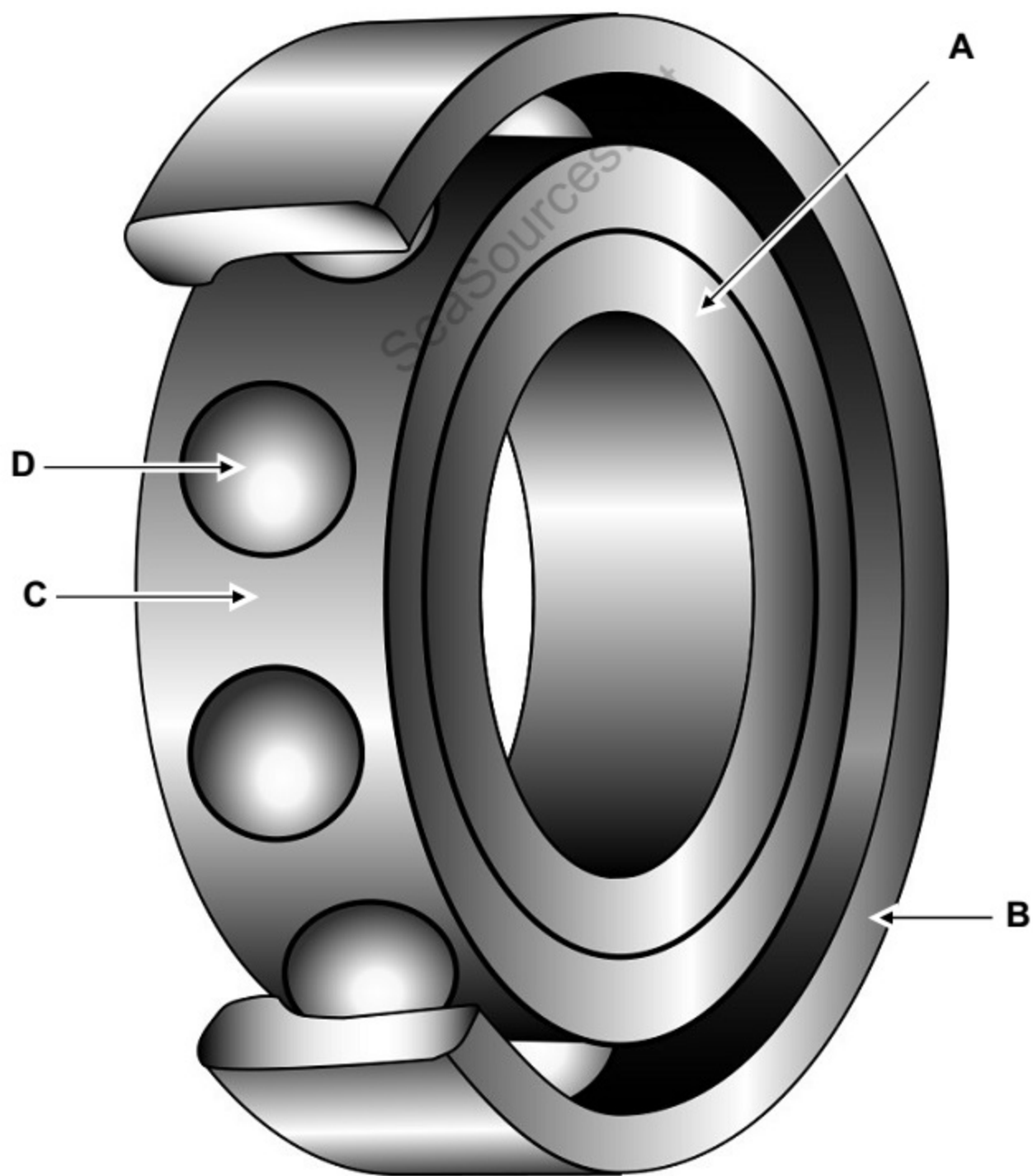
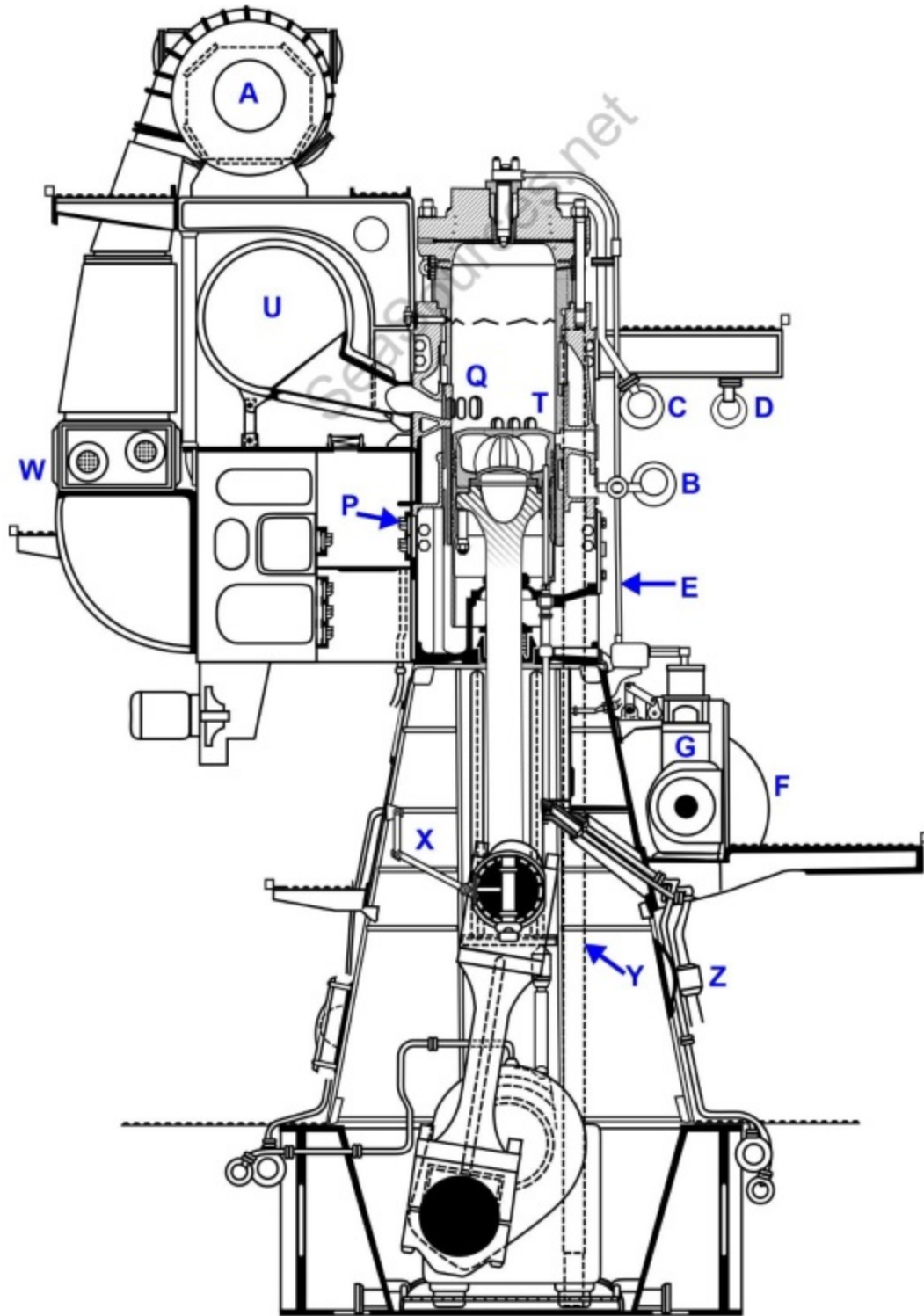


