Advanced Propulsion System
GEM 423E

Week 11: Contra Rotating Propellers

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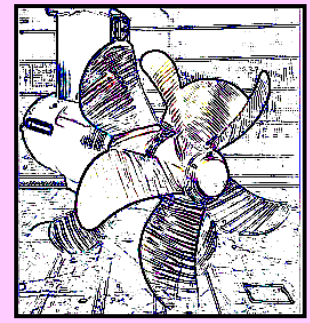
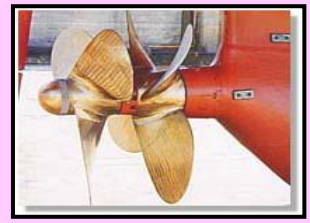


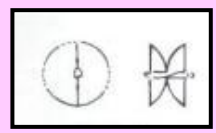
Different Applications

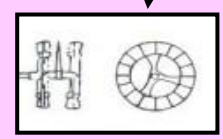


History

- The concept of having two propellers behind each other rotating in different directions is very old.
- Already in 1824 a Mr. Perkins in England had put forward the idea, but it took until 1836 before John Ericsson had produced an actual construction.

- Although Colonel John Stevens built and experimented with a single and a twin screw steam driven vessel in America, his ideas were not accepted and the credit for the actual invention of the screw propeller, belong to either or both Francis Petit Smith and John Ericsson.
- In 1836 Smith and Ericsson patented the screw propeller. Ericsson's design was single, twin, as well as a contra-rotating wheel!





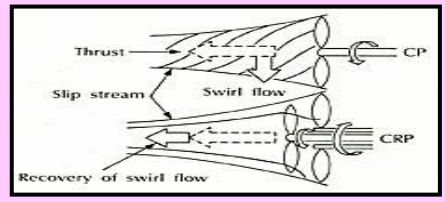
- Although the high efficiency obtained with contra-rotating propellers has long been known, until fairly recently material technology and the need for long concentric shafts running in different directions, made the concept both technically and economically unfeasible.

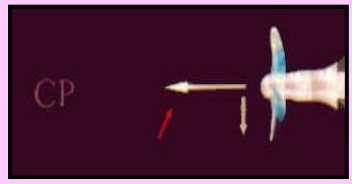
- After the oil crisis in 1973, the shipbuilding business came to a critical condition.
- Under such circumstances, however, many new techniques have been investigated and developed aiming at an high energy-saving ship of the next generation.
- Among them, the contra-rotating propeller system was one of the major subjects of study to achieve a large improvement of propulsion efficiency.

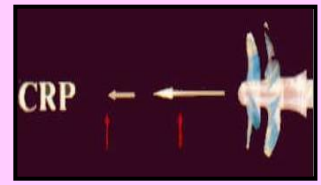
- Mitsubishi Heavy Industries, Ltd. (MHI) succeeded in retrofitting a contra-rotating propeller system to a car carrier for the first time in the world.
- In August 1988, as a result of technical studies for five years concerning contra-rotating dual shafts.
- Through sea trials and commercial operation for two years, a large energy saving advantage and sufficient reliability were verified.
- Taking the next step of development Steerprop now presents the dual-end CRP azimuth thruster

Principles

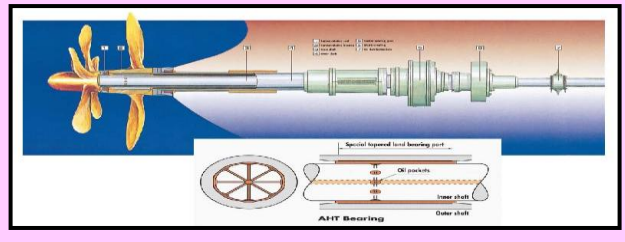
- CRP is a high efficiency propulsion system that recovers the rotational energy lost in the flow generated by the fore propeller by the aft propeller by contra-rotating them.
- Their opening words are, contra-rotating propellers (CRP) are recognized energy savers.

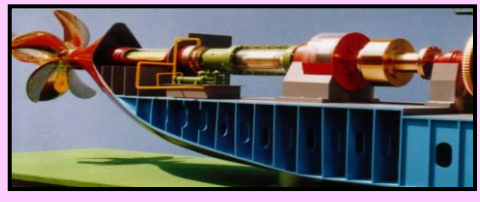






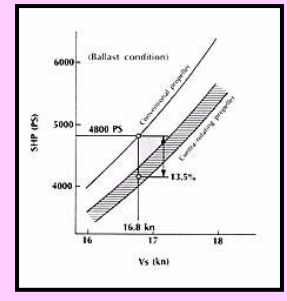
- The development of the CRP system covered not only the propeller, but also the drive shafting system including contra-rotating bearings.
- The new contra-rotating bearing is called AHT (Advanced Hydrostatic Taperland) bearing,and these bearings are used in the cannon structure.
- The AHT bearing is made up of special tapered land bearing parts and special oil pockets on the shaft surface.





Main Benefits

- The energy saving effect was 16% on the sea trials and 13.5% in average (about 10-17%) in the ship's operation.
- Unsurpassable efficiency
- Good fuel economy and low emissions
- Low levels of noise and vibration
- Possibility to use very small propellers in shallow draft vessels

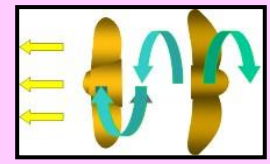


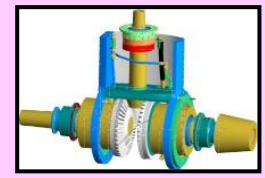
Dual End CRP-1

- The test series clearly showed the benefits of the dual-ended configuration and thus also proved the claims for high efficiency.
- The efficiency of the forward propeller was measured to be close to 0.9!

Dual End CRP-2

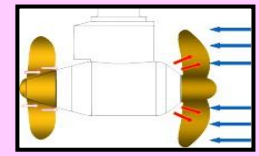
- The aft propeller recovers the swirl energy left in the slipstream by the first propeller
- The power is split between two propellers and gear sets. This makes it possible to reduce the propeller RPM and have two large propellers with light load and low speed of rotation.



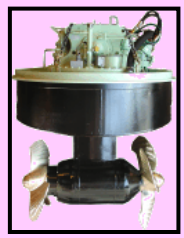


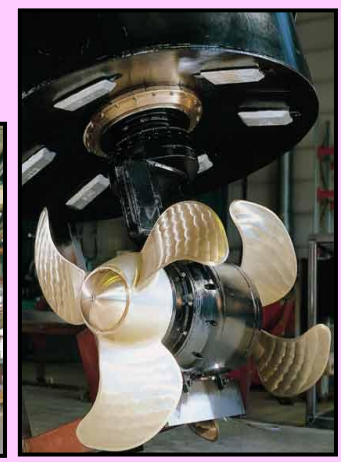
What This Means ?

•Less noise and vibrations due to better cavitation behavior and lower pressure pulses.
•Tip clearance can be reduced enabling a larger propeller to be used and thus higher efficiency
• The presence of the pod behind the propeller offers an additional gain: The pod geometry may be designed to create a pressure wave in front of it, which acts like an additional wake for the forward propeller.



Some Photos





Next Steps

- Engineers are studying to develop CRP propellers, and this 3 tandem propeller may be used in the future which is used in aeronatics now.