

A Practical Course for Engineers Working on Board Ships



# 《轮机英语》

## Marine Engineering English



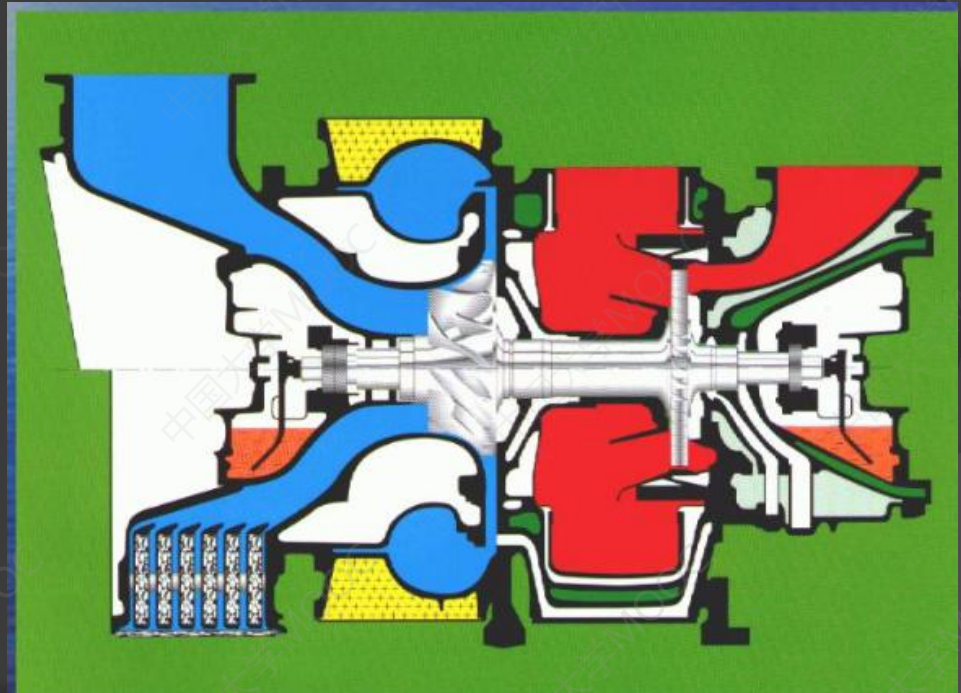
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# Lesson 6

## The Gas Exchange process



## Learning Objectives:

1. Grasp some useful words and expressions in the whole text.
2. After studying the lesson, he or she will have a better understanding of The Gas Exchange process

part 1

# New Words and Expressions





## Lesson 6 The Gas Exchange Process | Text

supercharge

aspect

comprise

turbine

density

filter silencer

moisture

foul

differential

swirl

appropriate

charge air cooler

cross flow scavenging

loop scavenging

uniflow scavenging

v. 增压

n. 方面

v. 包括

n. 透平, 涡轮机

n. 密度

n. 滤器消音器

n. 水分, 湿气

v. 弄脏, 阻塞

a. 差别的, 不同的

v. 使……涡旋运动

a. 适当的

进气冷却器

横流扫气

回流扫气

直流扫气

# part 2

## Text Analysis





A basic part of the cycle of an **internal combustion engine** is the supply of fresh air and removal of **exhaust gases**. This is the **gas exchange**.

内燃机

废气  
换气

换气是内燃机工作循环的一个基本环节





**Scavenging** is the removal of exhaust gases from the cylinder by blowing in fresh air. **Charging** is the filling of the engine cylinder with a supply or charge of fresh air ready for compression.

扫气  
进气  
(填充)

扫气就是用新鲜空气将气缸里的废气清扫干净。。。





Air supply is very important to the perfect combustion of fuel in the diesel engine. As the **air density** determines the maximum weight of fuel that can be burned per **working stroke** in the cylinder, it also determines the maximum power that can be developed by the engine.①

空气密度  
工作循环

本句中**As**引导原因状语从句, **that can be burned...**为定语从句修饰**maximum weight**, **that can be developed...**为定语从句修饰**power**。  
全句译为: 因为空气的密度决定了气缸中每一工作冲程所能燃烧的最大燃油量, 也决定了发动机可发出的最大功率。



If the **charge-air density** is increased by a **compressor** before it enters the cylinder, a **greater amount** of fuel can be burned, resulting in an increase of **power output.** 输出功率

船用的  
压缩机  
更大数量

空气密度增加，空气的总量增加，可燃烧的燃油增加  
输出功率增加。



This is the **main principle** of exhaust turbo-charging.