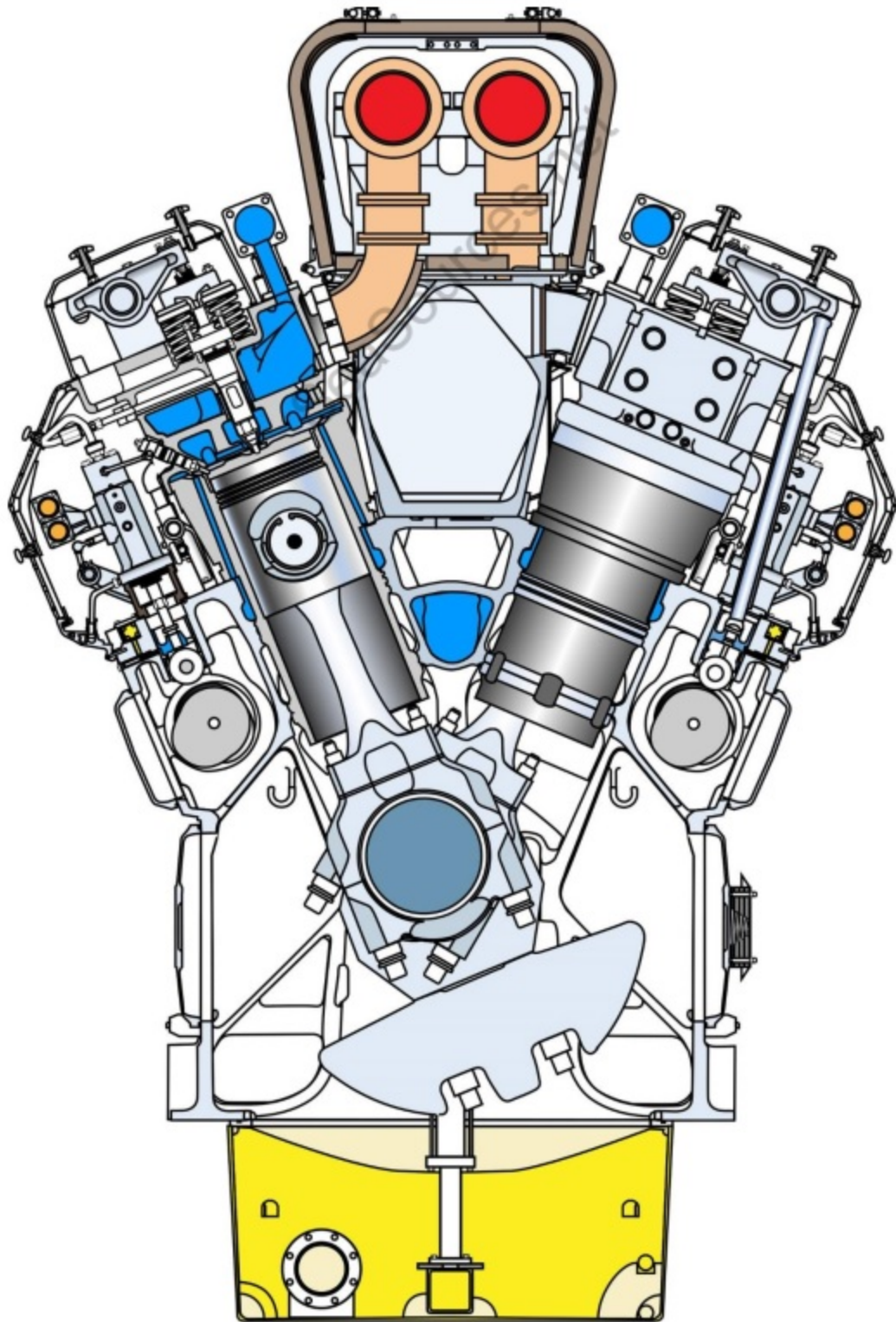
**MO-0001**



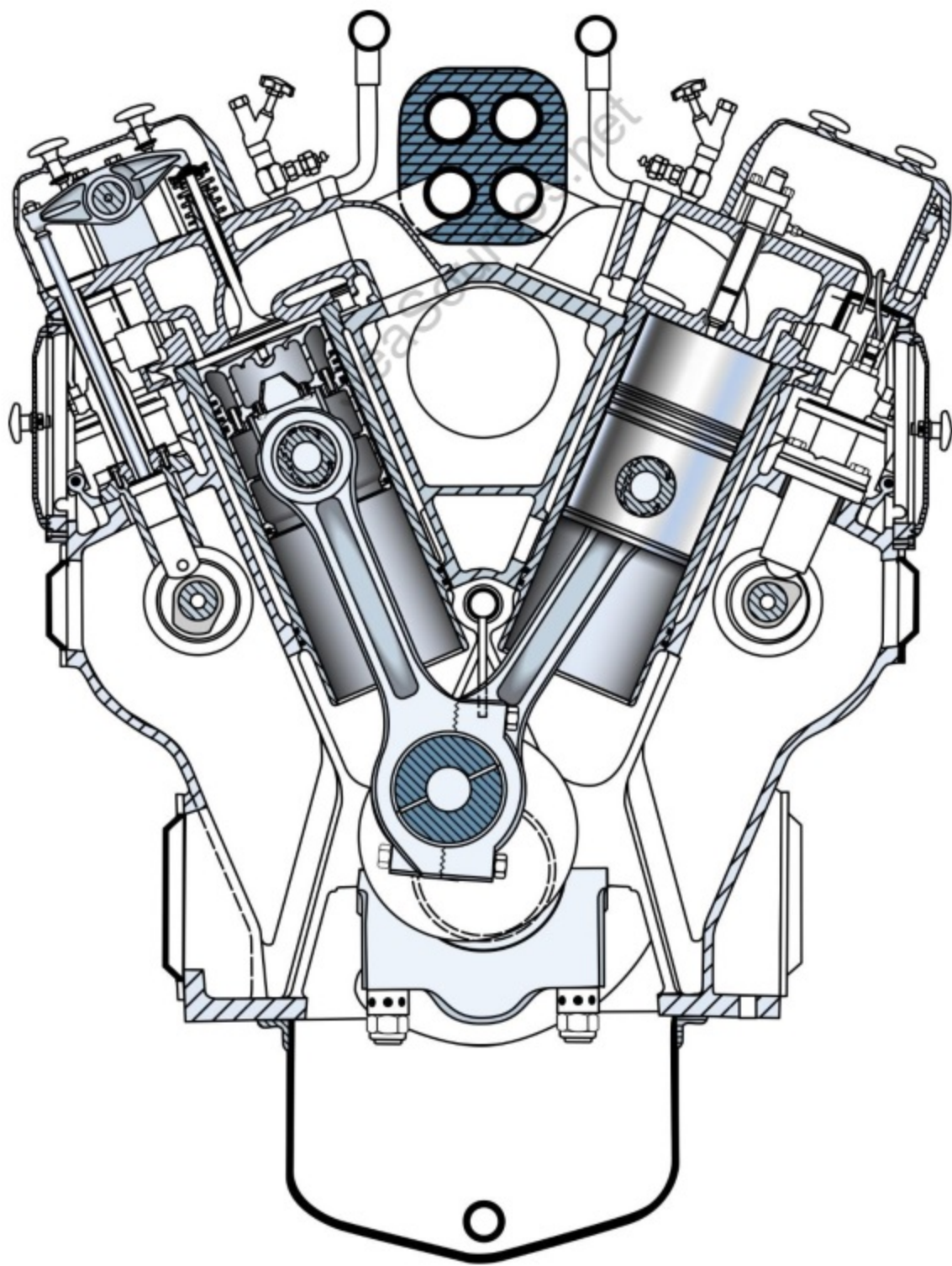
# MO-0003



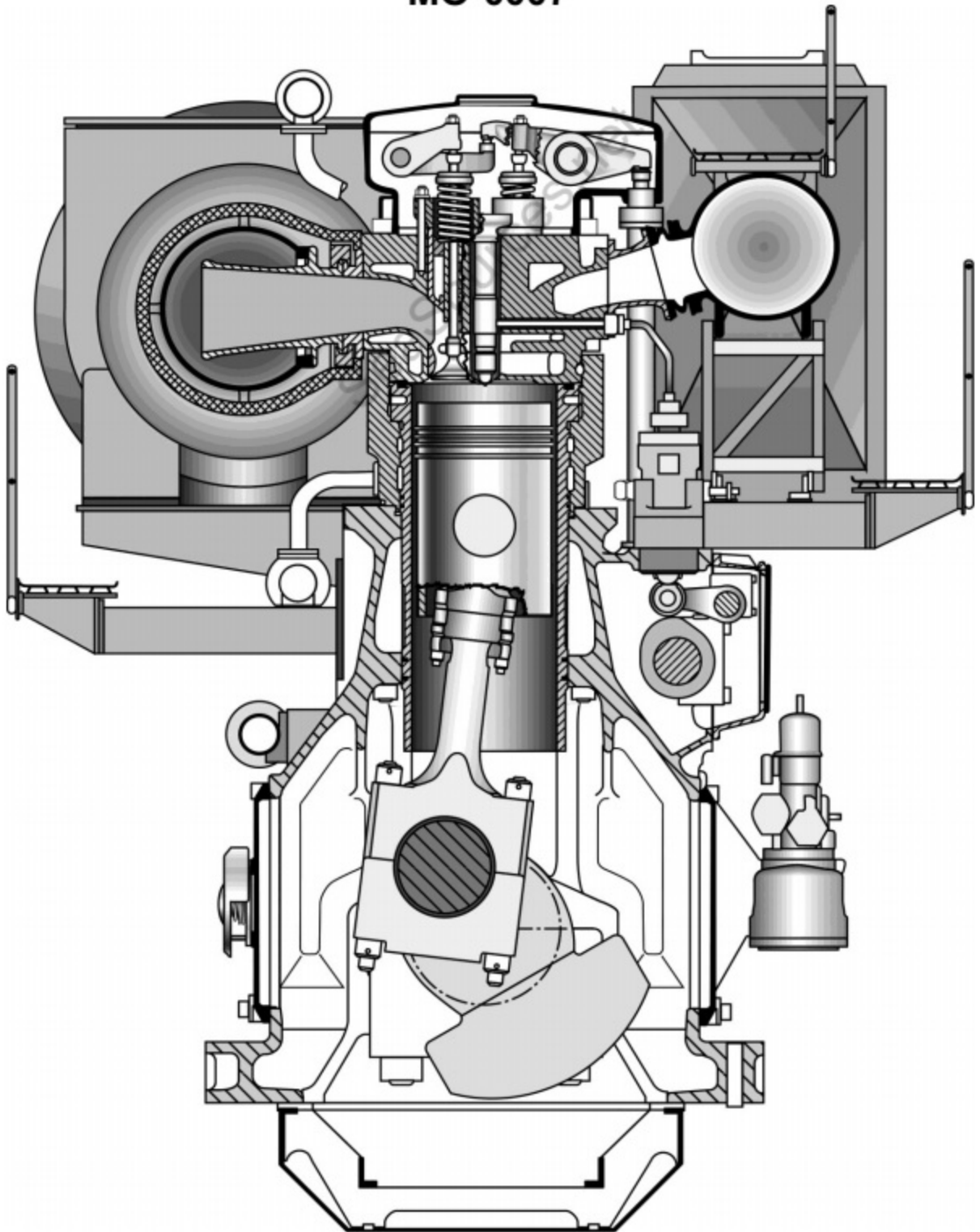
MO-0005



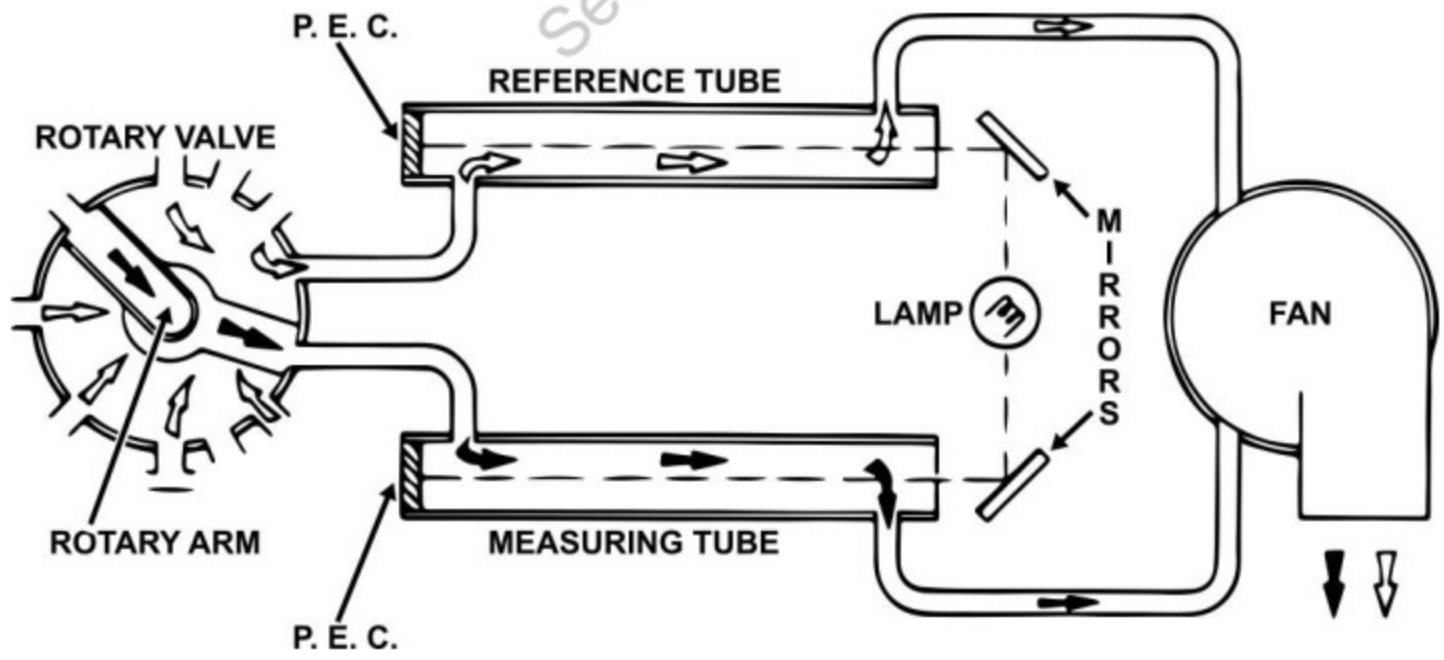
MO-0006



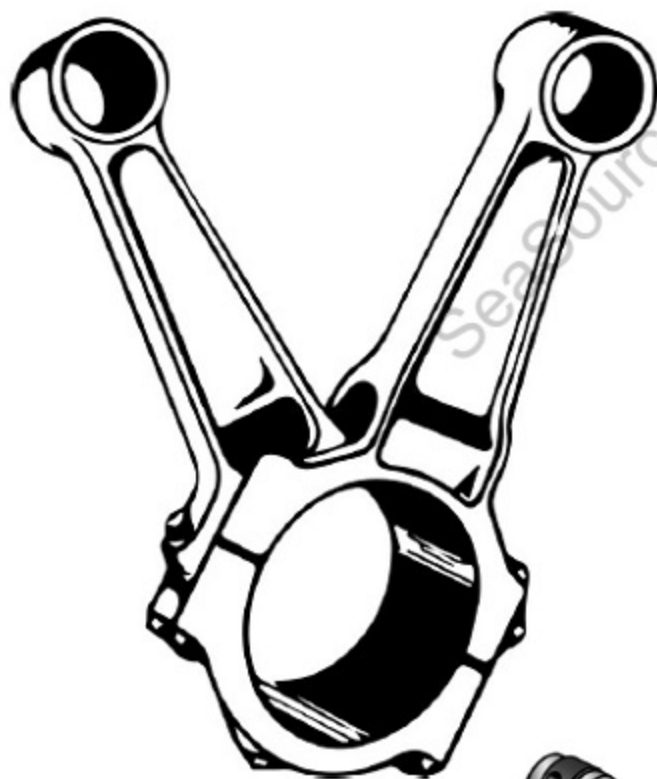
MO-0007



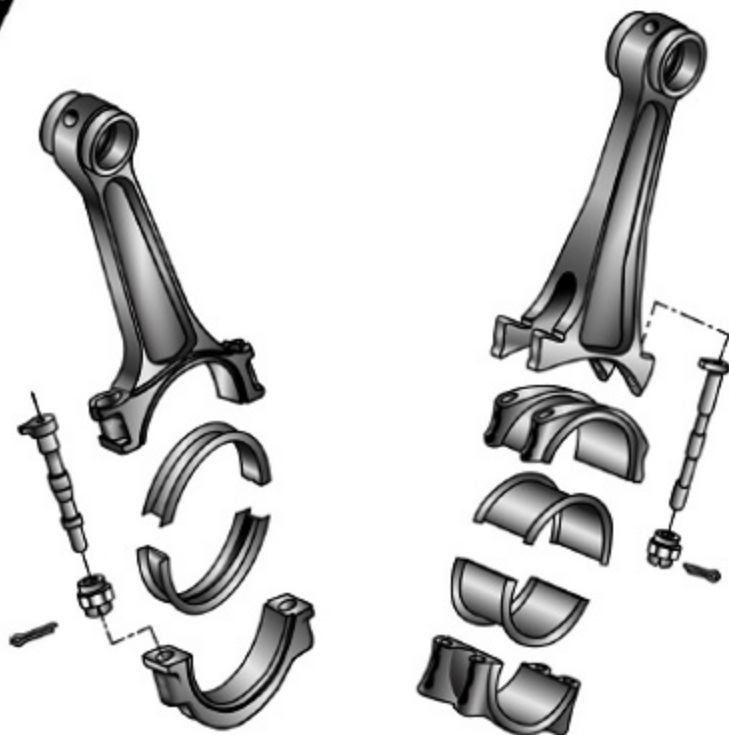
SeaSources.net



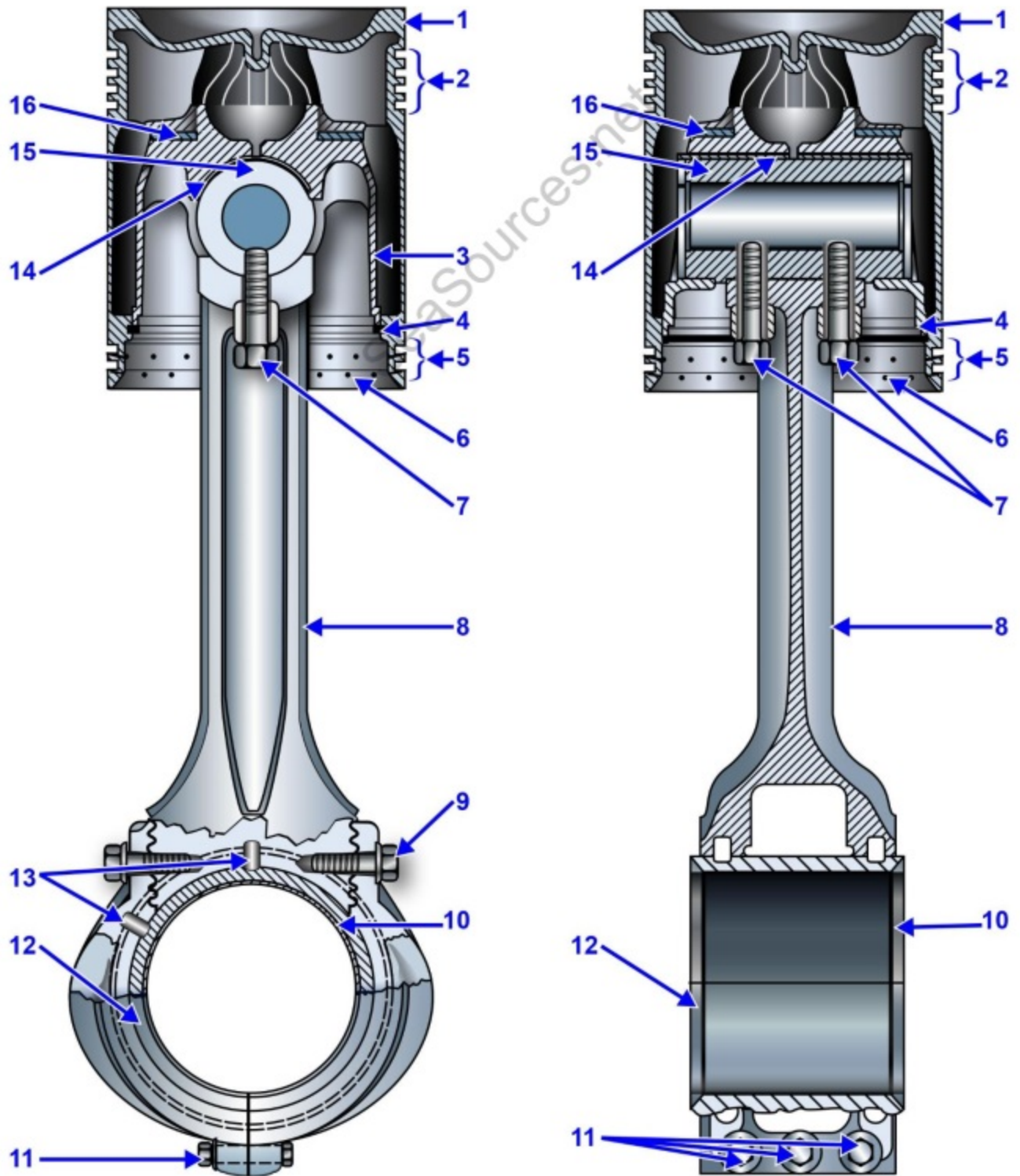
MO-0010



Exploded View

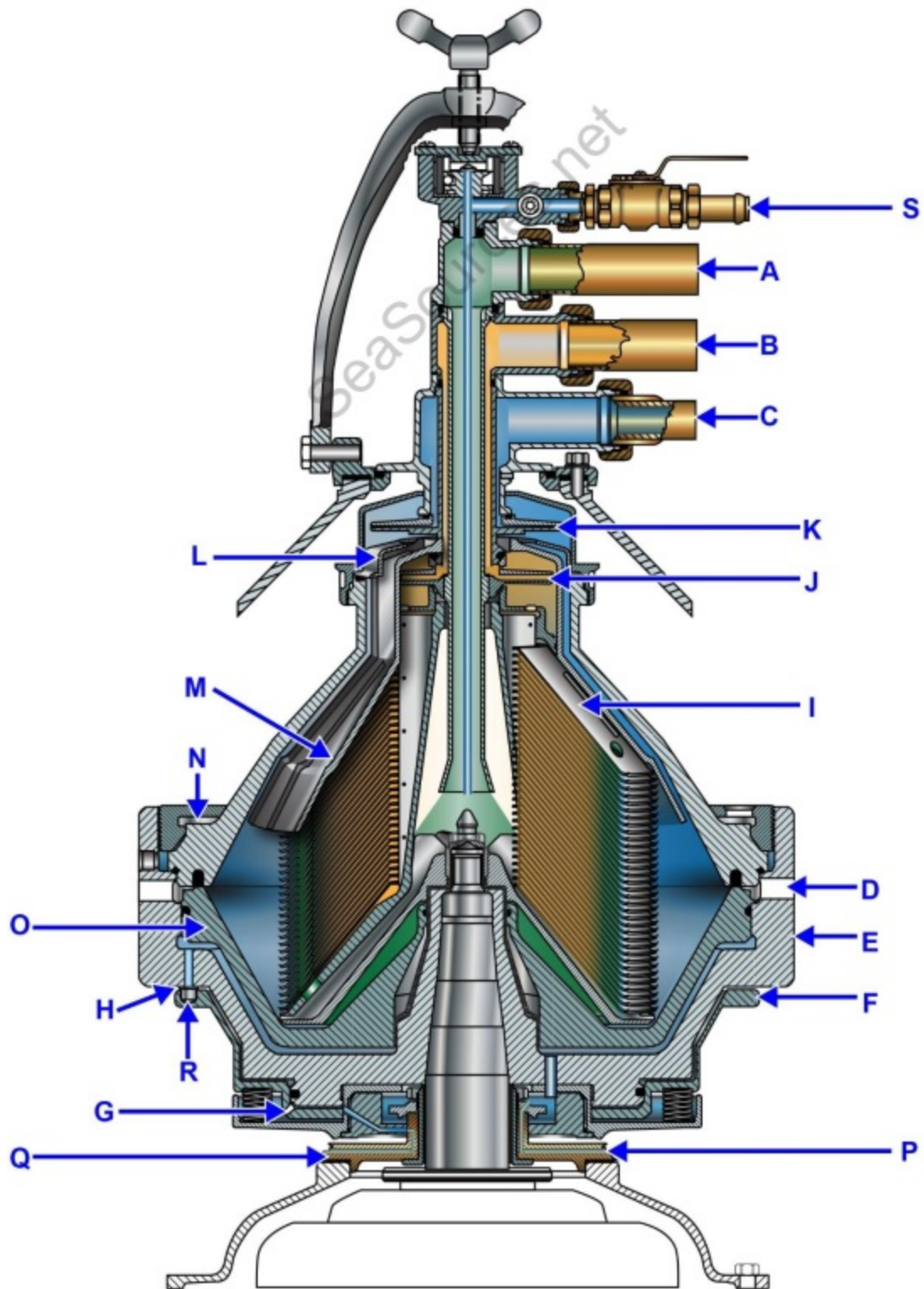


# MO-0011

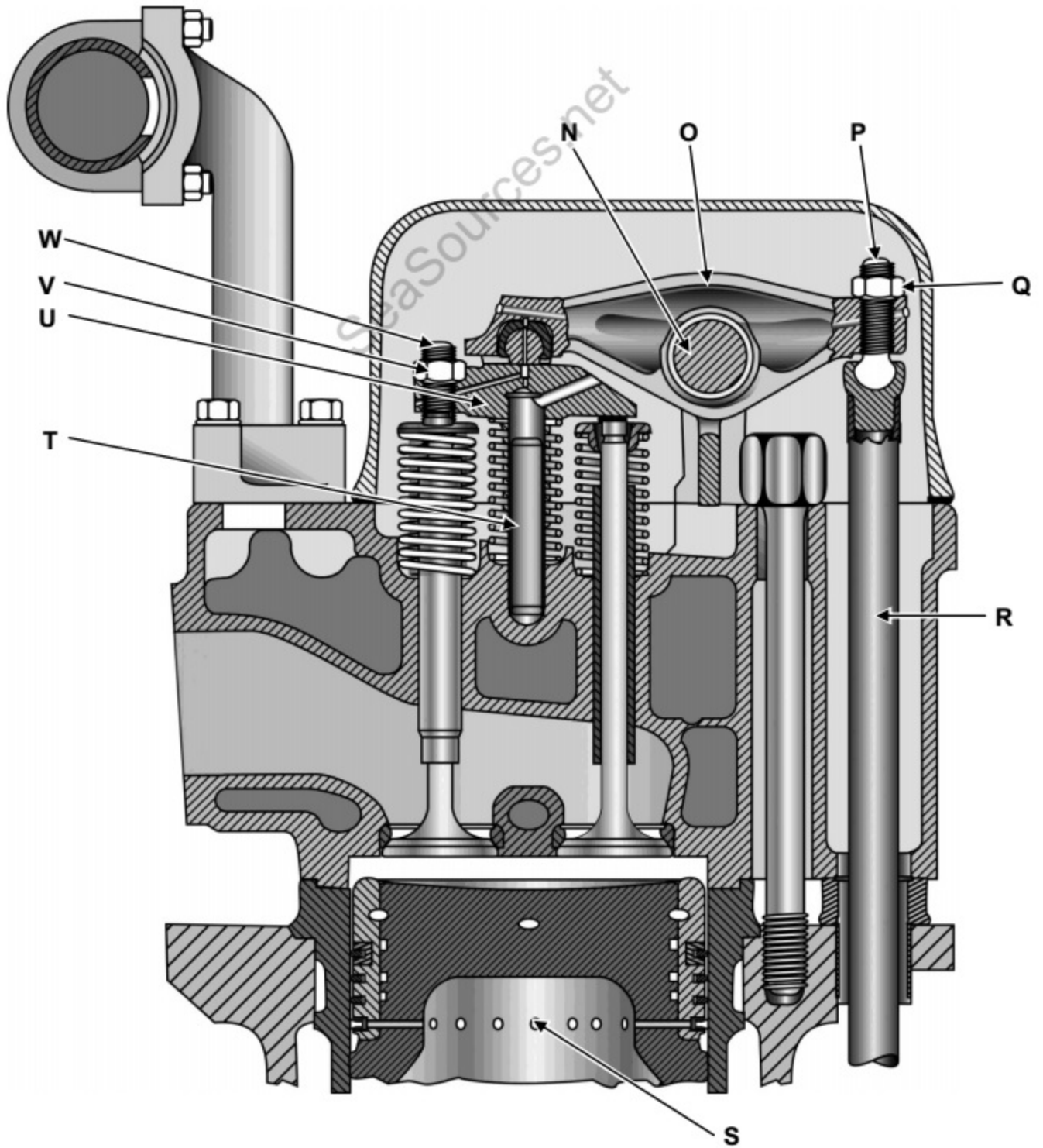




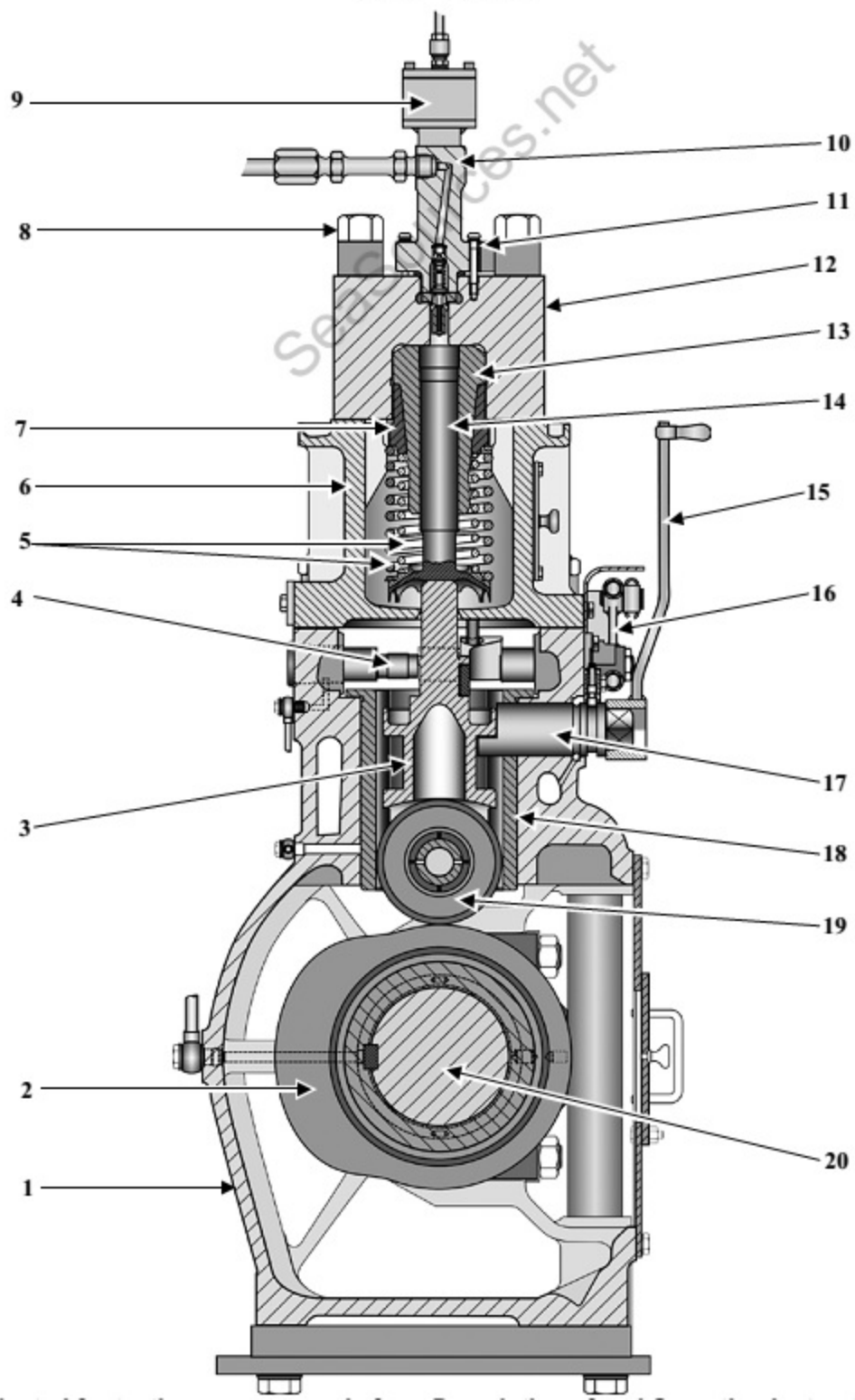
# MO-0012



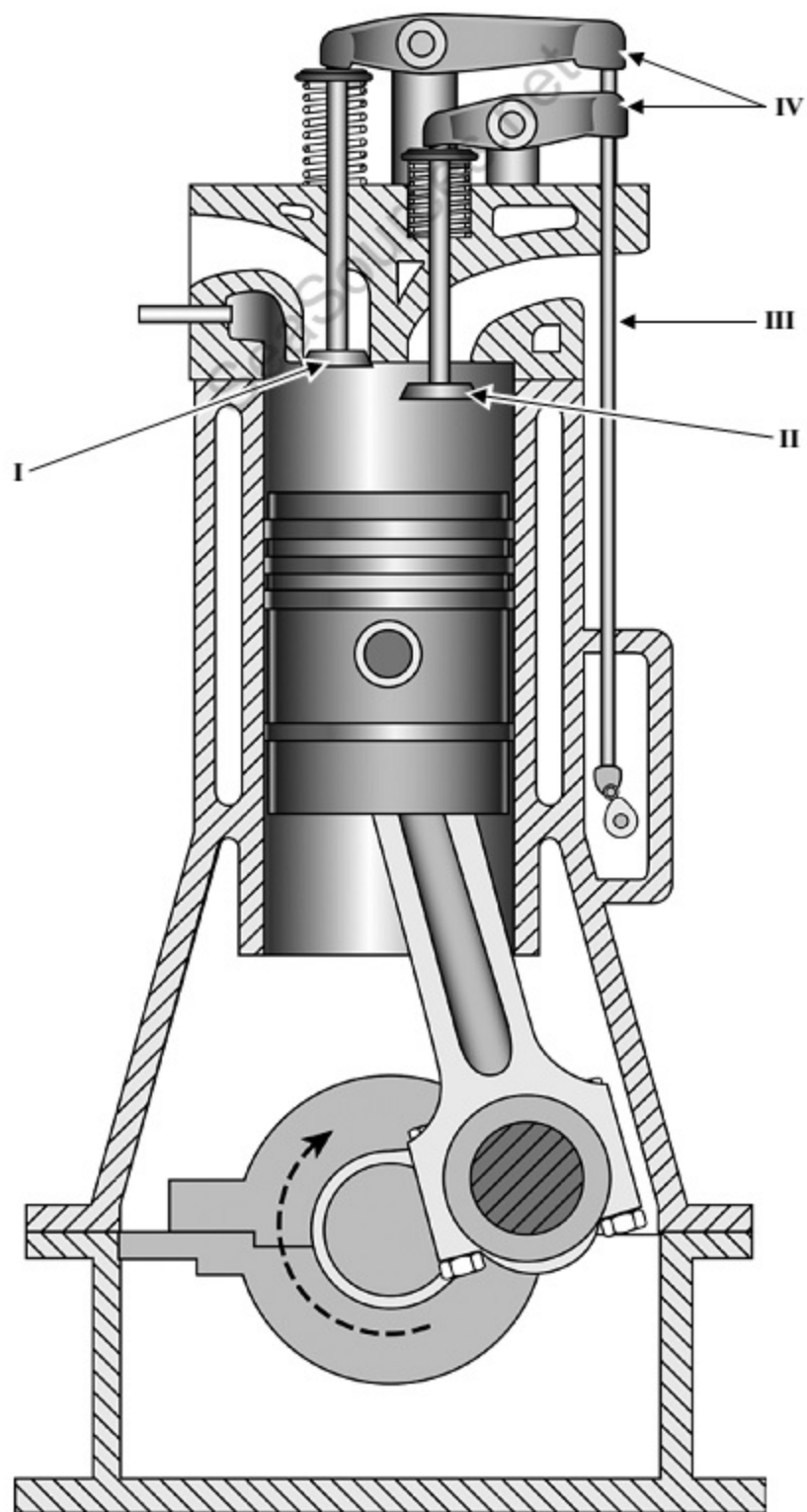
MO-0013



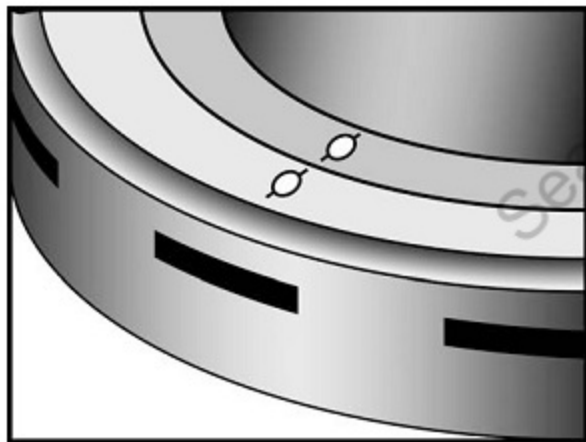
# MO-0016



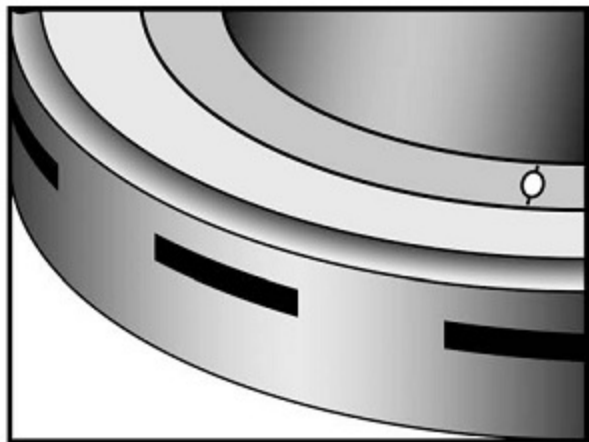
MO-0020



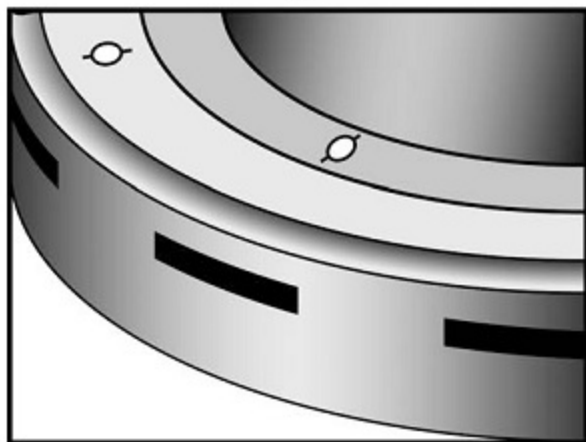
A



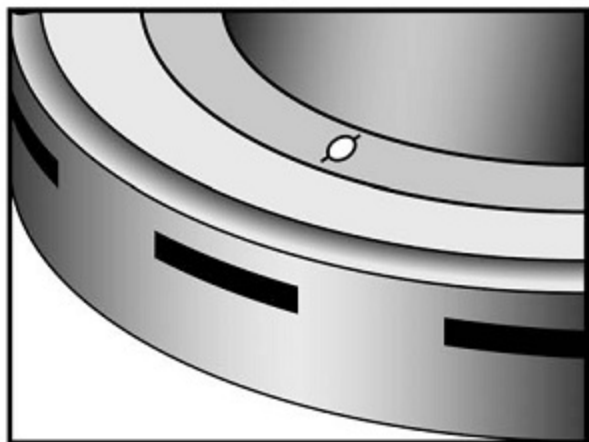
B

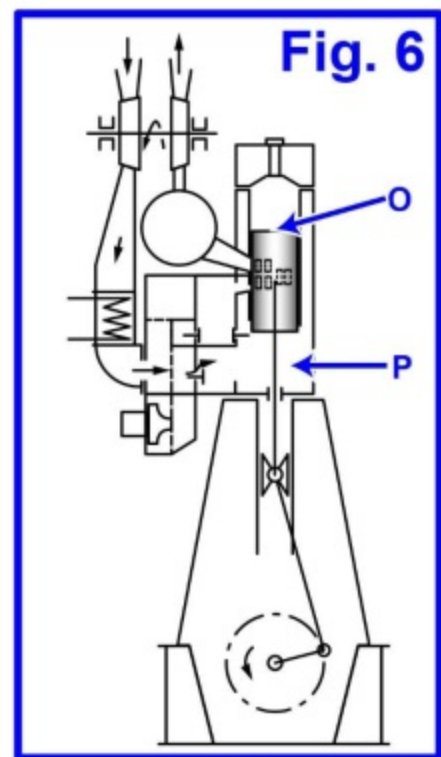
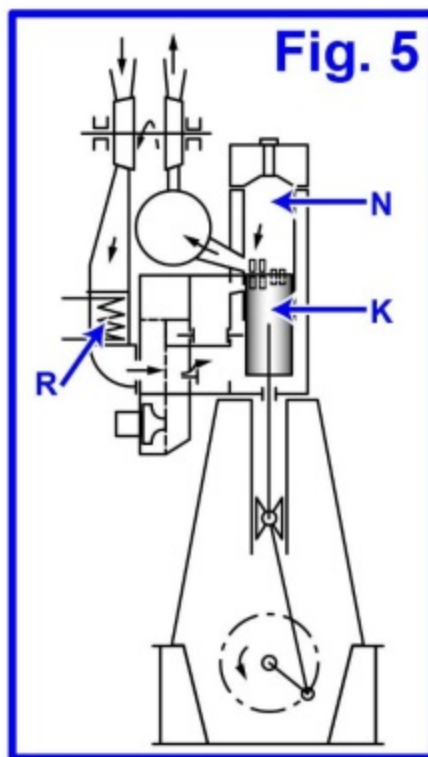
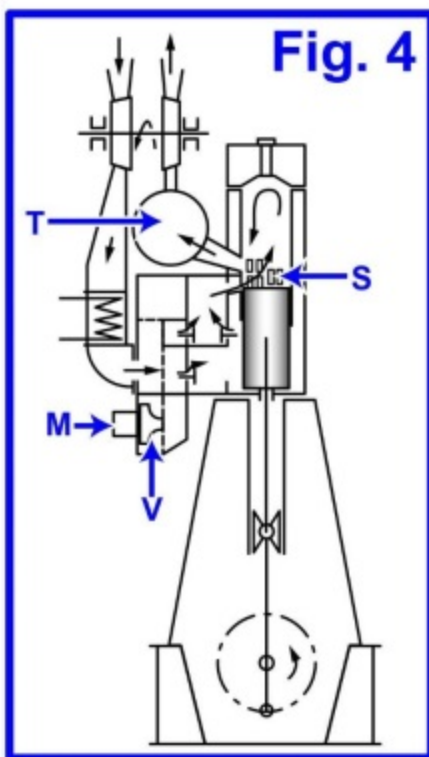
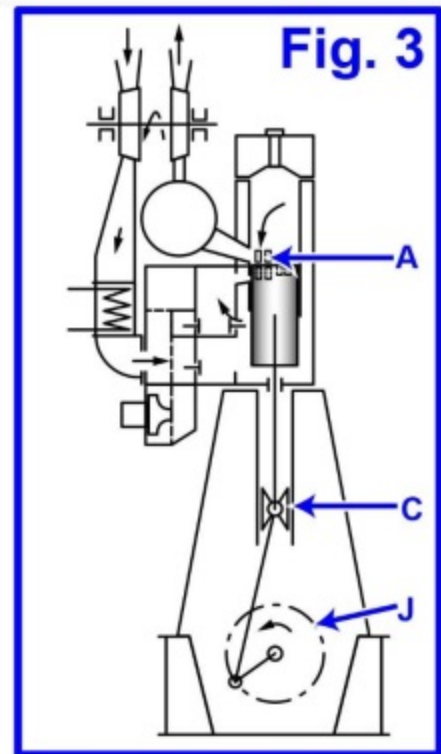
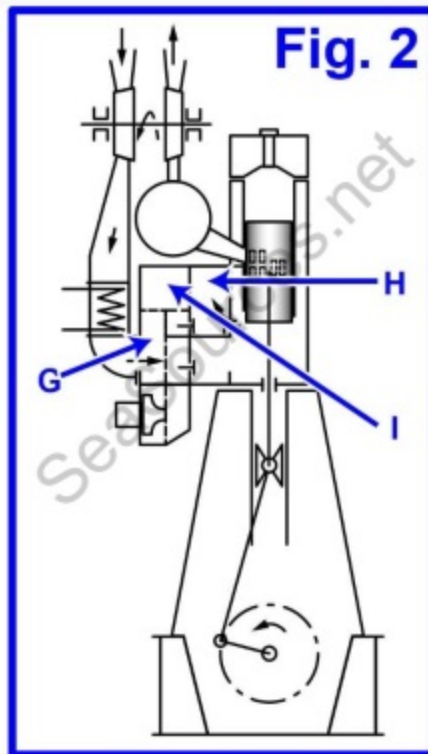
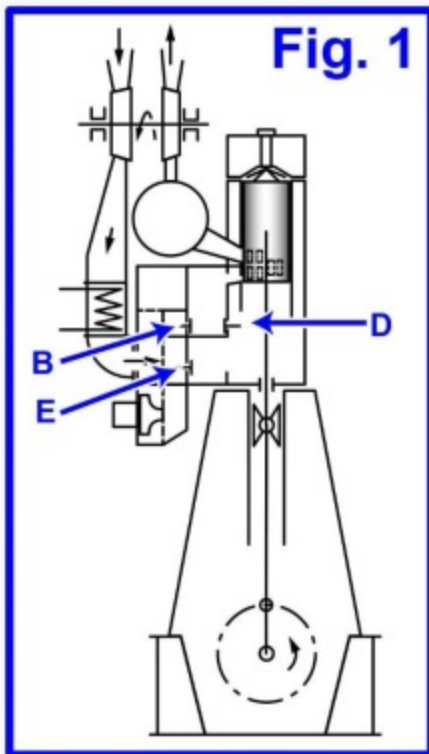


