МУЛЬТИМЕДИЙНАЯ ТРЕНАЖЕРНАЯ ПРОГРАММА

МТП «СУДОВЫЕ КОМПРЕССОРЫ»

Версия 1.0

Назначение:

Мультимедийная тренажерная программа предназначена для практической подготовки специалистов машинного отделения по эксплуатации системы сжатого воздуха в соответствии с требованиями Конвенции ПДНВ и национальными требованиями.

В МТП включены:

- Интерактивный имитатор пульта управления системой сжатого воздуха.
- Интерактивная мнемосхема системы подачи воздуха.
- Описание компрессоров различных типов и системы сжатого воздуха с фотографиями, схемами и анимационными роликами.
- Задания для проверки знаний.

Целевая аудитория

Машинная команда – Управления

Машинная команда – Эксплуатации

Машинная команда - Вспомогательный

Тип судна

Все типы

Нормативная база:

Конвенция ПДНВ:

- Правила III/1, III/2, III/3, III/4, III/5

Кодекс ПДНВ:

- Раздел A-III/1, Таблица A-III/1 «Спецификация минимального стандарта компетентности для вахтенных механиков судов с обслуживаемым или периодически необслуживаемым машинным отделением», сфера компетентности «Эксплуатация главных установок и вспомогательных механизмов и связанных с ними систем управления».
- Раздел A-III/2, Таблица A-III/2 «Спецификация минимального стандарта компетентности для старших механиков и вторых механиков с главной двигательной установкой мощностью 3 000 кВт или более», сфера компетентности «Эксплуатация, наблюдение, оценка работы и поддержание безопасности двигательной установки и вспомогательных механизмов».
- Раздел A-III/4, Таблица A-III/4 «Спецификация минимального стандарта компетентности для лиц рядового состава машинной вахты», сфера компетентности «Выполнение обычных обязанностей по вахте в машинном отделении, которые поручаются лицам рядового состава».
- Раздел A-III/5, Таблица A-III/5 «Спецификация минимального стандарта компетентности для лиц рядового состава в качестве квалифицированного моториста на судах с обслуживаемым или периодически необслуживаемым машинным отделением», сфера компетентности «Содействие наблюдению и управлению несением машинной вахты».

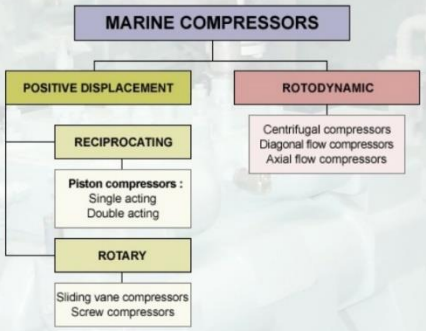
1. CLASSIFICATION OF MARINE COMPRESSORS

1.1 DEFINITION AND CLASSIFICATION

Compressor is the machine used for compression and transfer of the air, gases or steams from the space of lower pressure (suction pressure *p ss* on the compressor inlet) to the space of higher pressure (discharge pressure *p t* on the compressor outlet), in which the compression ratio σ described as the ratio of absolute discharge pressure to absolute suction pressure is higher than two ($\sigma = p_d / p_s > 2$).
The compressor accomplishes this task by supplying energy to the compressed medium. As a result the positive pressure difference is created between the discharge and suction side of the compressor working device (piston , impeller) i.e. $p_d > p_s$.
The compressor is driven by an electric motor, a diesel engine or a steam engine directly or via reduction gear.

Marine compressor means compressor used in ship systems.

Marine compressors are divided:
1) according to the principle of working - into positive displacement and rotodynamic compressors,
2) according to the task in ship systems - into starting air, service air, refrigerator, air condition compressors etc.,
3) according to the compressed medium - into air, refrigerants, technical gases compressors etc.



2. POSITIVE DISPLACEMENT COMPRESSORS

2.3.1 PISTON COMPRESSORS

The construction of single acting (trunk) one-stage air piston compressor is shown on figure 2.1.

