Diesel-Electric Drives for Boats

London Innovation and its subsidiary, Lynch Motor Company, have specialised in developing energy-efficient electric drives for boats, as set out in report 1.301.

Electric motors can give very high torques and therefore pull large diameter propellers without stalling. Thus a small motor weighing 10 or 11 Kg can give as much torque as an 18 HP diesel engine weighing 155 Kg. A twin motor (23kg) can give up to 16 KW and is ideal for large boats. Many boats, particularly narrow boats and yachts, are fitted with quite large AC mains-voltage generators - 4, 6 and even 8 KW - to run domestic equipment such as microwaves, ovens, hair driers &c. It is now realised that these generators can provide more than enough power to drive the boat also, thus eliminating the need for two diesel engines and freeing a considerable amount of space which can be used for additional berths or other accommodation.

Elimination of a second diesel engine not only liberates space and cuts capital costs by several thousand pounds, it also cuts maintenance costs drastically as the smaller generator motor is running under optimum conditions. Further, when the generator needs servicing it can be taken out of the boat and serviced much more conveniently on the workshop bench.

The following illustration uses an onboard 240volt AC generator to charge a moderate sized battery pack connected to a traction motor and also provides power for all auxiliary equipment. The capacity, size and voltage of the battery pack depends on several variables, particularly running time required and maximum power needed. The motor can be run from the battery pack without using the generator, or the generator can be kept in operation while the motor is running if demand warrants this. Normally an AC generator will be used as this is the simplest way to power domestic appliances. It is also possible to have a system which uses a DC generator. However in both cases there can be problems with charging and driving from a generator which is permanently connected to the battery if both functions are carried out at the same time. More sophisticated control circuitry will overcome this difficulty.

A further advantage of having a battery pack is that appliances - such as lights and TV sets - can be run without starting the generator. This will enable the generator to be run for part of the day only, and will avoid the need to run the generator at night, with attendant problems of noise, vibration and exhaust fumes. With an additional inverter AC appliances can also be run off the batteries. Appliances may run on DC (eg fluorescent lights) or on AC from an inverter.

Using drive systems with an overall propulsion efficiency (electrical input to mechanical power absorbed by boat drag) of 50% or more - as compared with 15%-20% found in conventional drives - the power requirements can be kept quite low. Typically about 1 KW for 26 ft sailing boat, 2-4 KW for 33 ft launch and for narrow boats from 30-60 ft. High torque motors will also provide up to 250% more power for manoeuvring or running against the current.

Aspects to be considered include:

a) Controller overheating
When running at partial load, the efficiency can be about 95% but the waste energy needs to be dissipated through a heat sink (air or water cooled), otherwise the controller output can cut back, or in some cases cut off completely. This can also happen when running at high power for long periods. The possibility of this happening can be reduced by careful selection of the controller and method of cooling – i.e. heat sink attached to the hull of the boat (if metal), or fan cooling.

b) Final Drive
In some cases it is possible to run the motor direct coupled but generally a speed reduction will be needed. Belt or chain drives have higher efficiencies than gearboxes, which should be avoided if possible. The propeller should be as large as can be fitted, with a pitch between 70-90% of the diameter depending on the direction of water flow at the stern. The pitch can be lower if the flow remains in line with the boat.

c) Battery Ventilation
To meet safety regulations, good natural or fan-assisted ventilation of the batteries is essential. Where a fan is fitted a timer system allowing 1 hour run on at the end of the charge cycle is also required.

The growing use of generators for all types of boats is likely to contribute greatly to the acceptance of electric drive systems.

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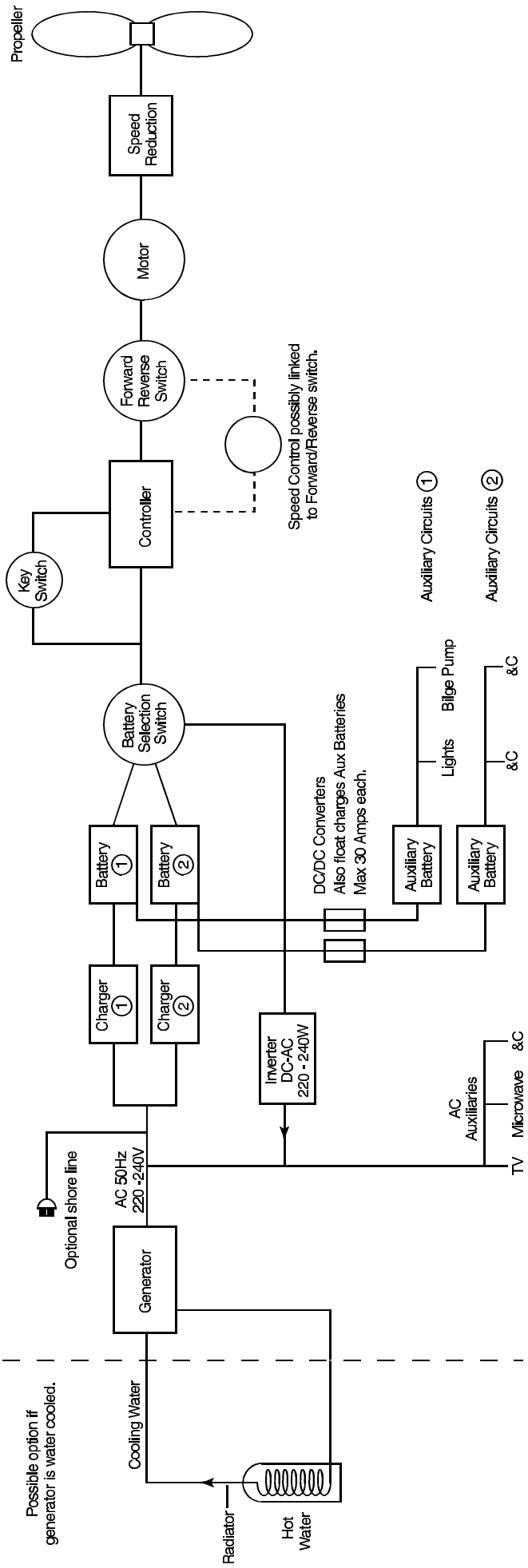

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