C

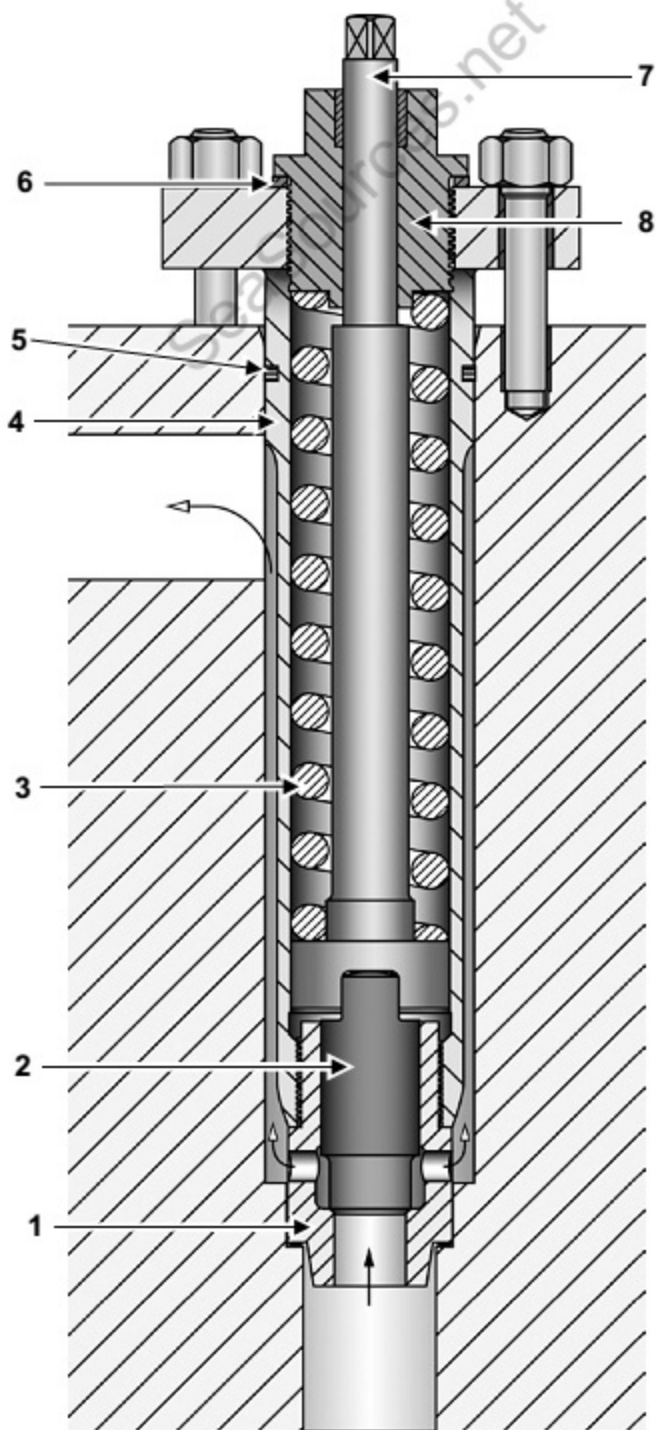


D

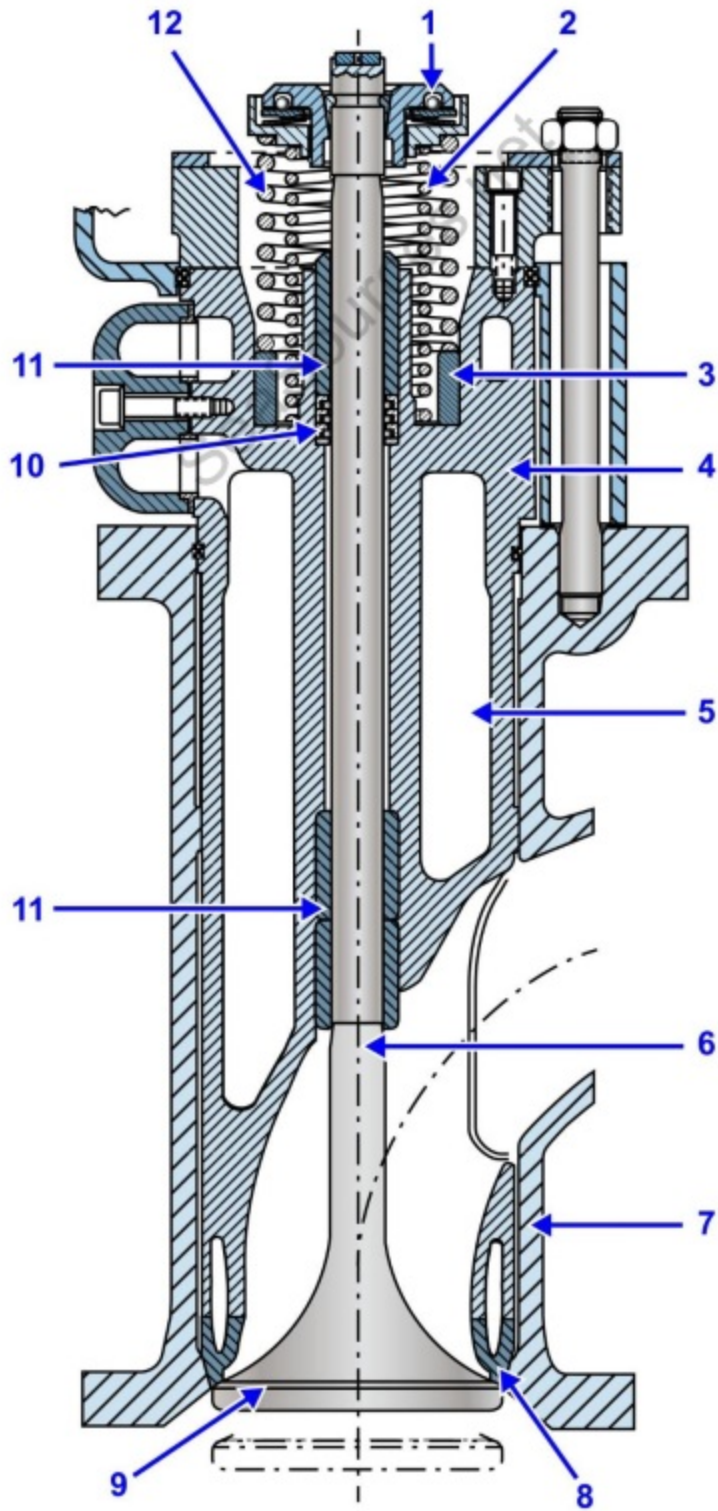




# MO-0026



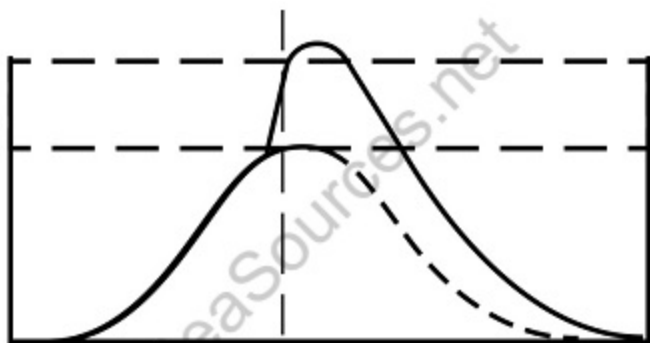
MO-0027



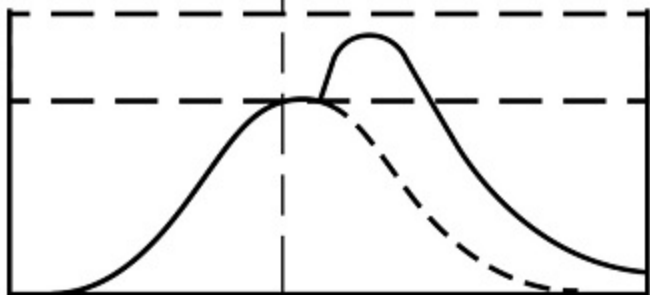


MO-0029

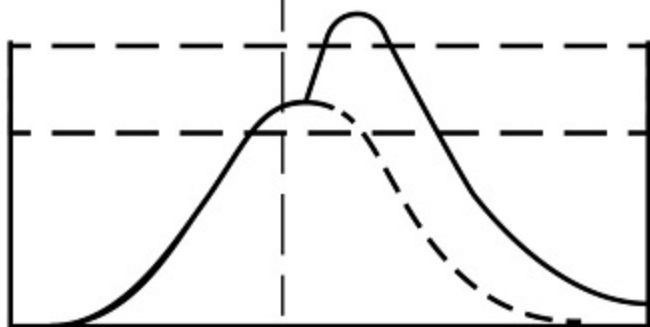
A



B



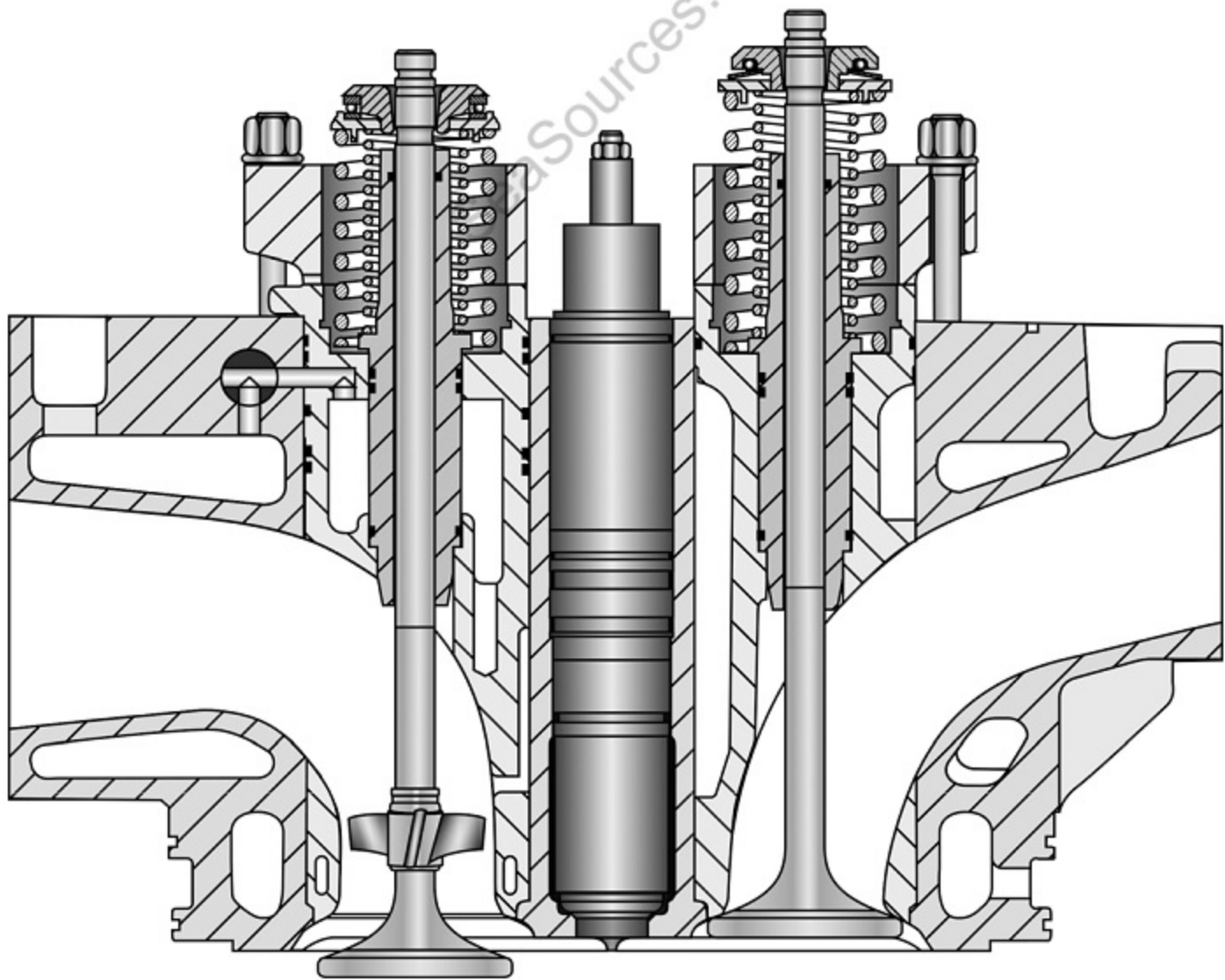
C



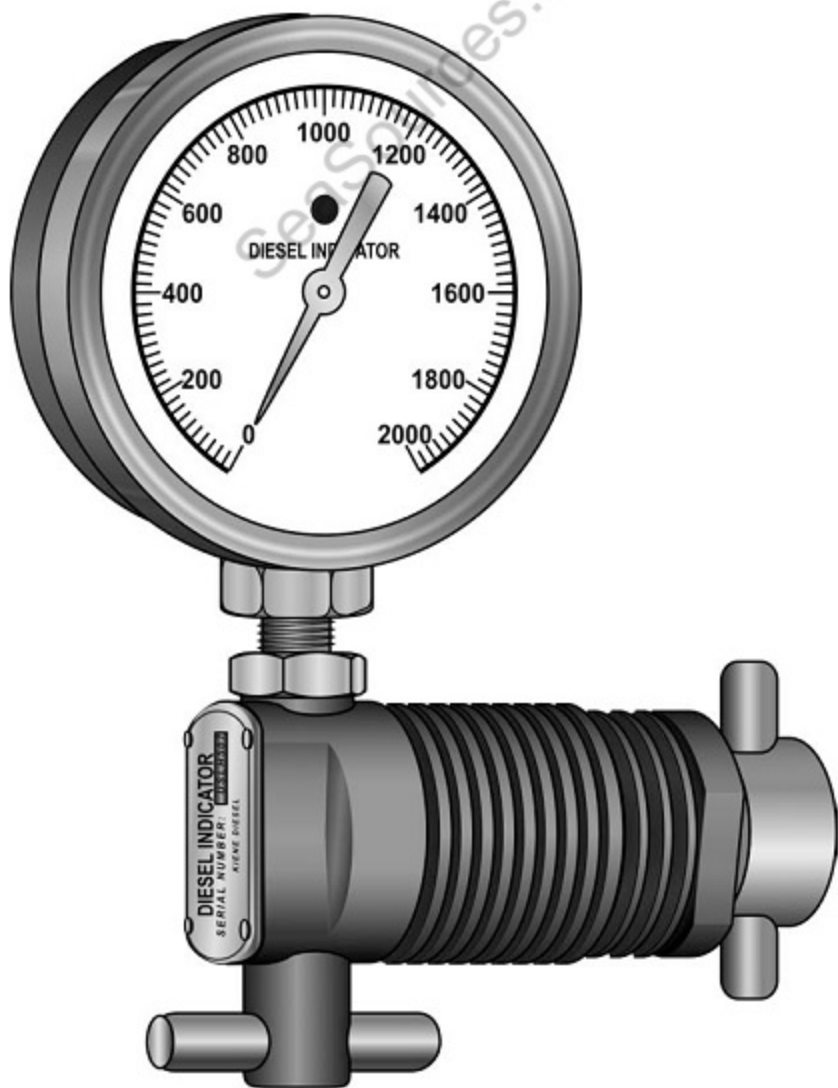
D

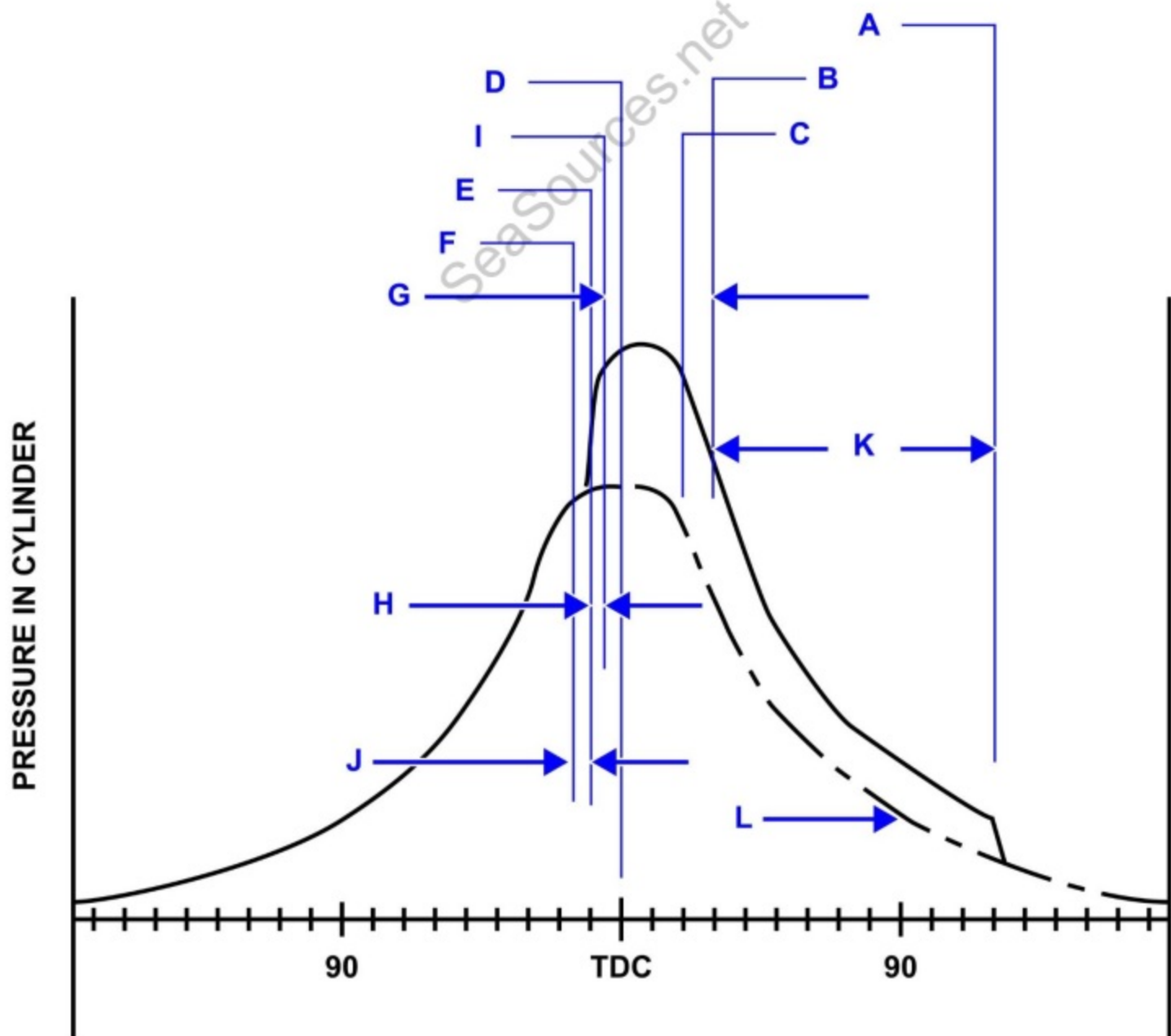


MO-0030

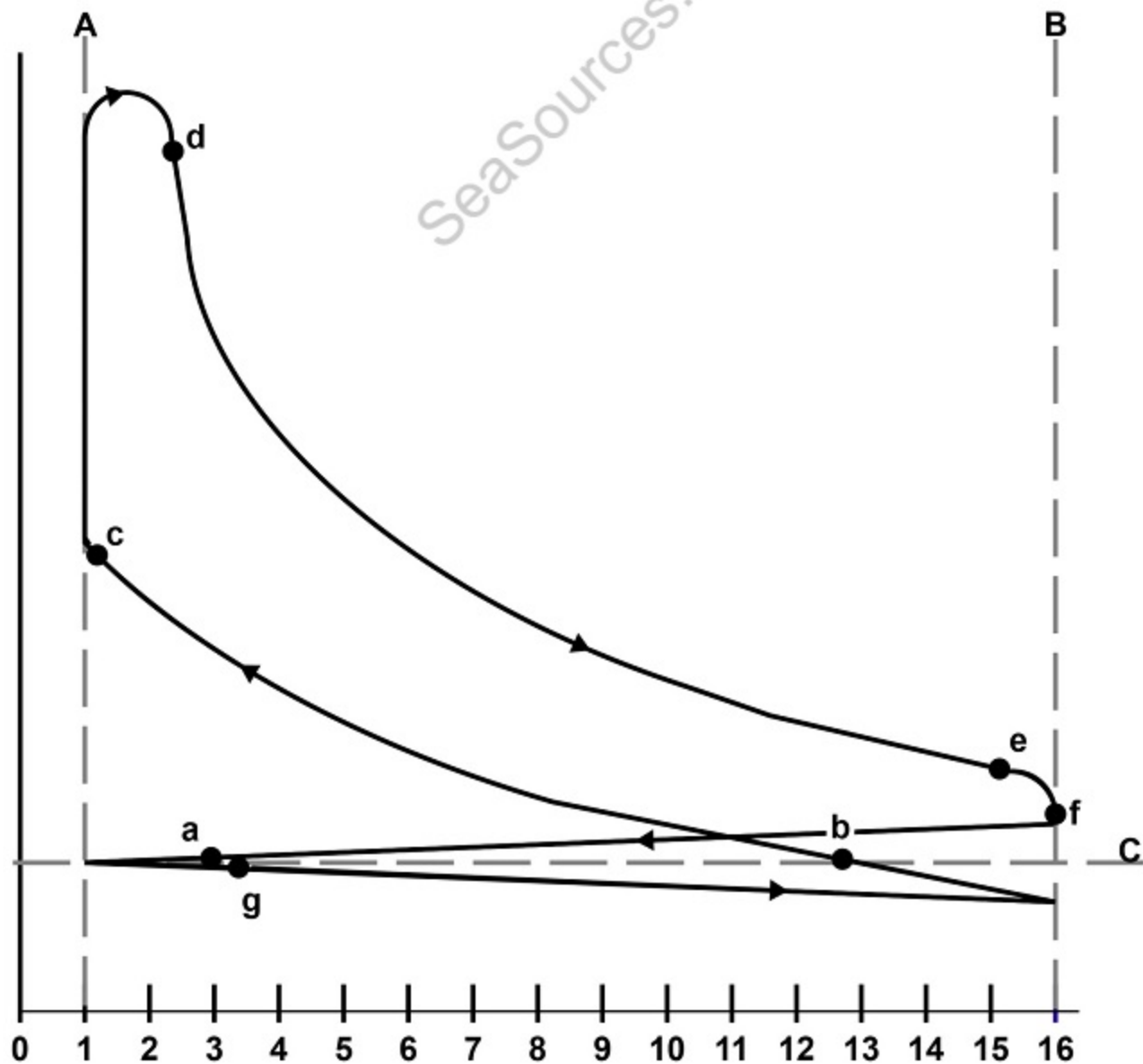


MO-0031

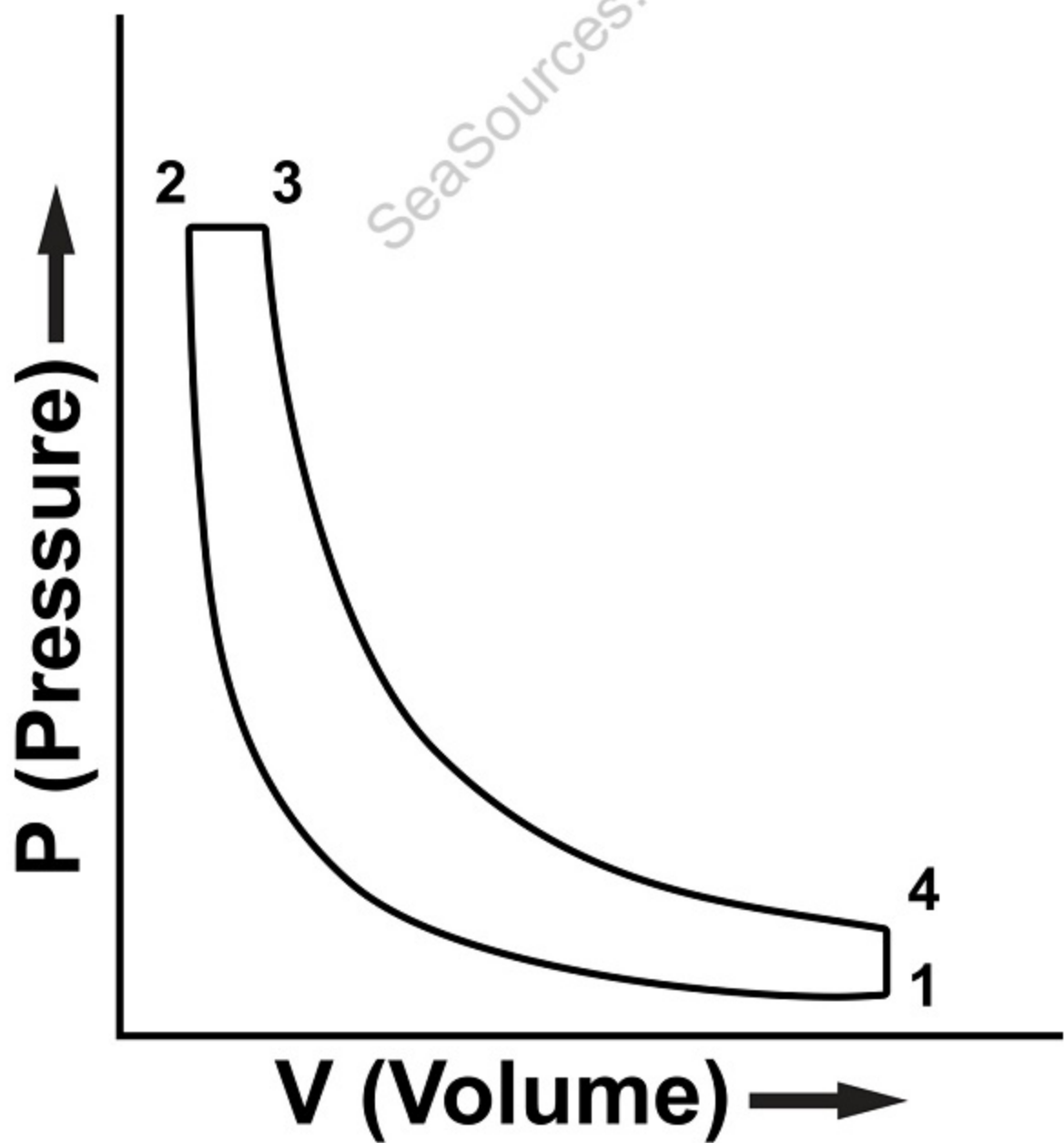




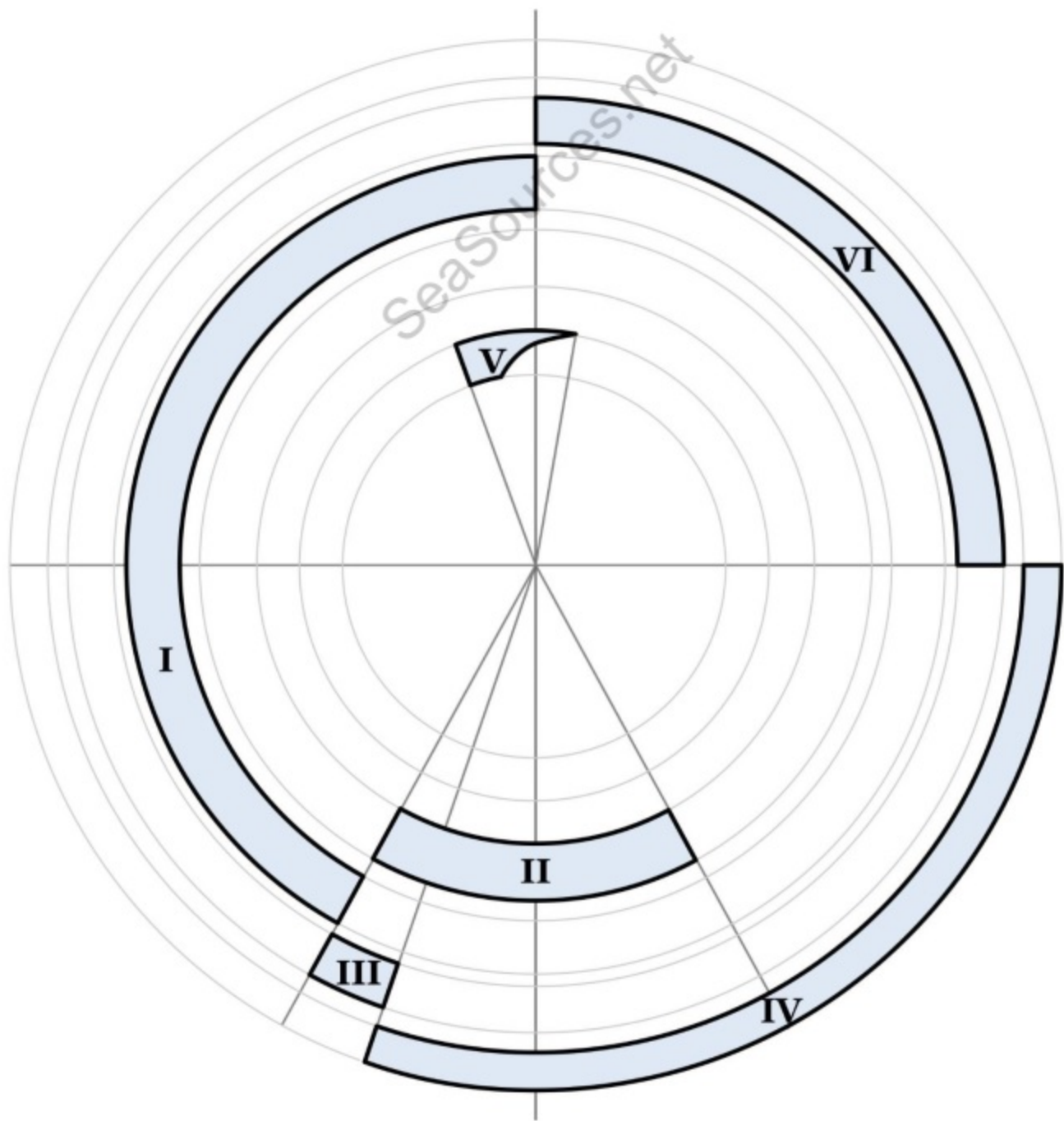
SeaSources.net



SeaSources.net



MO-0037



## MO-0038

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
<b>0</b>	<b>120</b>	<b>240</b>	<b>60</b>	<b>300</b>	<b>180</b>

This chart gives the relative positions of fuel injection cam noses on a six cylinder auxiliary diesel engine with a right hand rotation. At the moment indicated, #1 cylinder is at top dead center and combustion is taking place.

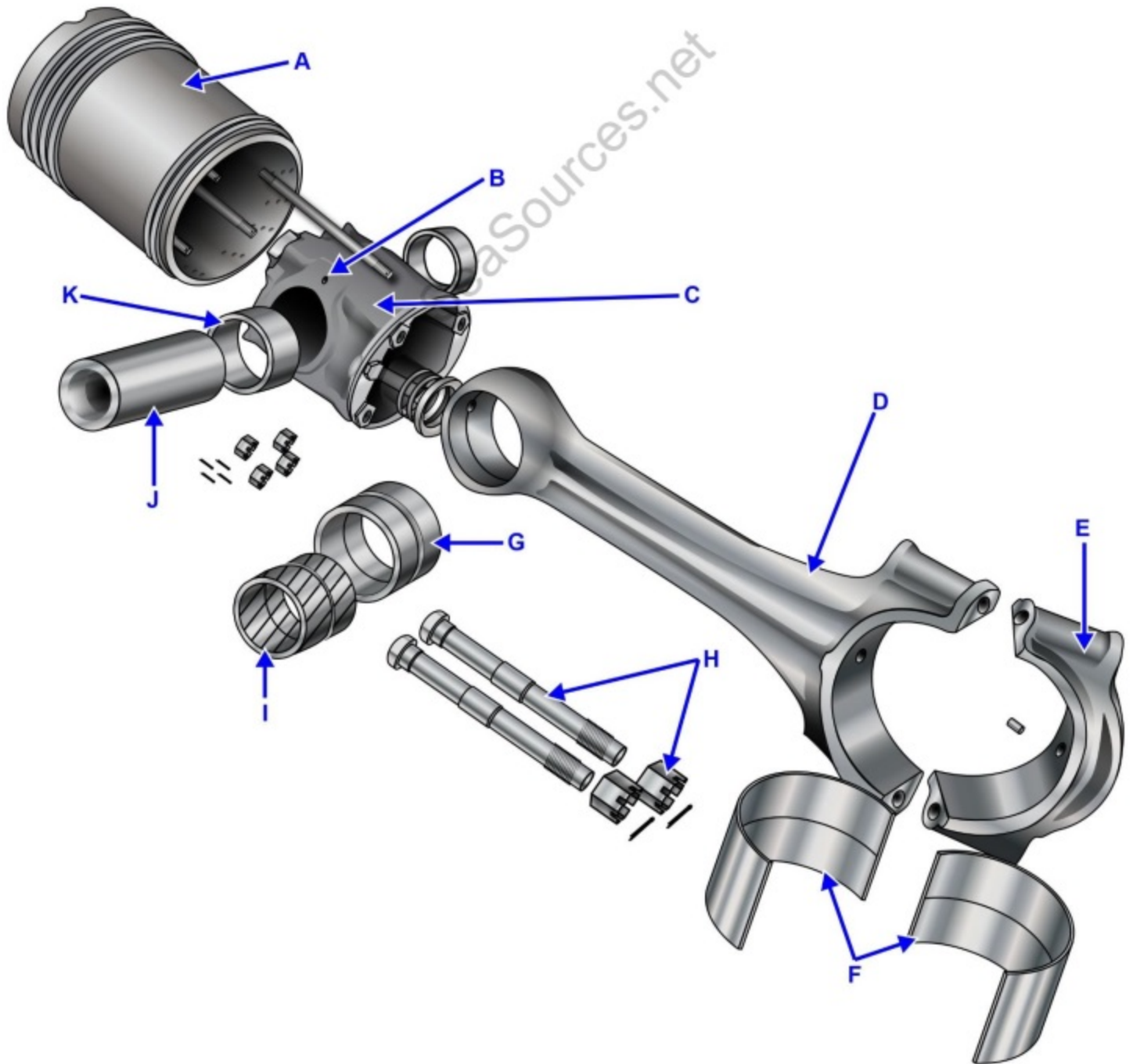


# MO-0039

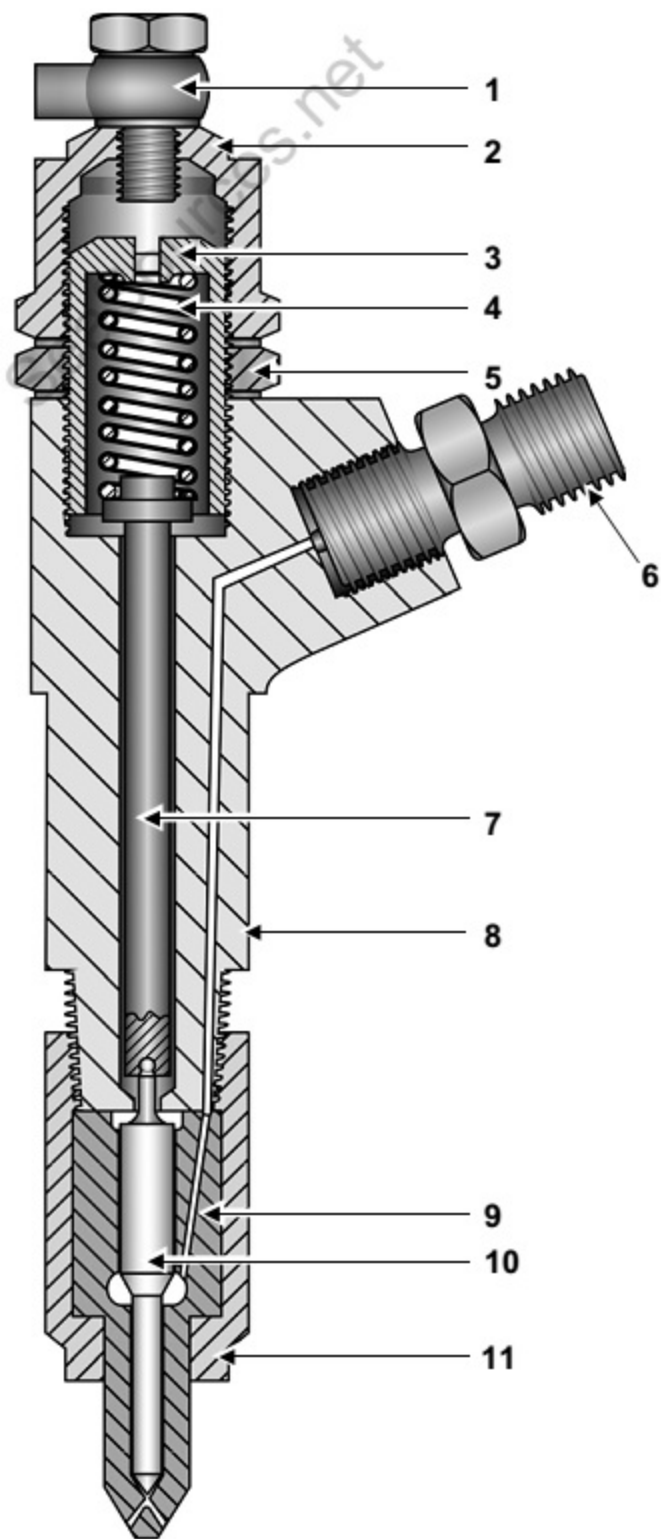
This information is for a two-stroke cycle marine engine and the flywheel is marked with reference to number one cylinder.

