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Electricity Generating Device

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(56) Related Art
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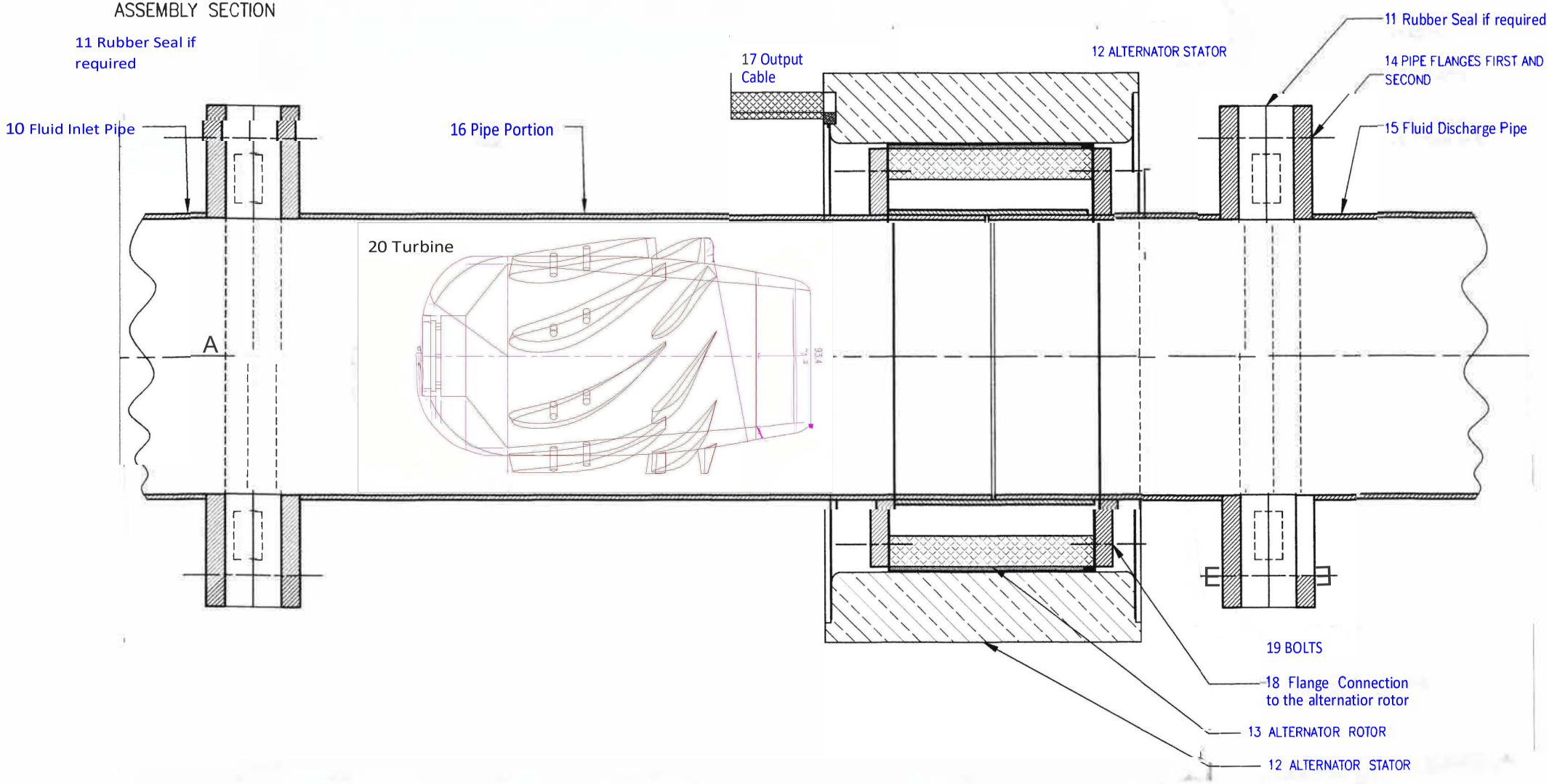
Abstract

The invention is an electricity-generating device designed to harness the power of fluid flow within a pipeline to produce electrical energy. This innovative device converts the kinetic energy of flowing water into electricity. Its in-pipe, submersible design ensures easy installation within existing downward pipelines. The integration of the turbine directly within the pipeline makes it a versatile choice for a wide range of pipe network applications.

FIGURE 1

WATER SIDE
ASSEMBLY SECTION



Electricity-Generating Device

Field of the invention

[001] This invention relates to microgenerators in the field of hydroelectric power, specifically designed to be submerged in water. It is an electricity-generating device meant to be integrated into an inline pipe network.

Background of the invention

[002] The problem we are attempting to address is the need for more efficient and cost-effective methods to produce power using the existing water pipe infrastructure. Traditional microgenerator technologies use an external through-pipe wall device to turn the generator, resulting in heavy and bulky designs that are not suitable for integration within the existing pipe infrastructure. Our invention aims to address this issue by utilising a compact and lightweight design with only two moving parts, making it more practical and efficient for generating power from fluid movement within water pipes. Significant energy is associated with water movement in a creek or river area. An aqueduct can be built to direct flow and harness this energy. This concept can also be applied to areas with tidal water, such as oceans or seas.