Main parts of compressor are piston **1**, cylinder block **2**, cylinder head **3**, crankshaft **4**, connecting rod **6**, intake (suction) valve **10** and discharge valve **11**.
The crank mechanism driving the piston is placed inside crankcase **9**, which together with cylinder block forms the compressor frame.
The piston is connected to the connecting rod by means of the piston pin **7** and sealed in the cylinder by the piston rings **8**.
There is the intake (suction) filter **12** placed on the air inlet into compressor.
The outlet pipe is fitted with non-return valve **13**.
The safety valve **14** and the relief valve **15** are mounted on the cylinder head.
The cylinder and the cylinder head are cooled by water in the jacket **16**.
The compressor is driven by an electric motor directly or via the V-belt transmission.

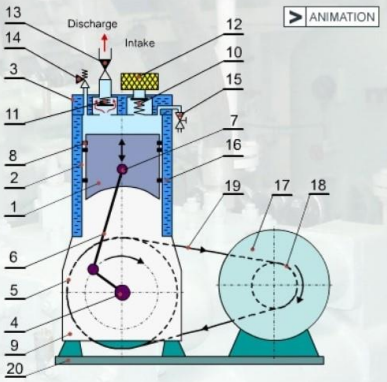


Fig. 2.1. Construction of single acting one-stage piston compressor
1 – piston; 2 – cylinder; 3 – cylinder head; 4 – crankshaft; 5 – flywheel; 6 – connecting rod; 7 – piston pin; 8 – piston ring; 9 – crankcase; 10 – intake valve; 11 – discharge valve; 12 – intake filter; 13 – non return valve; 14 – safety valve; 15 – relief valve; 16 – cooling water jacket; 17 – electric motor; 18 – pulley; 19 – V-belt; 20 – foundation

3. ROTODYNAMIC COMPRESSORS

3.3 ROTODYNAMIC CENTRIFUGAL COMPRESSORS

The basic parts of centrifugal compressor (fig. 3.1) are the casing **1**, the impeller **4** with blades **5** mounted on the shaft **2**, intake confusor **6**, guide inlet blades **7**, the diffuser **8** and the collecting channel **9**. The shaft is placed in the bearings **3** and sealed in the casing by the glands **10**. Inside casing the impeller has an internal seal **11**.

The compressor is directly driven by electric motor, steam turbine or gas turbine. If necessary the reduction gear may be used.

During the compressor operation the impeller rotates with high constant revolutions – the direction of rotation is shown by arrow marked **n** on figure 3.1. The gas rotating together with the impeller **4** moves outwards under the centrifugal forces which at the same time create the vacuum on the blades inlet and in the space from where the gas is drawn. Application of intake confusor **6** and inlet guide blading **7** causes the guidance of the flowing medium and minimises the energetic losses at the impeller intake. In the compressor impeller the energy is transferred to the compressed medium as a kinetic energy (velocity), potential energy (pressure) and thermal energy (increase of gas temperature). Simultaneously due to the compressibility of the gas its volume decreases. The compressed gas flows to the blading of the diffuser **8** where due to the increasing area of flow the velocity is reduced and the increase of pressure is continued. After the diffuser is left the compressed gas is led to the discharge pipe through the collecting channel **9**, where the further increase of pressure can occur.

The less advanced constructions of centrifugal compressors may have the inlet without the intake confusor and the diffuser without blading. In this case however the efficiency and the compression ratio decreases. One-stage centrifugal compressors achieve the compression ratio σ about 2,5 while the multi-stage centrifugal compressors achieve a bigger ratio.

ANIMATION

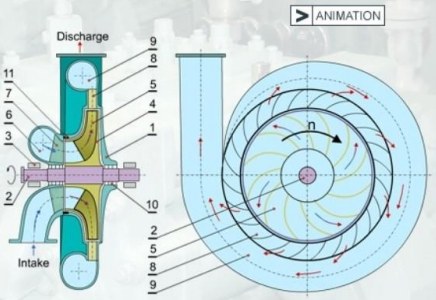


Fig. 3.1. Rotodynamic centrifugal compressor
1 – casing; 2 – shaft; 3 – shaft bearing; 4 – impeller; 5 – blade; 6 – intake confusor; 7 – guide blade; 8 – diffuser; 9 – collecting channel; 10 – shaft gland; 11 – impeller seal