<b>20-Cylinder</b>	
<b>Firing Order</b>	<b>Top Dead Center</b>
<b>1</b>	<b>0 DEGREES</b>
<b>14</b>	<b>27</b> “
<b>9</b>	<b>36</b> “
<b>16</b>	<b>63</b> ”
<b>4</b>	<b>72</b> “
<b>13</b>	<b>99</b> “
<b>6</b>	<b>108</b> “
<b>20</b>	<b>135</b> “
<b>3</b>	<b>144</b> “
<b>12</b>	<b>171</b> “
<b>10</b>	<b>180</b> “
<b>17</b>	<b>207</b> “
<b>2</b>	<b>216</b> “
<b>15</b>	<b>243</b> “
<b>7</b>	<b>252</b> “
<b>18</b>	<b>279</b> “
<b>5</b>	<b>288</b> “
<b>11</b>	<b>315</b> “
<b>8</b>	<b>324</b> “
<b>19</b>	<b>351</b> “

# MO-0040



# MO-0041



MO-0042

Fig. A

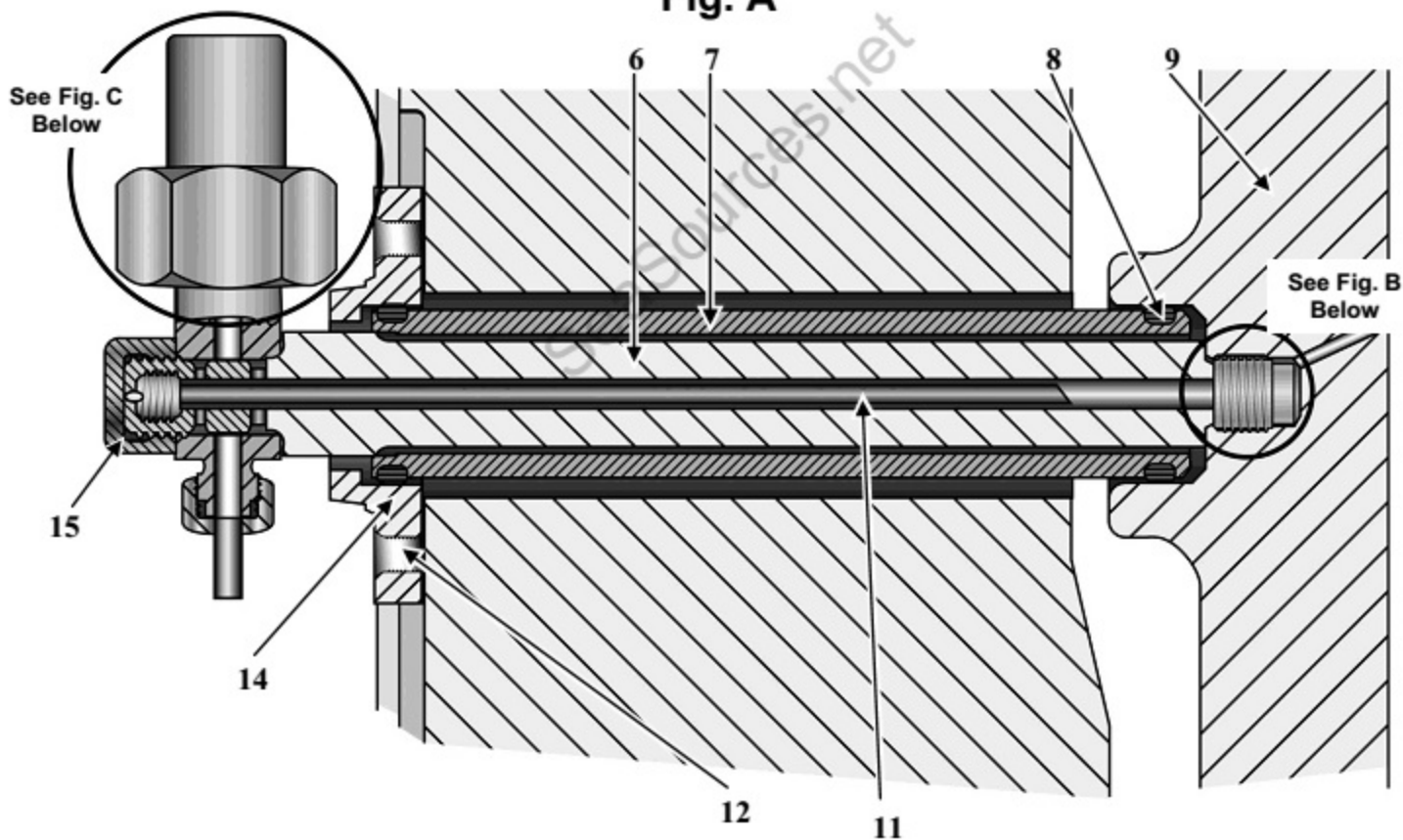


Fig. B

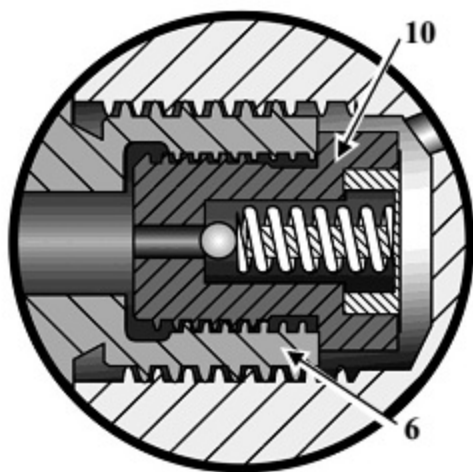
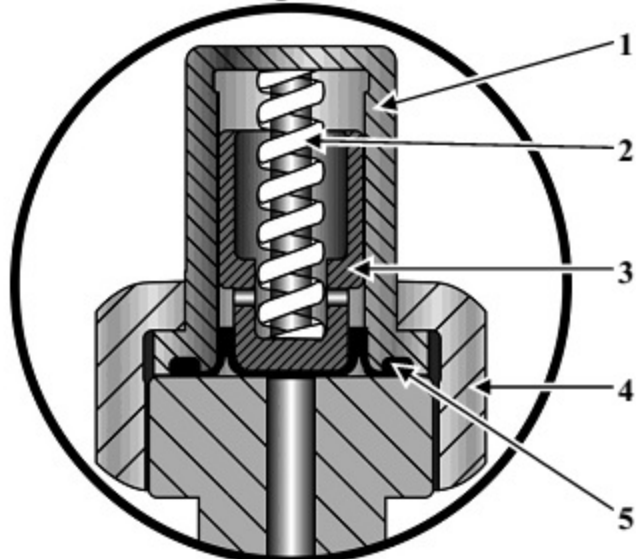
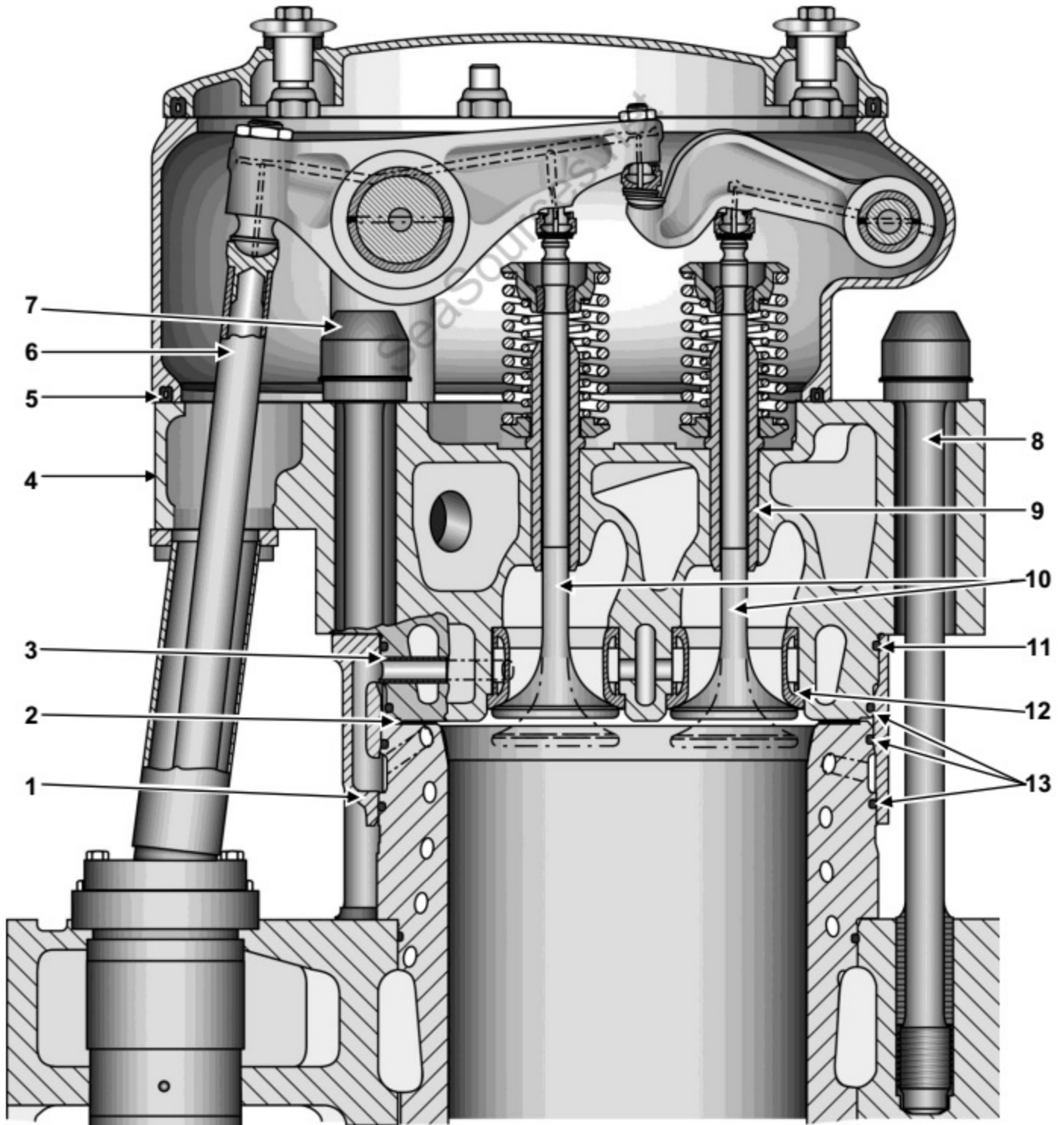


