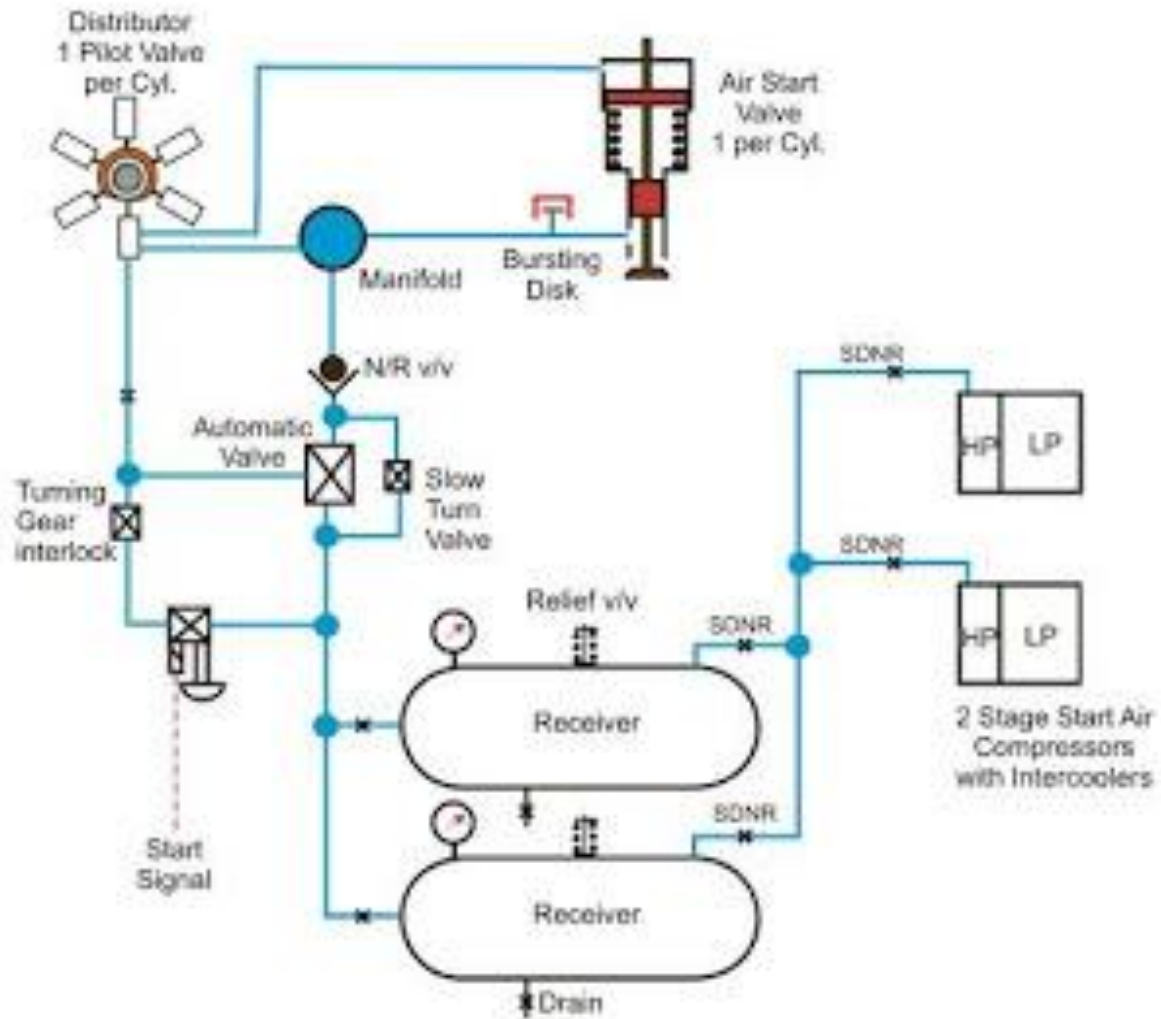


Main Engine Starting Air System

15



- ▶ Marine diesel engines are started by admitting compressed air to the cylinders at the appropriate point in the cycle. The air stored in receivers which are charged by compressors. A pressure of about 28 bar is usual.
- ▶ Compressed air from the receivers is supplied by a large bore pipe to an automatic or remote operating non-return valve and then to the cylinder air starting valve. Opening of the air starting valve will admit compressed air into the cylinder. The opening of the remote operating valve and the air starting valve is controlled by a pilot air system. The pilot air is drawn from the large bore pipe and passes to a pilot air control valve which is operated by the engine starting air lever.

Fill in the missing words

- ▶ Marine diesel engines are started by a _____ compressed air to the cylinders at the a _____ point in the cycle.
- ▶ The air is s _____ in receivers which are c _____ by compressors.
- ▶ A pressure of about 28 bar is u _____.
- ▶ Compressed air from the receivers is s _____ by a large bore pipe to an automatic or r _____ operating non-return valve and then to the cylinder air starting valve.
- ▶ Opening of the air starting valve will a _____ compressed air into the c _____.
- ▶ The o _____ of the remote operating valve and the air starting valve is c _____ by a pilot air system.
- ▶ The pilot air is d _____ from the large bore pipe and p _____ to a pilot air control valve which is o _____ by the engine starting air lever.