主要原理  
涡轮增压

涡轮增压的工作原理



In today's practice, the compressor, **i. e. a blower**, is driven by the **heat energy** obtained from the engine exhaust gases.

即：也就是  
鼓风机  
热能

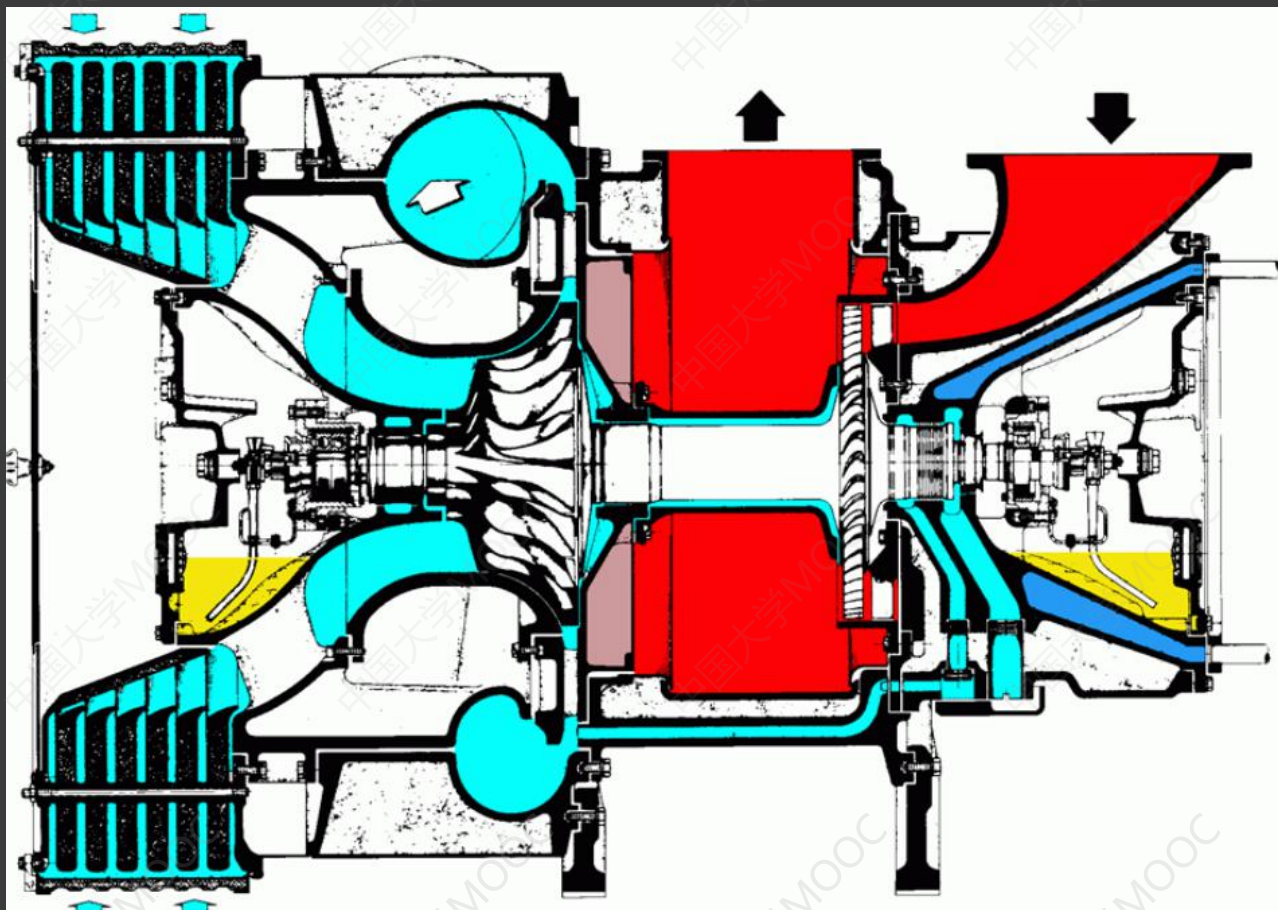
如今的实际情况是，压缩机，即鼓风机，由热能驱动  
热能来自于发动机的废气



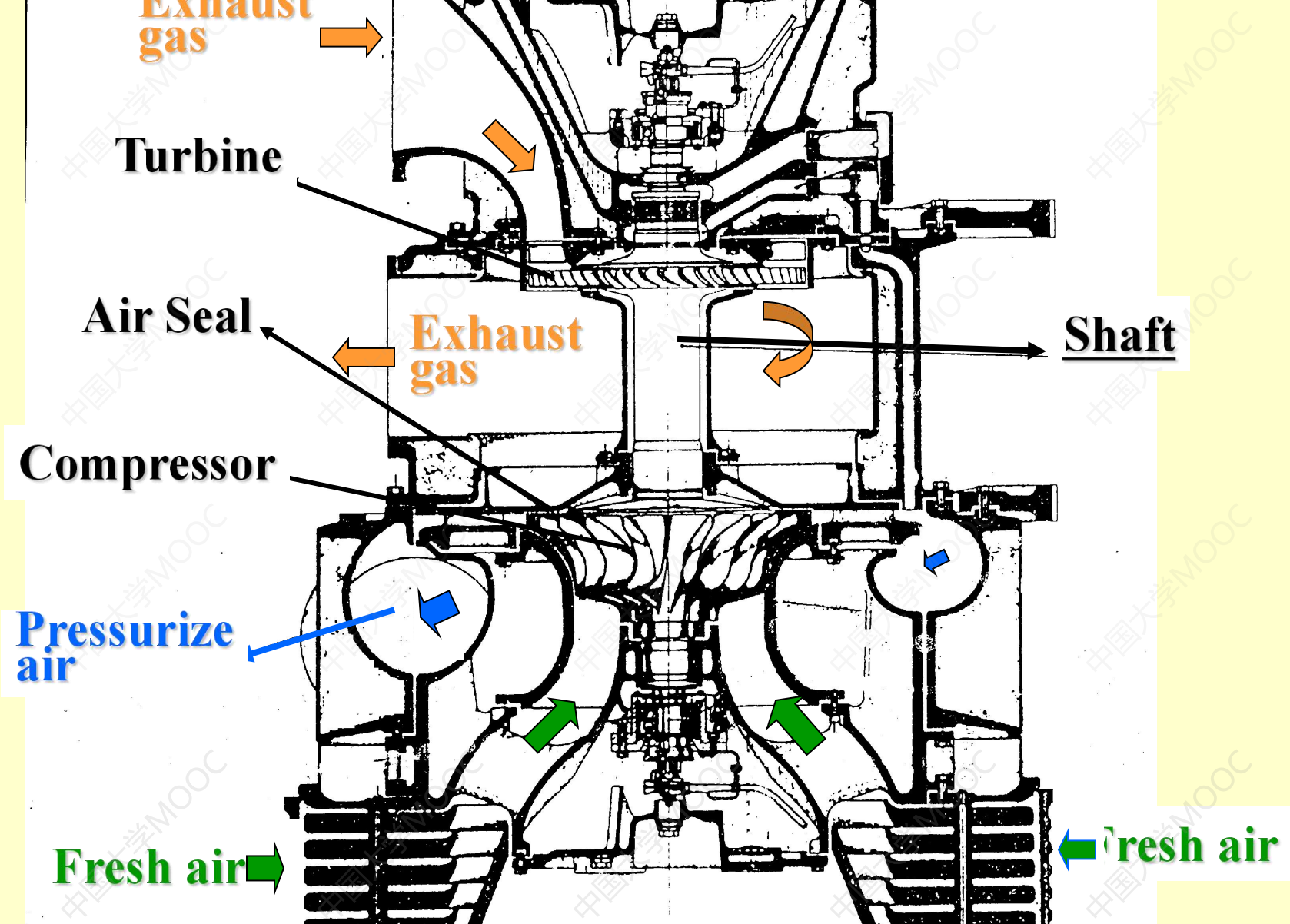
The **turbo-blower** comprises a **gas-turbine**, driven by the engine exhaust gases and directly **coupled** to the blower, which **draws** fresh air from the engine room and **discharges** it into the air inlet **manifold** on the engine.②

涡轮增压器  
废气透平  
连接

-- 本句中 **driven...and directly coupled...** 是过去分词修饰 **gas-turbine**, **which** 引导非限制性定语从句补充说明 **blower**。  
全句译为：涡轮增压器包含一个废气涡轮，该涡轮由发动机废气驱动并直接与增压器相联，增压器从机舱内吸入新鲜空气并排入发动机进气总管。











The power produced in the turbine must be equal to that required by the compressor. The air is pumped into the cylinder through the inlet ports. The turbo-blower is provided with a **filter silencer**.

