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DEPARTMENT OF MARINE ENGINEERING

Paper Presented On Topic

**“Modern Hybrid Propulsion System for the Futuristic
Navigation**

Move of Maritime Sector”

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Modern Hybrid Propulsion System for the Futuristic Navigation

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Abstract

The way that we power our ships that maybe the best but we are still on research for a new era in ship propulsion. This paper gives general overview about the existing hybrid propulsion systems. the limited oil reserves and environmental issues make to think about complementing conventional drive concepts in ship building for efficient operation, so it discusses options in amperium, storage solutions, hybrid hull design(composite), cold ironing stages of vessel which will paves the way for modern hybrid propulsion units in future.

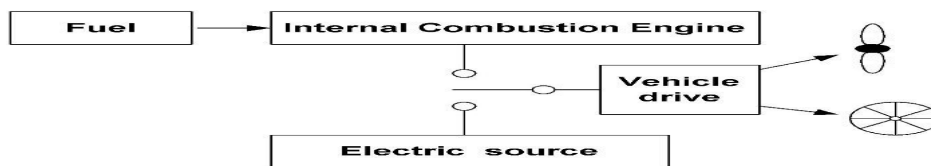
Keywords: amperium, hybrid, cold ironing, storage solutions, composite

Introduction

“Every single time there were naysayers”, and every single time they were wrong .and I am absolutely confident that as we make our next change –as we lead again in challenging the way we power our ships and that the naysayers who say it’s too expensive, the technology is just not there they are going to be proven wrong again because every time we’ve changed we’ve made us a better vessel, we able to lead the maritime sector so it will clearly point out the benefits for operators, owners, builders, and for the environment by the scope of options, thus this paper provides the green hybrid ship concept for futuristic navigation on the wide ocean.

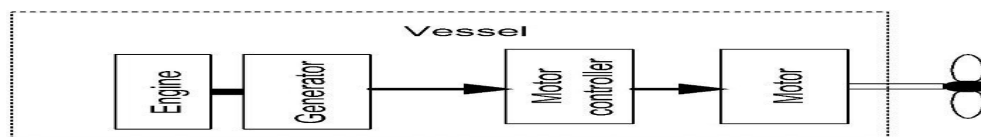
What do you mean by “hybrid?”

A “hybrid” drive means there is more than one power source that can turn the shaft, via an electrical interconnection. There might be a combination of batteries and diesel generators, all of which can feed their power into an electric propulsion motor.



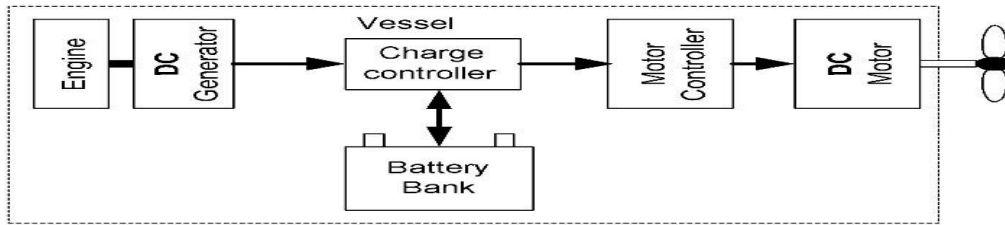
There are three basic Hybrid configurations, Diesel/Electric, Serial hybrid & Parallel Hybrid

Diesel/Electric



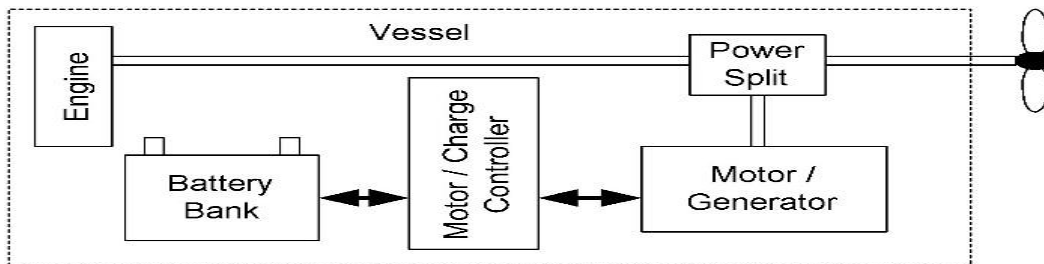
The engine is connected directly to an electrical generator. From this point on the power in the system is transferred electrically to the propeller shaft via a motor controller and electric motor. The system may have multiple generators and multiple motors connected to a common electrical bus. This technology is used in diesel/electric trains and many large ships such as the Queen Mary 2. By the strict definition this is not a hybrid as there is no electric storage of energy.

