the width of the vanes 6 meters, with the bottom vane just fully immersed in the water. Therefore, the area of the vane is $A = 36(m^2)$.As we can see,when the tidal flow comes, it pushes the vane working and turns the shaft round.The shaft turns the gear working, increasing the speed.Then the gear drives the electrical generator,outputing the electrical power.

At first, the vane is not moving ,and the vane speed is $V_0 = 0$ (m/s).When the tide comes, we presume the tidal flow speed $V_1 = 1$(m/s),$dV = V_1-V_0 = 1$.If the sea water flow direction is vertical to the bottom vane surface,and the mass of the sea water impacting on the immovable vane in one second is m, then we can calculateΣF ,in one second, dt = 1,

$\Sigma F = m\times dV/dt = m\times 1/1 = m = \rho \times A\times V_1\times t$ (2)

As we know, the sea water mass is m = ρv,and the density isρ = 1025(kg/m^3). Therefore ,in one second, when the water flow direction is vertical to the immovable vane, there is thirty-six cubic meters sea water impacting on the vane if the water flow speed is 1 (m/s).It means the volume v = 36(m^3).Then we can get the result, in one second,dt = 1,thirty-six square meters immovable vane in the sea water with 1(m/s) flow speed can get force ΣF, (1N = 1kg·m/s²)

$\Sigma F = mdV/dt = m = \rho v = 1025\times 36 = 36900$(N) (3)

2. Water Flow Speed 2(M/s) Calculation

As we see Fig. 2,first we calculate the vertical vane. We lift the shaft of the impeller above the sea water surface 1 meter,and keep length of the vanes 6 meters and width of the vanes 6 meters, with the bottom vane just fully immersed in the water. When the sea water flow speed is still $V_1 = 2$(m/s),it turns the shaft running. If we presume its rotation speed n = 1.3(rpm),when the distance between any point on the vane and the shaft is r,at this point, the linear velocity $V_{2,}$

$V_2 = \omega r = 2\pi nr/60$ (4)

$dV = V_1-V_2 = 2–2\pi nr/60$ (5)

When the sea water flow turns the shaft, the mass of sea water impacting on the vane is less than the mass when the shaft is immovable.We can approximately calculate how much mass impacting on the vane,$m = \rho v = \rho \times A\times V_1\times t$,

$m_1 = m\times(dV/V_1) = m\times(2–2\pi nr/60)/2 = 36900\times(2–2\pi nr/60)$ (6)

Therefore, we can get the force ΣF_1 in one second, dt = 1(s),

$\Sigma F_1 = m_1dV/dt = 36900\times(2–2\pi nr/60)^2$ (7)

The value of torque M_1 at this point is

$M_1 = \Sigma F_1\times r = 36900\times(2–2\pi nr/60)^2\times r$ (8)

According to the power formula $P = 2\pi nM/60$,we can get P

$P = 36900×(2−2πnr/60)^2×r×(2πn/60)$ (9)

As we see Fig.2,if r is a different value, we can get a different linear velocity.If the vane length is 6 meters, and the vane width is 6 meters,then we can approximately calculate the power of the station with the impeller shaft above the sea water surface 1 meter $\sum P_1$

$$\sum P_1 = \int_1^7 P\,dr = \int_1^7 36900×(2- 2πnr/60)^2×(2πnr/60)dr \quad (10)$$

Therefore,we presume the speed of impeller n=1.3(rpm),2πnr/60=0.136r,we can get $\sum P_1$

$$\sum P_1 = \int_1^7 36900×(0.0025r^3-0.07398r^2+0.544r)dr \quad (11)$$

$$\sum P_1 = 36900×(6.35-0.248)≈225163(W)≈225.1(KW) \quad (12)$$

3. Water Flow Speed 3(M/s) Calculation

When the flow speed is $V_1 = 3$ (m/s),if the vane is immovable, in one second, there is one hundred and eight cubic meters sea water impacting on the vane, $v = A×V_1×t = 36×3×1 = 108(m^3)$ .The sea water mass formula is m = ρv, and the density isρ = $1025(kg/m^3)$.Then we can get the result, in one second (dt = 1), thirty-six square meters immovable vane can get force ΣF ,dV = 3,