Summary of the Invention

[003] The present invention relates to an innovative electricity-generating device designed to harness the kinetic energy of fluid flow within a pipeline system. The device comprises several vital components that work in concert to convert the energy of flowing fluid into electrical power.

[004] At the heart of the invention is a unique rotor-stator assembly. The rotor, which is hollow, forms the core of the device and is connected to both a fluid inlet and a fluid outlet. As fluid enters the inlet, it passes through the rotor and exits via the outlet. Within the rotor, a rotating device is strategically positioned to interact with the fluid flow. This rotating device comprises multiple vanes fixed around a central hub attached to the rotor itself. As the fluid flows through the rotor, it engages with these vanes, causing the rotor to spin in relation to the stationary stator, thereby generating electricity.

[005] The device is designed to integrate within existing pipeline infrastructure. To achieve this, it includes a first pipe coupling device that connects the fluid inlet to an upstream fluid pipe and a second pipe coupling device that links the fluid outlet to a downstream discharge pipe. The pipe section is equipped with first and second flanges at its longitudinal ends, facilitating the secure connection to the pipe coupling devices. Each pipe coupling device incorporates a sealed thrust bearing. These bearings are critical as they support the rotor's rotation while maintaining the integrity of the fluid seal, preventing leaks and ensuring consistent performance.

[006] The innovation extends to integrating the rotating device with the pipe section and rotor. This is enhanced by including bearings mounted near each longitudinal end of the rotor. Each of these bearings is housed within a respective bearing channel that is associated with the stator, ensuring that the rotor remains securely in place while allowing for free rotation.

[007] The rotor's rotating device is designed for optimal fluid interaction. It features a central hub mounted within the hollow part of the rotor. Surrounding the central hub is a series of vanes each spaced apart from the hub to allow fluid to flow between them. These vanes are connected to the central hub, potentially at a single point, which ensures that the fluid is efficiently directed toward the vanes. This configuration not only maximises the rotational force generated by the fluid but also minimises resistance, thereby enhancing the overall efficiency of the electricity generation process.

[008] A central shaft extends through the rotor, further contributing to the device's structural integrity and operational efficiency. This shaft supports the central hub and is connected to a spoke arrangement via a bearing at each end. The spoke and rim arrangement are strategically placed between adjacent non-rotating pipe sections, providing additional stability and ensuring the rotor's motion is smoothly transmitted to the generator.

Detailed Description of the representations

A detailed description of a preferred embodiment will follow, with reference to the accompanying figures of the drawings.

[009] The electricity-generating device may be incorporated into any suitable fluid pipe wherein sufficient energy is associated with the fluid flowing through the fluid pipe to generate electricity.

[010] Referring to Figure 1: In this example, the water pipe is part of a water distribution pipe 16. The electricity-generating device in Figure 1 can be integrated into any appropriate fluid pipe where there is enough energy associated with the fluid flowing to generate electricity.

[011] The water inlet flange (10): Referring to Figure 1 introduces water into the pipe portion 16, initiating the energy conversion. The pipe portion 16 is connected to the inlet 10 and discharge pipe 15 through flanges 14. The flanges are connected using bolts 19. An annular flange 18 abuts the rotor 13 when the first and second pipe sections are connected. Each inlet and outlet pipe section includes a flange 14 connected to the end of the inlet 10 and outlet pipe 15 sections by bolts 19.

[012] Referring to Figure 1, operatively associated with pipe portion 16 is an alternator 12 having a rotor 13 fixed to the outer surface of pipe portion 16 and an alternator stator 12 connected to the rotor 13.

[013] Referring to Figure 1, in this example, the alternator 12 is a brushless type, and the arrangement is such that rotation of the pipe portion 16 causes the rotor 13 to rotate, thereby the alternator 12 to generate electricity at the alternator stator 12. The generated electricity may be extracted through an output cable 17.

[014] In this example, the turbine and vanes are shown more particularly in Figure 2, a cross-sectional view of the turbine 20. The turbine with a plurality of vanes and a convex profile faces the water flow during use.

[015] The vanes 24 are fixed to the outside of the turbine’s bulb so that water flows through the pipe portion during use in Arrow ‘A’ direction on the vanes 24, thereby causing the vanes 24 to rotate about the central hub portion and pipe portion. The front cap 27 protects the bearings by diverting the flow over the bulb and into the vanes. The water exits the turbine through the rear discharge spoke, designed to reduce cavitation.

[016] The Front Spoke 23: Referring to Figure 2, the front 3-spoke 23 with a central inner fixed cap is positioned behind the water inlet flange and the first case housing. The 3 spoke rim acts as a support bracket for the bearing protection cap.