Serial Hybrid



The serial hybrid is similar to the Diesel/Electric in that it breaks the mechanical connection between the engine and propeller shaft. However a battery bank is also connected to the common electric power bus. In this system you can stop the engine and use the stored energy in the battery bank. With large batteries you can have long periods of electric propulsion (and/or driving onboard electrical appliances) without resorting to the generator.

Parallel Hybrid



A parallel hybrid maintains the mechanical connection between the engine and propeller shaft. As its name implies the electric motor acts on the drive shaft in parallel with the engine. The Power split is a mechanical device that allows transfer of power between its connections. You can drive the propeller directly from the engine or from the electric motor or from both. You can also disconnect the propeller for a stand-alone generator function. During re-generation the engine is disconnected.

How hybrids reduce fuel consumption?

The hybrid technology that will be incorporated into the propulsion system of the new ship minimizes fuel consumption by using a specialized power management system to match required power to the most efficient combination of batteries, generators, and main engines at whatever power level is needed. For example

- 1) An Engine under low load operates with lower efficiency than when under a higher load.
- 2) At top speed, provided you have a properly matched propeller, the engine is operating with its highest efficiency.
- 3) At cruising speed the engine is usually lightly loaded and thus operating with poor efficiency.

4) Hybrids can help improve efficiency at cruising speed by engine cycling or buffering the energy from the engine and returning this to the drive shaft at a later time.

Engine cycling

So in our boat all we need to do when cruising is to change up a few gears to improve fuel economy, in our standard diesel engine craft we have only one forward gear. However in a Serial Hybrid or Diesel/Electric system we have mechanically disconnected the engine from the propeller. We can now vary the engine speed to match the power required by the craft, the electronics then converts this power to the voltage/current required by the motor to drive the shaft. Our electric transmission of power from engine to shaft performs the function of a continuously variable gear box. So our hybrid gives us the ability to change gear and provides the same improvements in fuel economy. Engine cycling (that is varying its speed according to the load) is one way a hybrid can improve engine efficiency. This cycling is normally performed automatically by an intelligent control system.

Energy buffering.

If the power requirement is low then regardless of the engine speed it cannot be operated efficiently. Energy buffering can help here. A hybrid can extract from the engine a higher power than required by propulsion. The extra energy supplied can then be stored (buffered) in the battery bank. Once the batteries are full you can turn the engine off and provide the low propulsion power demand with pure electric drive. When the batteries become depleted then you turn the engine back on again. The engine is thus operated in stop/start cycles and when it is running it is operating under a substantial load, this results in higher overall efficiency.

Futuristic Green hybrid vessels

Our futuristic green hybrid vessels designs with the following applications available they are

1. Cold ironing
2. Amperium (super conductor)
3. Hybrid hull concept
4. Improved storage solutions

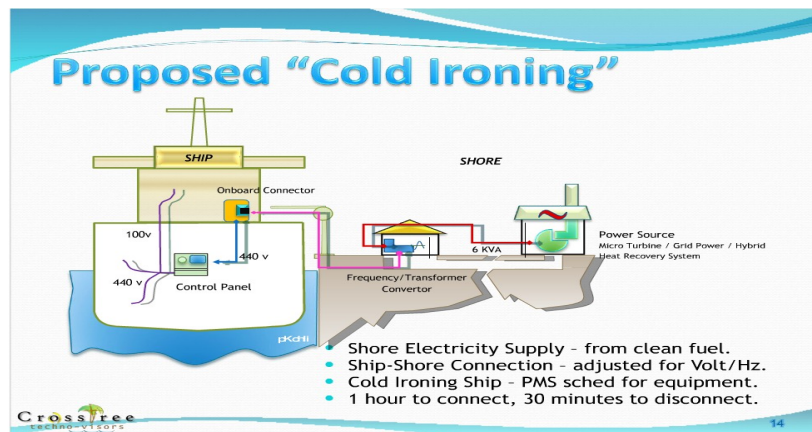
1. Cold ironing

It is also called as shore-power which enables ships to use shore side electricity source to power electronic systems including fuel systems, loading and unloading activities and to discontinue the use of its auxiliary engines, shore electric facilitates have diversified energy generation sources, having regulated emission controls. It will give a

wide opportunity to use the renewable energies produced by the plants such as offshore wind farms, ocean thermal energy conversion, bio-fuel, wave energy plants.