ΣF = mdV/dt = 332100(N) (13)

If we presume its rotation speed n = 2(rpm),when the distance between any point on the vane and the shaft is r,at this point, the linear velocity $V_{2,}$

$V_2 = ωr = 2πnr/60$ (14)

$dV = V_1-V_2 = 3 – 2πnr/60$ (15)

When the sea water flow turns the shaft, the mass of sea water impacting on the vane is less than the mass when the shaft is immovable.We can approximately calculate how much mass impacting on the vane,

$m_2 = ρv×(dV/V_1) = 36900×(3 – 2πnr/60)$ (16)

Therefore, we can get the force $ΣF_2$ in one second, dt = 1(s),

$ΣF_2 = m_2dV/dt = 36900×(3 – 2πnr/60)^2$ (17)

The value of torque M_2 at this point is

$M_2 = \Sigma F_2 \times r = 36900\times(3 - 2\pi nr/60)^2\times r$ (18)

According to the power formula $P = 2\pi nM/60$,we can get P

$P = 36900\times(3 - 2\pi nr/60)^2\times r\times(2\pi n/60)$ (19)

As we see Fig.2,if r is a different value, we can get a different linear velocity.If the vane length is 6 meters, and the width is 6 meters,then we can approximately calculate the power of the station with impeller shaft above the sea water surface 1 meter $\sum P_2$,

$$\sum P_2 = \int_1^7 P dr = \int_1^7 36900\times(3- 2\pi nr/60)^2\times(2\pi nr/60)dr \qquad (20)$$

Therefore,when n=2(rpm),2πnr/60=0.209r,we can get $\sum P_2$

$$\sum P_2 = \int_1^7 36900\times(0.009r^3-0.262r^2+1.881r)dr \qquad (21)$$

$$\sum P_2 = 36900(21.616-0.8554)\approx 766084(W)\approx 766(KW) \qquad (22)$$

4. Water Flow Speed 4(M/s) Calculation

When the flow speed is $V_1 = 4$ (m/s),if the vane is immovable, in one second, there is one hundred and forty-four cubic meters sea water impacting on the vane, $v = A\times V_1\times t = 36\times4\times1 = 144(m^3)$ .The sea water mass formula is $m = \rho v$, and the density is$\rho = 1025(kg/m^3)$.Then we can get the result, in one second (dt = 1), thirty-six square meters immovable vane can get force ΣF ,dV = 4,

$\Sigma F = mdV/dt = 590400(N)$ (23)

If we presume its rotation speed n = 3(rpm),when the distance between any point on the vane and the shaft is r,at this point, the linear velocity $V_{2,}$

$V_2 = \omega r = 2\pi nr/60$ (24)

$dV = V_1-V_2 = 4 - 2\pi nr/60$ (25)

When the sea water flow turns the shaft, the mass of sea water impacting on the vane is less than the mass when the shaft is immovable.We can approximately calculate how much mass impacting on the vane,

$m_3 = \rho v\times(dV/V_1) = 36900\times(4 - 2\pi nr/60)$ (26)

Therefore, we can get the force ΣF_3 in one second, dt = 1(s),

$\Sigma F_3 = m_3 dV/dt = 36900\times(4 - 2\pi nr/60)^2$ (27)

The value of torque M_3 at this point is

$M_3 = \Sigma F_3 \times r = 36900\times(4 - 2\pi nr/60)^2\times r$ (28)

According to the power formula $P = 2\pi nM/60$,we can get P

$P = 36900\times(4 - 2\pi nr/60)^2\times r\times(2\pi n/60)$ (29)

As we see Fig.2,if r is a different value, we can get a different linear velocity.If the vane length is 6 meters, and the width is 6 meters,then we can approximately calculate the power of the station with impeller shaft above the sea water surface 1 meter $\sum P_3$,

$$\sum P_3 = \int_1^7 P dr = \int_1^7 36900\times(4- 2\pi nr/60)^2\times(2\pi nr/60)dr \qquad (30)$$