[017] The bulb with vanes (turbine) 20: Referring to Figure 2, the turbine bulb 20, featuring multiple vanes, spins as water flows through, converting the water's kinetic energy into rotational energy. Fixed vanes 24 are strategically positioned around the turbine hub 20. Their convex shape, facing the water flow, enhances flow dynamics, reducing drag and improving hydrodynamic performance to enable a smoother water transition through the turbine.

[018] Bearing protection cap: Referring to Figure 2, a bearing protection cap 27 is designed to help maintain the integrity of the bearings and protect the shaft. It is positioned in the centre of the bulb and secured by the 3-spoke rim.

[019] Cylinder Cover 25: The cylinder covers 25 protects the turbine 20, designed as a single piece, ensuring the safety and integrity of the turbine mechanism.

[020] Shaft and Outer Casing 22: Referring to Figure 2, the outer casing 22 safeguards the shaft, ensuring that it operates smoothly to increase a longer lifespan. It provides protection from external elements and impacts; the casing contributes to the overall durability and efficient performance of the shaft. This protection is essential in maintaining the integrity of the shaft and preventing premature wear and tear.

[021] Water Inlet Flange 30: Referring to Figure 3, The inlet is attached to the upstream section of the pipeline, where it receives the incoming fluid. This flange is engineered to facilitate a seamless connection with the existing pipework.

[022] First Case 31: Referring to Figure 3, the first case, 31, encloses cylinder 25 and turbine 20, protecting them from external elements and ensuring efficient operation.

[023] Support Casing for Alternator 22: Referring to Figure 3, the second case, 32, houses the alternator, which converts the rotational energy from the turbine 20 into electrical energy. The alternator is supported by a dedicated casing 25 to ensure stability and reliability. Referring to Figure 1, the electricity can be extracted through output cable 17.

[024] Rear Support Bracket 21: Referring to Figure 3, the rear support bracket 21 arrangement is spaced from the stator 14 in Figure 1, between the turbine 20 and the water discharge flange. After passing through the turbine 20, the water exits the device through the water discharge flange 33, completing the energy conversion cycle.

[025] Water Discharge Flange 33: Referring to Figure 2, the outlet flange 33 is connected to the downstream section of the pipeline, where the fluid exits the device after passing through the rotor assembly. This flange ensures the fluid is sufficiently channelled back into the pipeline, maintaining a consistent flow of dynamics and pressure.

CLAIMS

1. **An inline in-pipe hydraulic generator** for producing electrical energy from fluid flow within a pipe, the generator comprising:
    - a turbine assembly positioned within the pipe, configured to rotate in response to the fluid flow;
    - an electrical generator operatively connected to the turbine assembly, wherein the rotation of the turbine assembly drives the electrical generator to produce electricity;
    - a housing that is integrated into the pipe, wherein the housing encases the turbine assembly and electrical generator, ensuring fluid-tight operation within the pipe.
2. **The inline in-pipe hydraulic generator of claim 1**, wherein the turbine assembly comprises a plurality of vanes arranged to optimise energy capture from the fluid flow.
3. **The inline in-pipe hydraulic generator of claim 2**, wherein the convex vanes are shaped and angled to minimise resistance to fluid flow while maximising rotational efficiency.
4. **The inline in-pipe hydraulic generator of claim 1**, wherein the electrical generator is a permanent magnet generator.
5. **The inline in-pipe hydraulic generator of claim 1**, wherein the housing includes a means for directing fluid flow towards the turbine assembly to enhance energy capture.
6. **The inline in-pipe hydraulic generator of claim 1**, wherein the generator is designed to produce up to 4kVA of electrical power.
7. **The inline in-pipe hydraulic generator of claim 1**, wherein the housing is constructed from a corrosion-resistant material suitable for use in various fluid environments.
8. **The inline in-pipe hydraulic generator of claim 1**, wherein the generator includes a modular design, allowing for easy installation and maintenance within existing pipeline infrastructure.