过滤消声器

涡轮产生的能量和压缩机需要的能量要平衡



**According to** the way the energy of the exhaust gases is **utilized**, pressure-charging can be divided into two main systems, namely, the **constant-pressure** system and the **pulse system**.

根据  
使用，利用

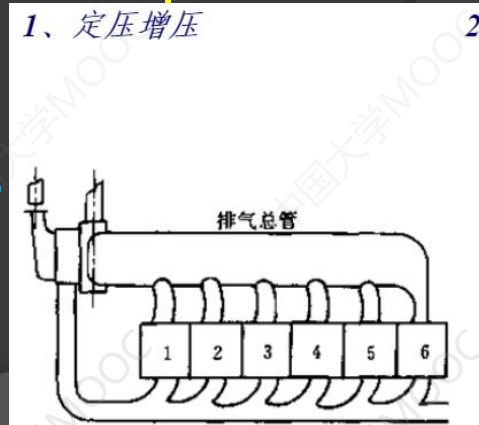
根据利用能量的方式，定压增压系统和脉冲增压系统



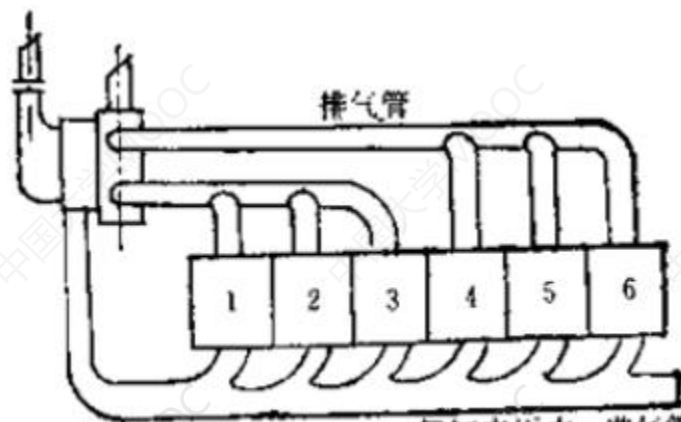
It is usually desirable to **fit charge-air coolers** to turbo-charged two stroke engines. The coolers are **located** between the turbo-blowers and the cylinders.

安装  
增压空气  
冷却器

增压空气冷却器，位于涡轮增压器和气缸之间



## 2、脉冲增压





As the charge-air **density increases**, the amount flowing into the cylinders is increased and as the charge-air temperature lowers, the exhaust temperature and the engine **thermal loading** are reduced.

密度增加  
热负荷

因为冷却，密度增加，温度的降低也降低了热负荷



The charge-air cooler is usually of the **water-cooled** design with the sea water circulating in it.

水冷  
循环

增压空气冷却器是水冷式的，且多是海水循环  
(新式发动机用淡水)



As the air passes through the charge air cooler, its temperature may be reduced and **moisture condensed**, with the condensation in danger of being carried into the engine. So a **water separator** should be mounted **beneath** the bottom part of the engine inlet manifold.

水分凝结  
水分离器  
底部

因为温度的降低，空气中水汽会凝结，因此需要在发动机进气总管的底部安装水分离器





It is very important that each cylinder should be well scavenged before the charged air is compressed, otherwise this fresh air charge will be fouled by the residual exhaust gases from the last cycle.③