Varied requirements

- Most ships operate on low voltage 440V electrical power, while large container and cruise ships operate on high voltages of 6.6 to 11 KV
- Frequency requirements also vary depending on place of construction of ship (50 or 60HZ)
- Power converters will be required either on board the ship or at the terminal to provide electricity
- Power load requirements vary from 1 to 4 megawatts for a container ship to 5 to 10 megawatts for a cruise ship



Results in

- Reduce use of fossil fuel
- Reduction in NOx and SOx emission
- Marine sector too moves to plug in hybrid vehicles system
- Time for maintenance of engine can be increased
- Renewable energy usage will be increased around the world

2. Amperium-super conductor

It is the new type of superconductor announced by the AMSC of Devens, Massachusetts it is second generation (2G) high temperature superconductor (HTS) wire, the wire is a ribbon shaped and comprises a core of 2G HTS material clad with

thin strips of metal such as copper or stainless steel and has an approximate width of 4.8 mm and thickness of 0.2 mm

Remarkable ability

- Conduct more than 100 times the electrical current of copper wire of the same dimensions so electrical systems incorporating Amperium wire instead of copper are significantly more compact and lighter than their copper based equivalent

In marine sector

- It will be used in ship propulsion motors and generators and for naval ship degaussing systems
- It will make significant advantages over conventional AC synchronous and induction machines (i.e.: by eliminating the primary cause of failure therefore offers greater reliability and longer MTBF)

E.g. AMSC has already delivered electric propulsion motors to the US Navy in sizes of 5MW at 230 rpm and 36.5MW at 120 rpm. The 36.5MW motor is less than half the size of the conventional motors used on the USS Zumwalt (DDG-1000) destroyer and is approximately 200 tonnes lighter the rapidly increasing use of diesel electric, hybrid and integrated electric propulsion systems for commercial and naval ships looks to benefit from this superconductor technology in the years ahead

3. Hybrid hull concept

In the past five years, several hybrid hull designs have been proposed incorporating many of the aforementioned performance characteristics, like stealth, stiffness, and strength. It is interesting to note that the aircraft industry (Airbus Industries for example with the A380) has started to work on hybrid aircraft structures for large passenger transport. Their construction bears a striking resemblance to the hybrid ship hull concepts. Two hybrid hull designs have thus far been proposed; and are illustrated in Figure 2. One design (Figure 2a) has a mid-section of stainless steel advanced double hull and bow and stern sections made of single skin cross-reinforced composite or sandwich composite. This design uses the steel in the centre of the ship to achieve the strength and stiffness required for large combatants, and the composite at the bow and stern to achieve all the weight reduction, address complex shapes, and provide other stealth features. The hull shown in Figure 2b has an all-composite skin along the entire hull reinforced with stainless steel framing in the mid-section. This provides the necessary stiffness, and can carry the hull-girder sea and whipping loads.

Advantages of a Hybrid Hull Design

The hybrid hull design takes advantage of materials where they Perform best:

- Steel is used for stiffness and strength
- Composites are used for light weight, creating complex shapes with exact tolerances, and reducing signature.
- Hybrid design does not require expensive composites. It relies on the use of low cost GRP, which has already gained Navy and shipyard acceptance. Hybrid design allows for low maintenance, elimination or reduction of corrosion problems, light weight, ability to use low cost/high performance composites, as well as embedded sensors and fibre optics for health monitoring. The hybrid design in Figure 2b would also reduce repair costs through the use of removable panels. This type of construction eliminates the problem of an entire hull delamination, which could result from the ship impacting ice, piers, or other hard objects. (Sandwich construction used in ships like the Visby incorporated special “stoppers” in the hull skin to prevent the entire hull from delaminating.) In addition, combatants with hybrid construction have the following advantages:
 - Superior performance in underwater explosions (UNDEX); 30% reduction in whipping Loads.
 - The hybrid hull in Figure 2b is perceived to be less vulnerable to internal explosions, because the outer skin would allow relief of internal blast pressure preventing extreme loading of the structural frame.
 - The use of low density composites saves weight, allowing for added additional protection systems.
 - The steel framing depicted in Figure 2b also provides options to reduce structural acoustic signatures.