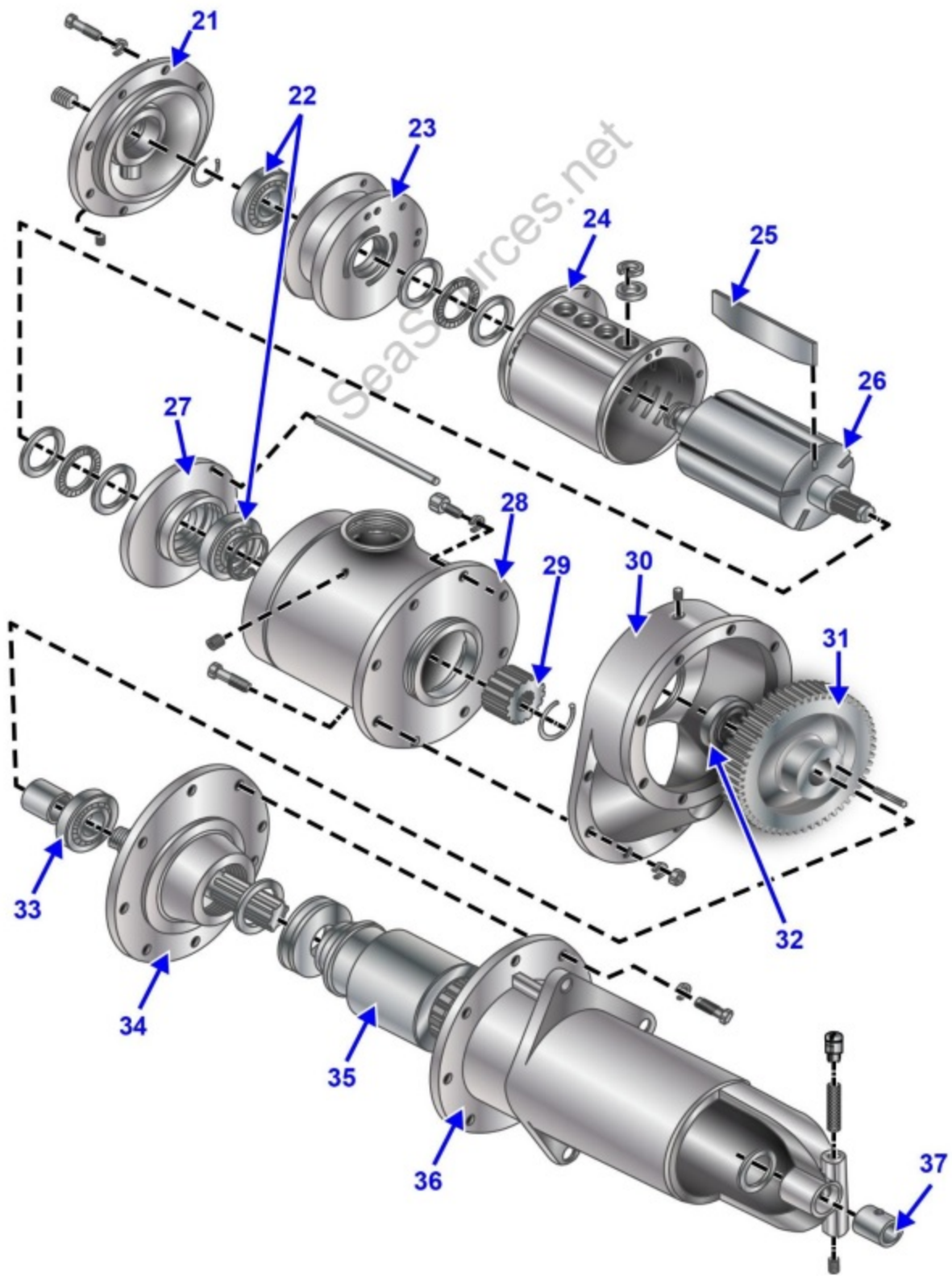
Fig. C



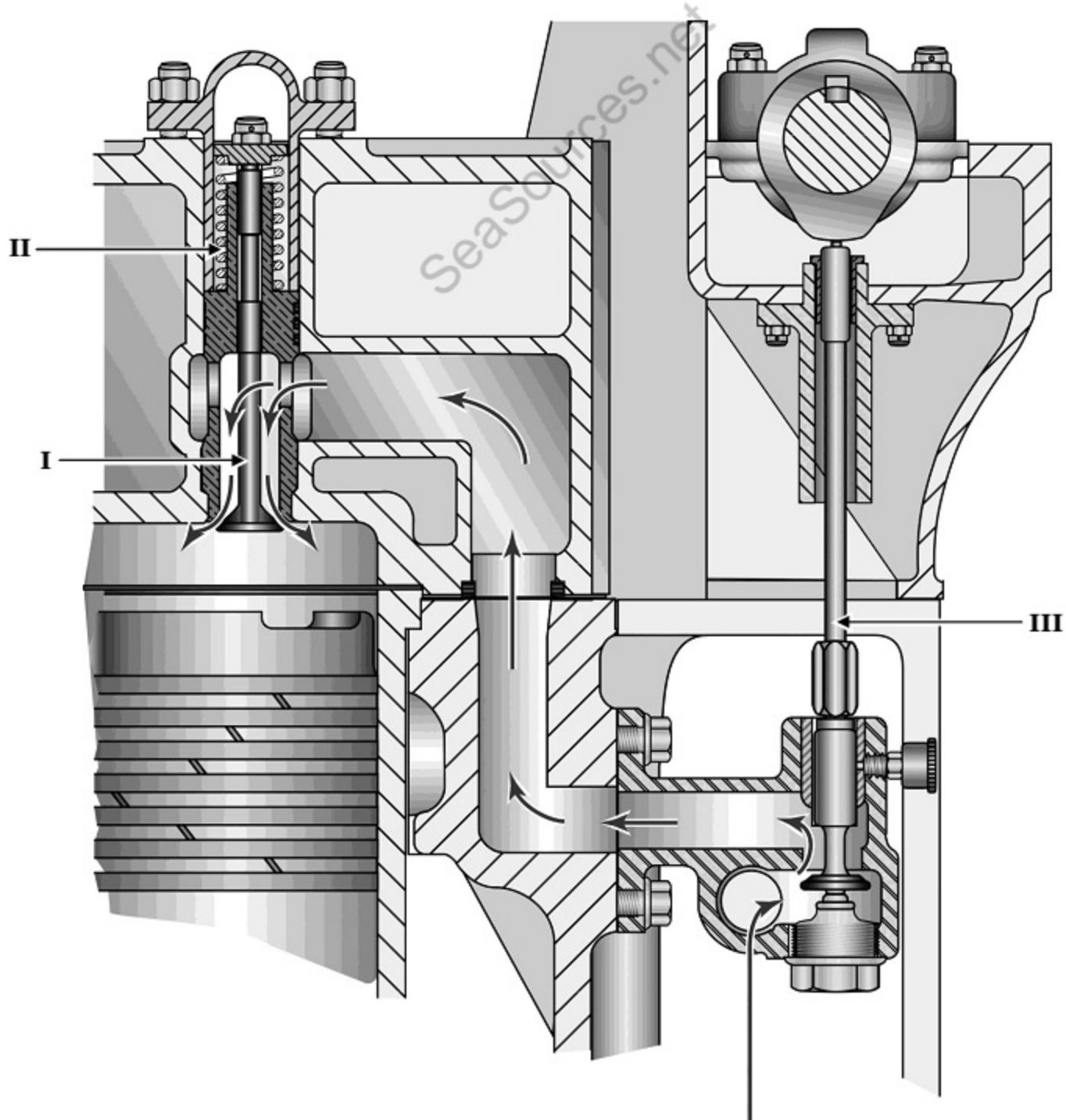
MO-0043



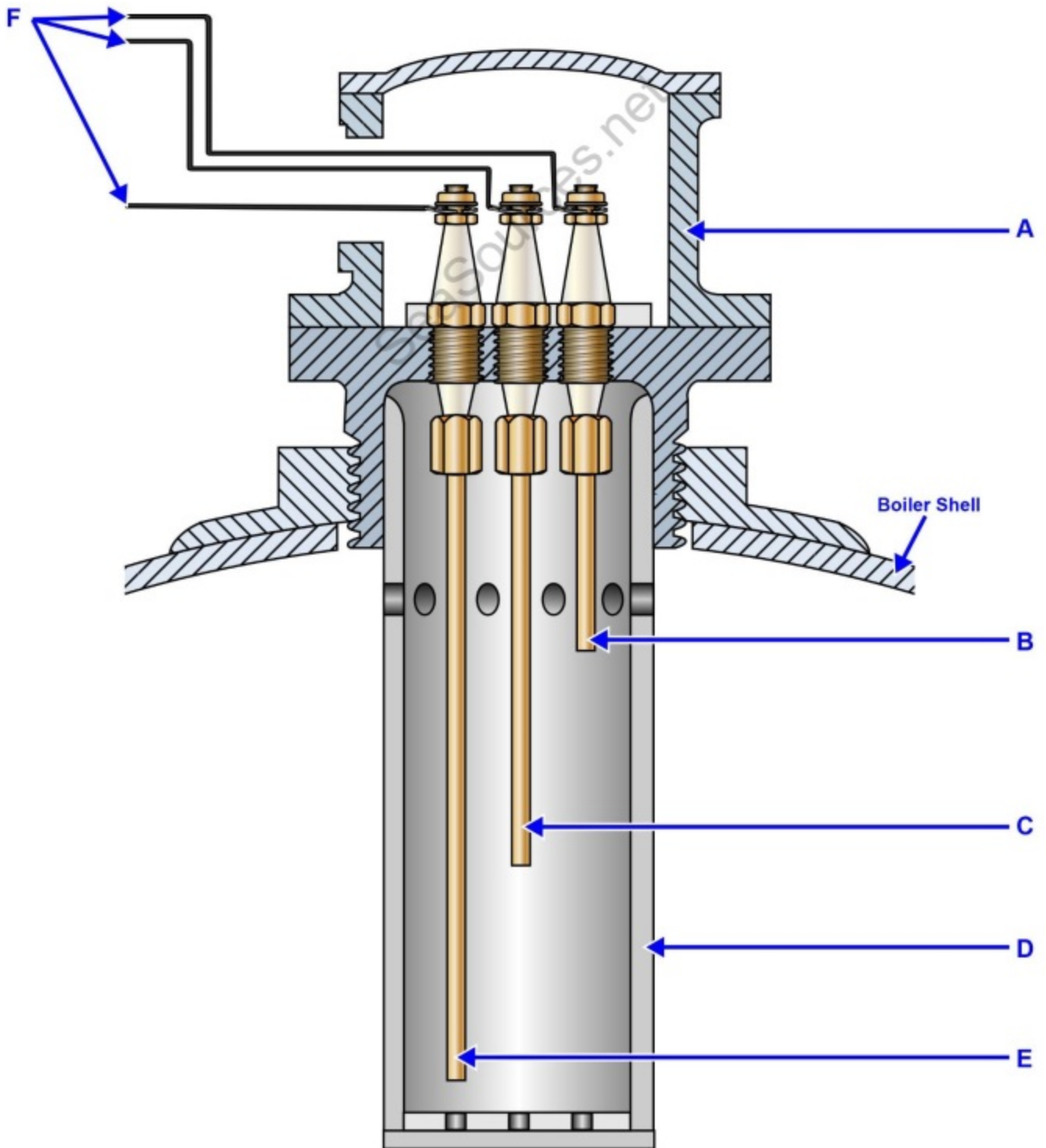
# MO-0044



MO-0046

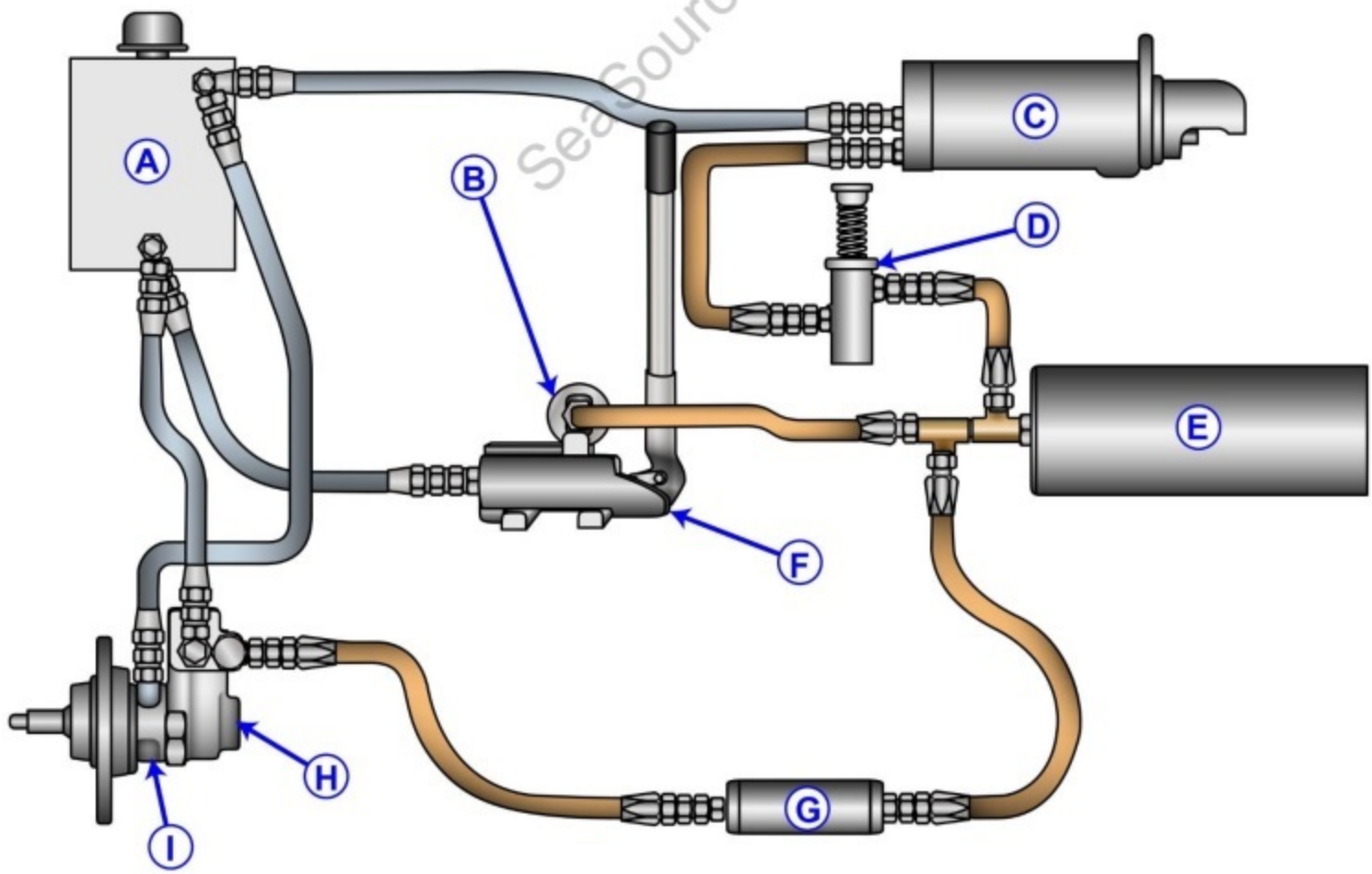


# MO-0047





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MO-0050

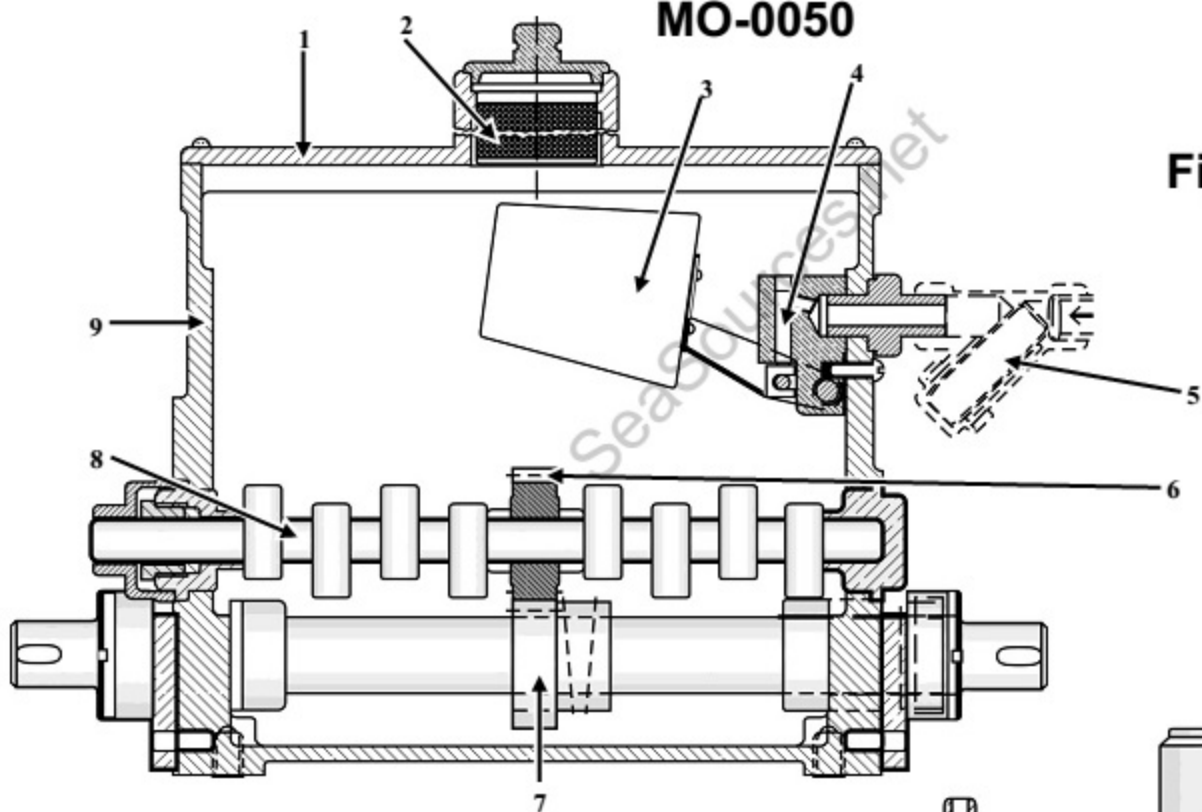
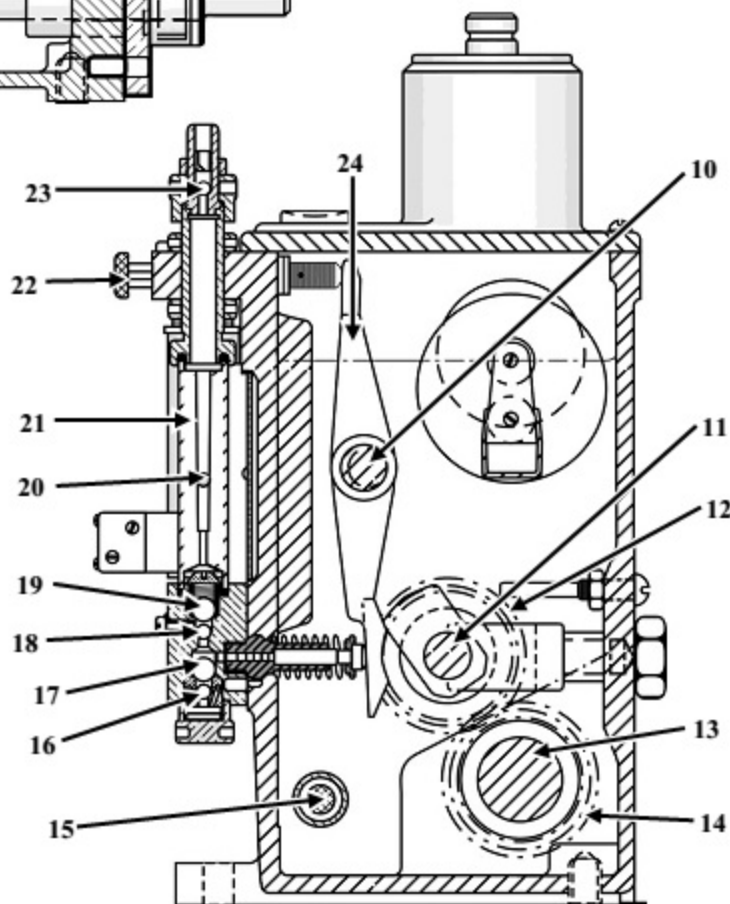
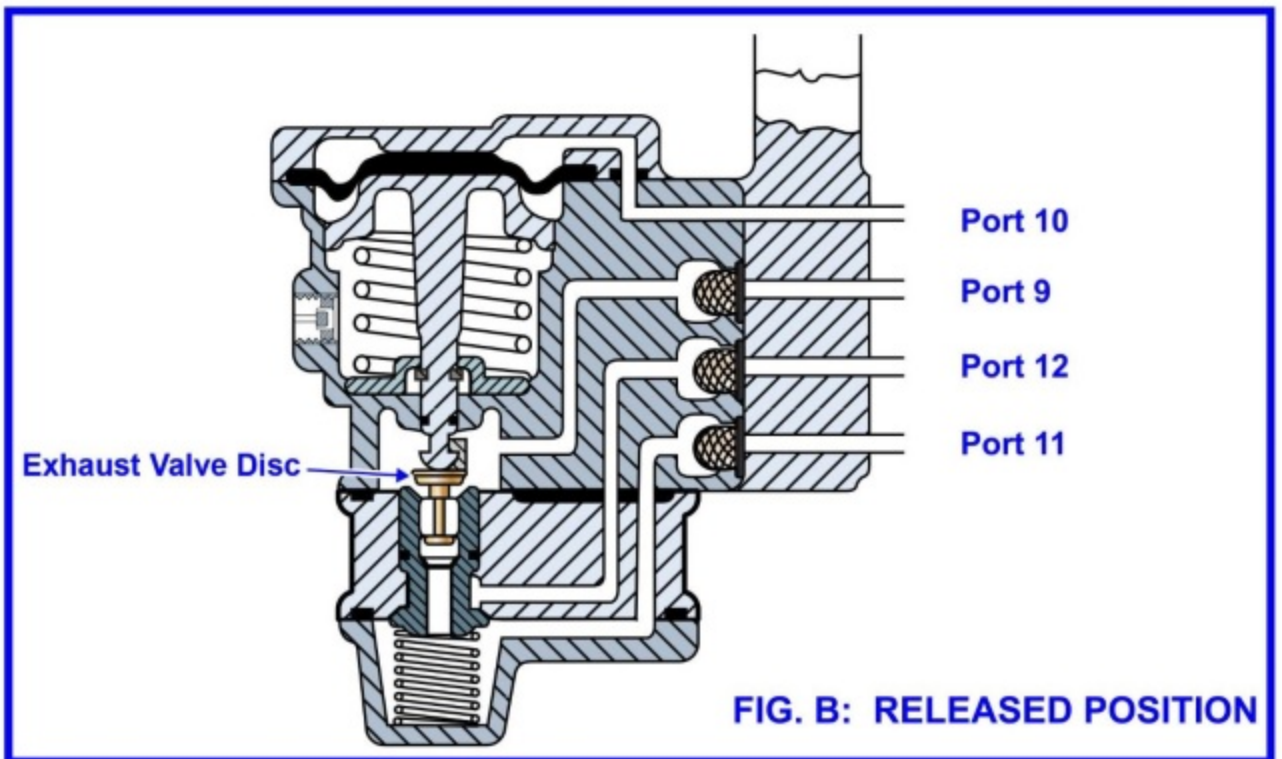
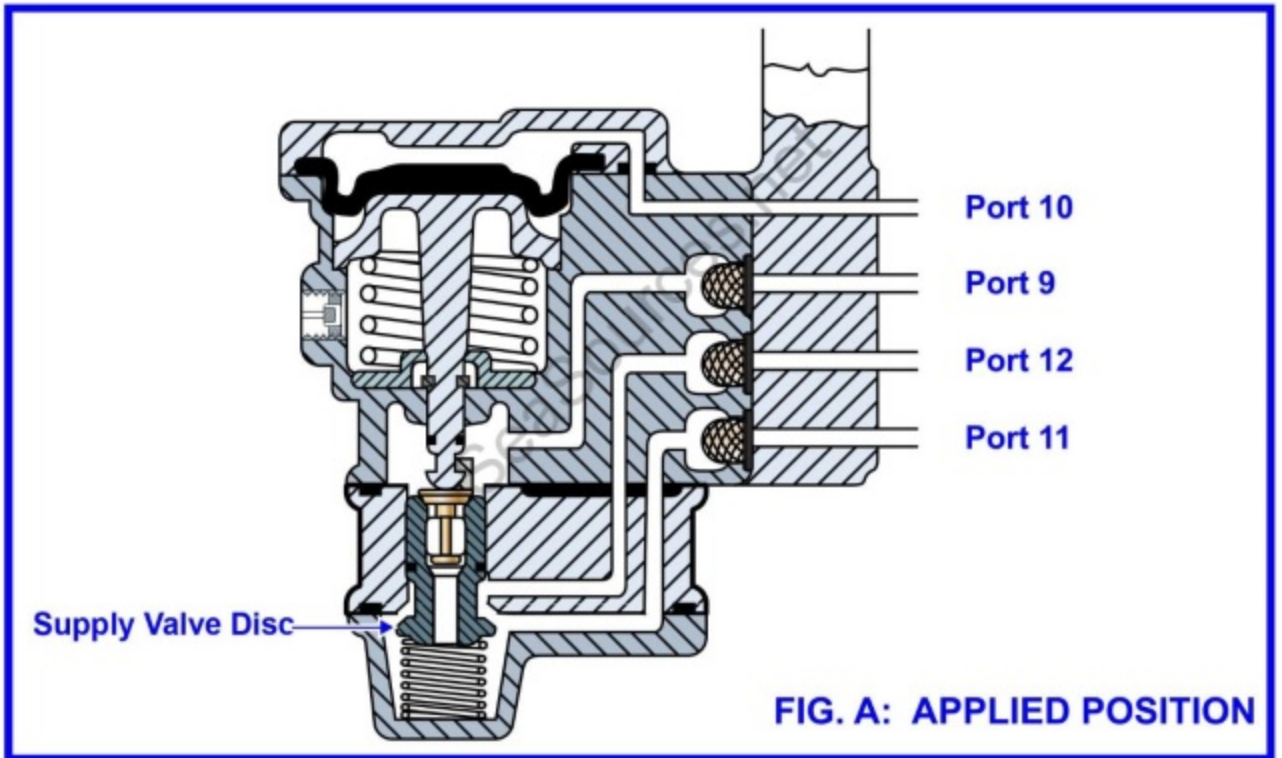


Figure A

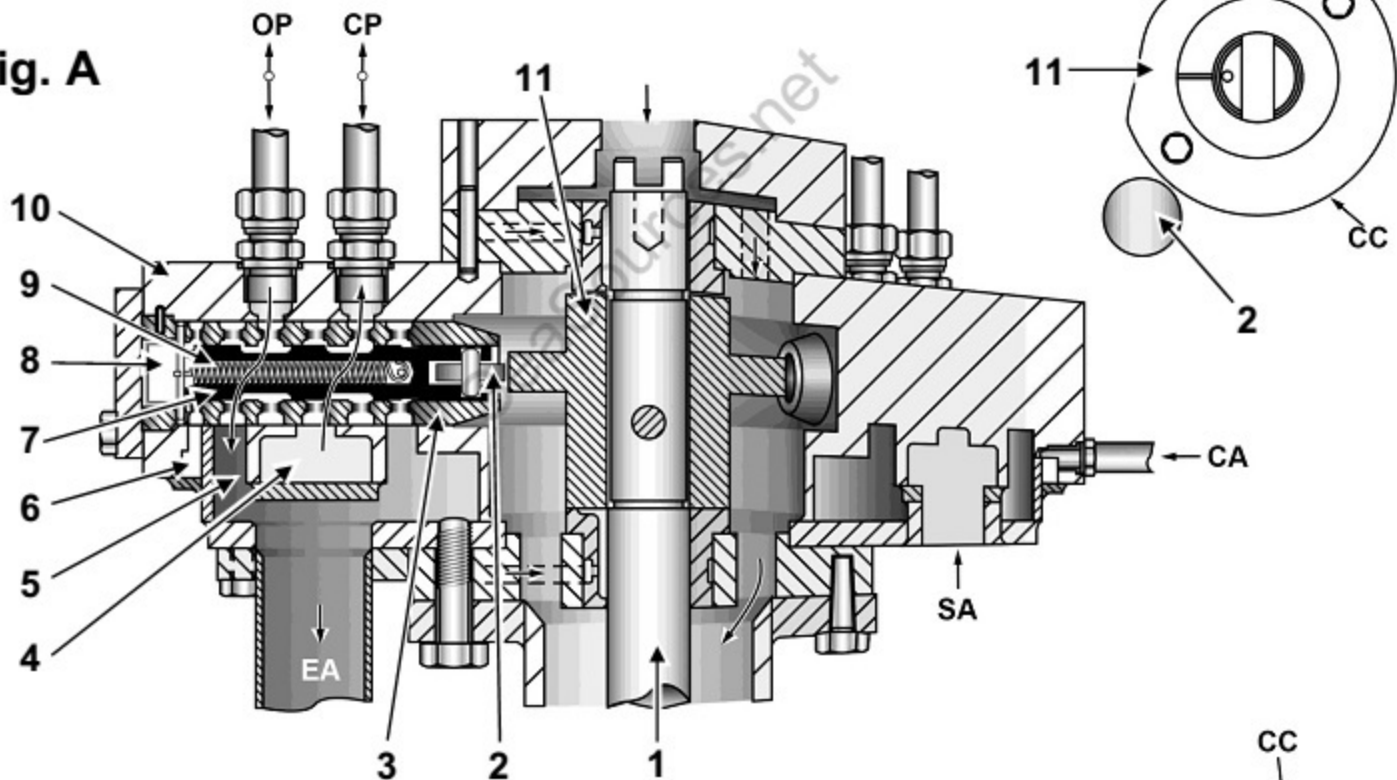
Figure B



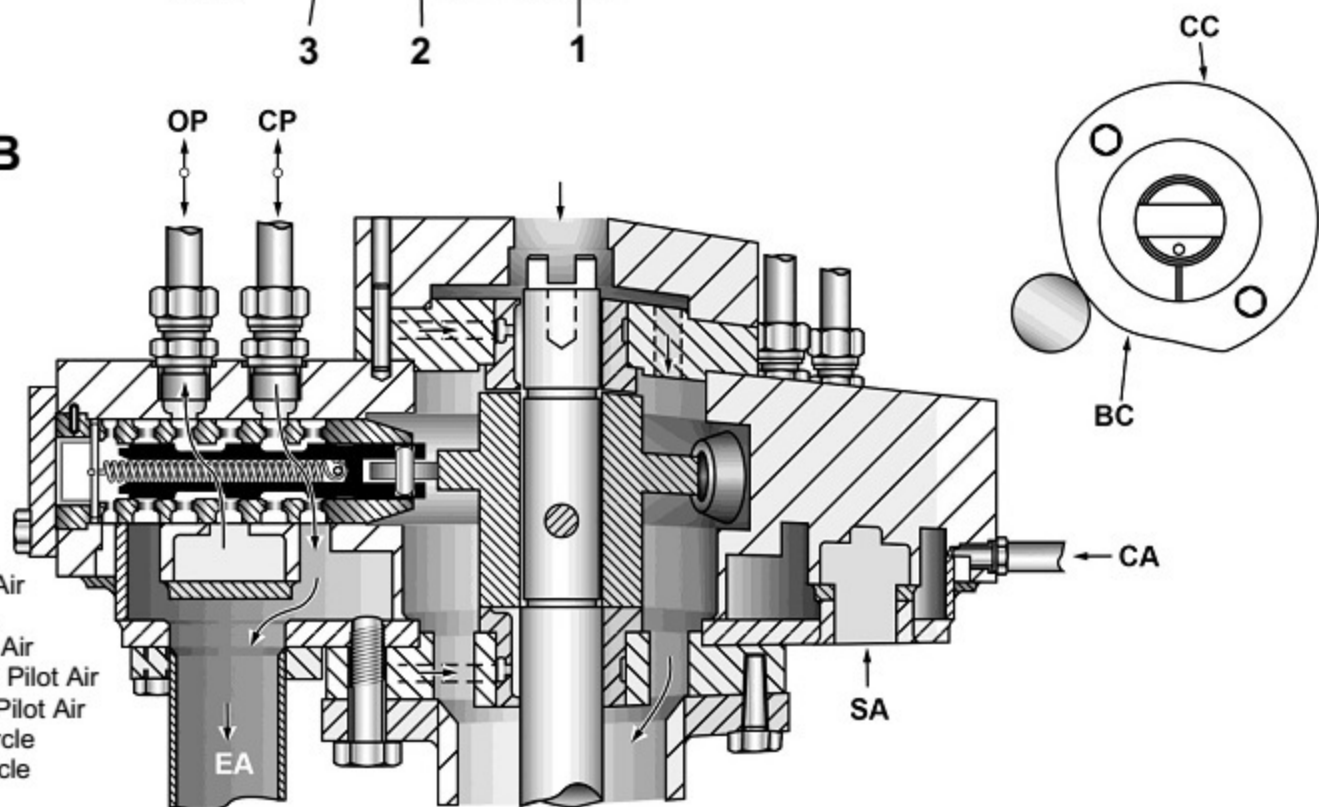


# MO-0053

**Fig. A**

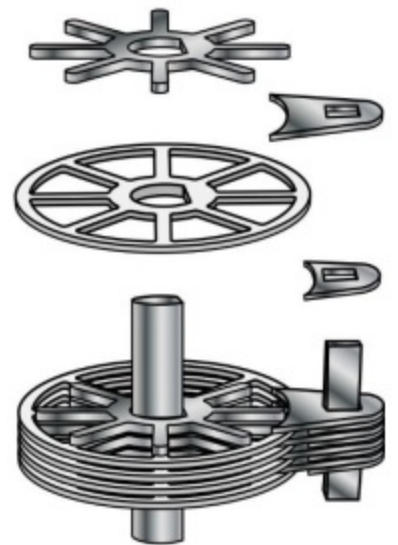
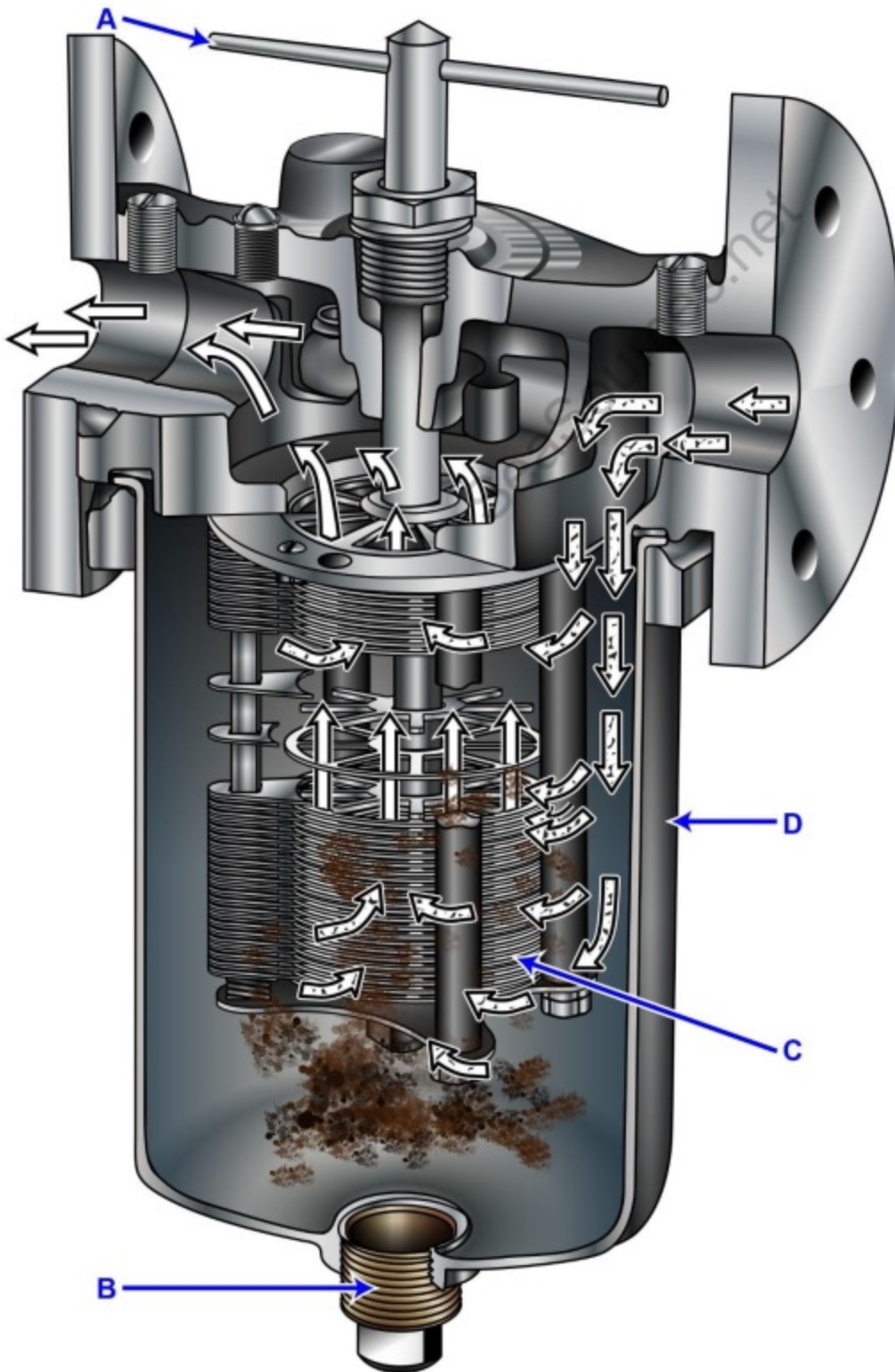


**Fig. B**

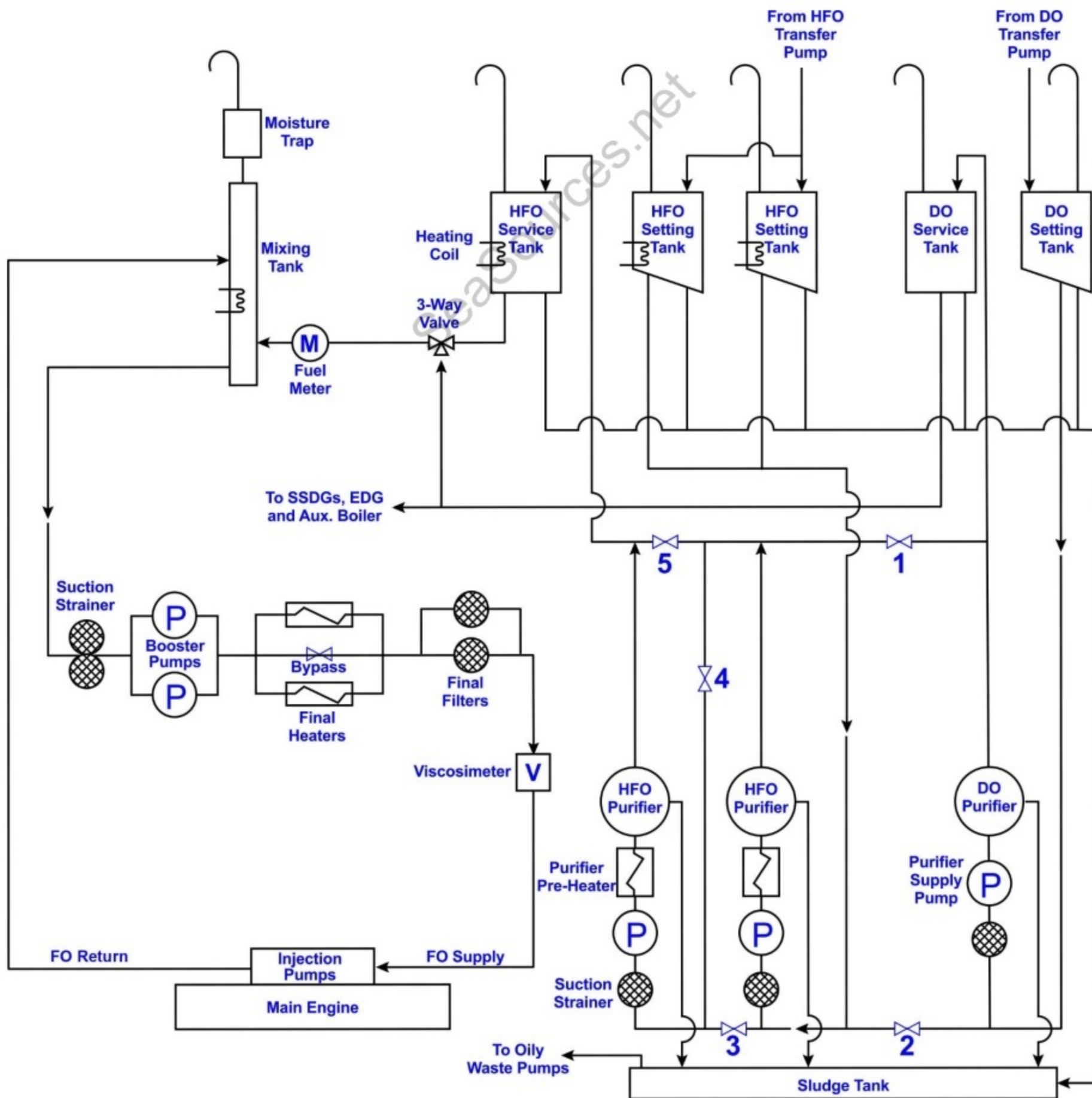


CA - Control Air  
 SA - Start Air  
 EA - Exhaust Air  
 OP - Opening Pilot Air  
 CP - Closing Pilot Air  
 BC - Base Circle  
 CC - Cam Circle

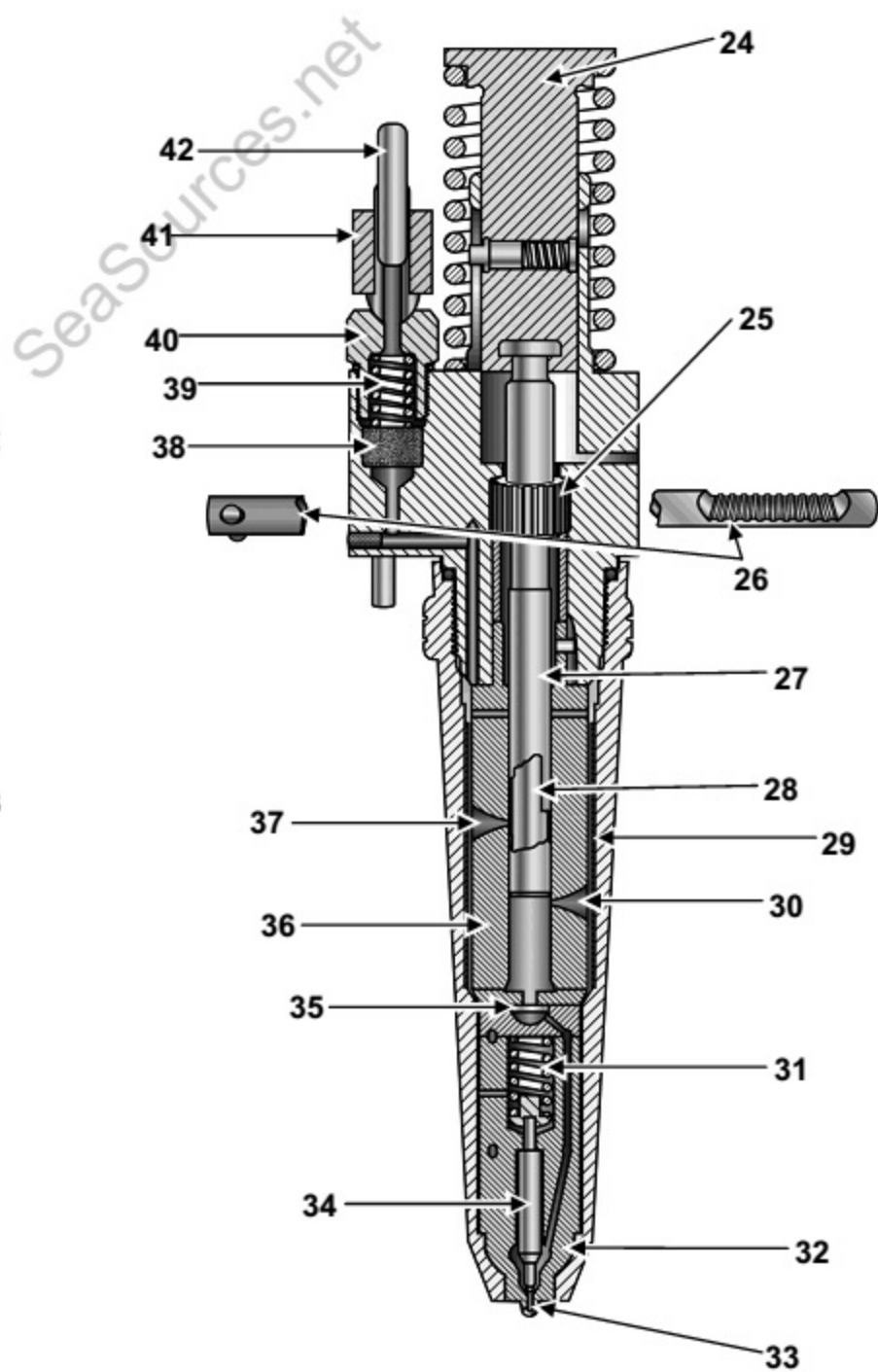
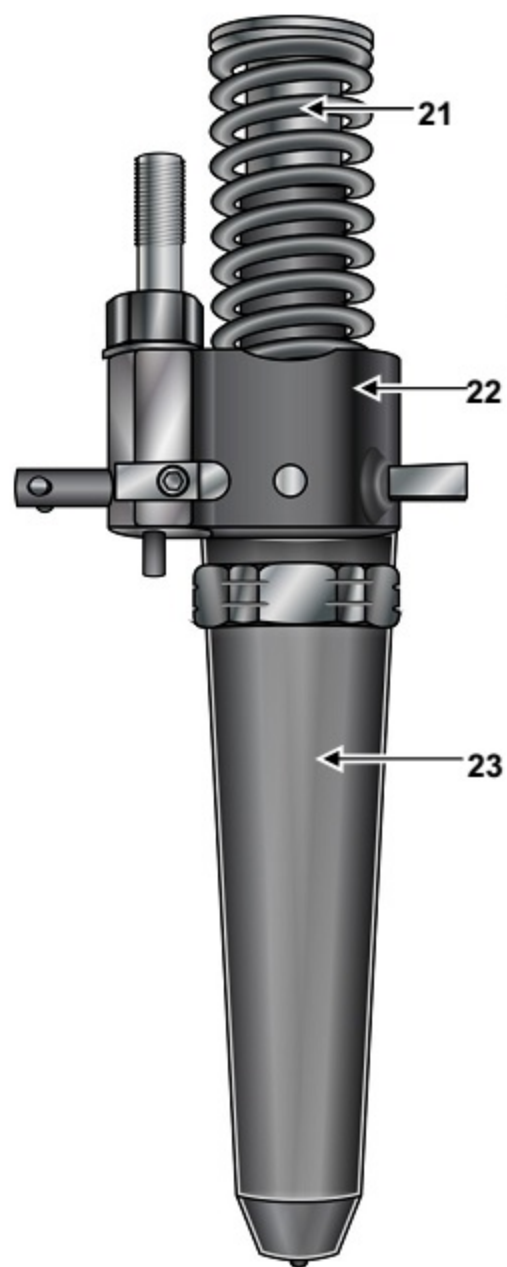
# MO-0057