Supply the missing terms

- ▶ Marine diesel engines are started by admitting _____ to the cylinders at the appropriate point in the _____.
- ▶ The air is stored in _____ which are charged by _____.
- ▶ A pressure of about 28 _____ is usual.
- ▶ Compressed air from the _____ is supplied by a large bore pipe to an automatic or remote operating _____ and then to the cylinder air starting valve.
- ▶ Opening of the _____ will admit compressed air into the cylinder.
- ▶ The opening of the remote operating valve and the _____ is controlled by a pilot air system.
- ▶ The pilot air is drawn from the large bore pipe and passes to a _____ which is operated by the engine starting air _____.

- ▶ When the starting lever is moved, part of the pilot air flows to the automatic or remote operating valve causing it to open. Another supply of pilot air for the appropriate direction-ahead or astern- is passed to the air distributor. This device consists of timing valves synchronized with the engine position in order to provide air to operate each starting valve in the correct order and timing as the engine rotates. Timing is controlled by cams or gear drive from the engine camshaft. The air starting valves are held closed by springs when not in use and opened by the pilot air enabling the compressed air from the receivers to enter directly the engine cylinders. An interlock is shown in the remote operating valve line which stops the valve opening when the engine turning gear is engaged. The remote operating valve prevents the return of air which has been further compressed by the engine into the system.

Underline the verbs showing the various steps in the operation of the air start system

- ▶ When the starting lever is moved, part of the pilot air flows to the automatic or remote operating valve causing it to open. Another supply of pilot air for the appropriate direction-ahead or astern- is passed to the air distributor. This device consists of timing valves synchronized with the engine position in order to provide air to operate each starting valve in the correct order and timing as the engine rotates. Timing is controlled by cams or gear drive from the engine camshaft. The air starting valves are held closed by springs when not in use and opened by the pilot air enabling the compressed air from the receivers to enter directly the engine cylinders. An interlock is shown in the remote operating valve line which stops the valve opening when the engine turning gear is engaged. The remote operating valve prevents the return of air which has been further compressed by the engine into the system.

- ▶ Lubricating oil from the compressor will under normal operations pass along the air lines and deposit on them. In the event of a cylinder air starting valve leaking, hot gases would pass into the air pipes and ignite the lubricating oil.
- ▶ If starting air is supplied to the engine, this would further feed the fire and could lead to an explosion in the pipelines. In order to prevent such an occurrence, cylinder starting valve should be properly maintained and pipelines regularly drained. In an attempt to reduce the effects of an explosion, flame traps and relief valves are provided in the pipelines. In addition an isolating non-return valve is fitted to the system.

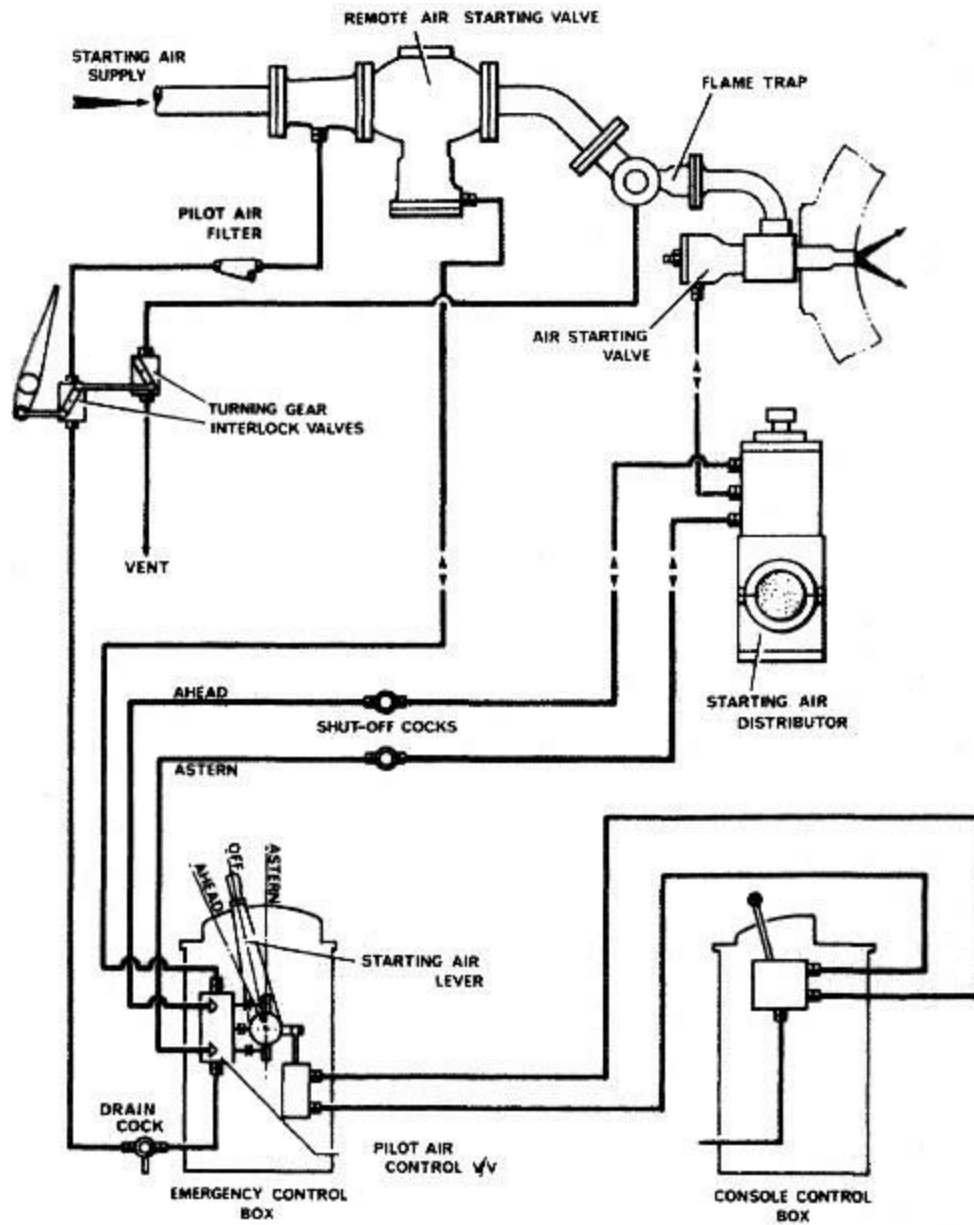
Cloze test – supply every fifth word of the text below