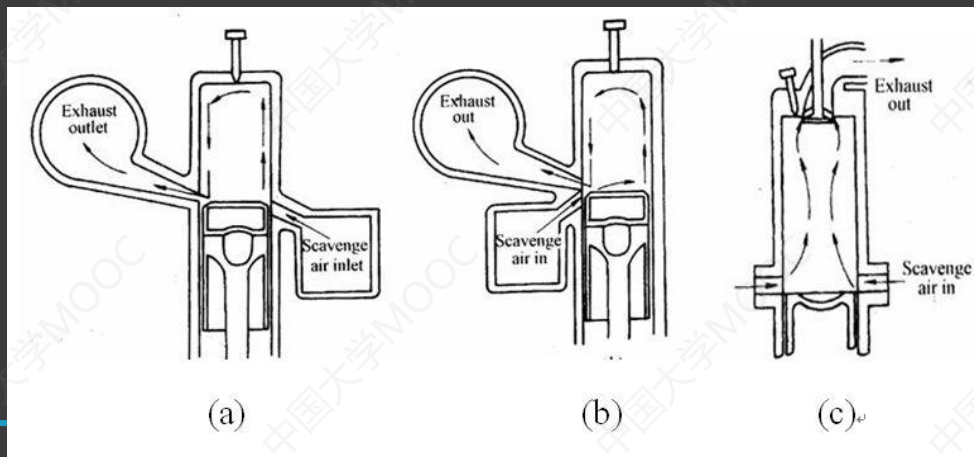
污染，弄脏

本句中**it**是形式主语，**that**引导真正的主语从句，**before** 引导时间状语从句，**otherwise** 引导让步状语从句。

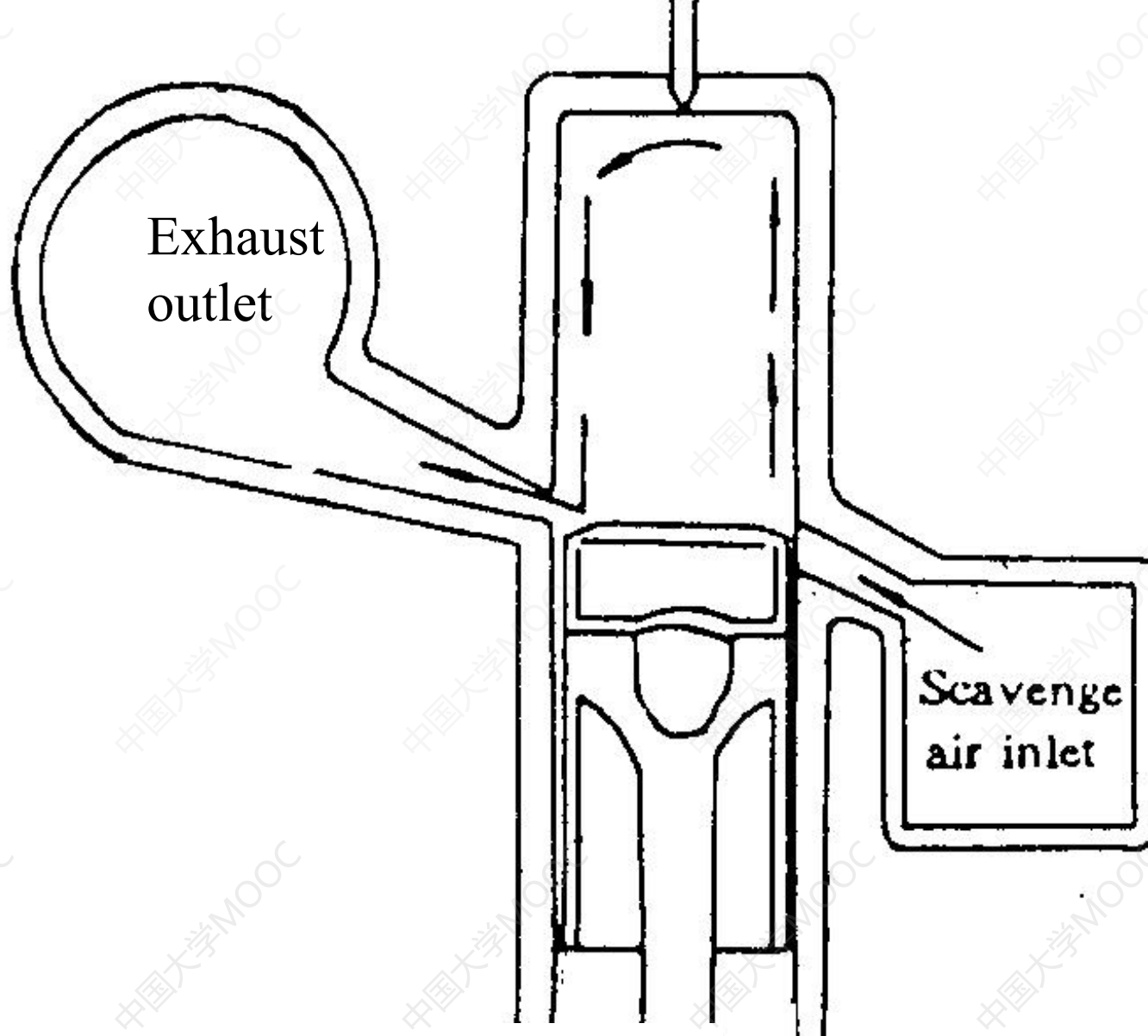
全句译为：各缸在增压空气被压缩前，进行良好的扫气是尤为重要的，否则充入的新鲜空气会被上一循环中的残余废气所污染。



Three basic systems are in common use: the cross flow, the loop and the uniflow.



