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Text 1 General

For an aircraft to remain in level unaccelerated flight, a thrust must be provided that is equal to and opposite in direction to the aircraft drag. This thrust, or propulsive force, is provided by a suitable type of heat engine. All heat engines have in common the ability to convert heat energy into mechanical energy, by the flow of some fluid mass through the engine.

In addition to the differences in the methods employed by the various types of powerplants for producing thrust, there are differences in their suitability for different types of aircraft.

Generally, all engines must meet certain general requirements of efficiency, economy, and reliability. Besides being economical in fuel consumption, an aircraft engine must be economical (the cost of original procurement and the cost of maintenance) and it must meet exacting requirements of efficiency and low weight per horsepower ratio. It must be capable of sustained high-power output with no sacrifice in reliability; it must also have the durability to operate for long periods of time between overhauls. It needs to be as compact as possible, yet have easy accessibility for maintenance. It is required to be as vibration free as possible and be able to cover a wide range of power output at various speeds and altitudes.

These requirements dictate the use of ignition systems that will deliver the firing impulse to the spark plugs or igniter plugs at the proper time in all kinds of weather and under other adverse conditions. Fuel-metering devices are needed that will deliver fuel in the correct proportion to the air ingested by the engine regardless of the attitude, altitude, or type of weather in which the engine is operated. The engine needs a type of oil system that delivers oil under the proper pressure to all of the operating parts of the engine when it is running. Also, it must have a system of damping units to damp out the vibrations of the engine when it is operating.

For aircraft whose cruising speeds will not exceed 250 m. p. h. the reciprocating engine is the usual choice. When economy is required in the low-speed range, the conventional reciprocating engine is chosen because of its excellent efficiency. When high-altitude performance is required, the turbo-supercharged reciprocating engine may be chosen because it is capable of maintaining rated power to a high altitude (above 30,000 feet).

In the range of cruising speeds from 180 to 350 m. p. h. the turbo-propeller engine performs better than other types of engines. It develops more power per pound of weight than does the reciprocating engine, thus allowing a greater fuel load or payload for engines of a given power. The maximum overall efficiency of a turboprop powerplant is less than that of a reciprocating engine at low speed. Turboprop engines operate most economically at high altitudes, but they have a slightly lower service ceiling than do turbosupercharged reciprocating engines. Economy of operation of turboprop engines, in terms of cargo-ton-miles per pound of fuel, will usually be poorer than that of reciprocating engines because cargo-type aircraft are usually designed for low-speed operation. On the other hand, cost of operation of the turboprop may approach that of the reciprocating engine because it burns cheaper fuel.

Aircraft intended to cruise from high subsonic speeds up to March 2.0 are powered by turbojet engines. Like the turboprop, the turbojet operates most efficiently at high altitudes. High-speed, turbojet-propelled aircraft fuel economy, in terms of miles per pound of fuel, is poorer than that attained at low speeds with reciprocating engines.

However, reciprocating engines are more complex in operation than other engines. Correct operation of reciprocating engines requires about twice the instrumentation required by turbojets or turboprops, and it requires several more controls. A change in power setting on some reciprocating engine installations may require the adjustment of five controls, but a change in power on a turbojet requires only a change in throttle setting. Furthermore, there are a greater number of critical temperatures and pressures to be watched on reciprocating engine installations than on turbojet or turboprop installations.

New Words and Expressions

suitability [sju: tərbiliti] *n.* 适合,适当,适用性

procurement [prərkjuəmənt] *n.* 取得,征购

sustained [səsrteind] *adj.* 持久的,经久不衰的

durability [ʥdjurərbiliti] *n.* 持久性,耐久性

overhaul [ʥəuvərhɔ: l] *vt.* 仔细检查,翻修 *n.* 彻底检查,全面检修

accessibility [kʥsesirbiliti] *n.* 可以得到,易接近

reciprocating engine *n.* [机]往复式发动机

turbo-supercharged engine 涡轮增压发动机

turbo-propeller engine 涡轮螺旋桨发动机

turbojet engine 涡轮喷气发动机

throttle [ɾθrɔtl] *n.* 节流阀,节气阀,喉咙

Exercises

I. Fill in the table below by giving the corresponding translation.

English	Chinese
	推力与拉力
theory and construction	
	热能转换为机械能
turbo-propeller engine	
	改变油门
the use of ignition system	
	电嘴或火花塞
turboprop installations	
	温度与压力
meet certain general requirements	
	保持额定功率
fuel-metering devices	

II. Fill in the following blanks with suitable words and translate them into Chinese.

1. By the flow of some fluid mass through the engine, all heat engines have in common the ability to convert ______ into ______.