5. COMPRESSED AIR SYSTEM

5.1 MAIN AIR SYSTEM

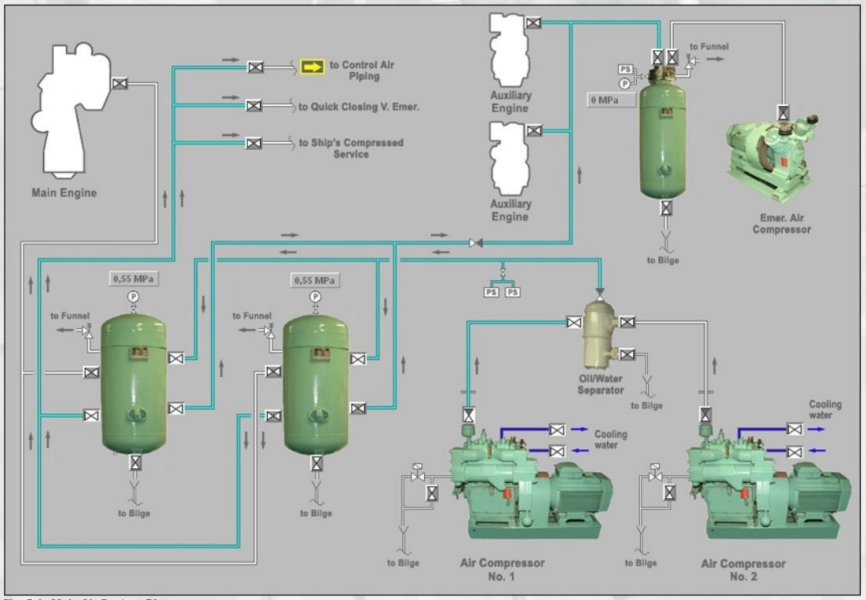
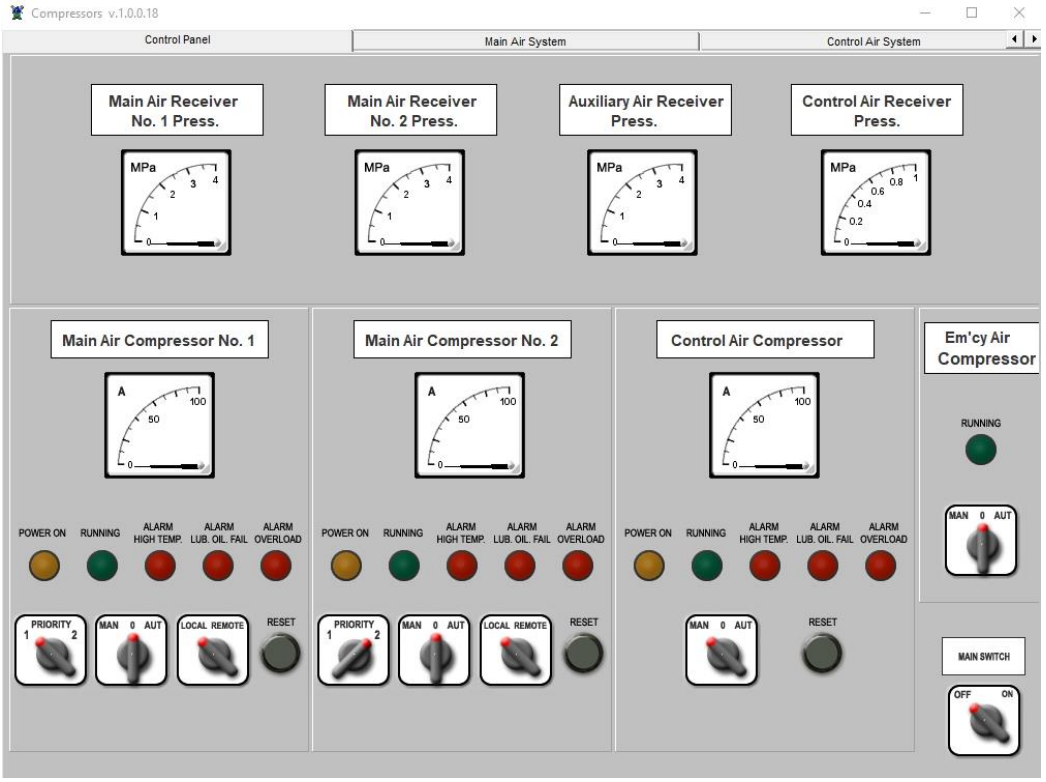
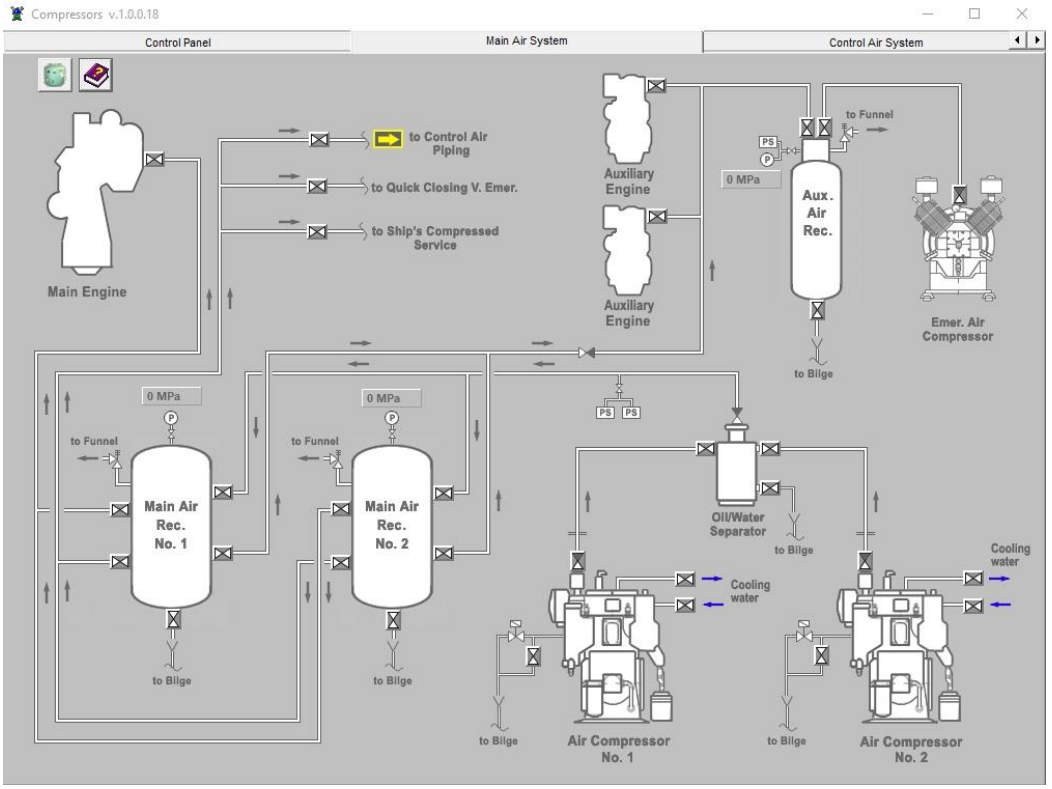


Fig. 5.1. Main Air System Diagram


Compressors v.1.0.0.18
Control Panel
Main Air System
Control Air System
Main Air Receiver No. 1 Press.
Main Air Receiver No. 2 Press.
Auxiliary Air Receiver Press.
Control Air Receiver Press.
MPa
Main Air Compressor No. 1
Main Air Compressor No. 2
Control Air Compressor
Em'cy Air Compressor
A
POWER ON
RUNNING
ALARM HIGH TEMP.
ALARM LUB. OIL. FAIL
ALARM OVERLOAD
PRIORITY
MAN 0 AUT
LOCAL REMOTE
RESET
MAIN SWITCH
OFF ON


Compressors v.1.0.0.18
Control Panel
Main Air System
Control Air System
to Control Air Piping
to Quick Closing V. Emer.
to Ship's Compressed Service
Main Engine
Auxiliary Engine
Auxiliary Engine
0 MPa
Aux. Air Rec.
to Funnel
to Bilge
Emer. Air Compressor
Main Air Rec. No. 1
Main Air Rec. No. 2
Oil/Water Separator
Cooling water
Air Compressor No. 1
Air Compressor No. 2