- ▶ Lubricating oil from the _____ will under normal operations _____ along the air lines _____ deposit on them. In _____ event of a cylinder _____ starting valve leaking, hot _____ would pass into the _____ pipes and ignite the _____ oil.
- ▶ If starting air _____ supplied to the engine, _____ would further feed the _____ and could lead to _____ explosion in the pipelines. _____ order to prevent such _____ occurrence, cylinder starting valve _____ be properly maintained and _____ regularly drained. In an _____ to reduce the effects _____ an explosion, flame _____ and relief valves are _____ in the pipelines. In _____ an isolating non-return _____ is fitted to the

- Compressed air systems are liable to contain a certain amount of water which is a result of condensation in the process of compression and cooling. Most of the water condenses out in the air receivers and it can be drained from the receivers by internal pipes so arranged as to blow any water from the very bottom of the receiver.

Complete the sentences below

- Compressed air systems are liable to contain a certain amount of water which is a result of
- Most of the water condenses out in the air receivers and it can be drained from the receivers by internal pipes so arranged as to



Writing skills

- Describe the operation of the air start system using the diagram above

Function of starting air system

- Diesel engines are started by supplying compressed air into the cylinders in the appropriate sequence for the required direction. A supply of compressed air is stored in air reservoirs or 'bottles' ready for immediate use. Up to 12 starts are possible with the stored quantity of compressed air. The starting air system usually has interlocks to prevent starting if everything is not in order.

Complete the sentences below - Function of starting air system

- Diesel engines are started by supplying compressed air into the cylinders in
.....
- A supply of compressed air is ready for immediate use.
- Up to 12 starts are possible with
.....
- The starting air system usually has interlocks to prevent

- Compressed air is supplied by air compressors to the air receivers. The compressed air is then supplied by a large bore pipe to a remote operating non-return or automatic valve and then to the cylinder air start valve. Opening of the cylinder air start valve will admit compressed air into the cylinder.
- The opening of the cylinder valve and the remote operating valve is controlled by a pilot air system. The pilot air is drawn from the large pipe and passes to a pilot air control valve which is operated by the engine air start lever.

Supply the right term

- Compressed air is supplied by _____ to the air receivers. The compressed air is then supplied by a large _____ to a remote operating non-return or automatic valve and then to the cylinder _____. Opening of the cylinder air start valve will _____ compressed air into the cylinder.
- The opening of the cylinder valve and the remote operating valve is controlled by _____. The pilot air is drawn from the large pipe and passes to a pilot _____ which is operated by the engine air start _____.

- When the air start lever is operated, a supply of pilot air enables the remote valve to open. Pilot air for the appropriate direction of operation is also supplied to an air distributor. This device is usually driven by the engine camshaft and supplies pilot air to the control cylinders of the cylinder air start valves. The pilot air is then supplied in the appropriate sequence for the direction of operation required. The cylinder air start valves are held closed by springs when not in use and opened by the pilot air enabling the compressed air direct from the receivers to enter the engine cylinder.

An interlock is shown in the remote operating valve line which stops the valve opening when the engine turning gear is engaged. The remote operating valve prevents the return of air which has been further compressed by the engine into the system.

