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The license may not give you all of the permissions necessary for your intended use. For example, other rights such as publicity, privacy, or moral rights may limit how you use the material. Self-contained propulsion system for boats This article needs additional citations for verification. Please help improve this article by adding citations to reliable sources. Unsourced material may be challenged and removed.Find sources: "Outboard motor" – news · newspapers · books · scholar · JSTOR (April 2012) (Learn how and when to remove this message) Basic parts of an outboard motor An outboard motor is a propulsion system for boats, consisting of a self-contained unit that includes engine, gearbox and propeller or jet drive, designed to be affixed to the outside of the transom. They are the most common motorised method of propelling small watercraft. As well as providing propulsion, outboards provide steering control, as they are designed to pivot over their mountings and thus control the direction of thrust. The skeg also acts as a rudder when the engine is not running. Unlike inboard motors, outboard motors can be easily removed for storage or repairs. Bolinder's two-cylinder Trim outboard engine A Mercury Marine 50 hp outboard engine, circa 1980 to 1983 1979 Evinrude 70 hp outboard, cowling and air silencer removed, exposing its shift/throttle/spark advance linkages, flywheel, and three carburetors In order to eliminate the chances of hitting bottom with an outboard motor, the motor can be tilted up to an elevated position either electronically or manually. This helps when traveling through shallow waters where there may be debris that could potentially damage the motor as well as the propeller. If the electric motor required to move the pistons which raise or lower the engine is malfunctioning, every outboard motor is equipped with a manual piston release which will allow the operator to drop the motor down to its lowest setting.[1] Large ships, boats and yachts will inevitably have inboard engines. Medium size vessels may have either inboards or outboards, and small vessels rarely have inboard motors. If one has a choice, these factors should be noted: Inboard engines are almost invariable diesel, allowing ruggedness, reliability and fuel economy. The very few outboards that are diesels tend to be large heavy items, suitable for workboats and very large RIBs. Diesel outboards are rarely found on leisure craft. Outboards may be easily removed from the vessel for safe-keeping and servicing. They are also vulnerable to theft (a risk rarely suffered by inboard engines). Outboards are cheaper and lighter than inboards. They are often fitted to cruising yachts. Cruising catamarans up to around 10 metres LOA frequently have a petrol longshaft engine with a propeller that is larger and slower-turning than other types. Catamarans that have an engine for each hull (to aid manoeverability) tend to have twin inboards, as twin outboards might interfere with rudder arrangements. While inboards may be mounted in a optimum position for balance, outboards must be mounted on (or shortly ahead of) the transom. This means that a significant weight is at the aft end of the boat, and this must be taken into consideration. An open seagoing boat with an outboard motor attached Large outboards are affixed to the transom using clamps and are either tiller steered or controlled from the helm. Generally motors of 100 hp plus are linked to controls at the helm. These range from 2-, 3-, and 4-cylinder models generating 15 to 135 horsepower (11 to 101 kW) suitable for hulls up to 17 feet (5.2 m) in length to powerful V6 and V8 cylinder blocks rated up to 627 hp (468 kW).,[2] with sufficient power to be used on boats of 37 feet (11 m) or longer. Small outboard motors, up to 15 horsepower (11 kW) or so, are easily portable. They are affixed to the boat via clamps and thus easily moved from boat to boat. These motors typically use a manual start system, with throttle and gearshift controls mounted on the body of the motor, and a tiller for steering. The smallest of these weigh as little as 12 kilograms (26 lb), have integral fuel tanks, and provide sufficient power to move a small dinghy at around 8 knots (15 km/h; 9.2 mph) This type of motor is typically used: to power small craft such as jon boats, dinghies, canoes, etc to provide auxiliary power for sailboats for trolling aboard larger craft, as small outboards are typically more efficient at trolling speeds. In this application, the motor is frequently installed on the transom alongside and connected to the primary outboard to enable helm steering. In addition many small motor manufacturers have begun offering variants with power trim/tilt and electric starting functions so that they may be completely controlled remotely Electric outboard motors are self-contained propulsory units for boats, first invented in 1973 by Morton Ray of Ray Electric Outboards.