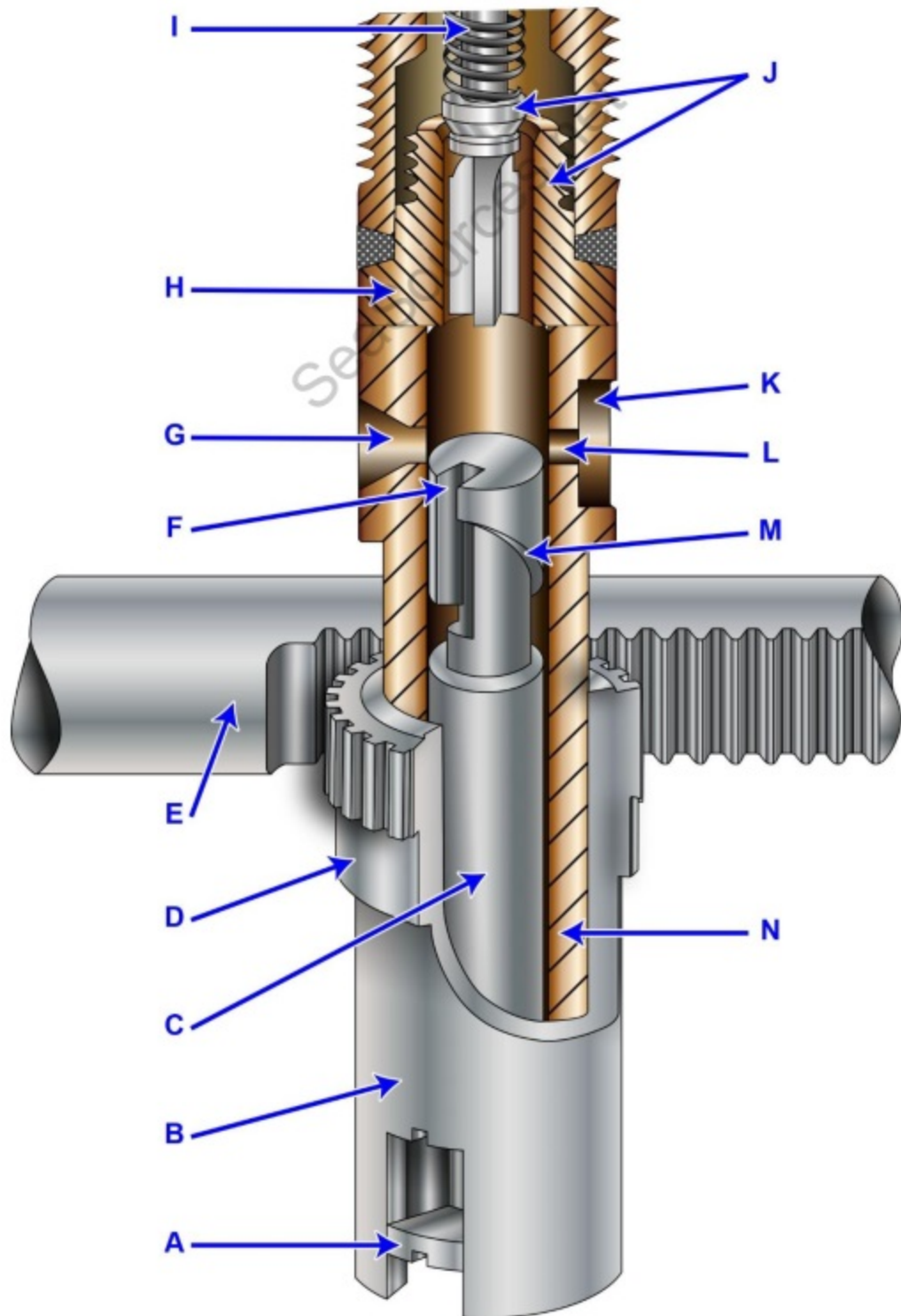
# MO-0058



# MO-0059

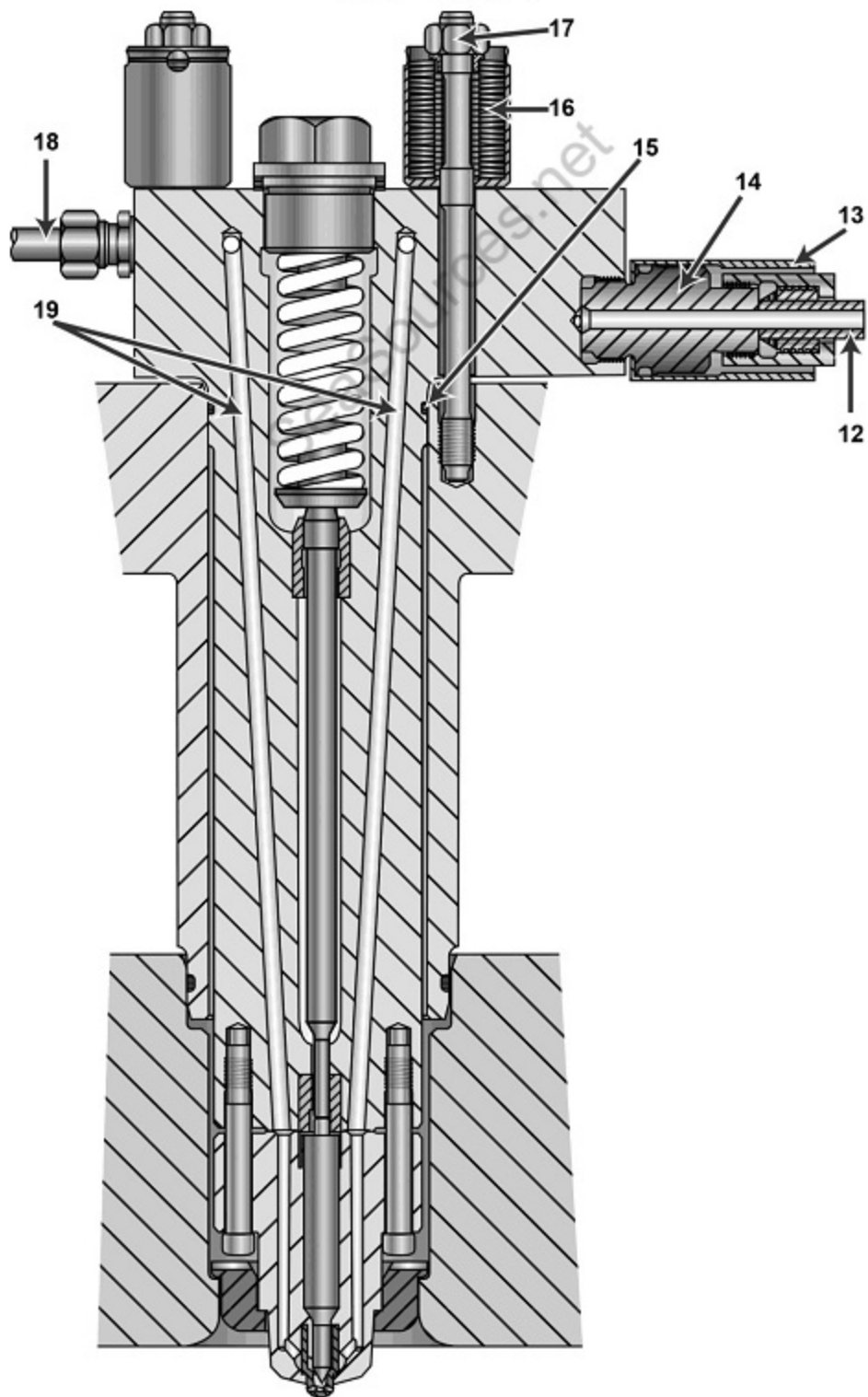


# MO-0061

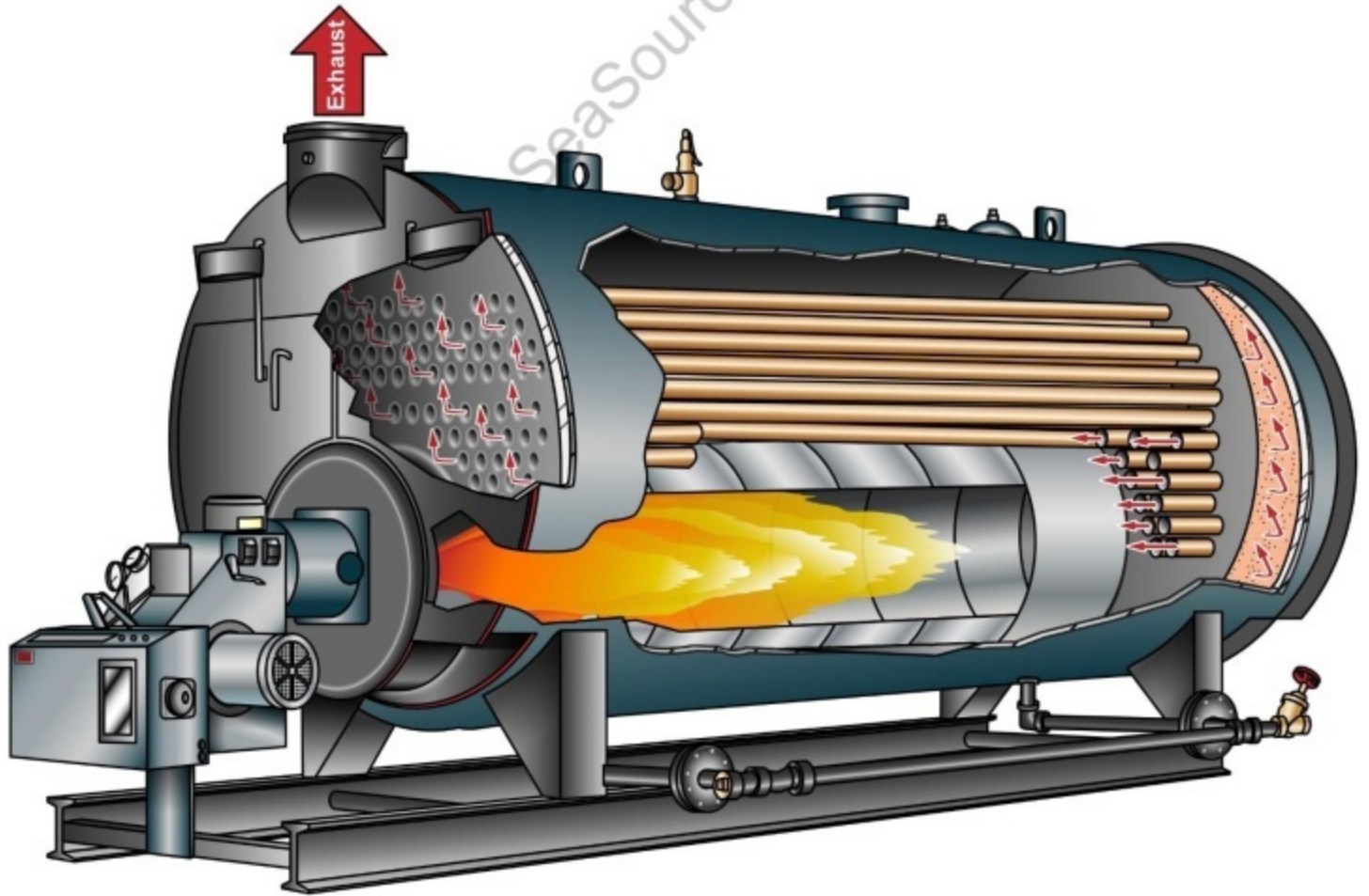




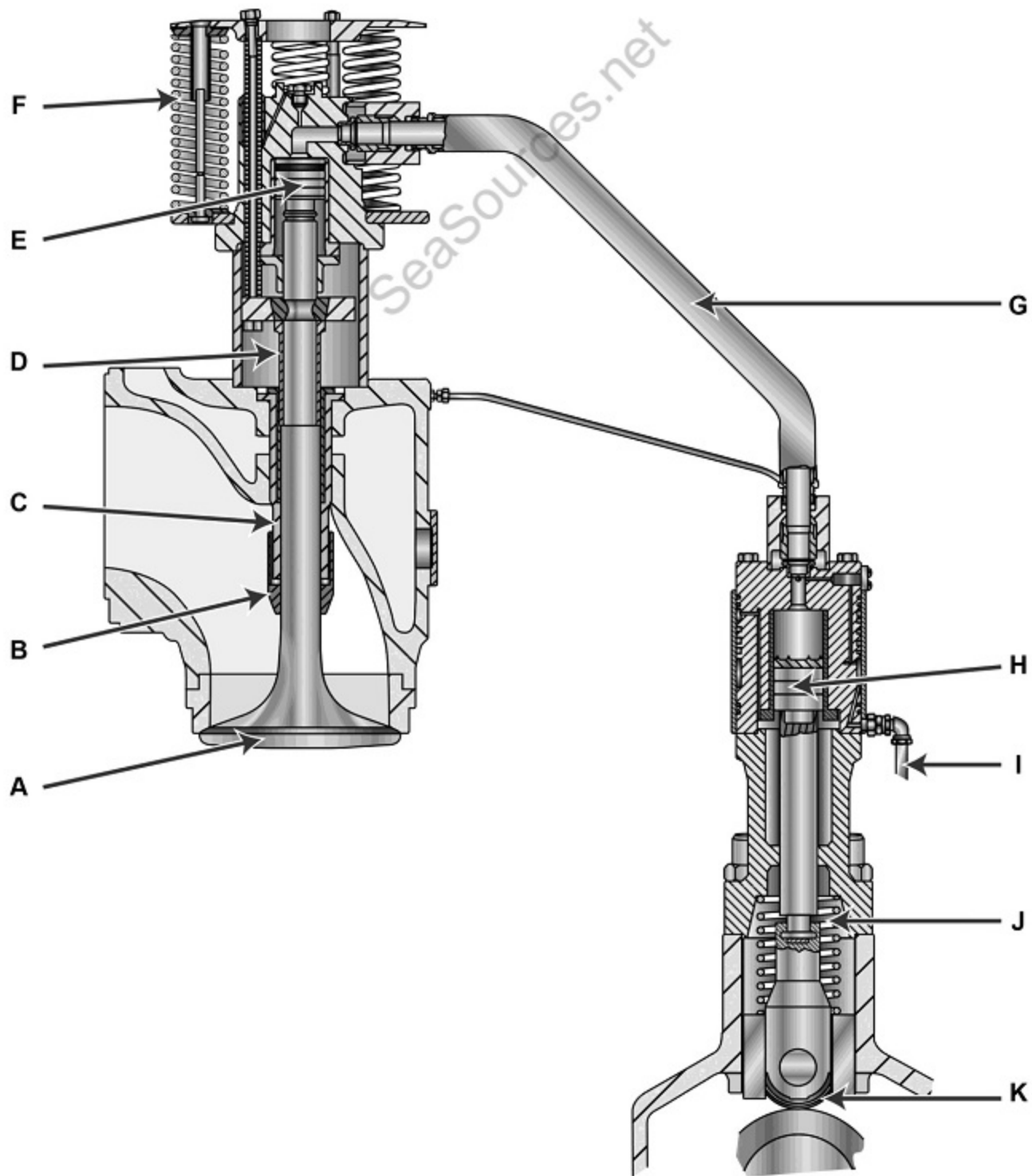
# MO-0062



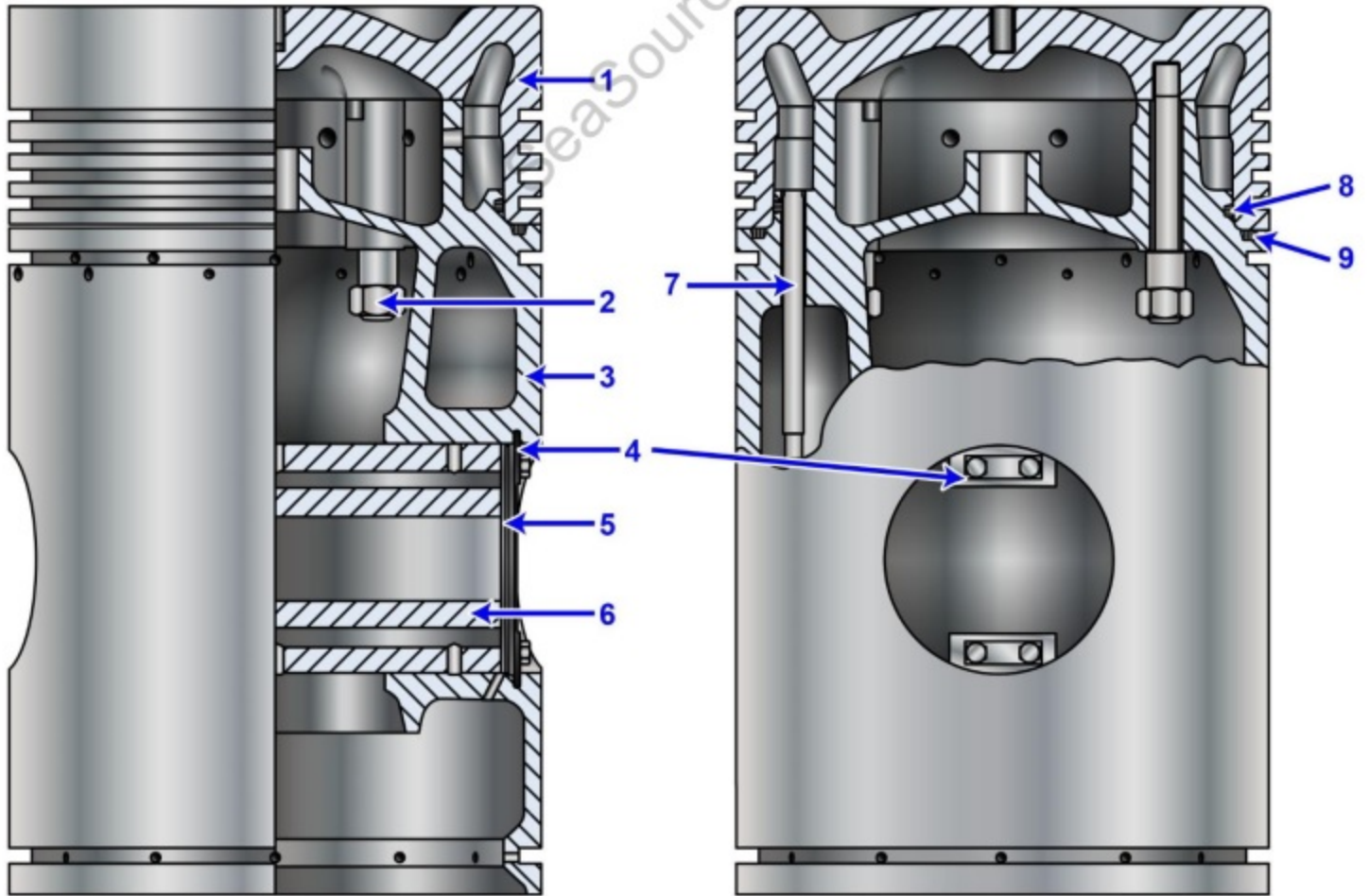
MO-0064



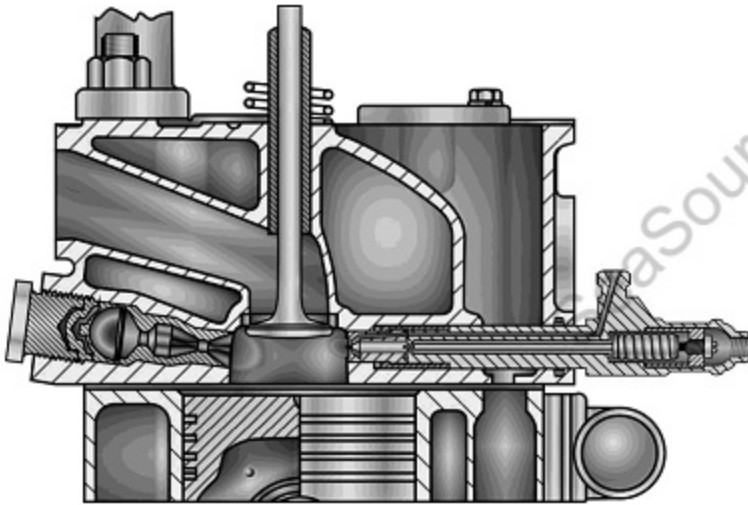
MO-0066



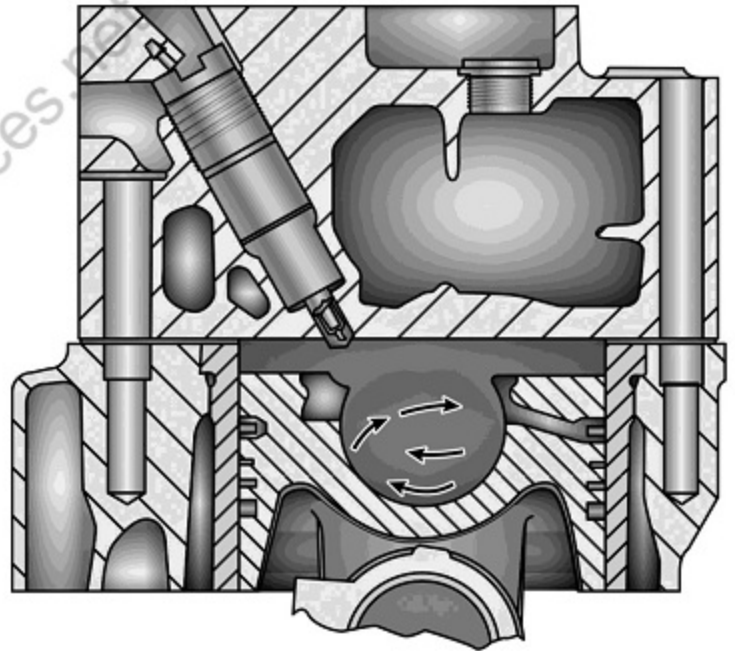
MO-0067



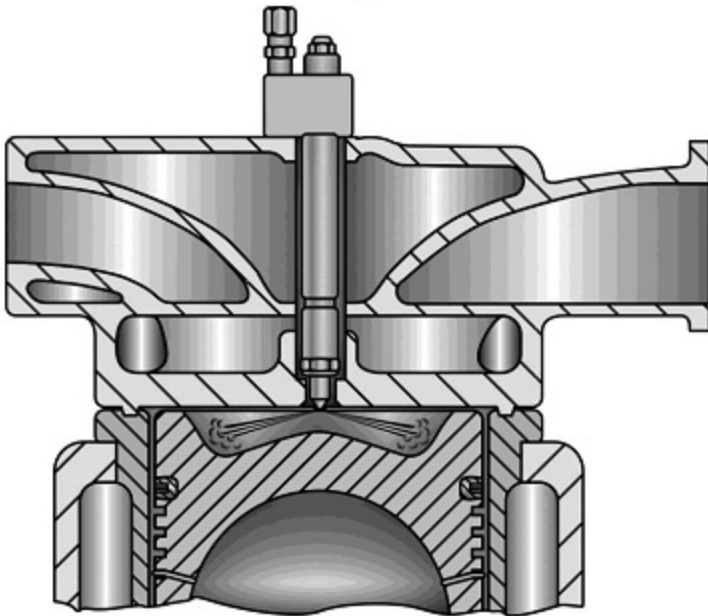
A



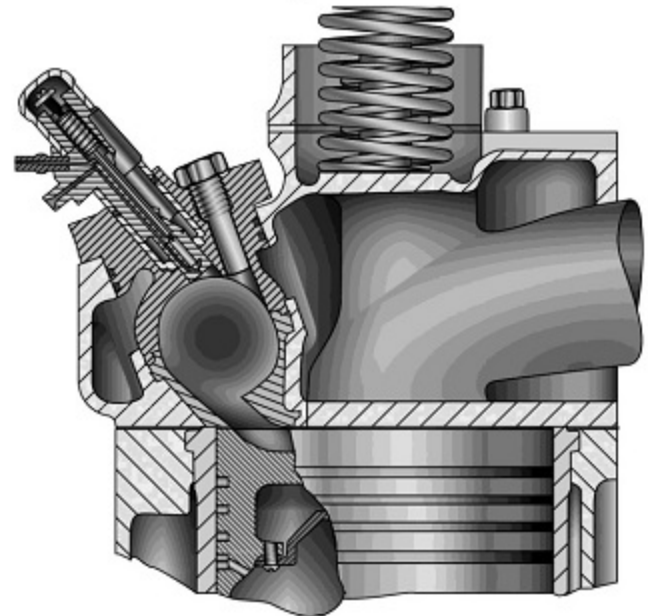
B



C



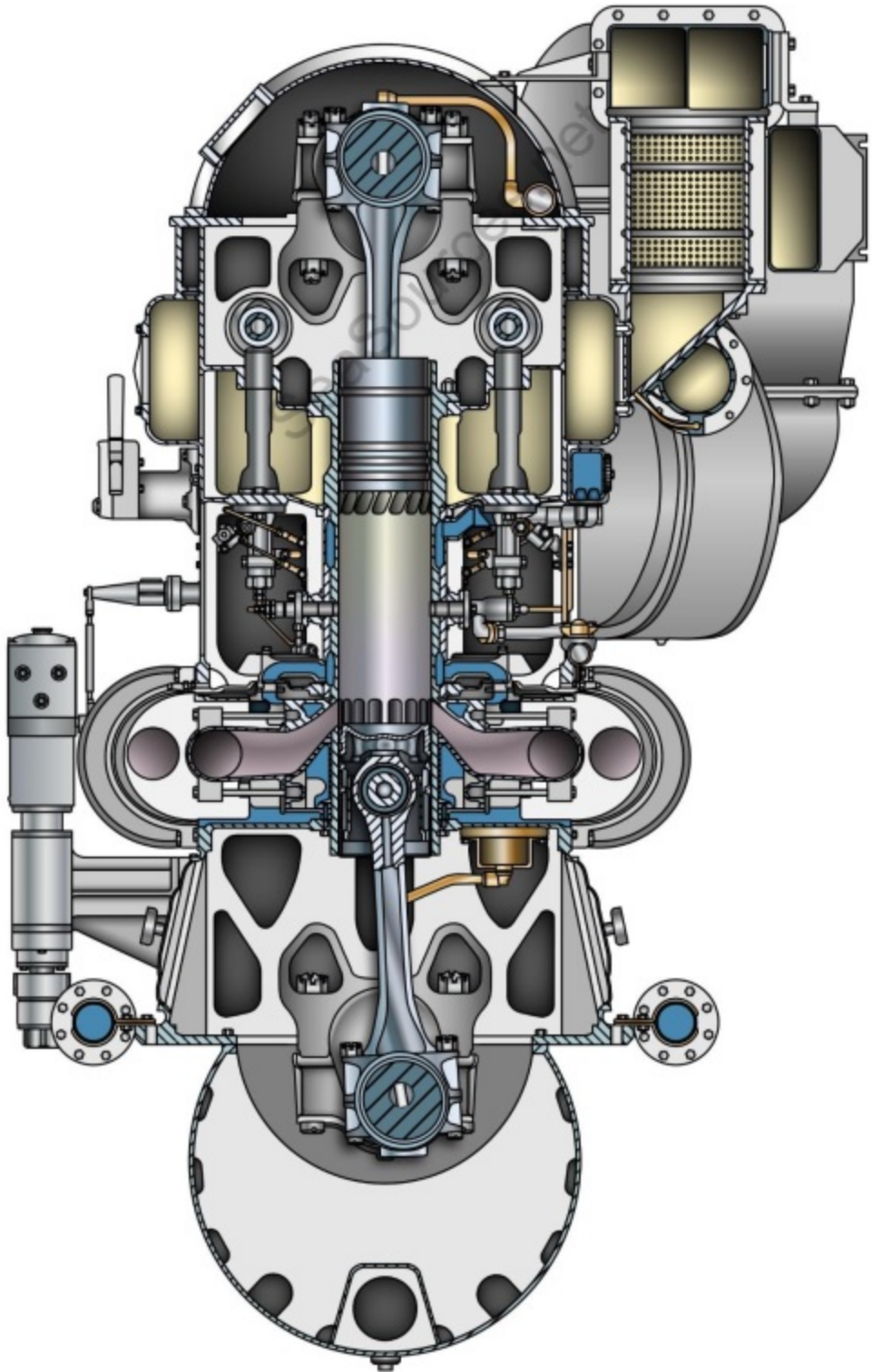
D



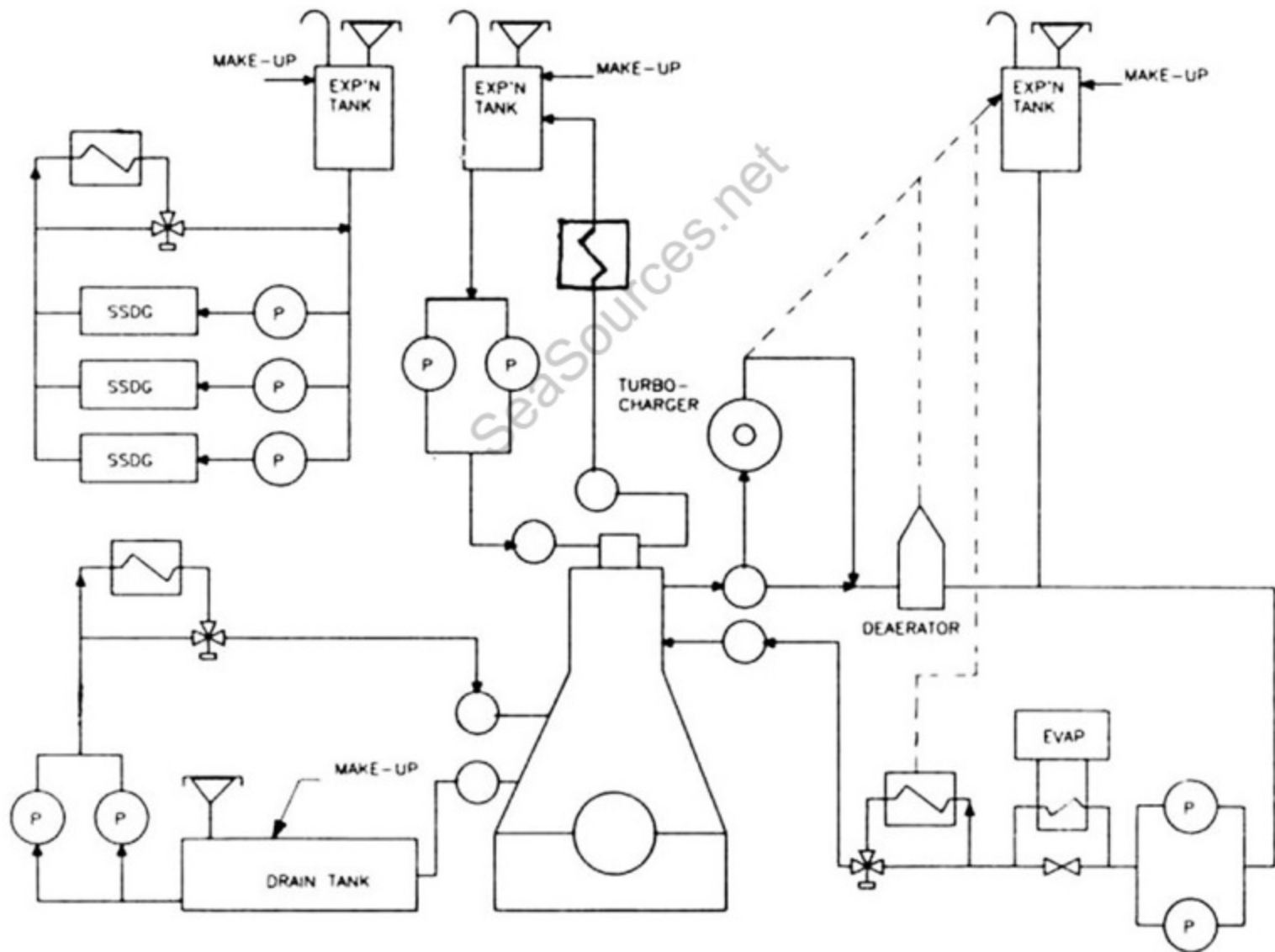
A & D

B & C

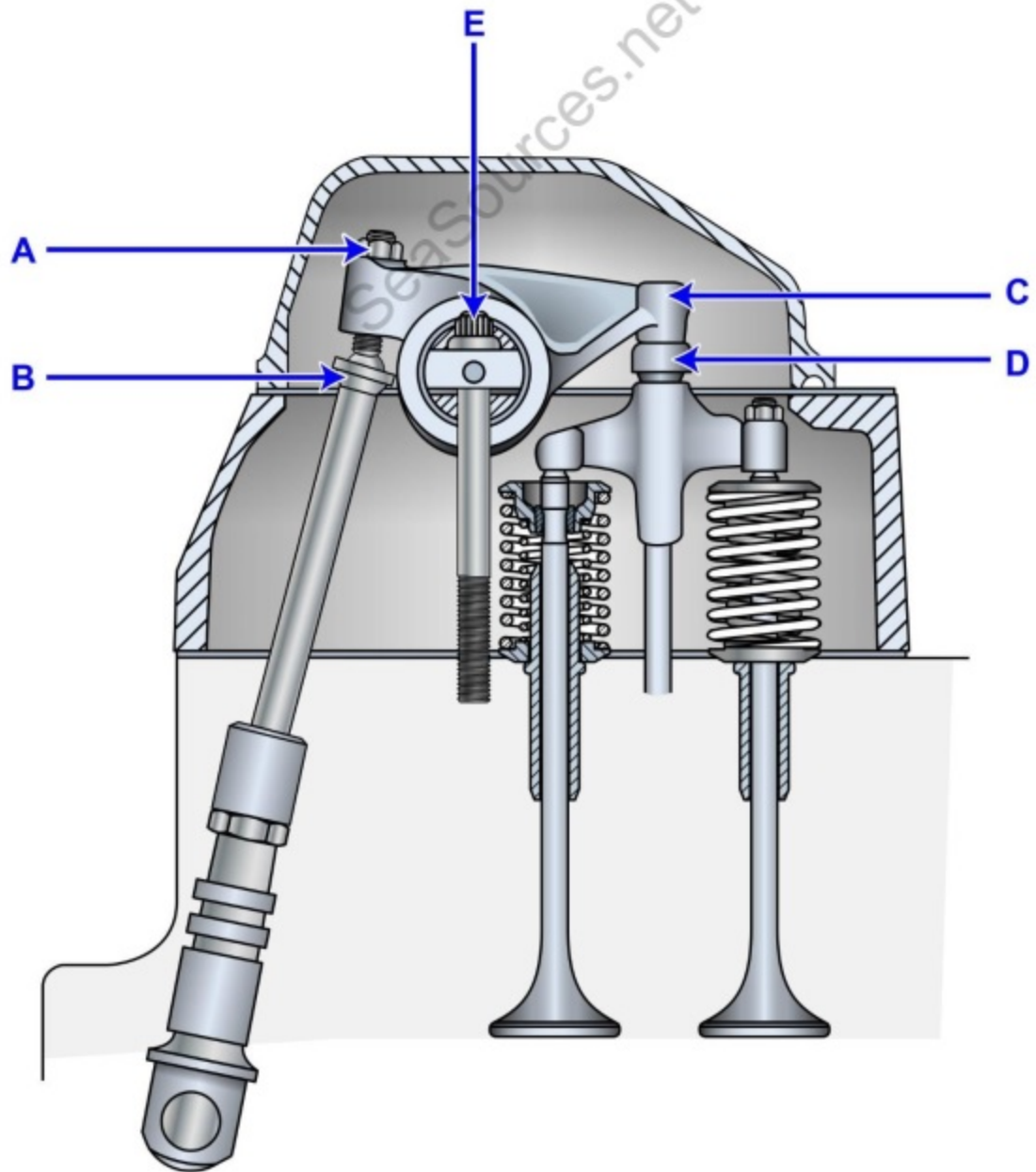
MO-0069