State whether the statements below are TRUE or FALSE, If FALSE supply the correct sentence.	T / F
When the air start lever is operated, a supply of pilot air closes the remote valve.	
Pilot air for the appropriate speed of operation is also supplied to an air distributor.	
This device is usually driven by the engine crankshaft and supplies pilot air to the control cylinders of the cylinder air start valves.	
The pilot air is then supplied in the appropriate sequence for the direction of operation required.	
The cylinder air start valves are held opened by springs when not in use and opened by the pilot air enabling the compressed air direct from the receivers to enter the engine cylinder.	
An interlock is shown in the remote operating valve line which stops the valve opening when the engine turning gear is engaged.	
The remote operating valve enables the return of air which has been further compressed by the engine into the system.	

- Lubricating oil from the compressor will under normal operation pass along the air lines and deposit on them. In the event of a cylinder air starting valve leaking, hot gases would pass into the air pipes and ignite the lubricating oil. If starting air is supplied to the engine this would further feed the fire and could lead to an explosion in the pipelines. In order to prevent such an occurrence, cylinder starting valves should be properly maintained and the pipelines regularly drained. Also oil discharged from compressors should be kept to a minimum, by careful maintenance.

Supply the appropriate verb

- Lubricating oil from the compressor will under normal operation _____ along the air lines and _____ on them.
- In the event of a cylinder air starting valve _____, hot gases would _____ into the air pipes and _____ the lubricating oil.
- If starting air _____ to the engine this would further _____ the fire and could lead to an explosion in the pipelines.
- In order to _____ such an occurrence, cylinder starting valves should be properly _____ and the pipelines regularly _____.
- Also oil discharged from compressors should be _____ to a minimum, by careful maintenance.

- In an attempt to reduce the effects of an explosion, flame traps, relief valves and bursting caps or discs are fitted to the pipelines. In addition an isolating non-return valve (the automatic valve) is fitted to the system. The loss of cooling water from an air compressor could lead to an overheated air discharge and possibly an explosion in the pipelines leading to the air reservoir. A high-temperature alarm or a fusible plug which will melt is used to guard against this possibility.

Underline the terms in the text below and give their equivalents in your mother tongue

- In an attempt to reduce the effects of an explosion, flame traps, relief valves and bursting caps or discs are fitted to the pipelines. In addition an isolating non-return valve (the automatic valve) is fitted to the system. The loss of cooling water from an air compressor could lead to an overheated air discharge and possibly an explosion in the pipelines leading to the air reservoir. A high-temperature alarm or a fusible plug which will melt is used to guard against this possibility.

QUESTIONS AND DISCUSSION

- ▶ How is starting of marine diesel engines effected ?
- ▶ What is compressed air made to pass through before entering the cylinders ?
- ▶ What pipelines does the starting system consist of ?
- ▶ Say what occurs when the starting lever is operated ?
- ▶ What is the function of the air distributor ?
- ▶ What is the air distributor driven by ?
- ▶ What is the purpose of the remote operating valve ?
- ▶ Why is a blocking device (interlock) fitted in the remote operating valve line ?
- ▶ What conditions may lead to an explosion in the starting air pipelines ?
- ▶ What precautions are adopted to prevent or minimize the danger of explosion ?
- ▶ Why must air receivers be fitted with drains ?

I . Say which of the following statements are TRUE and which are FALSE. If FALSE, state why.

- ▶ All engines are started by compressed air admitted to the cylinders.
- ▶ The cylinders are directly charged with starting air by compressors.
- ▶ The compressed air from the bottle is necessary to ignite the fuel.
- ▶ Valves, operated by a mechanism, control the admission of starting air to the working cylinders.
- ▶ The starting air valves are kept closed by means of spring when the engine is running.
- ▶ An automatic or remote control operating valve is fitted to each cylinder and each valve is connected to the starting air main.
- ▶ When the pilot air is admitted to the remote operating valve, it opens and allows air to be supplied to the starting valves.
- ▶ The air starting valve also acts as a non-return valve to prevent high pressure from the working cycle in the cylinder entering the starting system.

II. Complete the following sentences by choosing the correct endings:

The starting air valves on the cylinder are controlled

- ▶ hydraulically
- ▶ pneumatically
- ▶ mechanically

The device that governs the admission of compressed air to the starting valves at a given order and timings is

- ▶ the pilot air control valve
- ▶ the automatic or remote operating valve
- ▶ the air distributor

Compressed air is released into each cylinder when the piston is approximately at

- ▶ TDC
- ▶ BDC
- ▶ mid position

When the pilot air control valve is moved by the lever it admits air

- ▶ to the remote starting air valve
- ▶ to the starting air distributor
- ▶ simultaneously to the remote starting air valve and air distributor

The air distributor is controlled by

- ▶ a manually operated lever
- ▶ cams and gear drive from the engine camshaft
- ▶ by a hydraulic piston

The pilot valve is

- ▶ a by pass type valve
- ▶ a slow speed stop valve
- ▶ a quick speed valve

A direct reversing engine needs the availability of

- ▶ less capacity of strating air than a unidirectional engine
- ▶ a greater capacity of air than a unidirectional engine
- ▶ the same capacity of starting air as a unidirectional engine

Water in the starting air supply piping can result in extensive damage as

- ▶ it blocks the pipes causing bursting
- ▶ it causes corrosion to pipes and valves
- ▶ it may be carried to the engine

III. Fig.15.2. is a line diagram of a manually operated air starting system for a large, low speed engine. Using the information from Unit 15 complete the labelling and describe the system.