2. All engines must meet certain general requirements of ______ , ______ and ______.

3. Also, it must have a system of damping units to ______ the vibrations of the engine when it is operating.

4. It is required to be ______ vibration free ______ and be able to cover a wide range of power output at various speeds and altitudes.

5. Aircraft intended to cruise from high subsonic speeds up to ______ are powered by turbojet engines.

III. Fill in the blanks with the words given below according to the definition.

1. engine	2. plug
3. power	4. ignition system
5. turbojet engine	6. reciprocating engine

(　　) electrical device that fits into the cylinder head of an internal-combustion engine and ignites the gas by means of an electric spark

(　　) the mechanism that ignites the fuel in an internal-combustion engine

(　　) an internal-combustion engine in which the crankshaft is turned by pistons

(　　) jet engine in which a turbine drives air to the burner

(　　) the rate of doing work; measured in watts

(　　) motor that converts thermal energy to mechanical work

IV. Mark the following sentences with T(true) or F(false) according to the passage.

1. For an aircraft to remain in level unaccelerated flight, we must provide a thrust that is equal to and opposite in direction to the aircraft drag.

2. Not all heat engines have in common the ability to convert heat energy into mechanical energy.

3. In the range of cruising speeds from 350 to 180 m. p. h. other types of engines perform worse than the turbo-propeller engine.

4. The reciprocating engines are not simpler in operation than other engines.

5. A change in power setting on some reciprocating engine installations may require the adjustment of five or six controls, but a change in power on a turbojet requires only a change in throttle setting.

V. Answer the following questions briefly.

1. What should we do for an aircraft to remain in level unaccelerated flight?

2. What requirements do all engines meet?

3. Which engine performs the best in the range of cruising speeds from 180 to 350 m. p. h. ?

4. Are reciprocating engines more complicated or not in operation than other engines?

5. The cost of operation of the turboprop may approach that of the reciprocating engine. Why?

Text 2 Reciprocating Engines

Reciprocating engines may be classified according to cylinder arrangement with respect to the crankshaft (in-line, V-type, radial, and opposed) or according to the method of cooling (liquid cooled or air cooled). Actually, all engines are cooled by transferring excess heat to the surrounding air. In air-cooled engines, this heat transfer is direct from the cylinders to the air. In liquid-cooled engines, the heat is transferred from the cylinders to the coolant, which is then sent through tubing and cooled within a radiator placed in the airstream. The radiator must be large enough to cool the liquid efficiently. Heat is transferred to air more slowly than it is to a liquid. Therefore, it is necessary to provide thin metal fins on the cylinders of an air-cooled engine in order to have increased surface

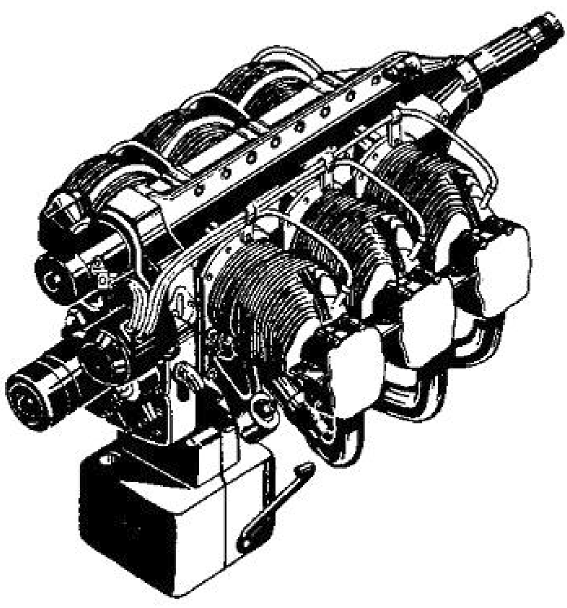

Fig. 1 – 1 **opposed engine**

for sufficient heat transfer. Most aircraft engines are air cooled.

The opposed-type engine, shown in Fig. 1 – 1, has two banks of cylinders directly opposite each other with a crankshaft in the center. The pistons of both cylinder banks are connected to the single crankshaft. Although the engine can be either liquid cooled or air cooled, the air-cooled version is used predominantly in aviation. It can be mounted with the cylinders in either a vertical or horizontal position.

The opposed-type engine has a low weight-to-horsepower ratio, and its narrow silhouette makes it ideal for horizontal installation on the aircraft wings.