三个常用系统：弯流（横流）、回流、直流

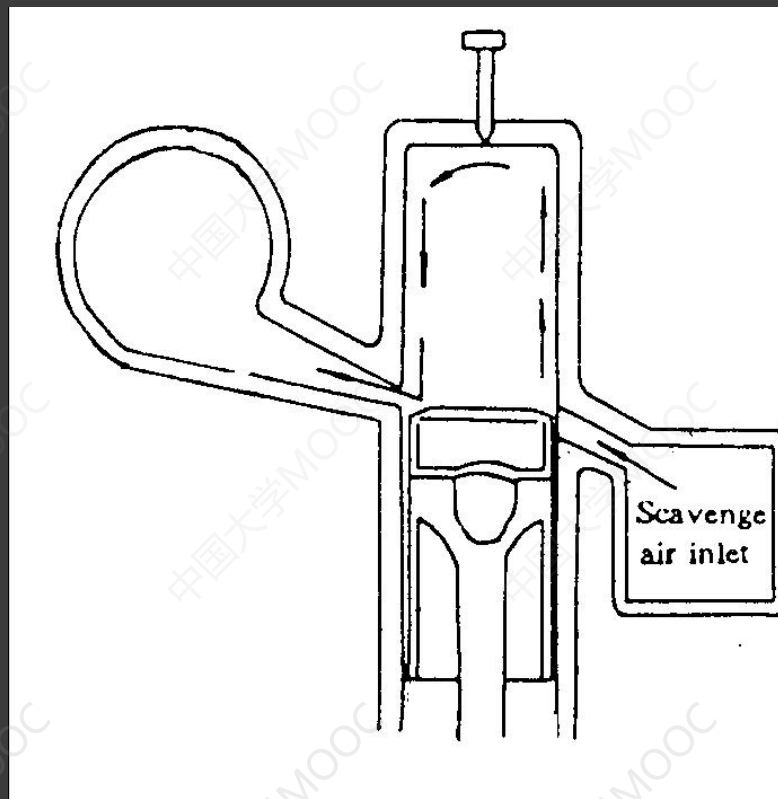




In cross scavenging the **incoming air** is directed upwards, pushing the exhaust gases before it. The exhaust gases then travel down and out of the exhaust ports.