GRAMMAR:

KONSTRUKCIJA **glagol + infinitiv**

(Aux Verb + INFINITIVE)

- ▶ *Opening of the air starting valve will admit compressed air into the cylinder.*
- ▶ *If starting air is supplied to the engine, this would further feed the fire and could lead to an explosion in the pipeline.*
- ▶ *The starting valve should be properly maintained and pipeline regularly drained.*
- ▶ *Water can be drained by the internal pipes ...*
- ▶ *In alternative construction the liners do not come in direct touch with the cooling water.*

U gornjim rečenicama INFINITIV u aktivnom i pasivnom obliku pojavljuje se bez prijedloga “to” iza pomoćnih i specijalnih glagola will, would, could, should, can, do.

Evo popisa glagola koji po pravilu uzimaju uvijek INFINITIV bez prijedloga:

CAN, COULD, MAY, MIGHT

SHALL, SHOULD, WILL, WOULD + INFINITIV

MUST, NEEDN'T

Iza ostalih glagola infinitiv gotovo uvijek ima prijedlog “to”. Evo nekoliko primjera iz prijašnjih lekcija:

- ▶ The purpose of these distributor valves is to time the admission of compressed air to the cylinder.
- ▶ This firing order is chosen to give the smoothest torque.
- ▶ This design tends to result in a high engine.
- ▶ The compression plate is interposed to ensure the correct compression ratio.
- ▶ These components are carefully designed to carry the high fatigue loads.
- ▶ The ring may be arranged to prevent oil from the crankcase entering the water jackets.
- ▶ A leak off hole is provided to ensure the cooling control.
- ▶ The crankshaft of medium speed diesel engines appear to be robust.
- ▶ The oil should be allowed to settle for one day at least.

U navedenim rečenicama infinitiv s prijedlogom stoji neposredno iza glagola, tj. Konstrukcija ima slijedeći redoslijed:

Subjekt & glagol + to-infinitiv

Ali u tehničkom jeziku vrlo je česta i ova struktura:

Subjekt & uzročni glagol + objekt + to-infinitiv

Npr:

The shim permits the piston to be poved nearer or farther from the cylinder head.

Further upward movement of the plunger causes the fuel to be raised in pressure.

The pilot air enables the compressed air from the receiver to enter directly the engine cylinders.

The distributor valves provide air to operate each starting valve in the correct order and timing.

The automatic or emote operating valve allows main starting air to pass to the air start valve manifold.

GRAMMAR EXERCISES

I. The VERB + to-INFINITIVE construction denotes PURPOSE. (See Lessons 4 and 5).

Rearrange the following sentences using SO THAT and IN ORDER THAT clauses to express purpose.

Eg.

Studs should be evenly tightened to provide a satisfactory joint.

- ▶ *Studs should be evenly tightened so that a satisfactory joint can be provided.*
- ▶ *Studs should be evenly tightened in order that a satisfactory joint may be provided.*

- ▶ Stop the fuel pump to prevent damage of the piston running too hot.
- ▶ The cylinder lubrication must be checked to ensure a safe operation of the piston.
- ▶ The piston crown is recessed to allow opening of pair of inlet and exhaust valves.
- ▶ Avoid the side of the engine to reduce the risk of accidents in case of the failure of the safety valves.
- ▶ The crankshaft rely on support of the main bearings to develop their full strength.
- ▶ Wait for some time before opening the doors to prevent ignition.
- ▶ Piston rings must resist corrosion, readily transfer heat and have thermal expansion to maintain ring groove clearances.
- ▶ The viscosity regulator controls the oil temperature to provide fuel at the correct viscosity for combustion.
- ▶ Check the piston clearance to find out the cause of the cylinder knocking.

- ▶ II The infinitive with “to” preceded by the structures TOO+ Adjective and Adjective+ ENOUGH denotes RESULT. (See Lesson 3)



- ▶ Ex. 1. The Chief Engineer came too late to prevent the damage.



- ▶ 2. The large end bearings are strong enough to withstand any load.



- ▶ Rearrange these sentences by using SO... THAT construction to express RESULT as in the following examples:



- ▶ 1a. The Chief engineer came so late that the damage could not be prevented.



- ▶ 2a. The large end bearings are so strong that they withstand any load.



- ▶ Note that the TOO + ADJECTIVE + to-INFINITIVE construction is replaced by a negative clause, while the ADJECTIVE + ENOUGH + to-INFINITIVE one by a positive clause.