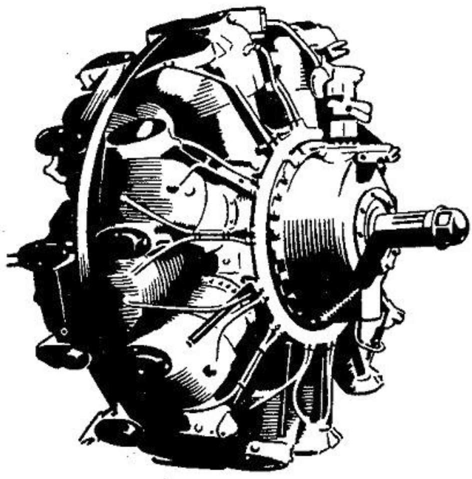

Fig. 1 – 2 **radial engine**

The radial engine consists of a row, or rows, of cylinders arranged radially about a central crankcase (see Fig. 1 – 2) . This type of engine has proven to be very rugged and dependable. The number of cylinders composing a row may be either three, five, seven, or nine. Some radial engines have two rows of seven or nine cylinders arranged radially about the crankcase.

The basic parts of a reciprocating engine are the crankcase, cylinders, pistons, connecting rods, valves, valve-operating mechanism, and crankshaft. In the head of each cylinder are the valves and spark plugs. One of the valves is in a passage leading from the induction system; the other is in a passage leading to the exhaust system. Inside each cylinder is a movable piston connected to a crankshaft by a connecting rod. Fig. 1 – 3 illustrates the basic parts of a reciprocating engine.

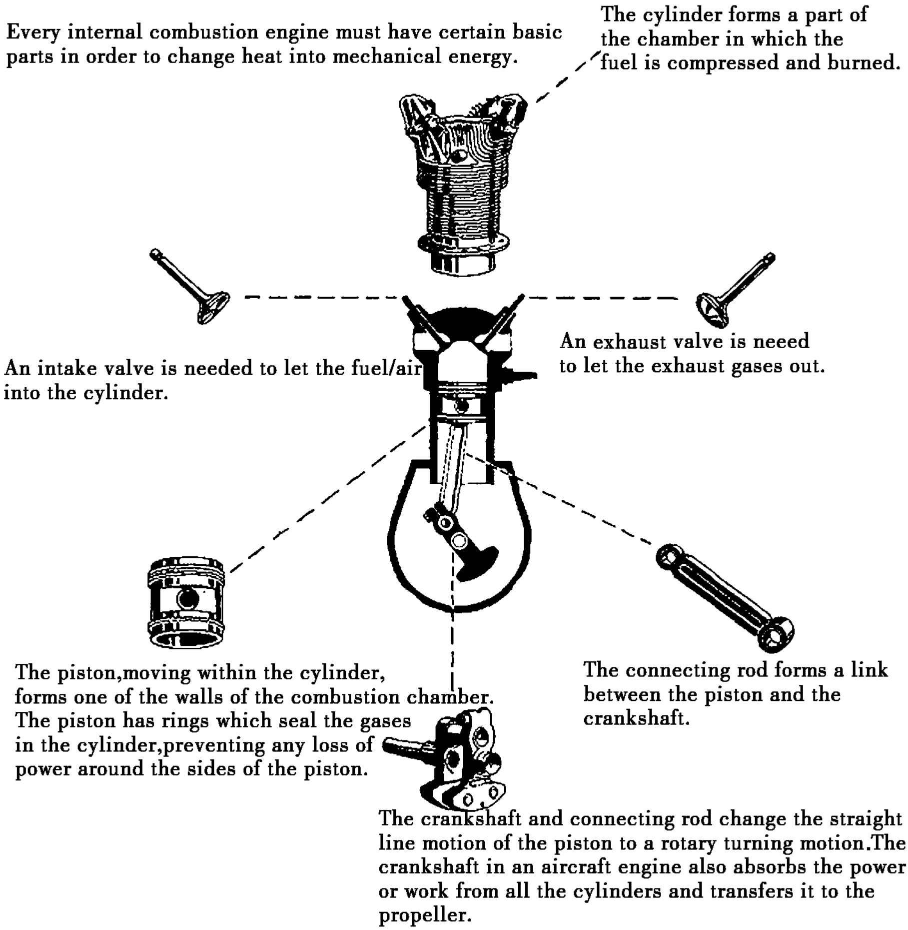

Fig. 1 – 3 basic parts of a reciprocating engine

An internal-combustion engine is a device for converting heat energy into mechanical energy. Gasoline is vaporized and mixed with air, forced or drawn into a cylinder, compressed by a piston, and then ignited by an electric spark. The conversion of the resultant heat energy into mechanical energy and then into work is accomplished in the cylinder. Fig. 1 – 4 illustrates the various engine components necessary to accomplish this conversion and also presents the principal terms used to indicate engine operation.