FIGURE 1

WATER SIDE
ASSEMBLY SECTION

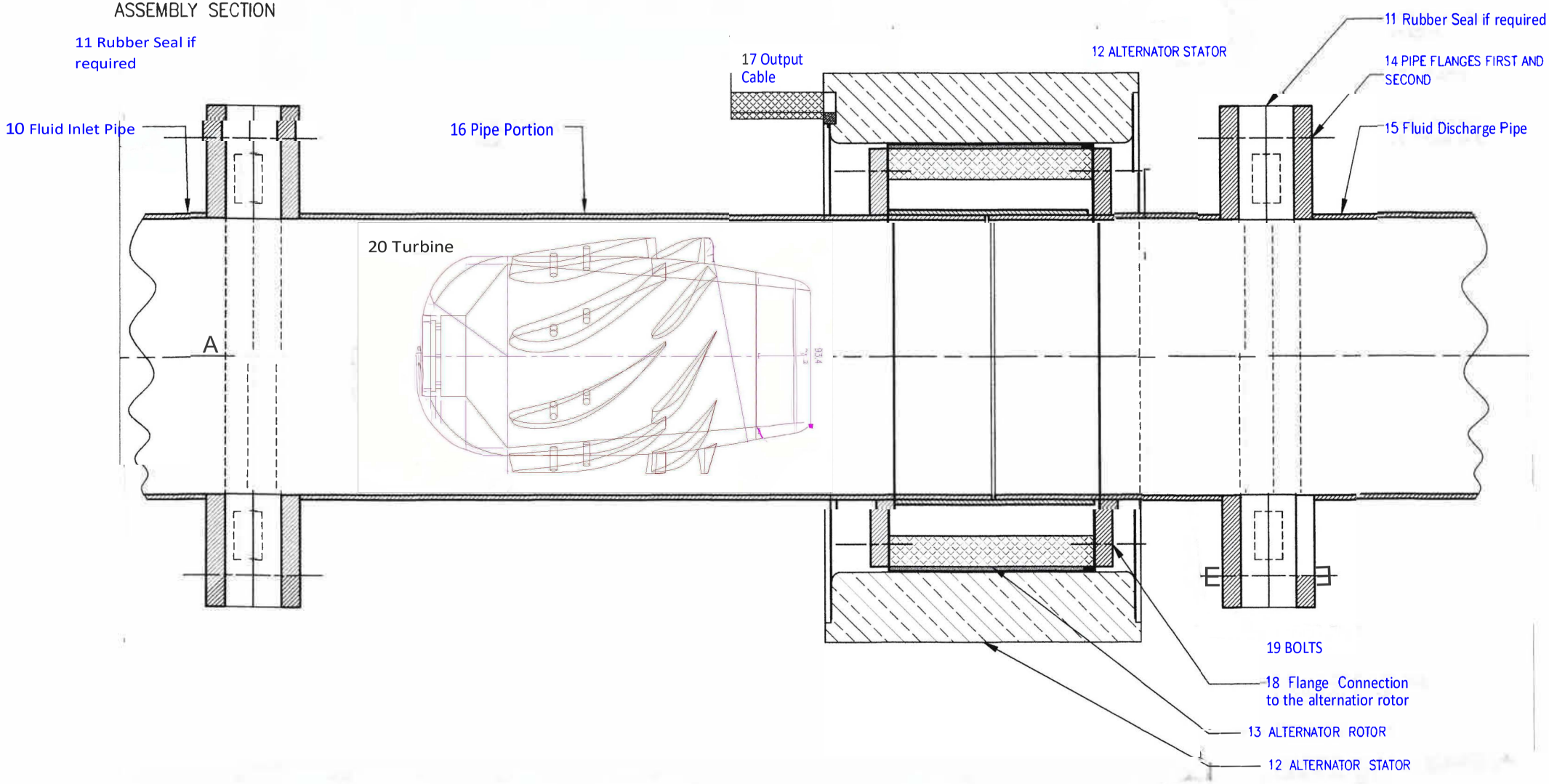