# MO-0072

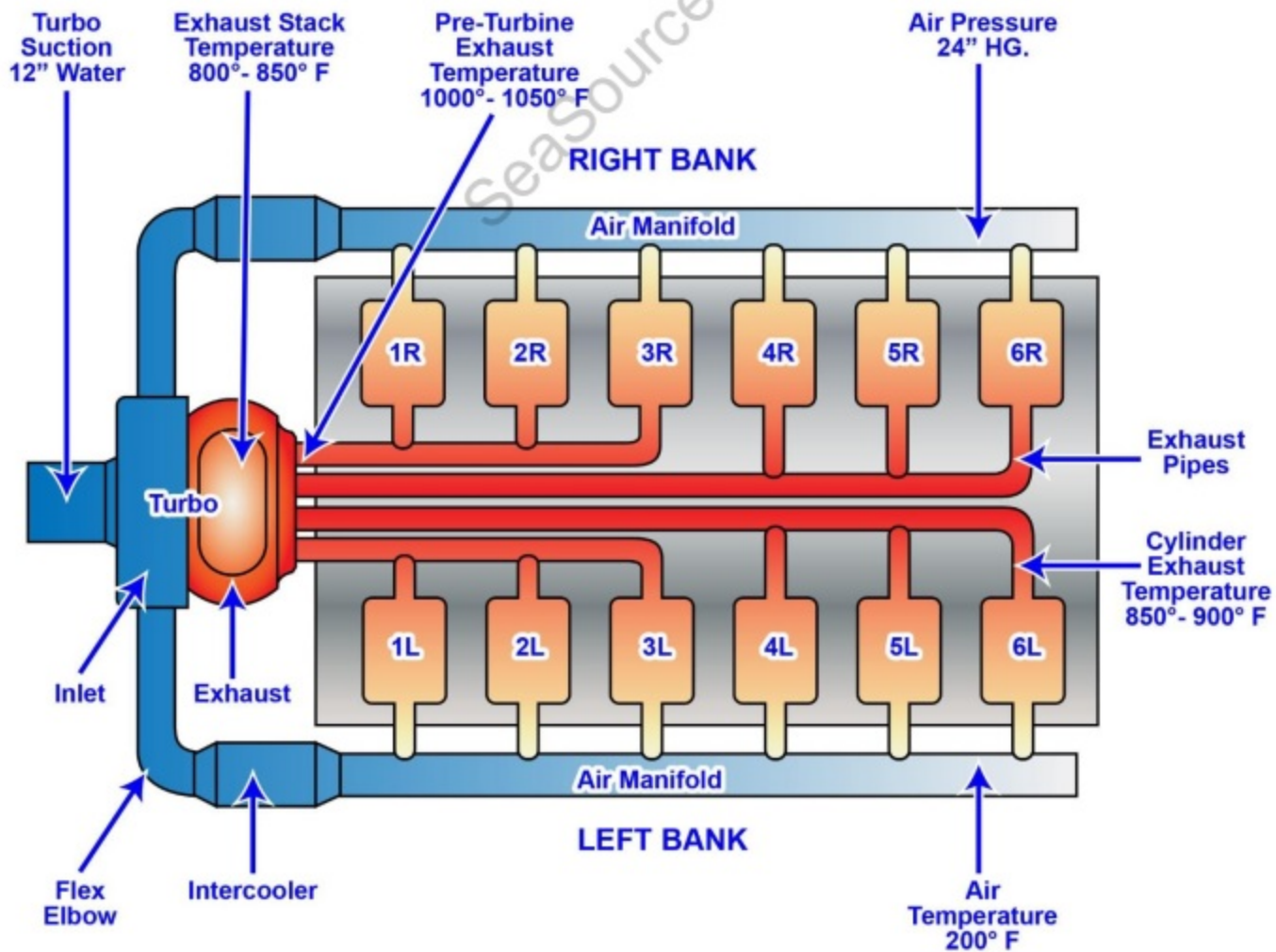


MO-0074

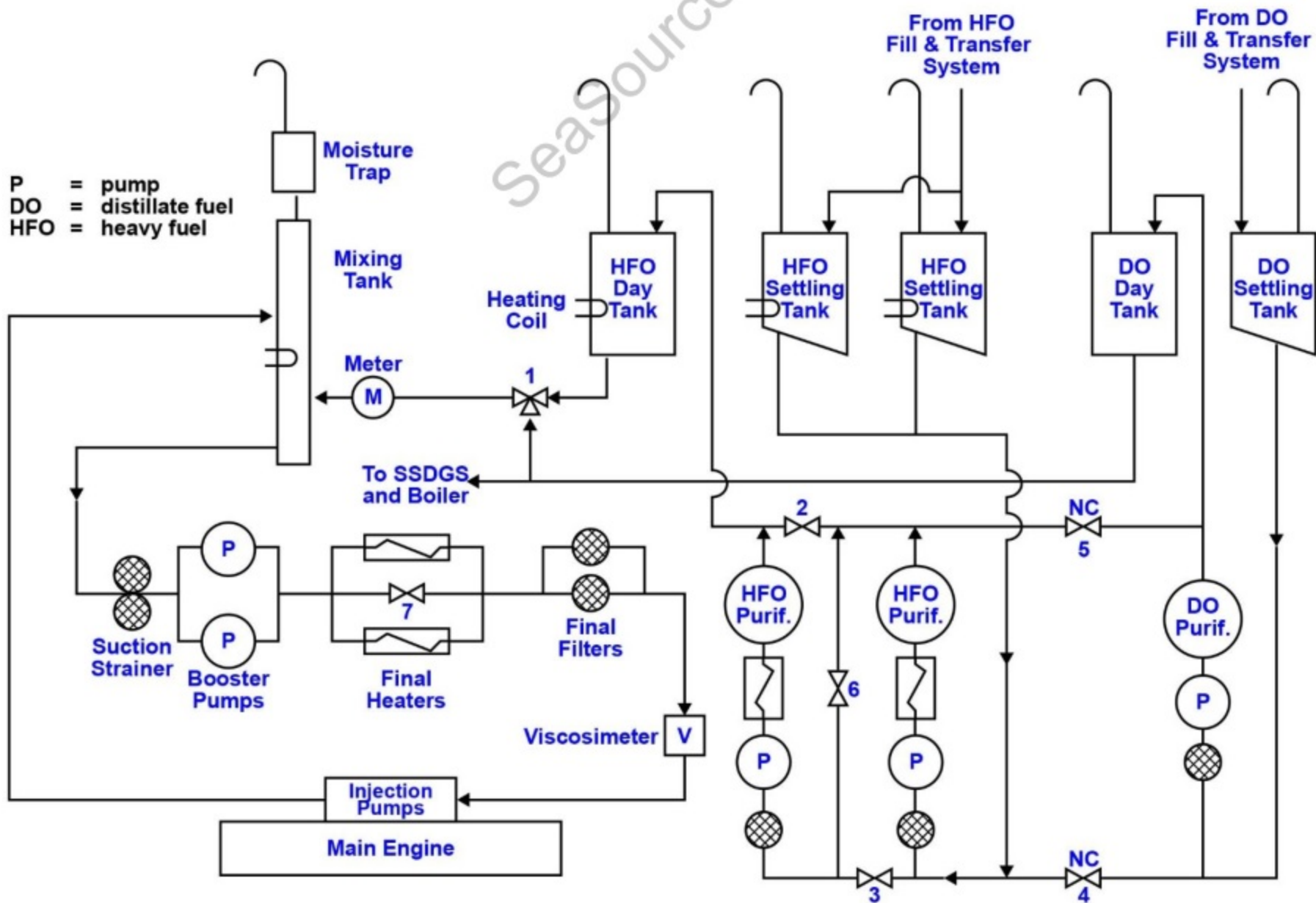


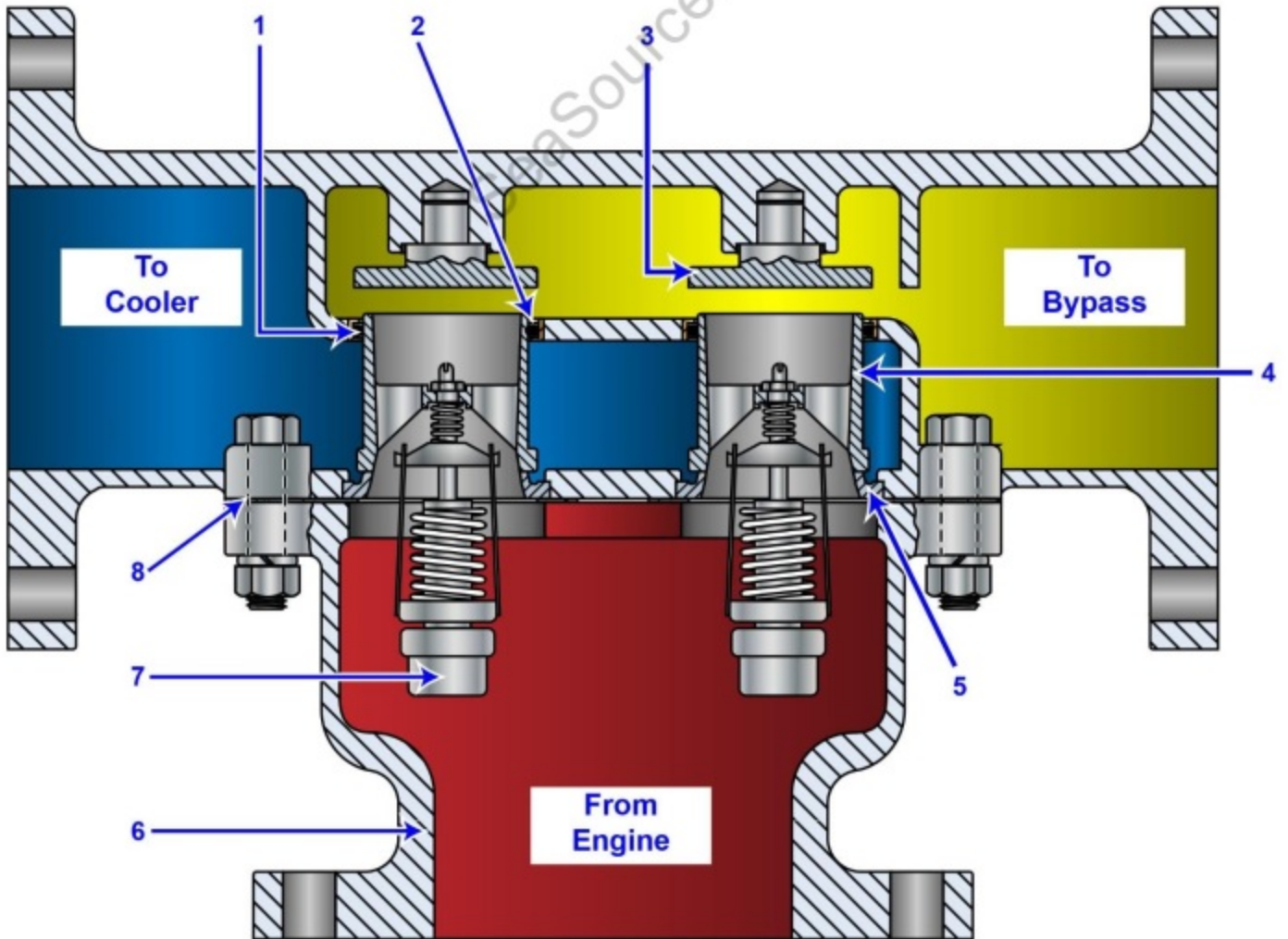


# MO-0076

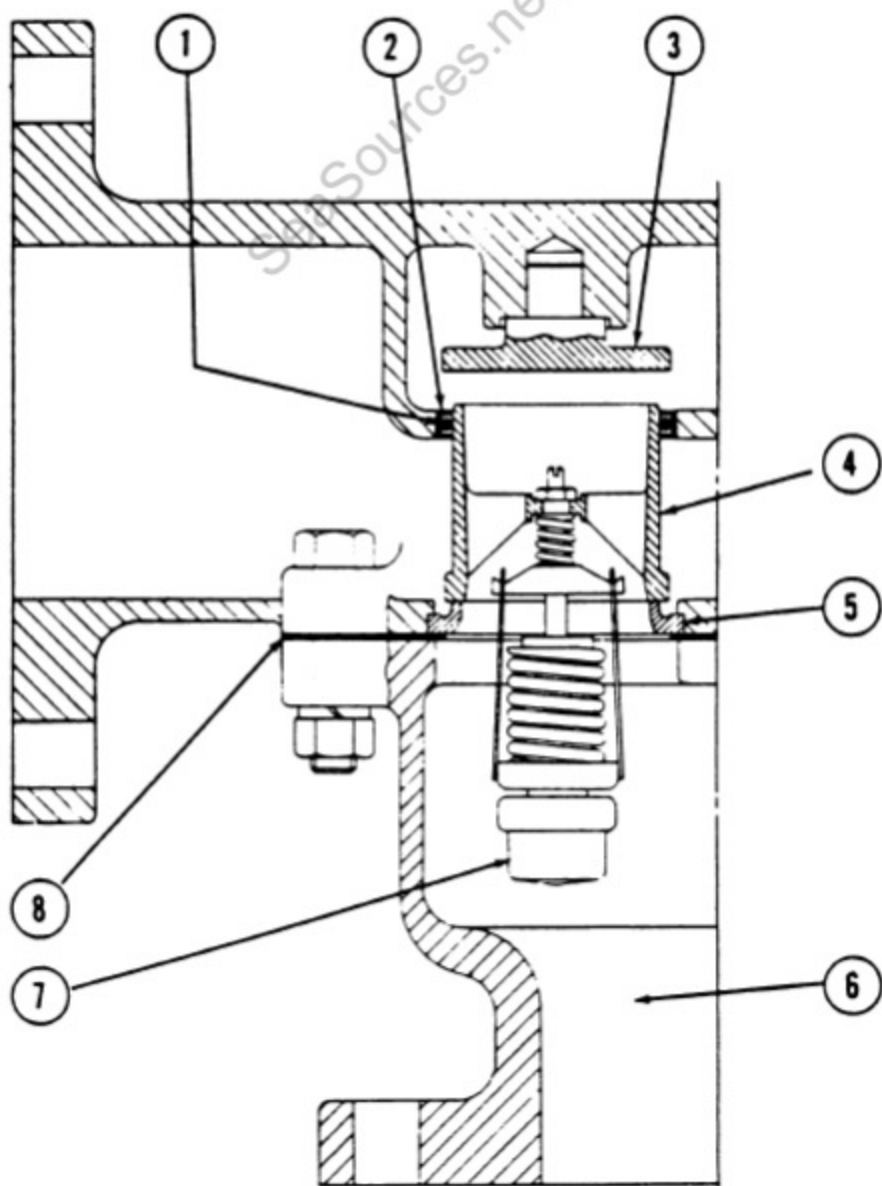


Seasources.net

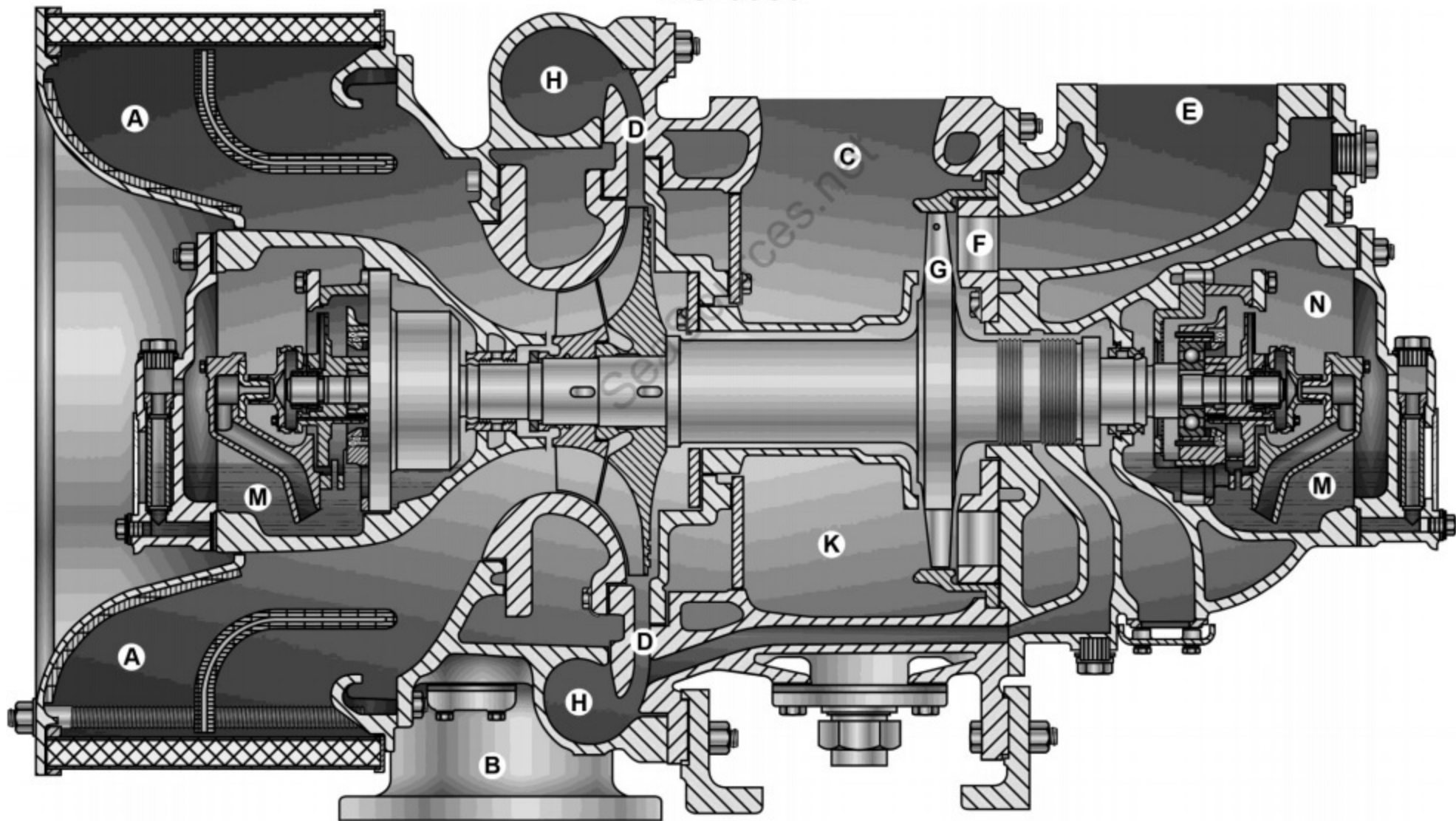




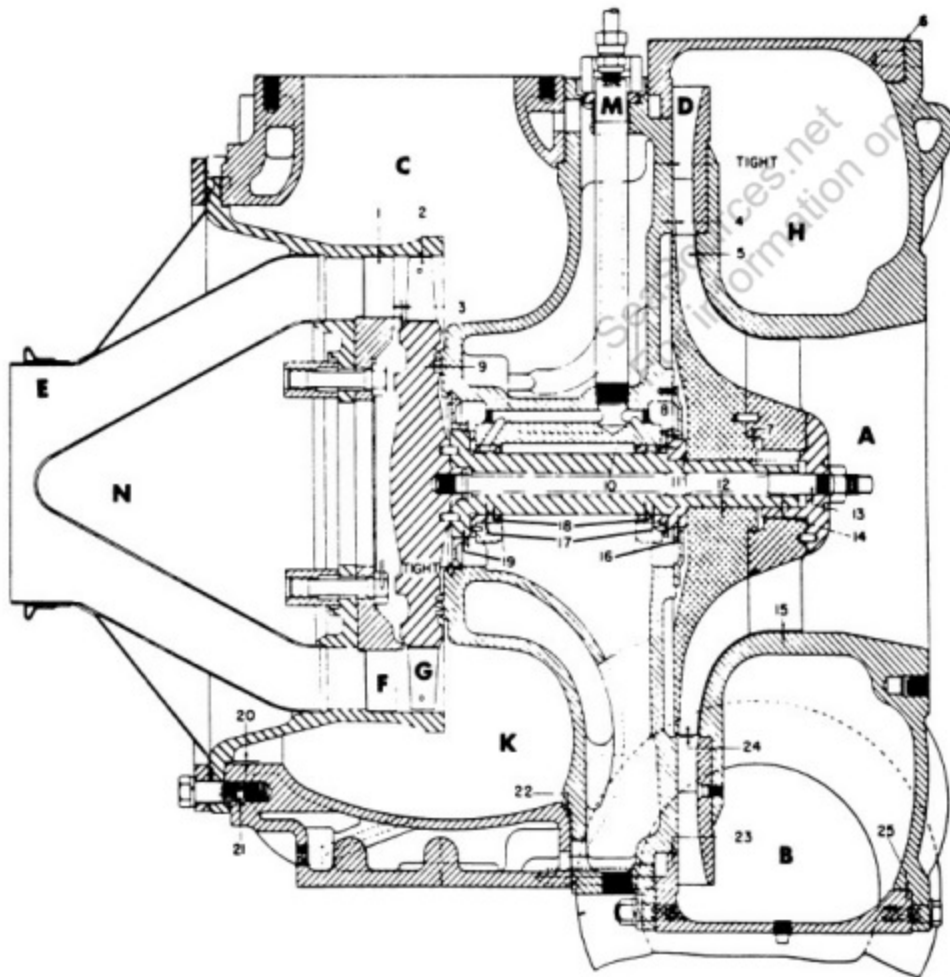
MO-0079



MO-0080



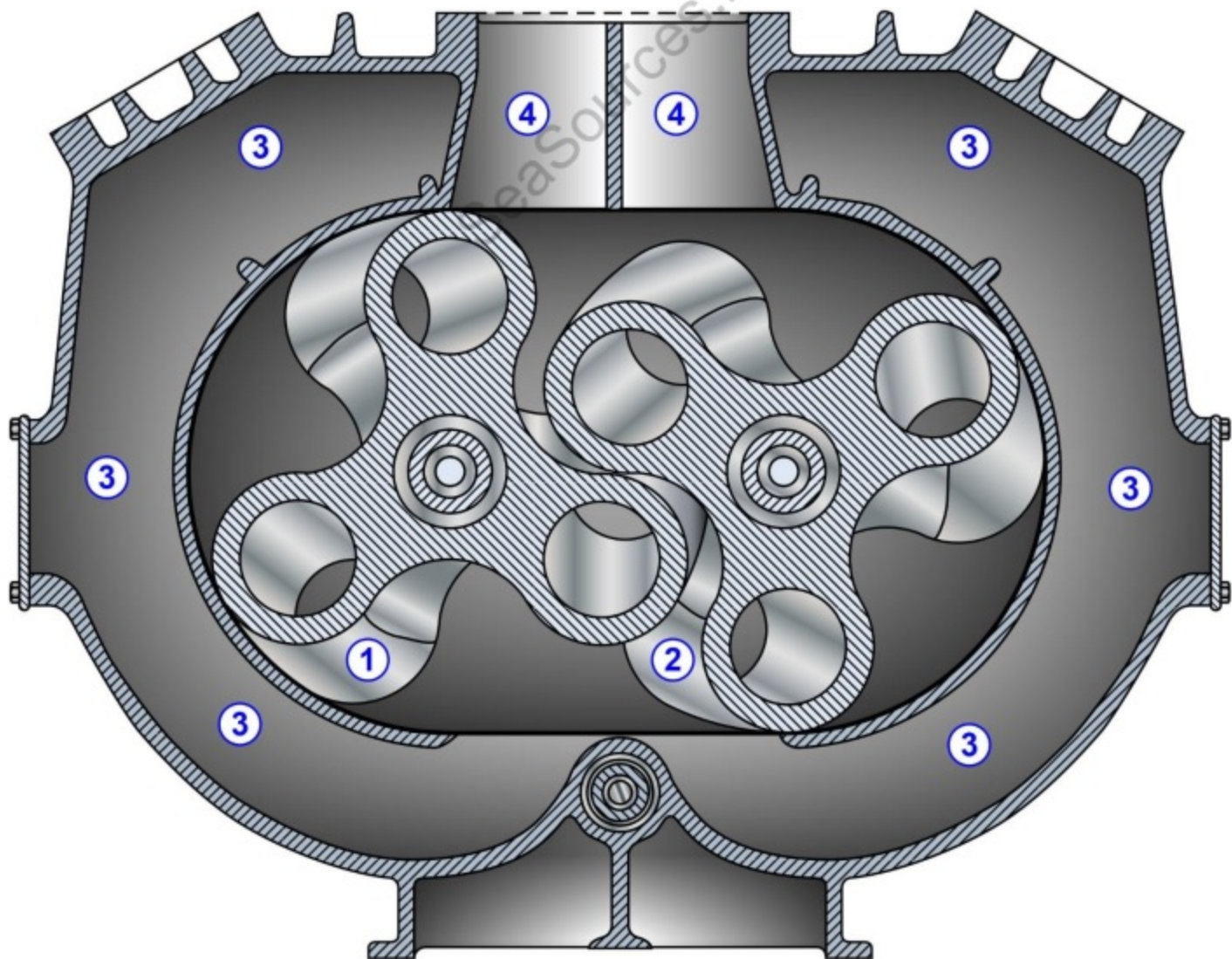
7/14/2016



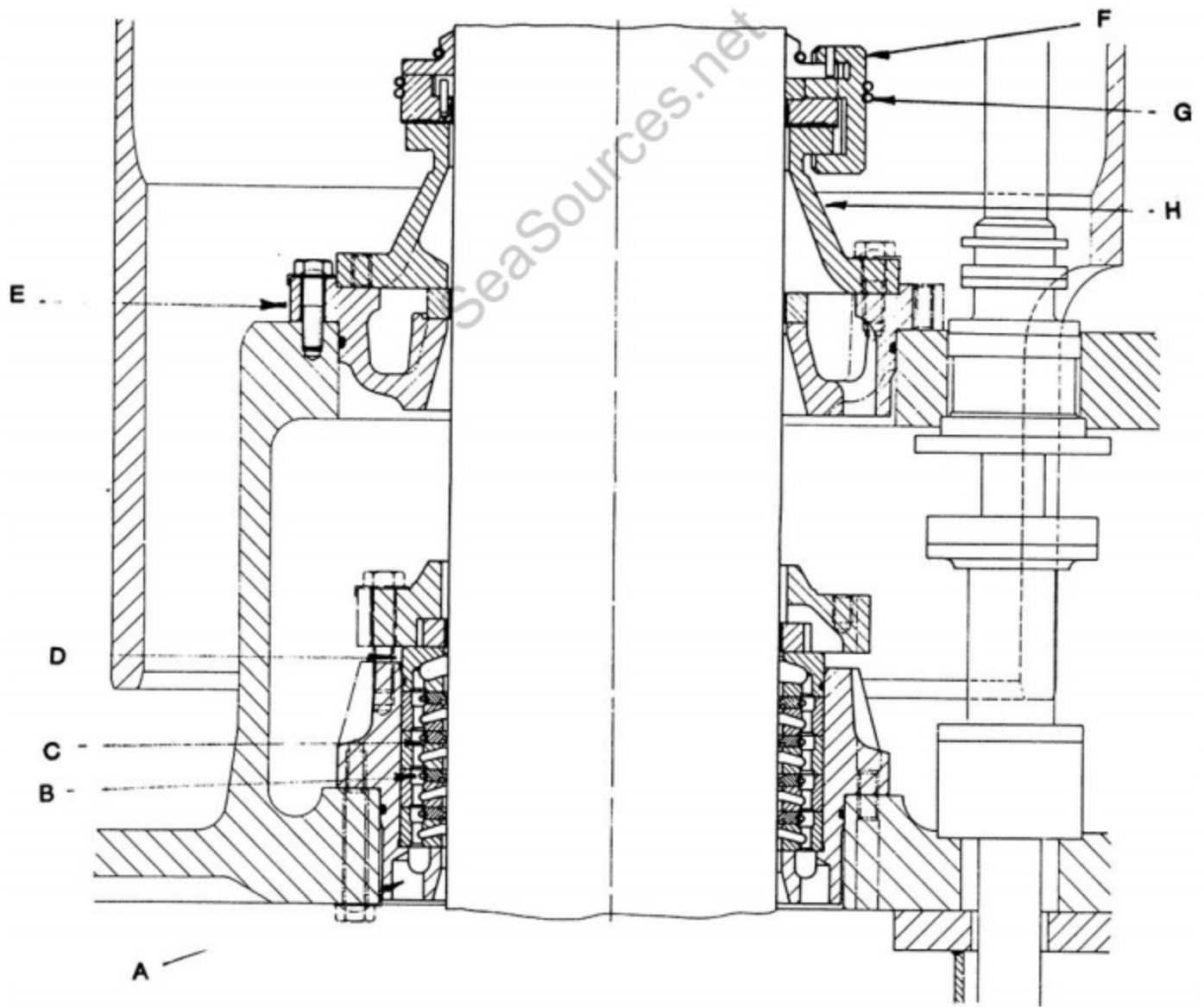
## Notes

- A = Air intake
- B = Air outlet
- C = Exhaust outlet
- D = Diffuser ring
- E = Exhaust gas inlet
- F = Fixed blades
- G = Turbine blades
- H = Compressor "Volute"
- K = Exhaust "Volute"
- M = Oil supply to shaft
- N = Turbine deflator cone