Therefore,when n=3(rpm),2πnr/60=0.314r,we can get $\sum P_2$

$$\sum P_3 = \int_1^7 36900\times(0.031r^3-0.788r^2+5.024r)dr \qquad (31)$$

$$\sum P_3 = 36900\times(51.531-2.257)\approx1818210(W)\approx1818(KW) \qquad (32)$$

5. Water Flow Speed 2(M/s) Calculation

As we see Fig. 2,first we calculate the vertical vane. We lift the shaft of the impeller above the sea water surface 1 meter,and keep the length of the vanes 12 meters and the width of the vanes 3 meters, with the bottom vane just fully immersed in the water. When the sea water flow speed is V_1 = 2(m/s),it begins to work on the shaft .

When the flow speed is V_1 = 2(m/s),and A = 36(m^2), according to formula(2),we can calculate the mass impacting on the vane in one second,

$m = \rho \times A\times V_1\times t = 73800$ (33)

If we presume its rotating speed n = 1.3(rpm),when the distance between any point on the vane and the shaft is r,at this point, the linear velocity $V_{2,}$

$V_2 = \omega r = 2\pi nr/60$ (34)

$dV = V_1 - V_2 = 2 - 2\pi nr/60$ (35)

When the sea water flow turns the shaft, the mass of sea water impacting on the vane is less than the mass when the shaft is immovable.We can approximately calculate how much mass impacting on the vane,$m = \rho v = \rho \times A \times V_1 \times t$,

$m_4 = m\times(dV/V_1) = m\times(2-2\pi nr/60)/2 = 36900\times(2-2\pi nr/60)$ (36)

Therefore, we can get the force ΣF_4 in one second, $dt = 1(s)$,

$\Sigma F_4 = m_4 dV/dt = 36900\times(2-2\pi nr/60)^2$ (37)

The value of torque M_4at this point is

$M_4 = \Sigma F_4\times r = 36900\times(2-2\pi nr/60)^2\times r$ (38)

According to the power formula $P = 2\pi nM/60$,we can get P

$P = 36900\times(2-2\pi nr/60)^2\times r\times(2\pi n/60)$ (39)

As we see Fig.2,if r is a different value, we can get a different linear velocity.If the vane length is 12 meters, and the vane width is 3 meters,then we can approximately calculate the power of the station when the impeller shaft is above the sea water surface 1 meter $\sum P_4$

$$\sum P_4=\int_1^4 Pdr=\int_1^4 36900\times(2- 2\pi nr/60)^2\times(2\pi nr/60)dr \qquad (40)$$

Therefore,we presume the speed of impeller n=1.3(rpm),2πnr/60=0.136r,we can get $\sum P_4$

$$\sum P_4=\int_1^4 36900\times(0.0025r^3-0.07398r^2+0.544r)dr \qquad (41)$$

$$\sum P_4=36900\times(2.929-0.248)\approx 98928(W)\approx 98.9(KW) \qquad (42)$$

6. Water Flow Speed 3(M/s) Calculation

When the flow speed is $V_1 = 3(m/s)$,and $A = 36(m^2)$, according to formula(2),we can calculate the mass impacting on the vane in one second,

$m = \rho \times A\times V_1\times t = 110700$ (43)

If we presume its rotating speed n = 2(rpm),when the distance between any point on the vane and the shaft is r,at this point, the linear velocity V_2,

$V_2 = \omega r = 2\pi nr/60$ (44)

$dV = V_1 - V_2 = 3 - 2\pi nr/60$ (45)

When the sea water flow turns the shaft, the mass of sea water impacting on the vane is less than the mass when the shaft is immovable.We can approximately calculate how much mass impacting on the vane,

$m_5 = \rho v \times (dV/V_1) = 36900 \times (3 - 2\pi nr/60)$ (46)

Therefore, we can get the force ΣF_5 in one second, dt = 1(s),

$\Sigma F_5 = m_5 dV/dt = 36900 \times (3 - 2\pi nr/60)^2$ (47)

The value of torque M_5 at this point is

$M_5 = \Sigma F_5 \times r = 36900 \times (3 - 2\pi nr/60)^2 \times r$ (48)