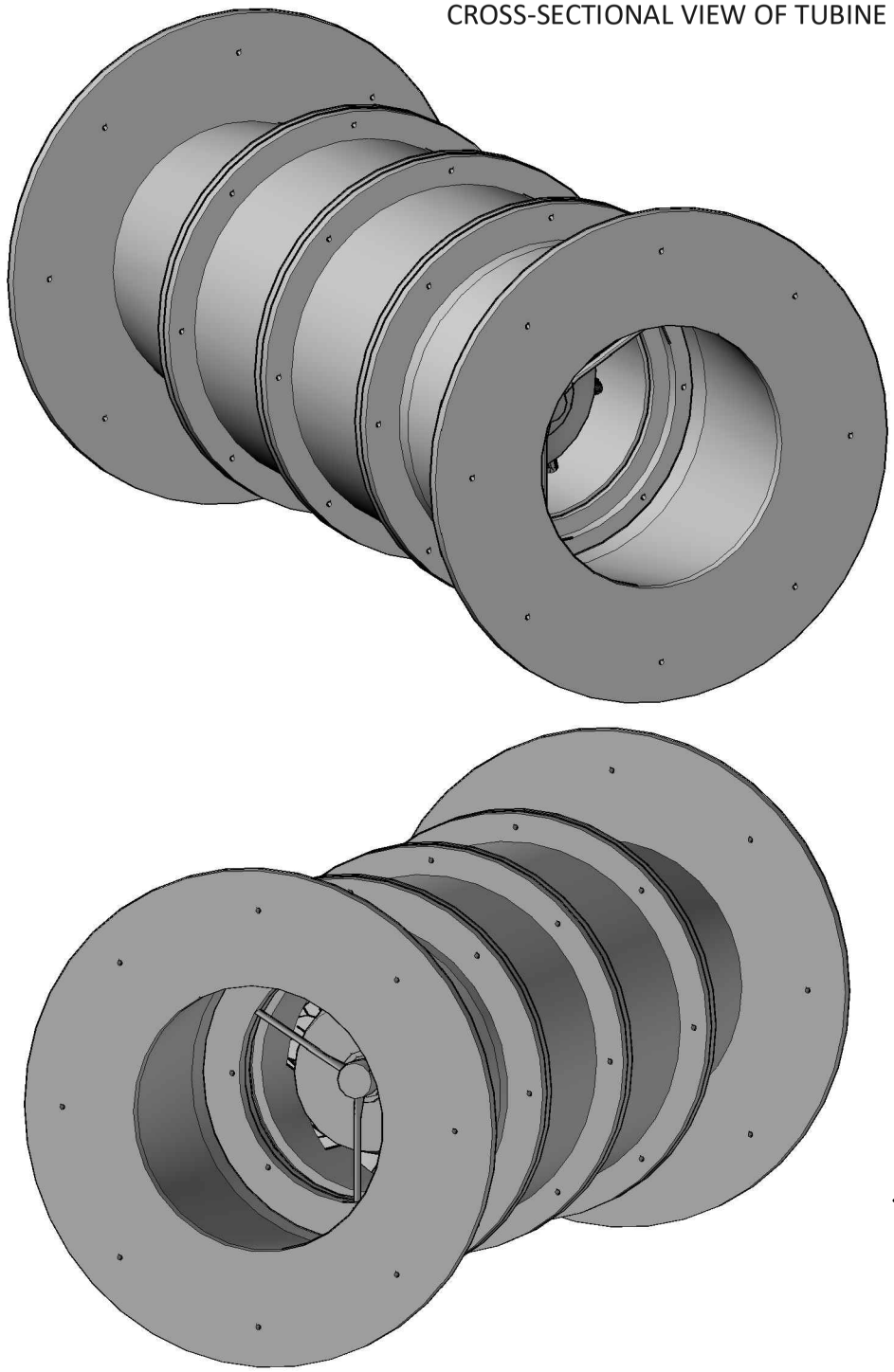