Rearrange these sentences by using **SO... THAT** construction to express **RESULT** :

1. The lubrication oil pressure in the bearing housing was too low to ensure correct lubrication.
2. The quantity of oil was ample enough to ensure the normal operation of all the moving parts of the engine.
3. The knocking in the cylinders grew too heavy to keep the engine running.
4. The bearings have become too hot to be cooled out by throwing the lubrication oil over them.
5. Indication of trouble in the cylinders is apparent enough to stop the engine at once.
6. The connecting rod is too heavy to be carried by hands.
7. In case of cranshaft misalignment fluctuating stresses will become high enough to cause the shaft failiure.
8. The hazard of fire is too serious for the crew to stay any longer in the engine room.
9. When the engine is working at a reduced power output, the temperture of the products of combustion will fall low enough to form corrosive acids.
10. An increased temperture will render oil too thin to lubricate the bearings properly.

Part II.

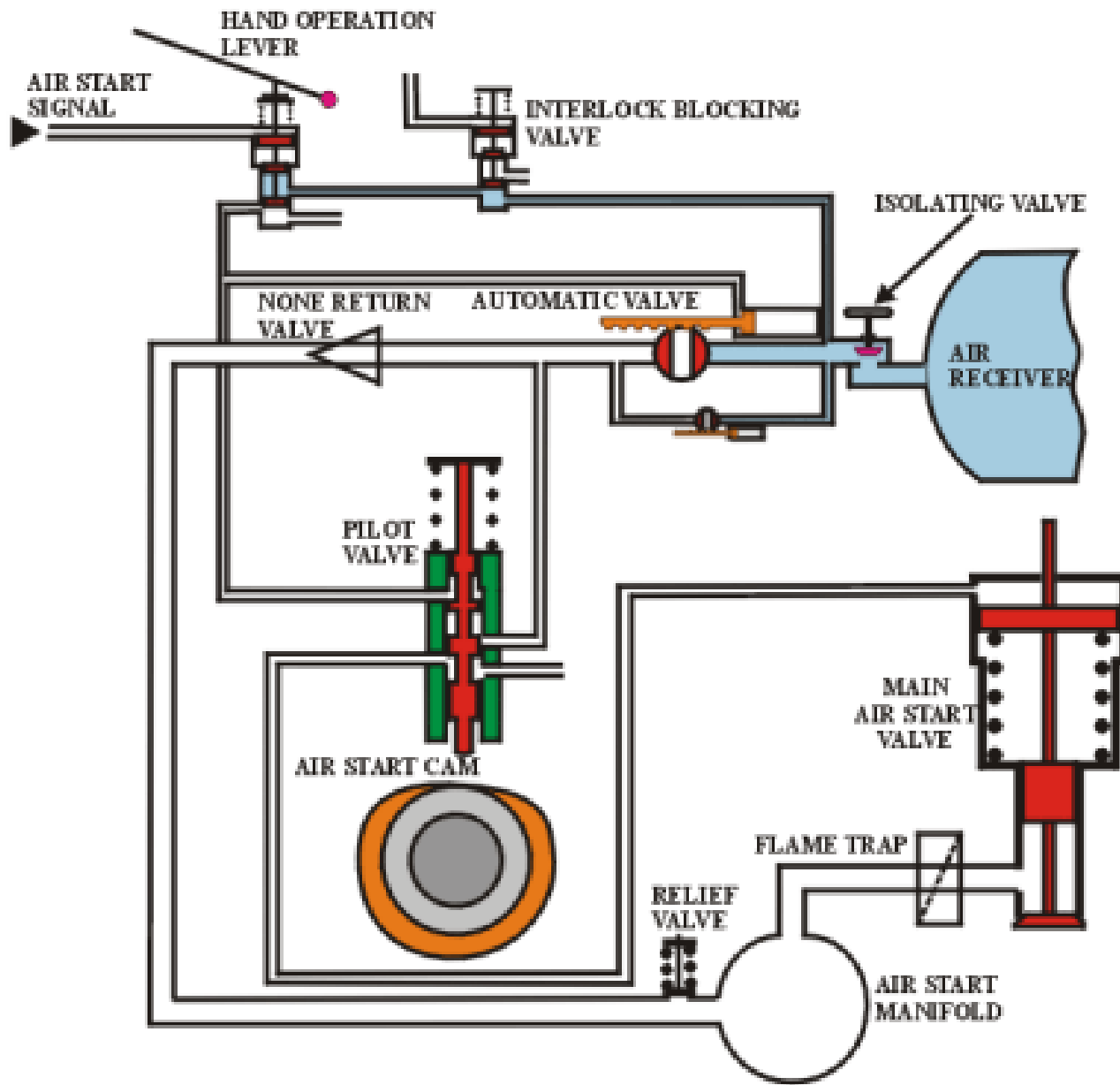
- The Air Start System

- For the video on starting air systems see Marineinsight – link:
- <https://www.youtube.com/watch?v=UnrJYcxfrTA>

Part II.