进气空气

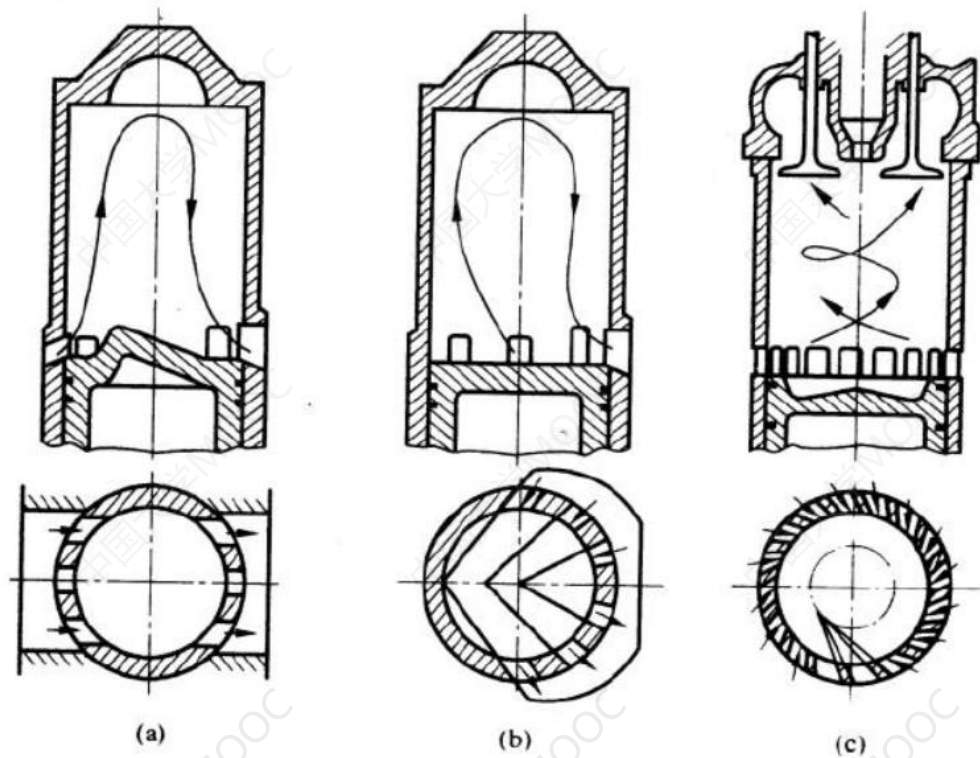
弯流扫气方式。。。



**a** 横流扫气

**b** 回流扫气

**c** 直流扫气





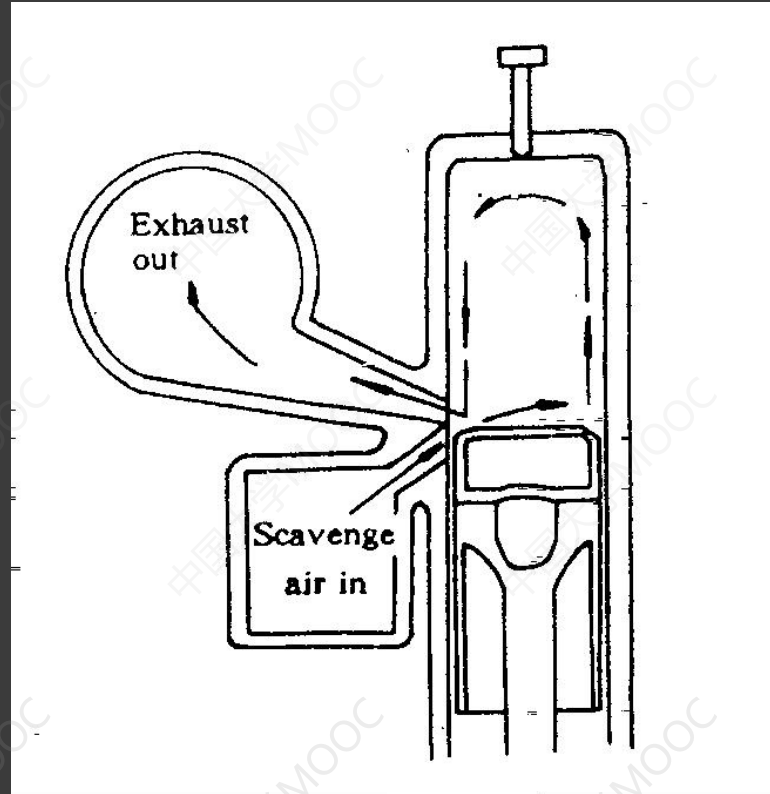
## Lesson 6 The Gas Exchange Process | Text

In loop scavenging the incoming air passes over the **piston crown** then **rises** towards the **cylinder head**. The exhaust gases are forced before the air passing down and out of exhaust ports located just above the inlet ports.

活塞头  
气缸盖

回流扫气方式。。。



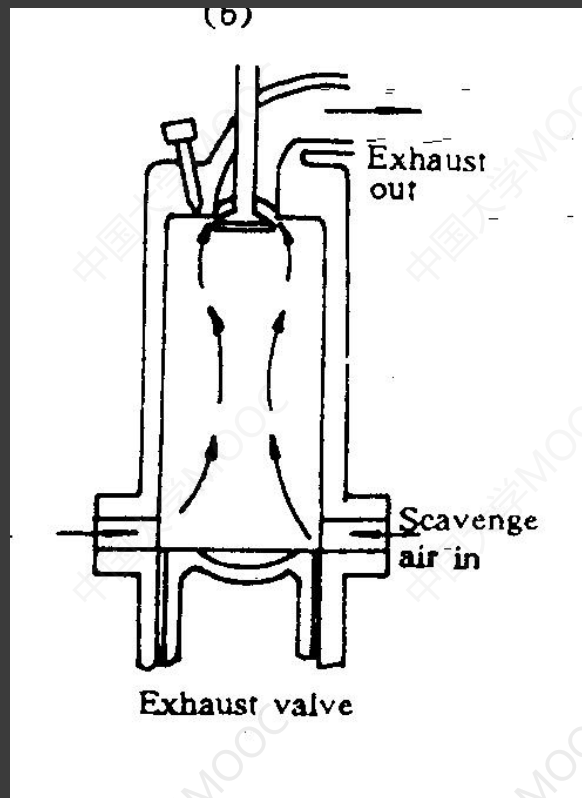




With **uniflow scavenging** the incoming air enters at the lower end of the cylinder and leaves at the top.

直流  
扫气方式

直流扫气方式。。。





Each of the system has various **advantages and disadvantages.**

Cross scavenging requires the fitting of a **piston skirt** to prevent air or exhaust gas escape when the piston is at the top of the stroke.