FIGURE 2

CROSS-SECTIONAL VIEW OF TUBINE



Outside Casing Assembly

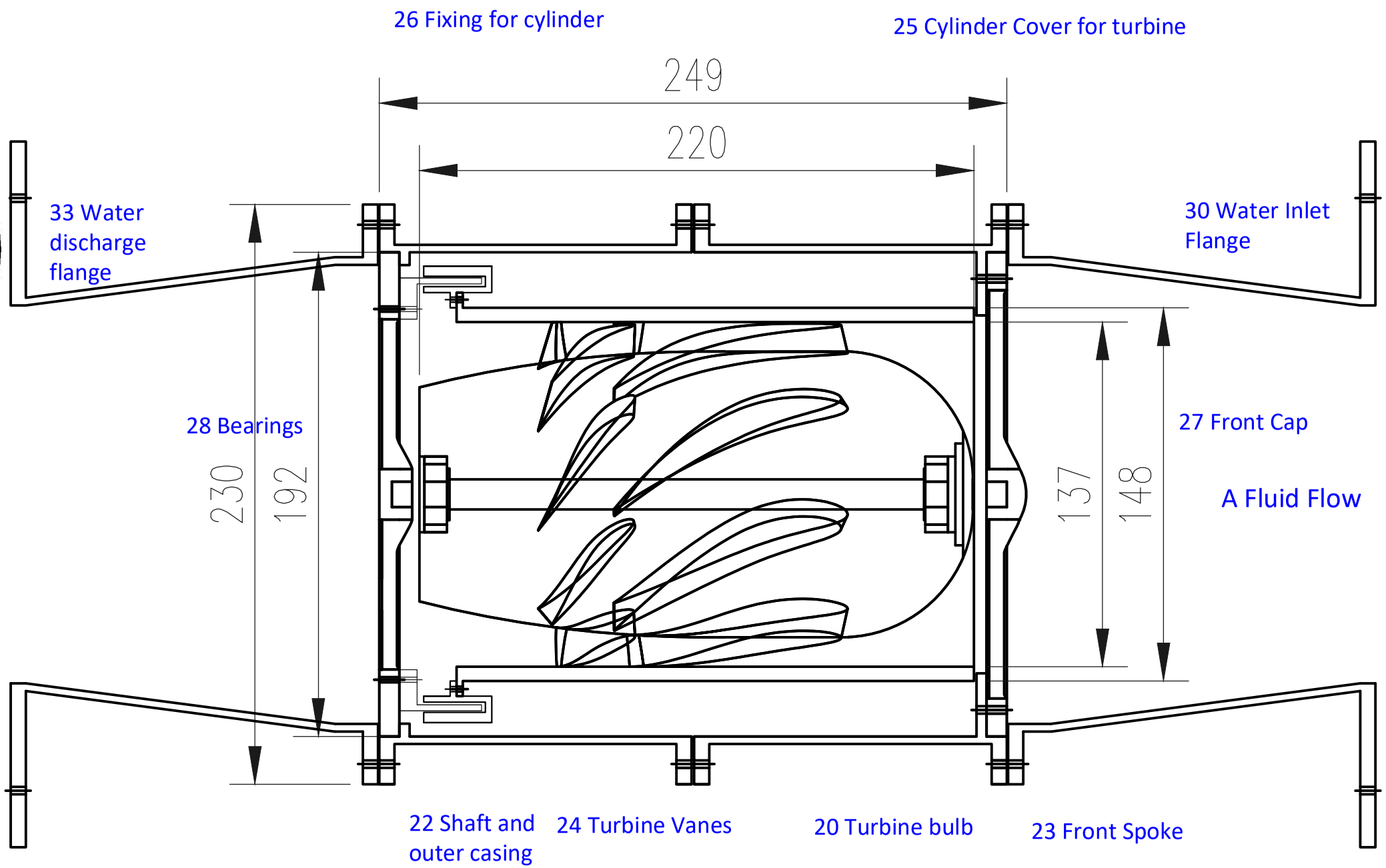
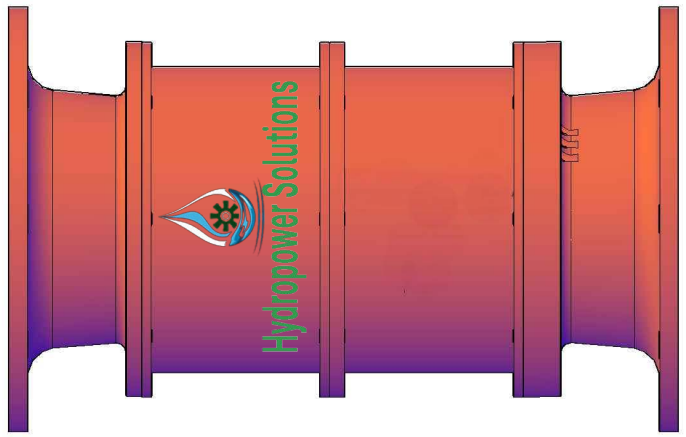
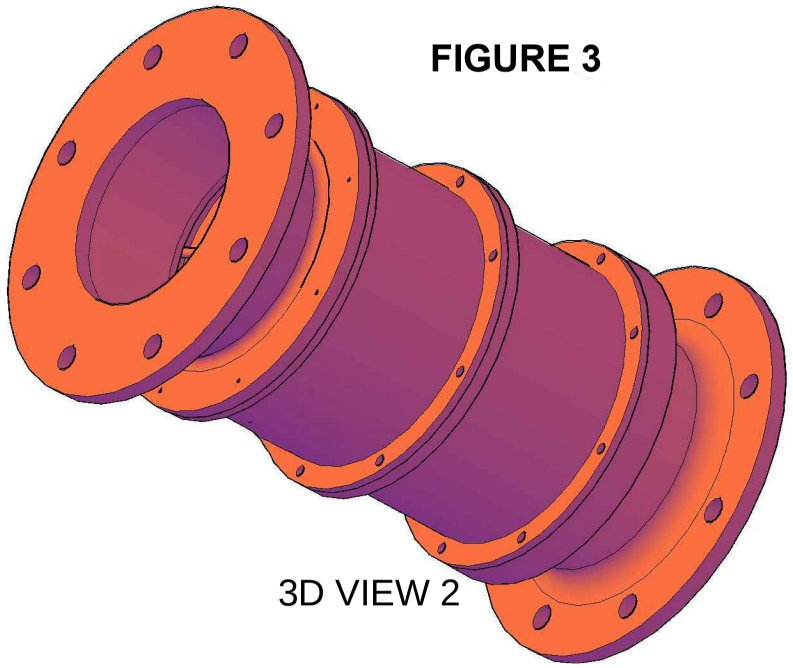