According to the power formula $P = 2\pi nM/60$,we can get P

$P = 36900 \times (3 - 2\pi nr/60)^2 \times r \times (2\pi n/60)$ (49)

As we see Fig.2,if r is a different value, we can get a different linear velocity.If the vane length is 12 meters, and the width is 3 meters,then we can approximately calculate the power of the station when the impeller shaft is above the sea water surface 1 meter $\sum P_5$

$$\sum P_5 = \int_1^4 P dr = \int_1^4 36900 \times (3 - 2\pi nr/60)^2 \times (2\pi nr/60) dr \qquad (50)$$

Therefore,when n=2(rpm),$2\pi nr/60=0.209r$,we can get $\sum P_5$

$$\sum P_5 = \int_1^4 36900 \times (0.009r^3 - 0.262r^2 + 1.881r) dr \qquad (51)$$

$$\sum P_5 = 36900 \times (10.0434 - 0.85545) \approx 339035(W) \approx 339(KW) \qquad (52)$$

7. Water Flow Speed 4(M/s) Calculation

When the flow speed is $V_1 = 4$ (m/s),and $A = 36(m^2)$, according to formula(2),we can calculate the mass impacting on the vane in one second,

$m = \rho \times A \times V_1 \times t = 147600$ (53)

If we presume its rotating speed n = 3(rpm),when the distance between any point on the vane and the shaft is r,at this point, the linear velocity $V_{2,}$

$V_2 = \omega r = 2\pi nr/60$ (54)

$dV = V_1 - V_2 = 4 - 2\pi nr/60$ (55)

When the sea water flow turns the shaft, the mass of sea water impacting on the vane is less than the mass when the shaft is immovable.We can approximately calculate how much mass impacting on the vane,

$m_6 = \rho v\times(dV/V_1) = 36900\times(4 - 2\pi nr/60)$ (56)

Therefore, we can get the force ΣF_6 in one second, dt = 1(s),

$\Sigma F_6 = m_6 dV/dt = 36900\times(4 - 2\pi nr/60)^2$ (57)

The value of torque M_6 at this point is

$M_6 = \Sigma F_6 \times r = 36900\times(4 - 2\pi nr/60)^2\times r$ (58)

According to the power formula $P = 2\pi nM/60$,we can get P

$P = 36900\times(4 - 2\pi nr/60)^2\times r\times(2\pi n/60)$ (59)

As we see Fig.2,if r is a different value, we can get a different linear velocity.If the vane length is 12 meters, and the width is 3 meters,then we can approximately calculate the power of the station when the impeller shaft is above the sea water surface 1 meter $\sum P_6$

$$\sum P_6 = \int_1^4 P dr = \int_1^4 36900\times(4- 2\pi nr/60)^2\times(2\pi nr/60)dr \qquad (60)$$

Therefore,when n=3(rpm),$2\pi nr/60=0.314r$,we can get $\sum P_6$

$$\sum P_6 = \int_1^4 36900\times(0.031r^3-0.788r^2+5.024r)dr \qquad (61)$$

$$\sum P_6 = 36900\times(25.392-2.257)\approx 853681(W)\approx 853(KW) \qquad (62)$$

8. Conclusion

We design a new tidal power station as Fig. 1, including one impeller with the vane length 6 meters and the vane width 6 meters,and the impeller shaft above the sea water surface 1 meter. When the sea water flow speed is 2(m/s),and the impeller speed is 1.3 (rpm),we can get the green energy of this power station 225.1(KW).When the sea water flow speed is 3(m/s),and the impeller speed is 2(rpm),we can get the green energy 766(KW).When the sea water flow speed is 4(m/s),and the impeller speed is 3 (rpm),we can get the green energy 1818(KW).We build a table as following, Table.1. the vane width 6 meters

flow speed(m/s)	**2**	**3**	**4**
impeller speed(rpm)	1.3	2	3
Power(KW)	225.1	766	1818