[3] These are not to be confused with trolling motors, which are not designed as a primary source of power. Most electric outboard motors have 0.5- to 4-kilowatt direct-current (DC) electric motors, operated at 12 to 60 volts DC. Recently developed outboard motors are powered with an alternating current (AC) or DC electric motor in the power head like a conventional petrol engine. With this setup, a motor can produce 10 kW output or more and is able to replace a petrol engine of 15 HP or more. The advantage of the induction or asynchronous motor is the power transfer to the rotor by means of electromagnetic induction. As these engines do not use permanent magnets, they require less maintenance and develop more torque at lower propeller speeds. Pump-jet propulsion is available as an option on most outboard motors. Although less efficient than an open propeller, they are particularly useful in applications where the ability to operate in very shallow water is important. They also eliminate the laceration dangers of an open propeller. Propane outboard motors are available from several manufacturers. These products have several advantages such as lower emissions, absence of ethanol-related issues, and no need for choke once the system is pressurized.[4] Lehr is regarded as the first manufacturer to have brought a propane-powered outboard motor to market by Popular Mechanics and other boating publications.[5][6][7][8] The first known outboard motor was a small 11 pound (5 kg) electric unit designed around 1870 by Gustave Trouvé,[9] and patented in May 1880 (Patent N° 136,560).[10] Later about 25 petrol powered outboards may have been produced in 1896 by American Motors Co[9]—but neither of these two pioneering efforts appear to have had much impact. The Waterman outboard engine appears to be the first gasoline-powered outboard offered for sale in significant numbers.[11] It was developed from 1903 in Grosse Ile, Michigan, with a patent application filed in 1905[12] Starting in 1906,[13][14] the company went on to make thousands of his "Porto-Motor"[15] units,[16] claiming 25,000 sales by 1914.[17] The inboard boat motor firm of Caille Motor Company of Detroit were instrumental in making the cylinder and engines. The most successful early outboard motor,[16] was created by Norwegian-American inventor Ole Evinrude in 1909.[18] Historically, a majority of outboards have been two-stroke powerheads fitted with a carburetor due to the design's inherent simplicity, reliability, low cost and light weight. Drawbacks include increased pollution, due to the high volume of unburned gasoline and oil in their exhaust, and louder noise. Four-stroke outboards have been sold since the late 1920s, such as the Roness and Sharland. In 1962 Homelite introduced a four-stroke outboard a 55-horsepower (41 kW) motor, based on the four-cylinder Crosley automobile engine. This outboard was called the Bearcat and was later purchased by Fischer-Pierce, the makers of Boston Whaler, for use in their boats because of their advantages over two-stroke engines. In 1964, Honda Motor Co. introduced its first four-stroke powerhead.[19] In 1984, Yamaha introduced their first four-stroke outboards, which were only available in the low-power range. In 1990 Honda released 35 hp and 45 hp four-stroke models. They continued to lead in the development of four-stroke engines throughout the 1990s as US and European exhaust emissions regulations such as CARB (California Air Resources Board) led to the proliferation of four-stroke outboards. At first, North American manufacturers such as Mercury and OMC used engine technology from Japanese manufacturers such as Yamaha and Suzuki until they were able to develop their own four-stroke engine. The inherent advantages of four-stroke motors included: lower pollution (especially oil in the water), noise reduction, increased fuel economy, and increased torque at low engine speeds. Honda Marine Group, Mercury Marine, Mercury Racing, Nissan Marine, Suzuki Marine, Tohatsu Outboards, Yamaha Marine, and China Oshen-Hyfong marine have all developed new four-stroke engines. Some are carburetted, usually the smaller engines. The balance are electronically fuel-injected. Depending on the manufacturer, newer engines benefit from advanced technology such as multiple valves per cylinder, variable camshaft timing (Honda's VTEC), boosted low end torque (Honda's BLAST), 3-way cooling systems, and closed loop fuel injection. Mercury Verado four-strokes are unique in that they are supercharged. Mercury Marine, Mercury Racing, Tohatsu, Yamaha Marine, Nissan and Evinrude each developed computer-controlled direct-injected two-stroke engines. Each brand boasts a different method of DI. Fuel economy on both direct-injected and four-stroke outboards measures from a 10 percent to 80 percent improvement compared with conventional two-strokes.[20] However, the gap between two-stroke and four-stroke outboard fuel economy is beginning to narrow. Two-stroke outboard motor manufacturers have recently introduced technologies that help to improve two-stroke fuel economy.[21] In 2012, Lehr inc. introduced some small (