- Large Marine Diesel Engines are started using high pressure compressed air. The air is admitted into the cylinder when the piston is just past TDC and continued until just before the exhaust valve opens. There is always more than one air start valve open: - a situation known as overlap. This ensures that the engine will start in any position. The opening of the main air start valves is controlled by a set of pilot valves located in the air start distributor, which in turn are timed to operate by a drive linked to the main camshaft. In the example shown, a small camshaft is used to control the opening and closing of the air start pilot valves.





- The drawing shows the principle of operation of an air start system. Large air receivers are used to store the compressed air. The diagram shows the isolating valve open so air is being allowed as far as the automatic valve and the air start control valve.
- When the engine is required to start, a low pressure air signal is sent to the air start control valve (which can also be hand operated in an emergency). The air pushes a piston down which opens the valve and allows high pressure air to flow to the pilot valve and the automatic valve operating pistons. The pilot valve is forced down onto the cam profile and the automatic valve opens and high pressure air is led to the main air start valves and the pilot valve. When the pilot

- An interlock blocking valve will operate, for instance if the turning gear is left in, and this will stop high pressure air from reaching the air start control valve and thus either the automatic valve or the pilot valve.
- A slow turning valve is fitted. This will open instead of the main automatic valve if the engine has been stopped for more than 30 minutes during manoeuvring. It will only supply enough air to turn the engine over very slowly; This is a precaution in case a cylinder has had oil or water leak into it which would cause damage to the engine when starting. If the engine completes a full revolution on the slow turn, then the main automatic valve opens and the engine will start.

- International Association of Classification Society rules state:
- In order to protect starting air mains against explosion arising from improper functioning of starting valves, the following devices must be fitted:
- An isolation non-return valve or equivalent at the starting air supply connection to each engine.
- A bursting disc or flame arrester in way of the starting valve of each cylinder for **direct reversing engines** having a main starting manifold. **OR**
- At the supply inlet to the starting air manifold for **non-reversing engines**
- Devices under (ii) above may be omitted for engines having a bore not exceeding 230 mm

TRANSLATION

IV Translate into English using the VERB + (to)-INFINITIVE construction:

- ▶ Nadamo se da ćemo uputiti motor u prvom pokušaju.
- ▶ Pokušali smo napuniti spremnik zraka, ali nismo mogli uputiti kompresor.
- ▶ Željeli smo spriječiti opasnost od eksplozije.
- ▶ Pripremi se da pokreneš pomoćni motor.
- ▶ Radije ćemo najprije pustit probni zrak u cilindre.
- ▶ Nismo uspjeli uputiti motor.
- ▶ Uspio je otkloniti kvar.

Starting Air System Precautions

- Great care is to be exercised in the operation and maintenance of starting air systems. The hazard of compressed air and lubricating oil forming an explosive mixture must be avoided. Oil from any source must be excluded from the starting air system.

Air compressor, starting air reservoir blow down drains are to be operated at regular intervals, and if automatic, their function verified.

- It is absolutely essential that if an air starting valve is in any way suspect that immediate action is taken i.e. shutting the fuel off the unit in accordance with the manufacturer's instructions, "gagging" the valve shut, and replacing the valve at the first opportunity.

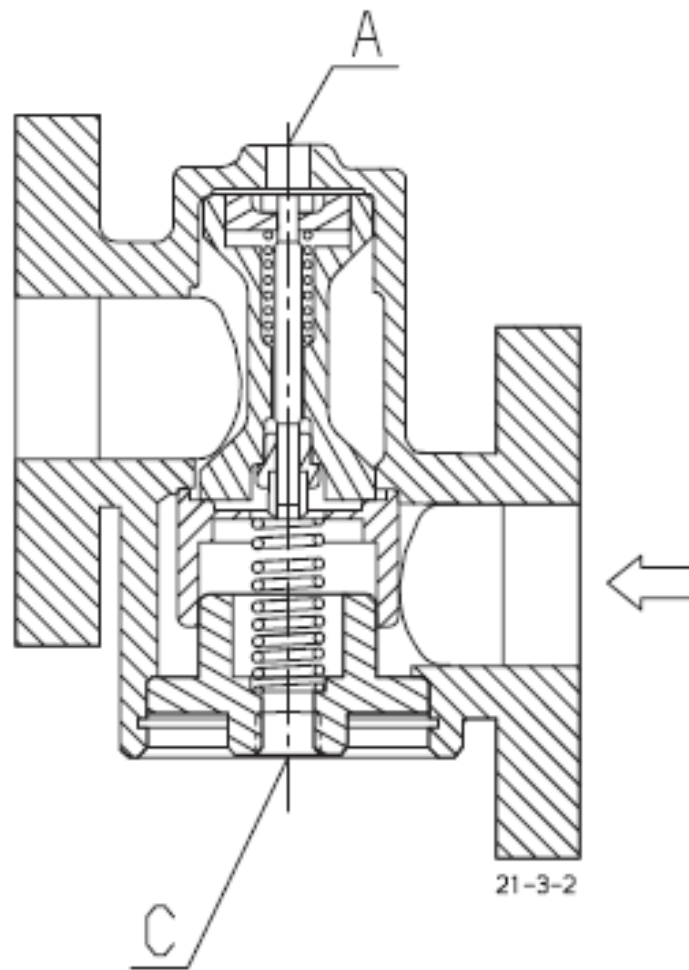
Only in exceptional circumstances and according to the Master's authority is the main engine to be operated with leaking air starting system valves.