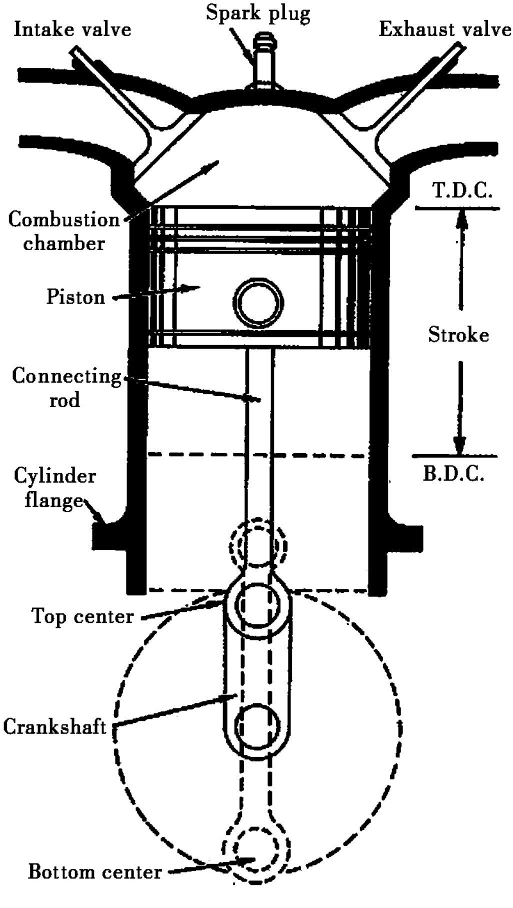

Fig. 1 – 4 components and terminology of engine operation

The operating cycle of an internal combustion reciprocating engine includes the series of events required to induct, compress, ignite, burn, and expand the fuel/air charge in the cylinder, and to scavenge or exhaust the byproducts of the combustion process.

New Words and Expressions

crankshaft [ɾkr ŋkʃɑ: ft] *n.* 机轴,曲轴

coolant [ɾku: lənt] *n.* 冷冻剂

silhouette [ʥsiluɾet] *n.* 影子,轮廓 *vt.* 使显出轮廓

crankcase [ɾkr ŋkkeis] *n.* 曲轴箱

rugged [ɾrʌgid] *adj.* 高低不平的,粗糙的

rod [rɔd] *n.* 杆,棒

induction [inɾdʌkʃən]进气通道

scavenge [ɾsk vindʒ] *vt.* 打扫,排除废气

Exercises

I. Fill in the table below by giving the corresponding translation.

English	Chinese
	液冷发动机
the method of cooling	
	曲轴
aircraft engines	
	对立式发动机
the radial engine	
	坚固可靠
internal-combustion engine	
	电火花
the operating cycle	

English	Chinese
	散热片
either liquid cooled or air cooled	

II. Fill in the following blanks with suitable words and translate them into Chinese.

1. Reciprocating engines may be classified according to _______ or _______.

2. Therefore, it is _______ to provide thin metal fins on the cylinders of an air-cooled engine in order to have increased surface for sufficient heat transfer. Most aircraft engines are _______.

3. _______ has two banks of cylinders directly opposite each other with a crankshaft in the center.

4. The number of cylinders composing a row may be either _______, _______, _______, or _______. Some radial engines have _______ rows of _______ or _______ cylinders arranged radially about the crankcase.

5. The basic parts of _______ are the crankcase, cylinders, pistons, connecting rods, valves, valve-operating mechanism, and crankshaft.

6. Gasoline is _______ and mixed with air, forced or drawn into _____, compressed by _______ and then ignited by _______.

III. Fill in the blanks with the words given below according to

the definition.

1. crankshaft　　2. coolant

3. radial engine　　4. piston

5. vaporize　　6. valve

(　　) a fluid agent (gas or liquid) that produces cooling

(　　) a rotating shaft driven by (or driving) a crank

(　　) mechanical device that has a plunging or thrusting motion

(　　) turn into gas

(　　) a structure in a hollow organ (like the heart) with a flap to insure one-way flow of fluid through it

(　　) an internal-combustion engine having cylinders arranged radially around a central crankcase

IV. Mark the following sentences with T(true) or F(false) according to the passage.

1. Not all engines are cooled by transferring excess heat to the surrounding air.

2. The opposed-type engine has two banks of cylinders directly next to a crankshaft in the center.

3. Gasoline is vaporized and mixed with water, forced or drawn into a cylinder, compressed by a piston, and then ignited by an electric spark.

4. Every internal combustion engine must have certain basic parts in order to change heat into mechanical energy.

5. The connecting rod forms a link between the piston and the crankshaft.

V. Answer the following questions briefly.

1. All engines are cooled by transferring excess heat to the surrounding air. How do the air-cooled engines and liquid-cooled engines work?

2. Which engine can be either liquid cooled or air cooled?

3. How does an internal-combustion engine convert heat energy into mechanical energy?

4. What is the operating cycle of an internal combustion reciprocating engine?

5. What parts does the radial engine consist of?