New flywheel design to reduce weight and cost

A new design for a reduced weight flywheel has been developed by Winterthur Gas & Diesel Ltd. to save material and lower the overall production cost.

The flywheel is a central part of an engine to smooth the rotational movement of the crank shaft, which is by nature non uniform. The energy produced by the gas forces is stored in the rotation of the flywheel and is recovered when the excitation of the gas forces wears of.

In large 2-stroke marine diesel engines, the balancing weight to reduce the first order forces and moments is incorporated in the body of the flywheel resulting in huge weights standing off of the actual wheel.

The outline of a flywheel is given by the gearing which is used during maintenance to rotate and lock the engine to a certain position.

Up to present flywheel consists of the gearing, the hub for mounting it on the crank shaft and weights spanning from the hub all towards the gearing. Two holes are applied for mounting and lifting purposes. This design results in a large amount of material doing a small contribution to the desired inertia, which is a design target.

Contribution of material towards the inertia is, speaking in non-engineering and non-strictly terms, the mass of a certain point of mass times the distance of the respective point to the rotation axis squared.

The key idea behind the new design is to distribute the material where its impact is the most, i.e. as far away from the rotation axis as possible to meet the desired inertia target and to reduce weight, and hence reduce cost.

To meet the desired inertia with very few material, holes are added in a circular pattern near the hub thus removing material with little inertial effect. This circular pattern has a rotational symmetry but is not limited to it. This symmetry can be broken by removing a hole to shift the centre of gravity resulting in an unbalance to contribute to the first order counter measures.

Outside of these holes, but inside the gearing, a ring can be placed to achieve the desired inertia. The ring has gaps, preferably either one or two, resulting in a shift of the centre of gravity to the desired location to meet the balancing targets. This ring has for example a slender section, i.e. it is much higher than thick to move the material as far away from the rotation axis as possible.

Figure 1: Flywheel with ring and single gap

The design of this flywheel is carried out with a software especially developed for this purpose which reduces the weight by simultaneously achieving the desired inertia and balancing measure.

The resulting flywheel-counterweight system is optimized in weight. The clever distribution of mass results in a weight and material reduction of 5 to 50%, preferably up to 20%. Depending on the engine and the version of the flywheel this quantifies as 100 to 8000 kg, preferably 1000 kg to 4500 kg.

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