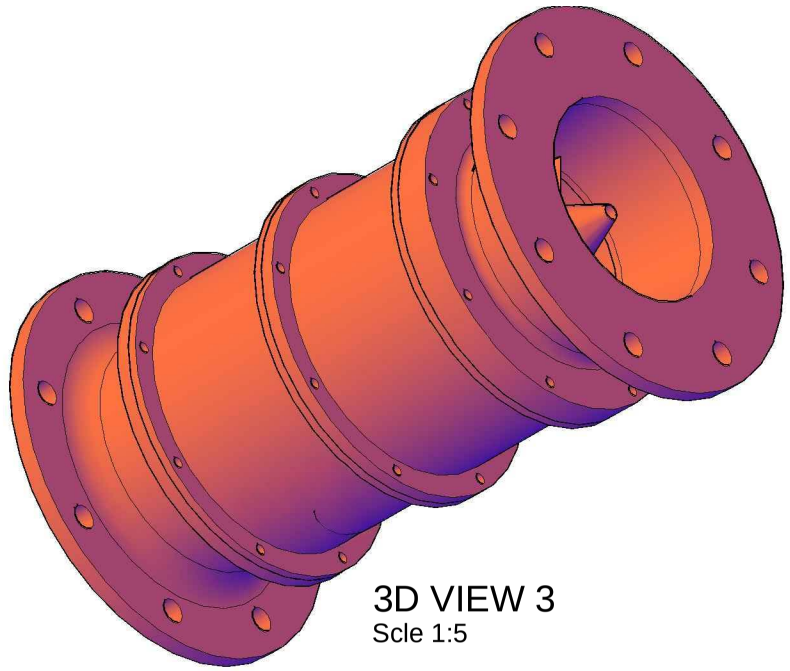
FIGURE 3



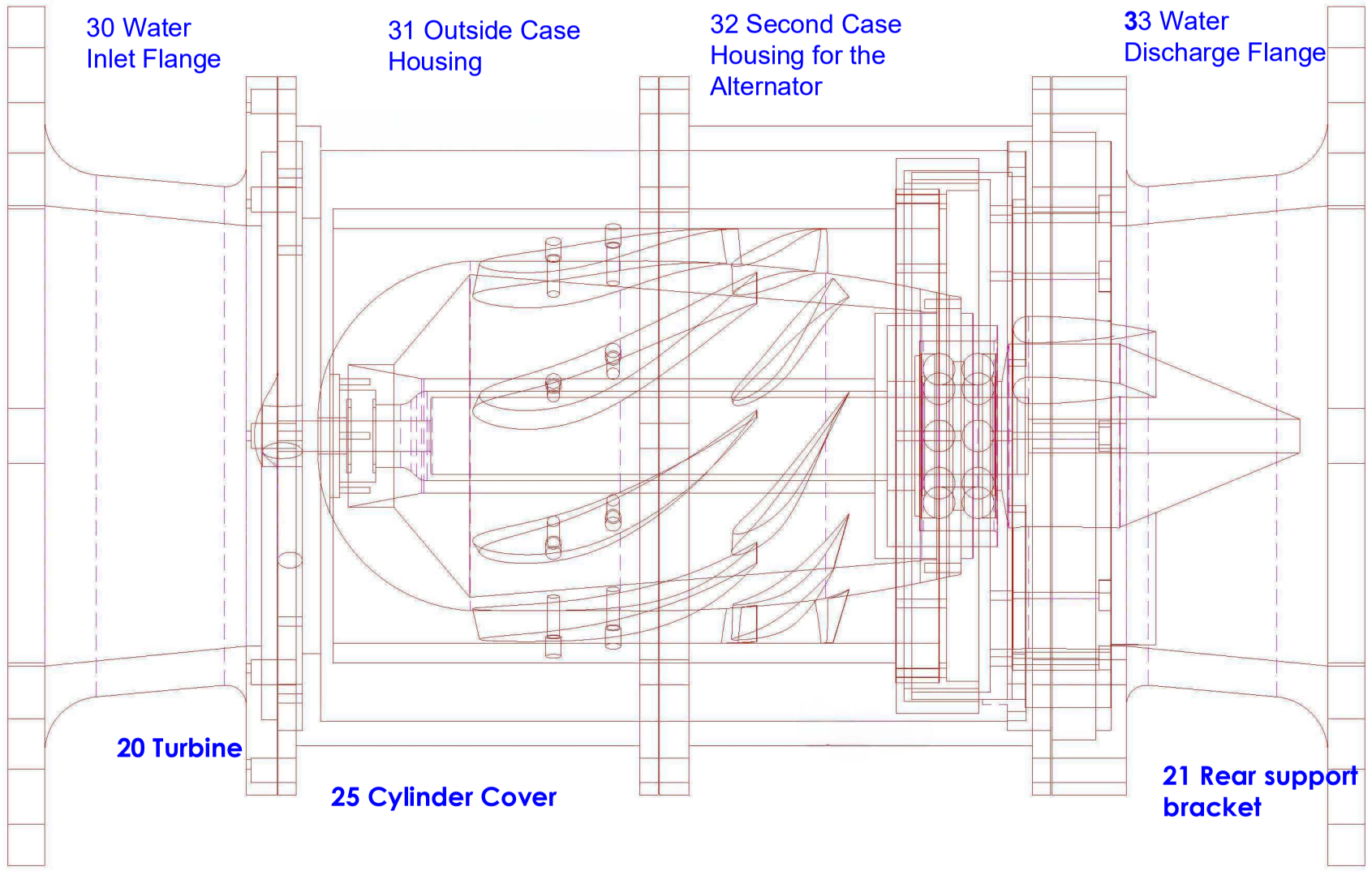
3D VIEW 1

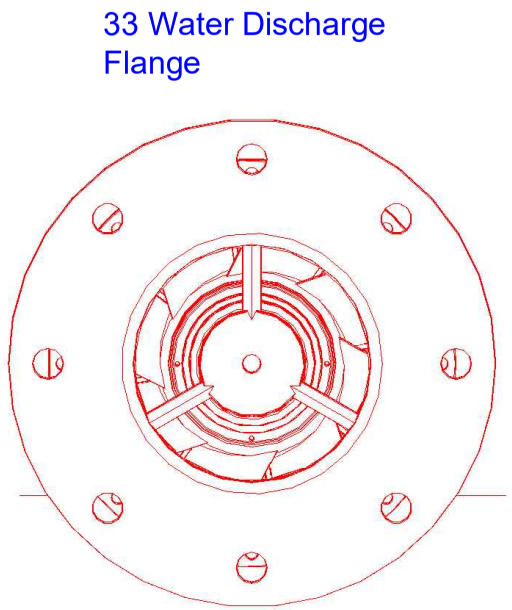


3D VIEW 2

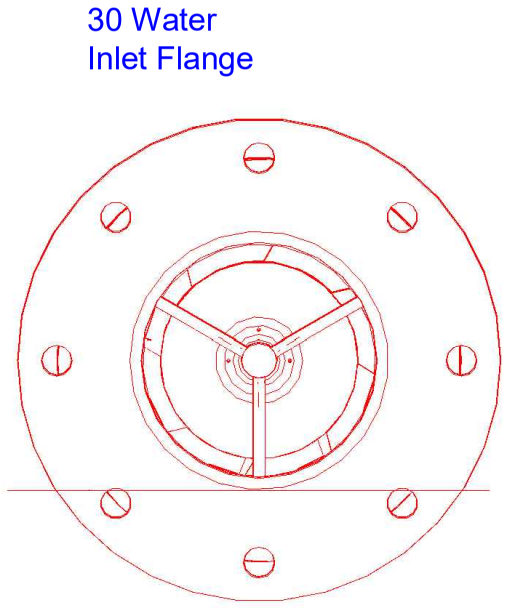


3D VIEW 3
Scle 1:5





REAR ELEVATION



FRONT ELEVATION

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Figure 4

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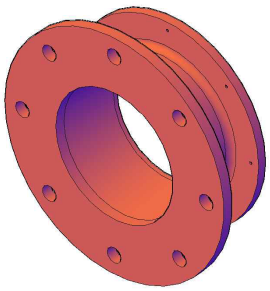
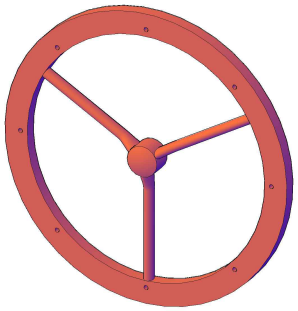
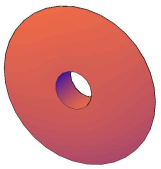


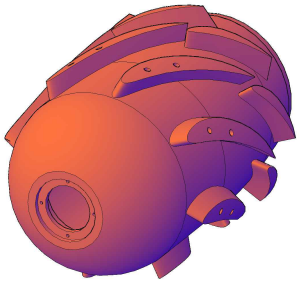
30.Water inlet Flange



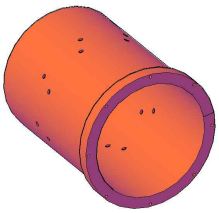
23. Front Spoke



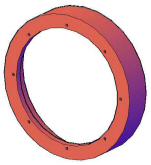