Air starting systems usually incorporate two or more air reservoirs. According to experience with the main engine plant, the Chief Engineer is to issue standing instructions regarding the air reservoirs which are to be online during

- Periodic inspection of air starting system pipelines is to be carried out to ensure that no build up of oil is occurring. Highly flammable cleaning fluids must never be used in any part of the starting air system. Any residue of liquid or vapours could result in an explosion.

Routine duties must include the manual checking of the main air starting valve pipes for any increase in temperature, which would indicate leakage of combustion gasses into the system. It is particularly relevant during manoeuvring when the main air starting reservoirs are open to the system despite the existence of non-return valves and other devices.

Main starting valve



8 Things Marine Engineers Must Know About Starting Air System On Ship

<http://www.marineinsight.com/marine/marine-news/headline/8-things-to-consider-while-operating-starting-air-system-of-marine-engines/>

- **1. The required range of starting air pressure**
- The starting air pressure should be such that it provides enough speed to the piston during its compression stroke for quickly compressing the charge air and reaching the required temperature to initiate combustion of the injected fuel. The starting air pressure is generally of the same range for both the main propulsion engines and the auxiliary engines i.e. between 25 and 42 bars. If the air pressure goes higher than this, then the components of the engine should be sturdy and robust to cater for the same.
- The regulation says that the starting air reservoirs should be able to provide 12 consecutive starts without replenishment. For non-reversible engines, 6 consecutive starts are

- **2. The time period for the induction of starting air**
- It is in the expansion stroke that the starting air valves are opened to provide a positive torque to the engine. For 2 Stroke engines, the starting air valves are opened when the piston just passes the top dead centre and closed when the exhaust valves are about to open in uniflow scavenged engines and exhaust ports in closed and loop scavenged engines. In 4 Stroke engines, the exhaust valves are open for a similar phase when the piston passes the top dead centre and closes before the exhaust valve opens in the expansion stroke.
- For 2 stroke engines the starting air valve is open approximately 10 degrees before TDC (this is actually

- **3. The overlap period**

- Overlap is the simultaneous opening of two starting air valves during the starting air sequence. It is necessary to start the engine in any crank position and thus this ensures that at least one valve will open when the starting air is inducted in. If there is no overlap provided, then the engine could stop in any position with all the starting air valves closed, when the starting air was given.
- There should be a minimum overlap of 15 degrees provided and the ideal condition should be between 20 degrees and 90 degrees.
- For a 4 cylinder 2 stroke engine the firing interval is 90 degrees ($360/4$) and if the starting air period is 115 degrees

- **4. Indications of leaking starting air valves and the cause of their leakage**

- The leakage of starting air valves is indicated by the overheating of line between the starting air valve and the starting air manifold, when the engine is in operation. The heating generally occurs due to the passage of hot gases from the engine cylinder to the starting air line. Thus during manoeuvring, each starting air line should be felt for temperature close to the starting air valves. The common causes of leakage includes foreign particles deposited between the valve and the valve seat from the starting air supply system, preventing the valve to close fully or valve operating sluggishly because of incorrect clearance between

- **5. Running of engine with the leaking starting air valve**
- If overheating of a particular line is felt and the starting air valve leakage is detected, then the starting air branch on the starting air manifold will have to be blanked off. If two or more starting air valves are removed from the engine, then there could be a possibility of engine failing to start in a particular crank position during manoeuvring. Thus, the reversing control can be operated and the engine can be given a small starting air in the reverse direction to obtain a different crank position or the turning gear could be engaged and one of the pistons shall be moved in position just after top dead centre to get the positive torque to turn the engine.

- **6. Slow turning valve**

- If during manoeuvring, the starting air is not inducted for 30 minutes, while the engine is on wheel house control, then there's an automatic activation of the slow turning mode in which the engine is turned very slowly for at 8-10 rpm and the air is restricted by a slow turning valve. This is done as a precautionary measure to prevent damage to the engine while starting, if there were an oil or water leakage.

- **7. Running direction interlock**

- Interlocks are the blocking devices which ensure that the engine is started or reversed only when some conditions are fulfilled or satisfied. Running direction interlock is an essential trait that prevents the injection of fuel to the engine when the telegraph doesn't synchronise with the running direction of the engine. It is an important application in the crash manoeuvring when the starting air is used to apply brakes on the engine by reversing the operation.

- **8. Turning gear interlock**

- Turning gear interlock is another important thing that prevents the admission of starting air to the engine cylinders when the turning gear is engaged. If the starting air is admitted with the turning gear engaged, then the turning gear along with the motor will fly off puncturing the bulkhead. Thus the interlock is necessary to prevent such accidents.



Starting Air Bottles