MODERN SEAMANSHIP

THIRTEENTH EDITION

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Secondary or Main Steam System. The secondary system is the steam system. It is completely isolated from the primary system since the primary water goes through the tubes of the boiler while the secondary water, which is boiling to make steam, is on the shell side of the boiler.

Steam rises from the boiler to the steam drum where the water is separated from the steam. The dry saturated steam then flows back to the engine room where it drives ship service turbogenerator sets (SSTG), coolant turbogenerator sets (CTG), and the main propulsion turbines.

Provision is made in some ships for declutching the propulsion turbines and reduction gears from the propeller shafts so that the ship can be driven through the water by electric motors mounted integrally on the propeller shafts. The electric motors can receive power from the battery, from diesel engines, or from AC-DC motor generator sets.

Radiation. When the reactor is in operation, the lower level of the reactor compartment is kept isolated and personnel cannot enter this space. Within a few minutes after shutdown the reactor compartment lower level can be entered to perform maintenance work.

The shield of the *Skipjack* reactor reduces the radiation to a level such that during a cruise lasting the life of the reactor, the average crew member will receive less radiation than he would during a lifetime from x-rays and cosmic rays and natural radioactivity in the sea, air, drinking water, and ground. In one year of operation the average crew member received less than the Bureau of Standards allowable radiation dosage for one week.

Startup. A typical schedule for startup from a cold condition follows:

Four hours before getting under way—one man starts a precritical checkoff, which is a thorough check of all reactor control equipment. The in-port watch in the engine room and reactor compartment checks systems lined up for operation.

Two hours before under-way time—engineering duty section stations the watch. Commence pulling rods.

One and one-half hours before under-way time—reactor startup completed—warming up primary loop and steam lines.

Thirty minutes before under-way time—warm up turbines. Put turbogenerator sets in operation.

Fifteen minutes before under-way time—ready to answer bells.

4.2. How the Deck Officer Can Promote Efficient Boiler Operation. Some deck officers seem to feel that the engineer's only reason for blowing tubes is to spread fine carbon dust over the clean topside, and consequently they refuse to allow tubes to be blown on their watch. An understanding of the reason for blowing tubes may temper their reluctance to grant the necessary permission. The oil burned in boilers leaves a layer of soot on the outside of the small water tubes previously discussed. This soot is undesirable for the following reasons: (1) The soot acts as an insulator and slows heat transfer to the water within the tubes. (2) If the soot remains in a boiler when fires are secured, it absorbs moisture from the air; the moisture activates the sulfuric acid in the soot, and this acid in turn attacks the metal of the tubes and boiler drum. (3) If allowed to remain too long, the soot packs into a solid mass and can be removed only by tedious hand cleaning. To maintain maximum boiler efficiency, tubes should be blown, while under way, once every 4-hour watch and, while in port, twice a day. When "tubes are blown," high-pressure steam is admitted to perforated tubes (known as soot blower elements) which are permanently installed within the boiler. The elements are rotated so that steam jets from the perforations play on all the tube surfaces within the boiler, cleaning them thoroughly. Tubes should be blown when the wind is abeam. The officer of the deck should also be aware that maximum efficiency usually is served by steaming with a light brown haze

4.3. Combustion In Internal-Combustion Engines. The fuel for an internal-combustion engine is burned within the engine and the products of combustion pass directly through the engine, resulting in the transformation of

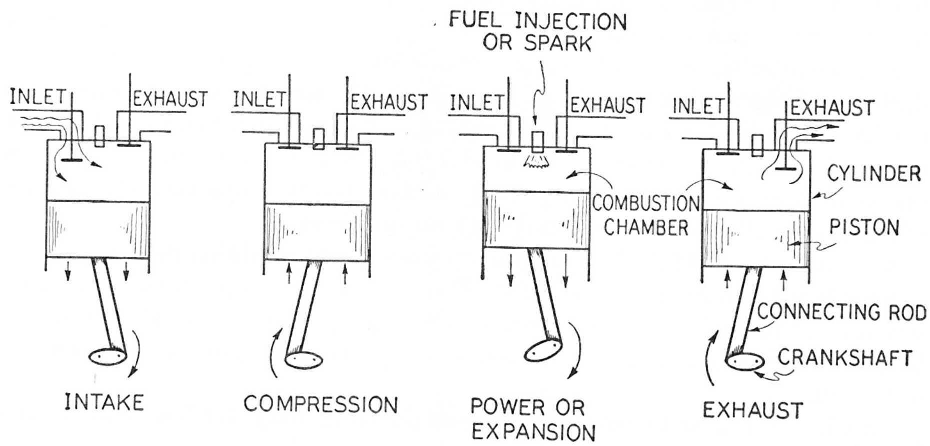

FIG. 4.3 ONE CYLINDER OF A SPARK IGNITION OR COMPRESSION IGNITION ENGINE (FOUR STROKE CYCLE) SHOWING THE FOUR PHASES IN ONE COMPLETE FIRING CYCLE

heat into mechanical energy. There are basic differences in the three common types of combustion chambers in internal-combustion engines. In the spark ignition, commonly referred to as the gasoline engine, combustion chambers are located in each cylinder and comprise the space between the top of the piston and the top of the cylinder. Fuel is admitted periodically and is ignited by an electrical spark. The fuel and air are mixed in the carburetor and enter the combustion chamber together. The gasoline engine is seldom seen in naval vessels or boats now because of its extreme fuel fire hazard.

The compression ignition or diesel engine is a reciprocating engine very similar to the spark ignition engine shown in Fig. 4.3. The main differences are that the fuel is ignited in the diesel engine by the high temperature of the highly compressed air in the combustion chamber; air only is taken in on the intake