We design a new tidal power station as Fig. 1, including one impeller with the vane length 12 meters and the vane width 3 meters,and the impeller shaft above the sea water surface 1 meter.When the sea water flow speed is 2(m/s),and the impeller speed is 1.3 (rpm),we can get the green energy 32.9(KW).When the sea water flow speed is 3(m/s),and the impeller speed is 2(rpm),we can get the green energy 339(KW).When the sea water flow speed is 4(m/s),and we presume the impeller speed is 3 (rpm),we can get the green energy 853(KW).We are happy to see the value is considerable,and we can build a table as the following:

Table.2. the vane width 3 meters

flow speed(m/s)	**2**	**3**	**4**
impeller speed(rpm)	1.3	2	3
Power(KW)	98.9	339	853

After comparison,we can see,the value when the vane width is 6 meters is much better than 3 meters. We can build tidal power stations at some good places where the sea is very deep to get more power ,such as some sea straits and semienclosed bays.They have great depth,and we can build bigger radius of the impeller to get more power.According to tidal flow, the more the tidal flow speed, the more the power.We can build tidal power stations at places where the tidal flow is much better.

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Figures

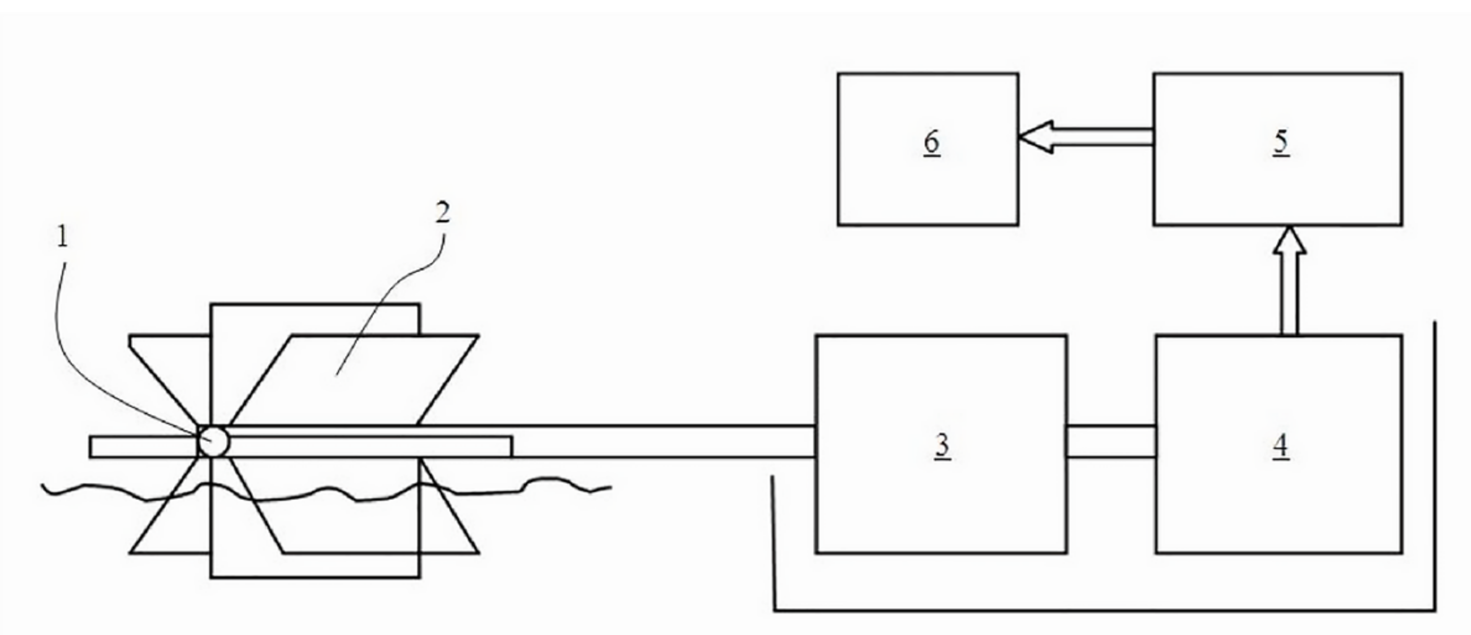

Figure 1

Tidal power station(1.shaft;2.vane;3.gear box;4.electrical generator;5.inverter;6.user)