27. Bearing protection cap



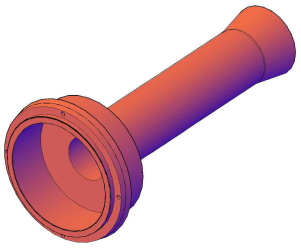
20. Bulb with vanes - turbine



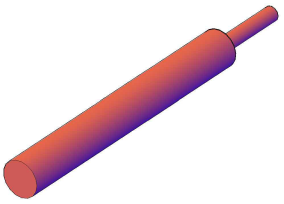
25. Cylinder cover for bulb



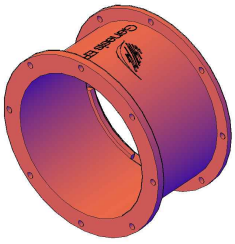
Cylinder Cap



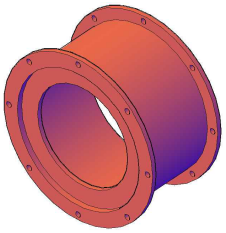
22. ShaftCasing



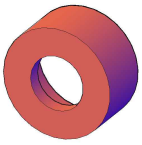
22A. Shaft



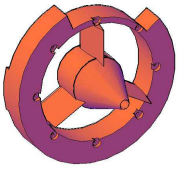
31. Outside Case



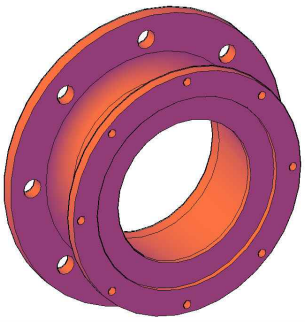
32 Second Case houses alternator



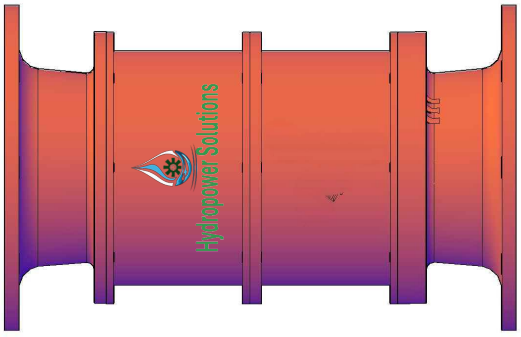
Rear bearing cap



21. Rear support bracket



33. Water discharge flange



34. Complete Unit ready for installation