弯流扫气方式需要长的活塞裙

优点和缺点  
活塞裙



Loop scavenge **arrangements** have low temperature air and high temperature exhaust gas passing through **adjacent** ports, causing temperature differential problems for the **liner material**.

裝置  
鄰近的  
缸套材料

回流扫气方式的气口挨得近，因此材料有热应力的问题



Uniflow is the **most efficient** scavenging system but requires an **exhaust valve** in the cylinder head.

最有效率  
排气阀

直流扫气最有效率。。。



All these systems have the ports **angled** to **swirl** the incoming air and direct it in the **appropriate path**.

角度  
旋转  
恰当的路径

进气口都有一定角度，使得进气能够旋转。。。。



***part 3***

# ***Exercise & Examination***



## Lesson 6 The Gas Exchange Process | Exercise

1. **Clearance** volume scavenging in a turbocharged, four-stroke/cycle diesel engine is accomplished\_\_\_\_\_.

- A. during the valve **overlap** period
- B. with only the exhaust valve open
- C. at a pressure below atmospheric
- D. without cooling the cylinders or pistons

**A**

间隙、空隙

重叠

在增压四冲程柴油机中,气缸余隙容积的扫气是在气阀重叠期间完成的。



2. Valve **cages** are used on some large diesel engines to \_\_\_\_\_.

- A. reduce wear on the valve stem
- B. permit the use of alloy valve seat materials
- C. reduce heat transfer from the valve seat
- D. facilitate valve removal for servicing

**D**

笼子，壳体

一些大型发动机中使用阀壳,其目的是方便气阀拆出检修。



## Lesson 6 The Gas Exchange Process | Exercise

3. Valve lash, or **clearance** refers to the\_\_\_\_\_.

A. clearance between the top of the valve stem and the **rocker arm**

B. compression of the valve springs

C. clearance between the valve seat inserts and the head

D. out of roundness of the fuel injection cams

**A**

间隙

摇臂

气阀间隙指的是阀杆顶部和摇臂之间的间隙。



## Lesson 6 The Gas Exchange Process | Exercise

4. Valves in the **cylinder head** of a diesel engine are opened by the direct action of the \_\_\_\_\_.

- A. exhaust pressure
- B. valve spring pressure
- C. rocker arm movement
- D. wrist pin movement

C

气缸盖

柴油机气缸上的气阀由摇臂运动直接打开。



5. The **exhaust ports** of a diesel engine using the **cross-flow** scavenging method are opened and closed by the \_\_\_\_\_.

- A. reciprocating motion of exhaust valves
- B. rotary motion of the camshaft
- C. reciprocating motion of the piston
- D. developed differential

C

排气口

横流扫气

使用横流式扫气的柴油机的排气口通过活塞的往复运动启闭。



6. "Scavenging" on a diesel engine means\_\_\_\_\_.

- A. injecting fuel oil into a cylinder
- B. removing exhaust gases from the cylinder
- C. forcing air into the cylinders under pressure after the exhaust valve has closed
- D. a combination of all the above

B

做扫气

柴油机扫气是指从气缸内去除废气。



## Lesson 6 The Gas Exchange Process | Exercise

7. All three **scavenging systems** have the ports \_\_\_\_\_ to swirl the incoming air and **direct** it in the appropriate path.

- A. angled
- B. rounded
- C. being angled
- D. being rounded

A

扫气系统

引导

所有三种扫气系统中,气口都成一定角度,使进气作回转运动。





## Lesson 6 The Gas Exchange Process | Exercise

8. A **pyrometer** is an **instrument** used to measure the temperature of the diesel engine\_\_\_\_\_.

- A. exhaust
- B. fuel oil
- C. cooling water
- D. cylinder liner

高温计

仪器仪表

A

高温计常用来测量排气温度。



## Lesson 6 The Gas Exchange Process | Exercise

9. Usually we take the cooling effect of the air flown through the cylinder during the **overlap period** as \_\_\_\_\_.

- A. inevitable
- B. harmful
- C. helpful
- D. unacceptable

重叠期间

C

通常我们认为在气阀重叠期通过气缸的贯穿气流产生的冷却效果是有益的。



10. **After-cooling** of a turbocharged diesel engine will result in\_\_\_\_\_.

- A. higher torque but lower brake horsepower
- B. lower torque but higher brake horsepower
- C. higher torque and higher brake horsepower
- D. lower torque and lower brake horsepower

C

后冷却

涡轮增压柴油机后(空)冷器会导致高的扭矩和高的制动马力。