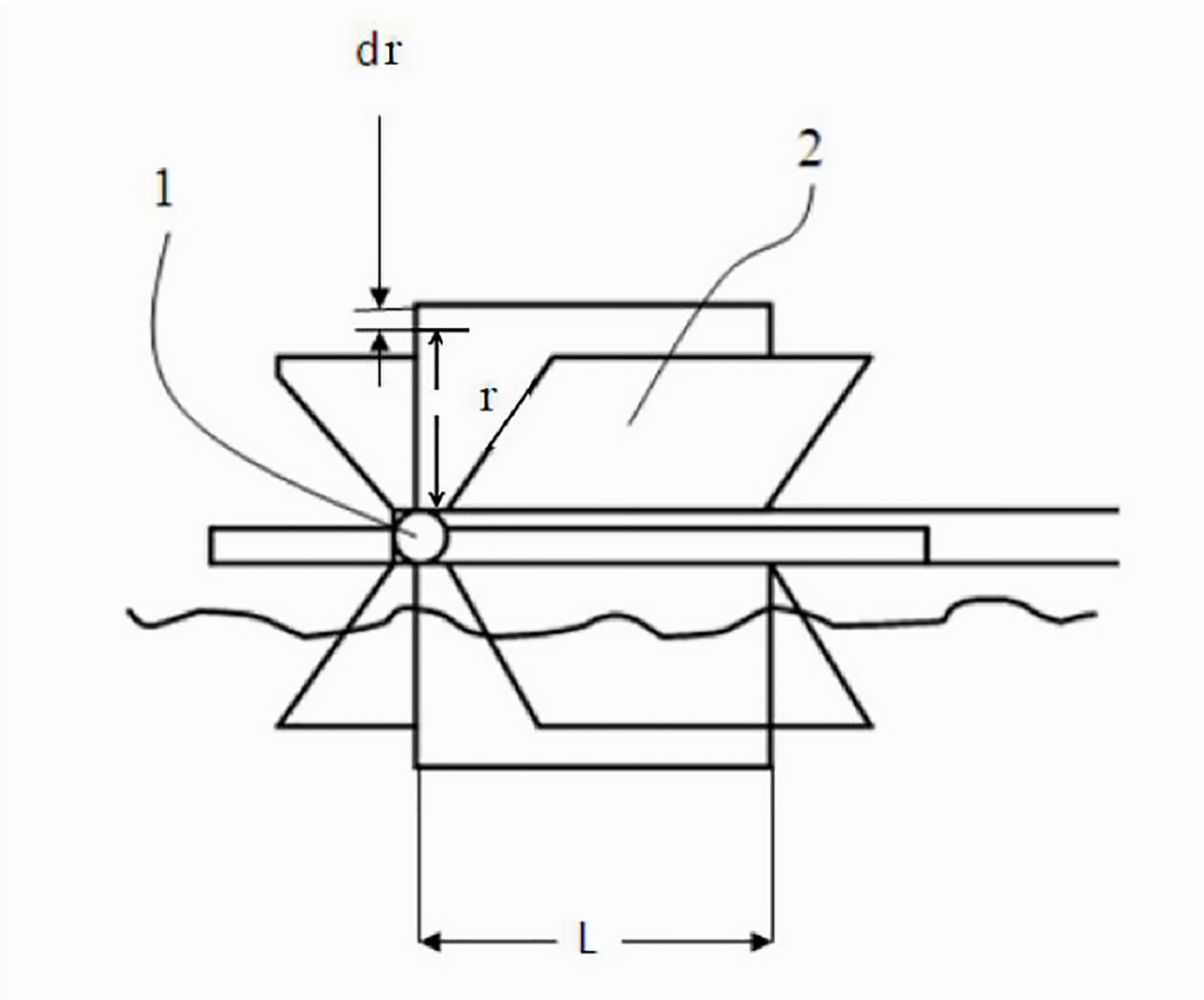

Figure 2

Tidal power station vane(1.shaft;2.vane)