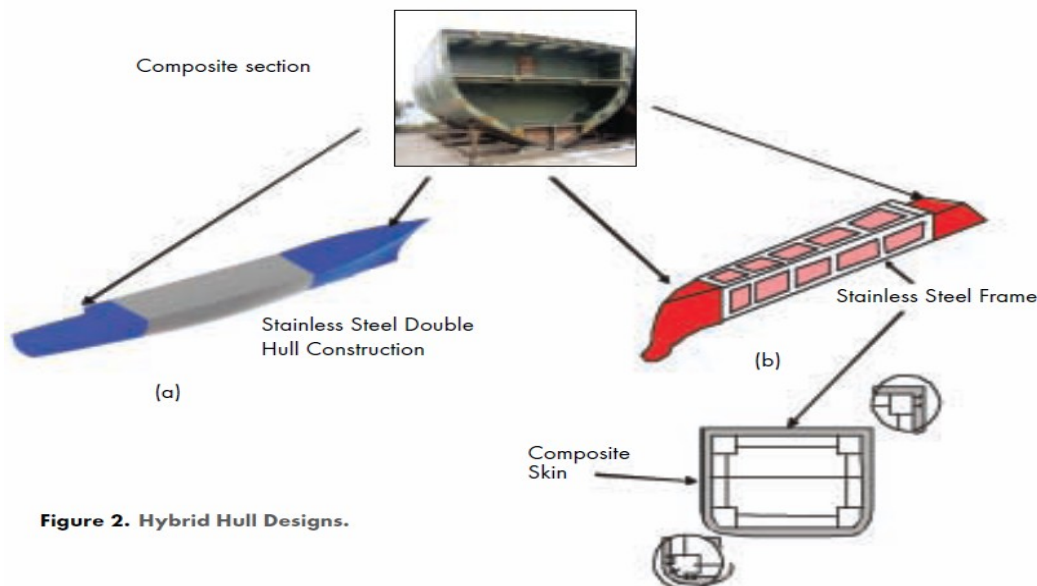


Figure 2. Hybrid Hull Designs.

4.Improved storage solutions

For many years, nickel-cadmium had been the only suitable battery for portable equipment from wireless communications to mobile computing. Nickel-metal-hydride and lithium-ion emerged in the early 1990s, fighting nose-to-nose to gain customer's acceptance. Today, lithium-ion is the fastest growing and most promising battery chemistry.

The lithium-ion battery

Advantages

- High energy density - potential for yet higher capacities.
- Does not need prolonged priming when new. One regular charge is all that's needed.
- Relatively low self-discharge - self-discharge is less than half that of nickel-based batteries.
- Low Maintenance - no periodic discharge is needed; there is no memory.
- Specialty cells can provide very high current to applications such as power tools.

Limitations

- Requires protection circuit to maintain voltage and current within safe limits.
- Subject to aging, even if not in use - storage in a cool place at 40% charge reduces the aging effect.
- Transportation restrictions - shipment of larger quantities may be subject to regulatory control. This restriction does not apply to personal carry-on batteries.
- Expensive to manufacture - about 40 percent higher in cost than nickel-cadmium.
- Not fully mature - metals and chemicals are changing on a continuing basis.

Manufacturers are constantly improving lithium-ion. New and enhanced chemical combinations are introduced every six months or so. With such rapid progress, it is difficult to assess how well the revised battery will age. Storage in a cool place slows the aging process of lithium-ion (and other chemistries). Manufacturers recommend storage temperatures of 15°C (59°F). In addition, the battery should be partially charged during storage. The manufacturer recommends a 40% charge. The most economical lithium-ion

battery in terms of cost-to-energy ratio is the cylindrical 18650 (18 is the diameter and 650 the length in mm). This cell is used for mobile computing and other applications that do not demand ultra-thin geometry. If a slim pack is required, the prismatic lithium-ion cell is the best choice. These cells come at a higher cost in terms of stored energy.

Futuristic green hybrid design

Advantages

- Fuel efficiency is increased
- Easy to upgrade
- Operational flexibility
- During hybrid propulsion the engine & motor can be use of to operate at a nearly optimum operating point.
- Rotation speed is higher by a factor of approximately 4 to 10 times than the rotation speed of the diesel engine for the ship propeller.
- It avoids the thermal problems resulting from low rotation speed and high cylinder changes.
- Cost of investment of fuel is decreased.

Disadvantages

- Initial cost is high
- It will lead to more work for engineers

Conclusion

There is still a huge research and development work to be done on innovative electrical/hybrid propulsion systems for fully green ship concepts; these were only few new things that will be incorporated in the hybrid vessels other than these air lubrication systems, cold flame exhaust systems, and many other options was on R&D stages and the naval industry should take the advantage of this knowledge and technology sure there will be an price hike on oil sectors so moving to hybrid technologies will again move us forward in the maritime sector for futuristic navigation system

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