MO-0082

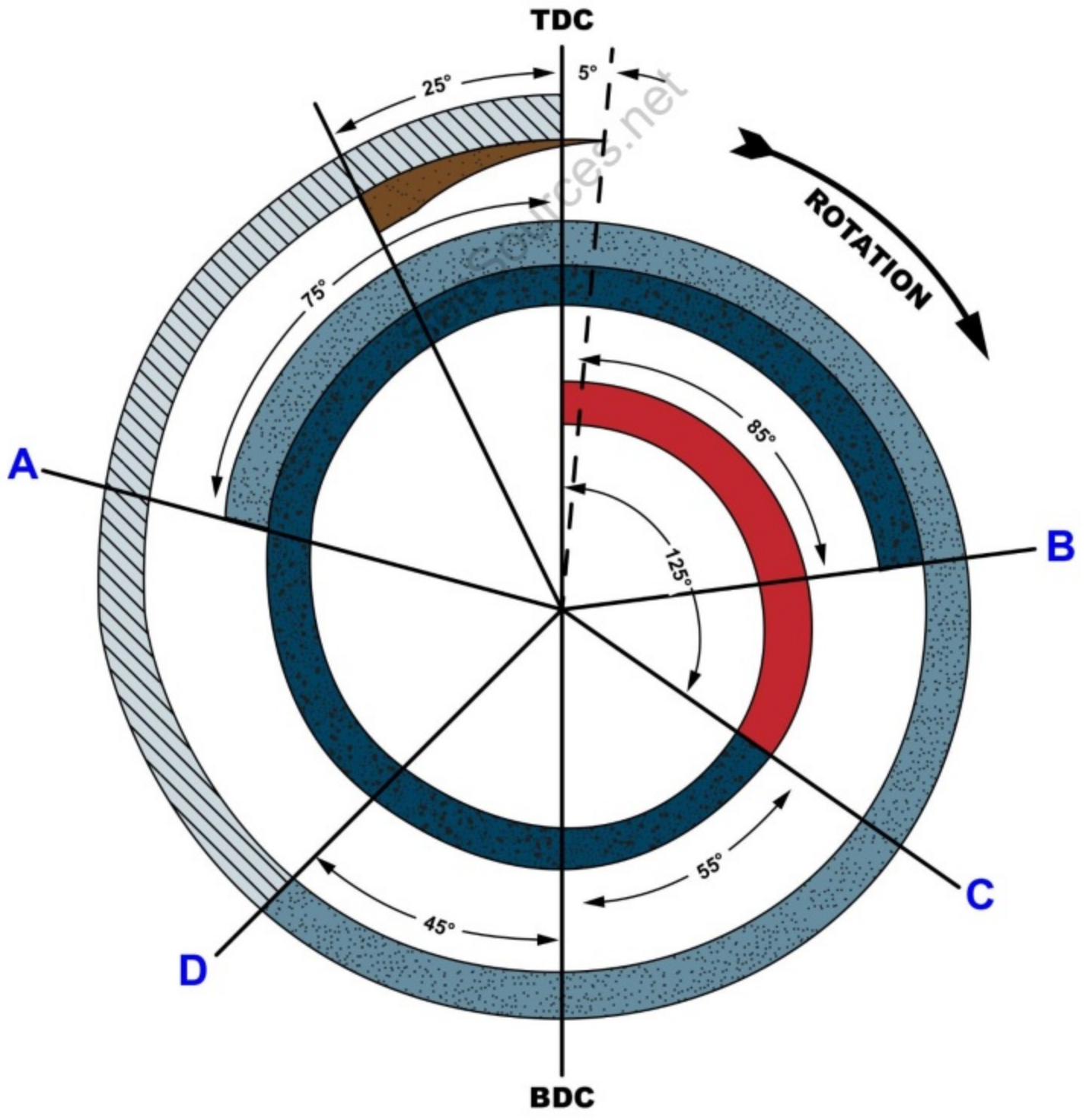


MO-0083

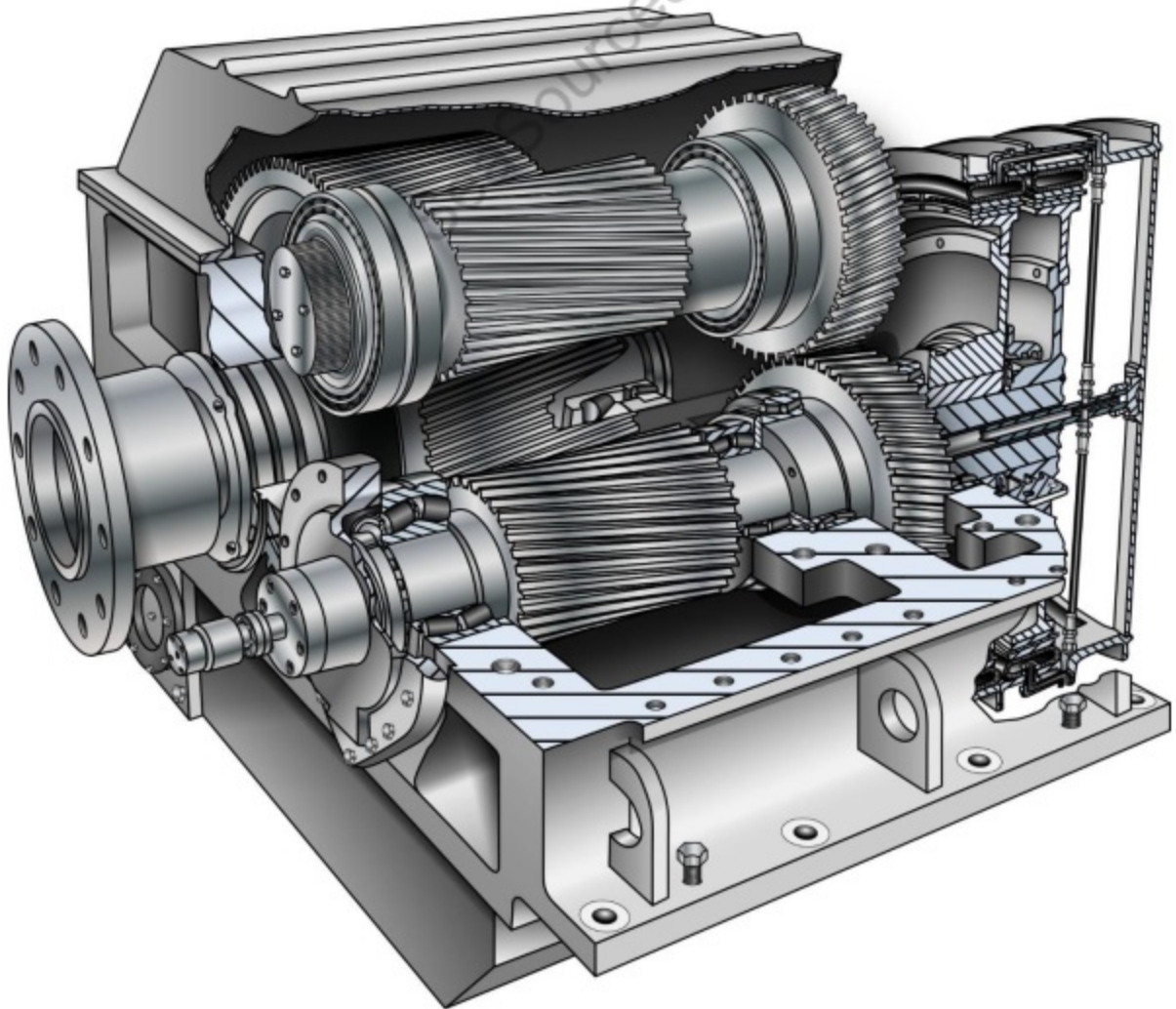




MO-0084

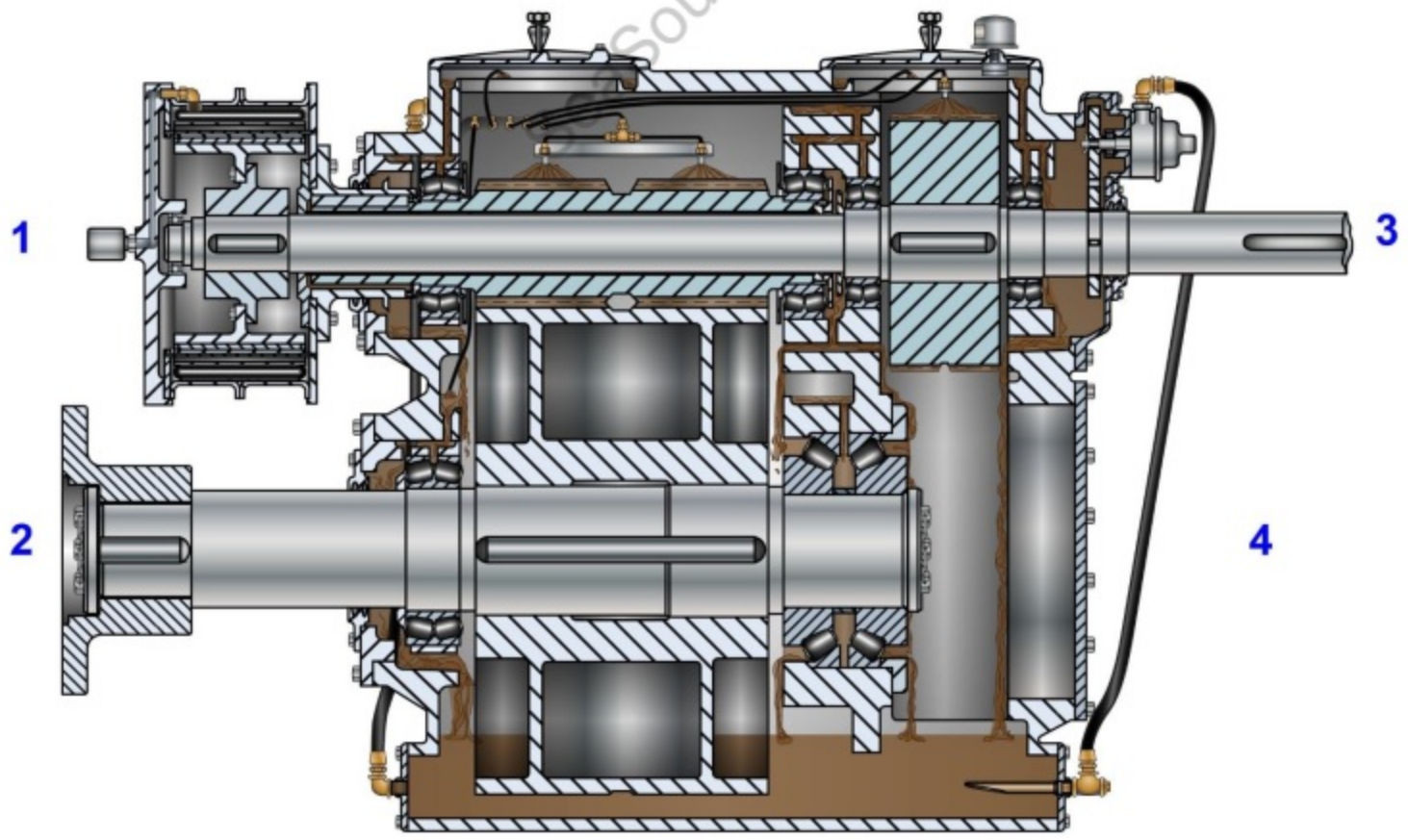


MO-0085

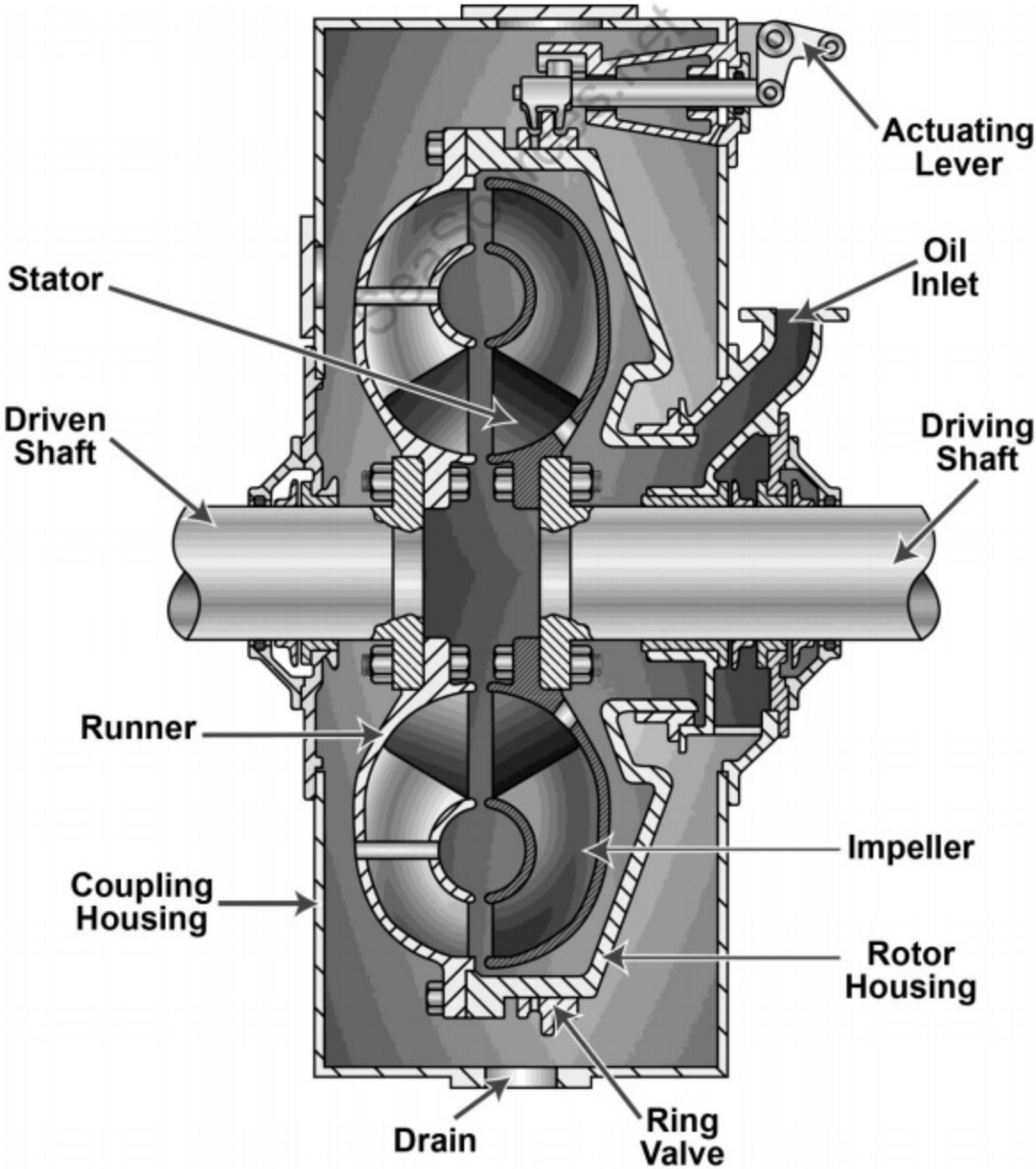


MO-0086

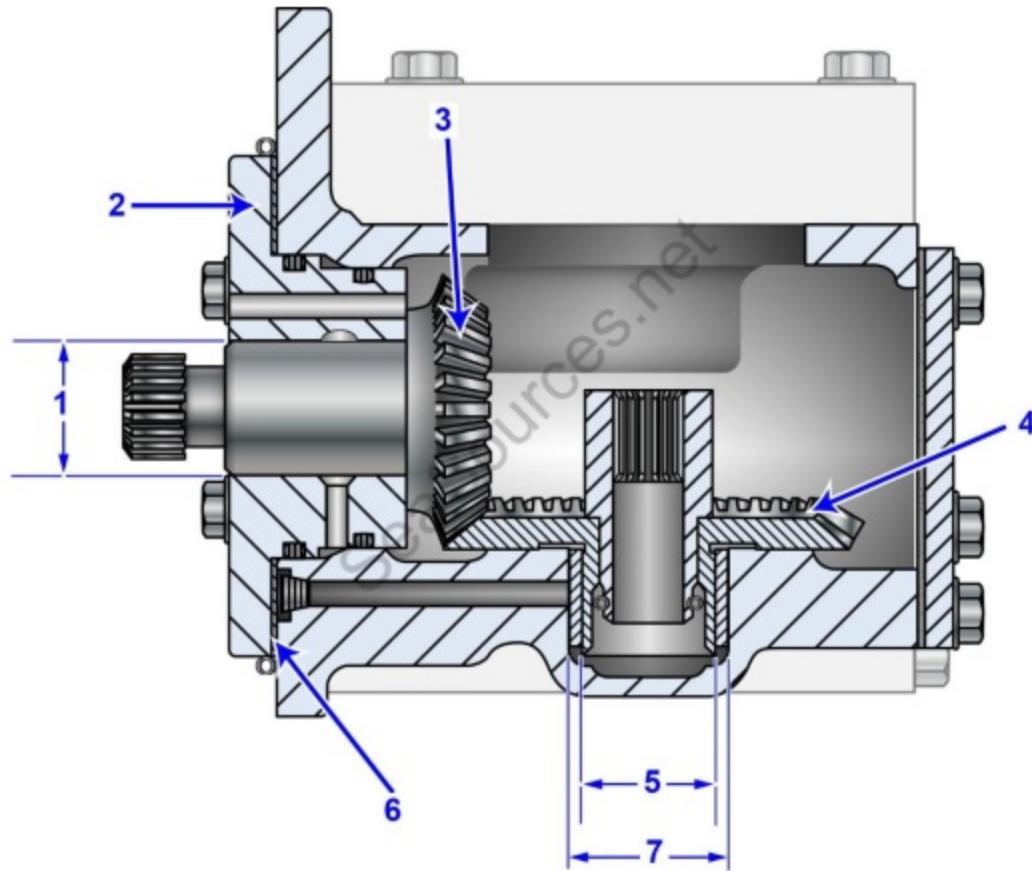
Sources.net



**MO-0089**



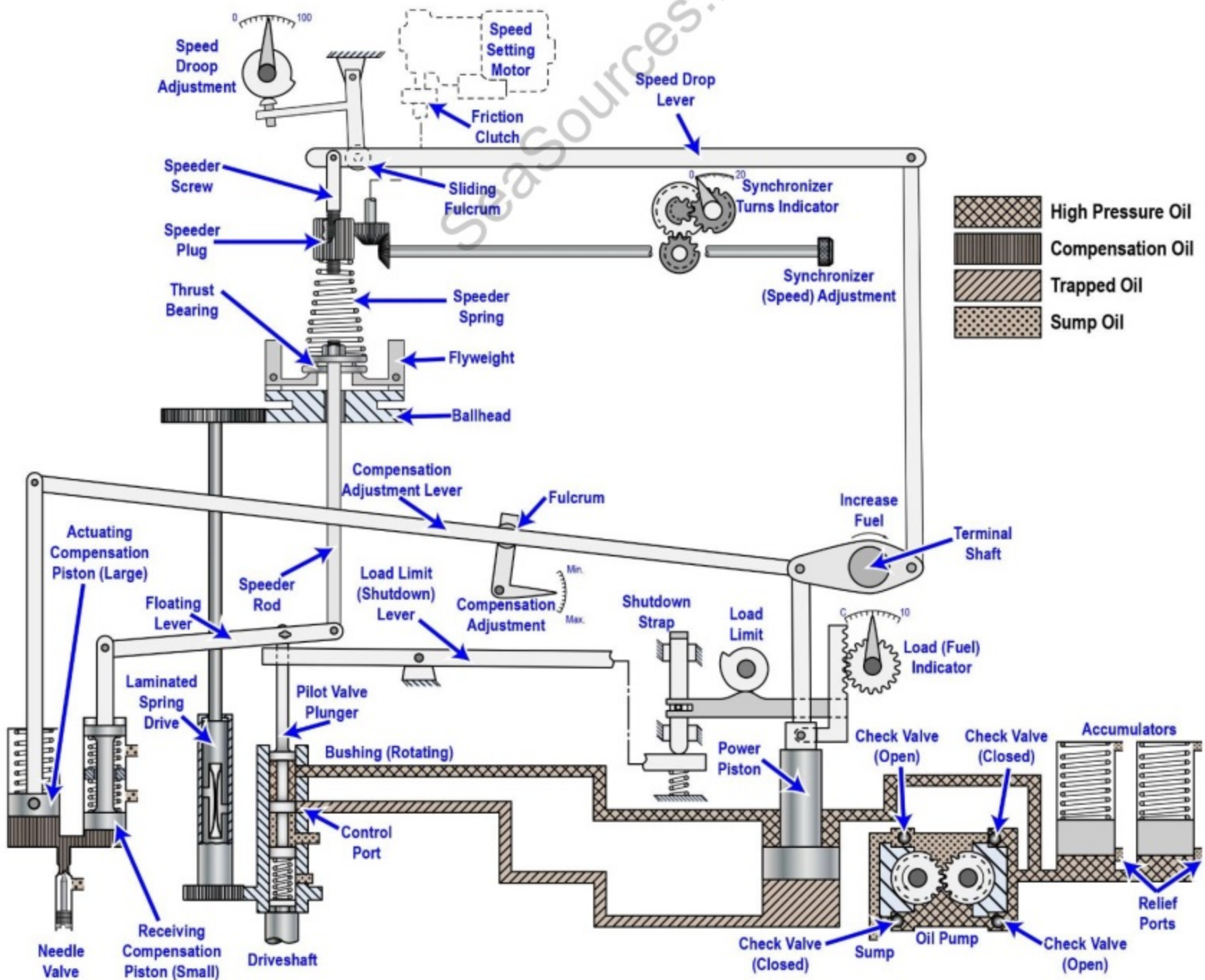
# MO-0091



## 7N1889 & 8N9662 Drive Groups Used With UG8-L Woodward Governors 1W2135 Drive Group Used With Caterpillar 3161 Governors

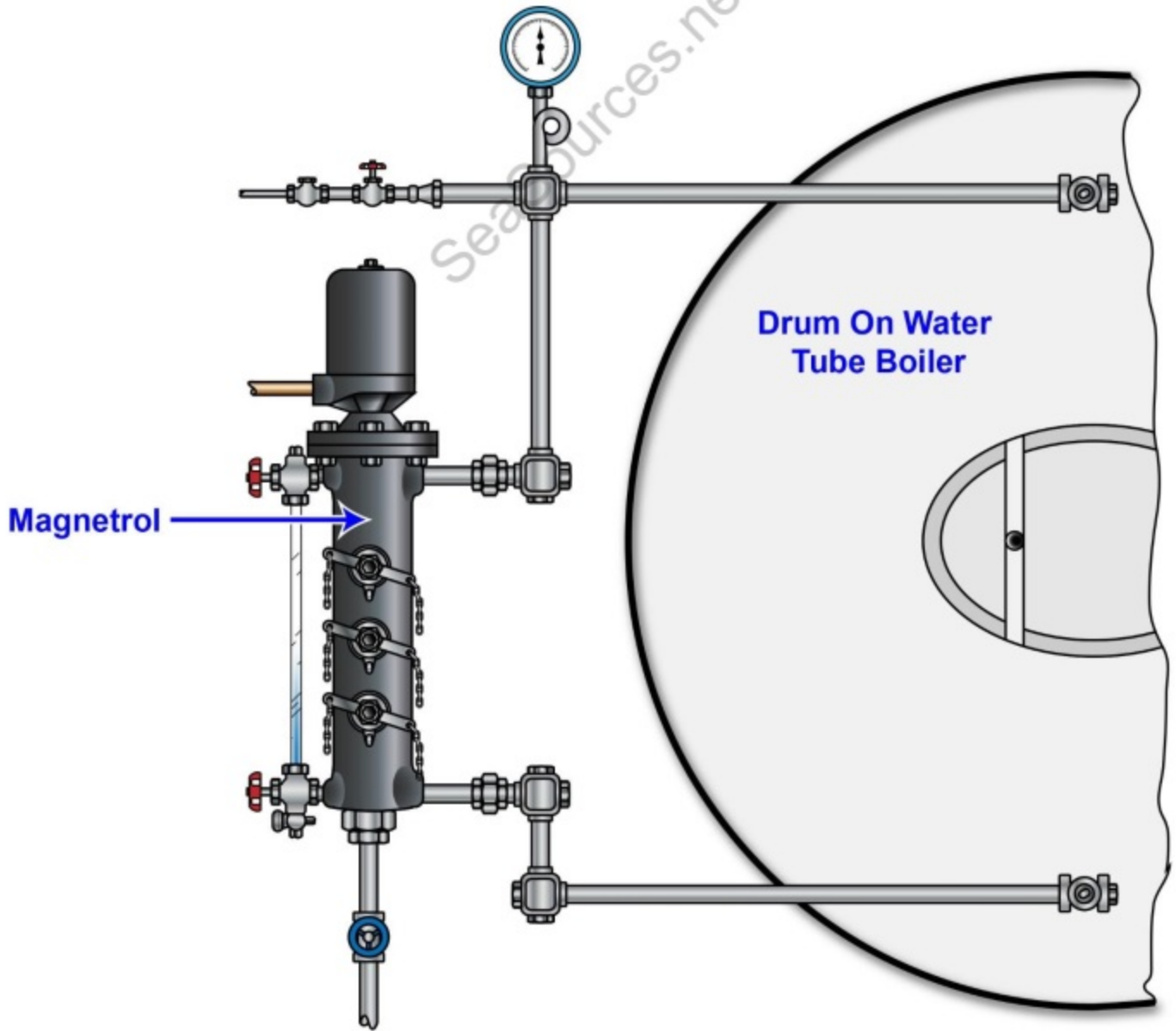
- |   |  |
|---|--|
| 1. Diameter of bore in adaptor (2).....   | 34.072 ± 0.025 mm (1.3414 ± .0010 in.)                   |
| Diameter of shaft on governor drive pinion (3) .....  | 34.000 ± 0.013 mm (1.3386 ± .0005 in.)                   |
| 2. Adaptor  |  |
| 3. Governor drive pinion  |  |
| 4. Bevel gear   |  |
| 5. Diameter of shaft on bevel gear (4) .....  | 34.000 ± 0.013 mm (1.3386 ± .0005 in.)                   |
| Diameter of bore in bearing after assembly in drive housing ...   | 34.072 ± 0.039 mm (1.3414 ± .0015 in.)                   |
| 6. Shims. Use as required to get a gear clearance (backlash)<br>between pinion (3) and gear (4) of..... | 0.100 + 0.050 or -0.025 mm (.0039 = 0.020 or -.0010 in.) |
| 7. Diameter of bore in drive housing.....   | 40.432 ± 0.025 mm (1.5918 ± .0010 in.)                   |
| Diameter of bearing .....   | 40.545 ± 0.013 mm (1.5963 ± .0005 in.)                   |

# MO-0092



MO-0093

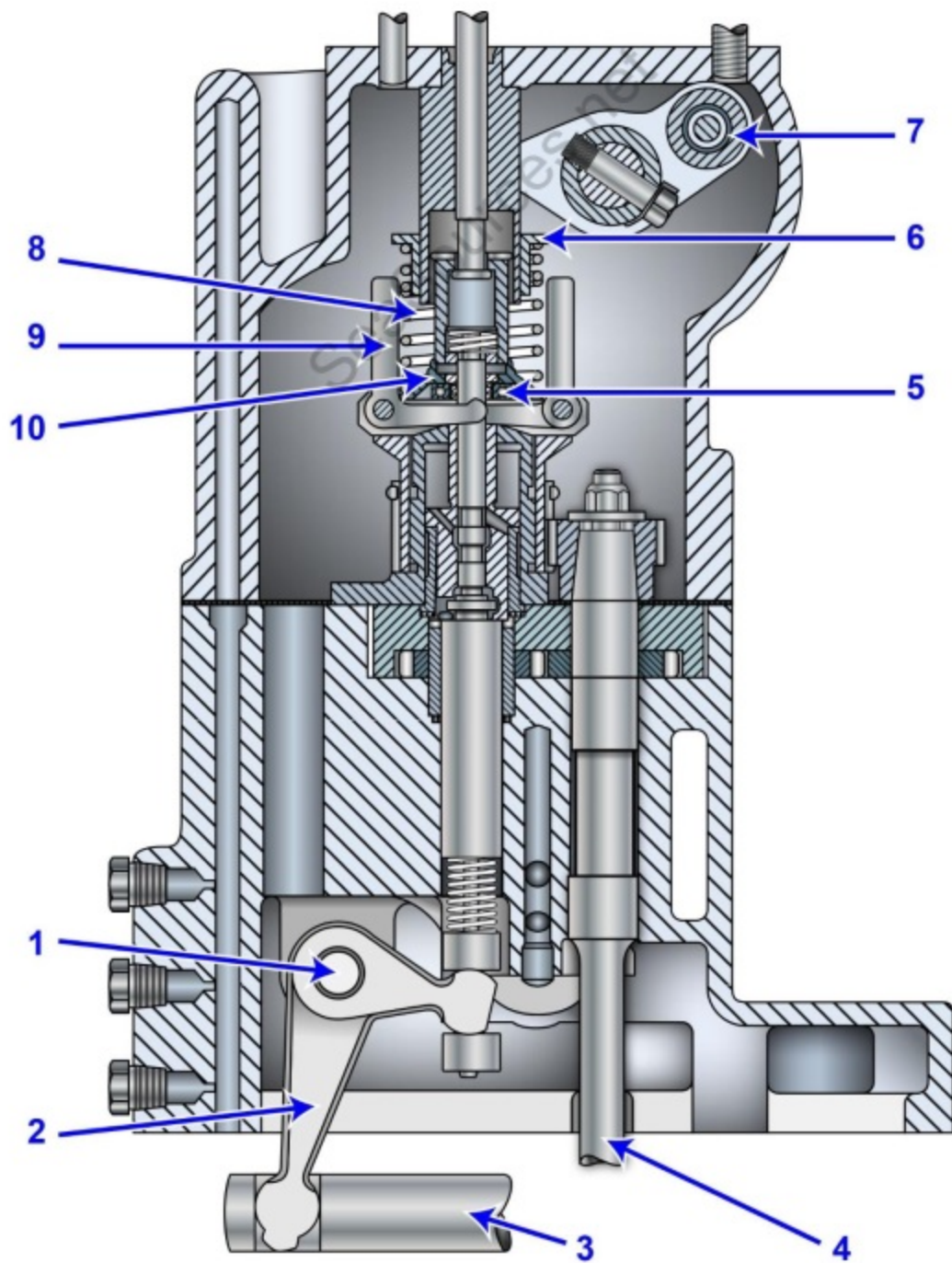
SeaSources.net



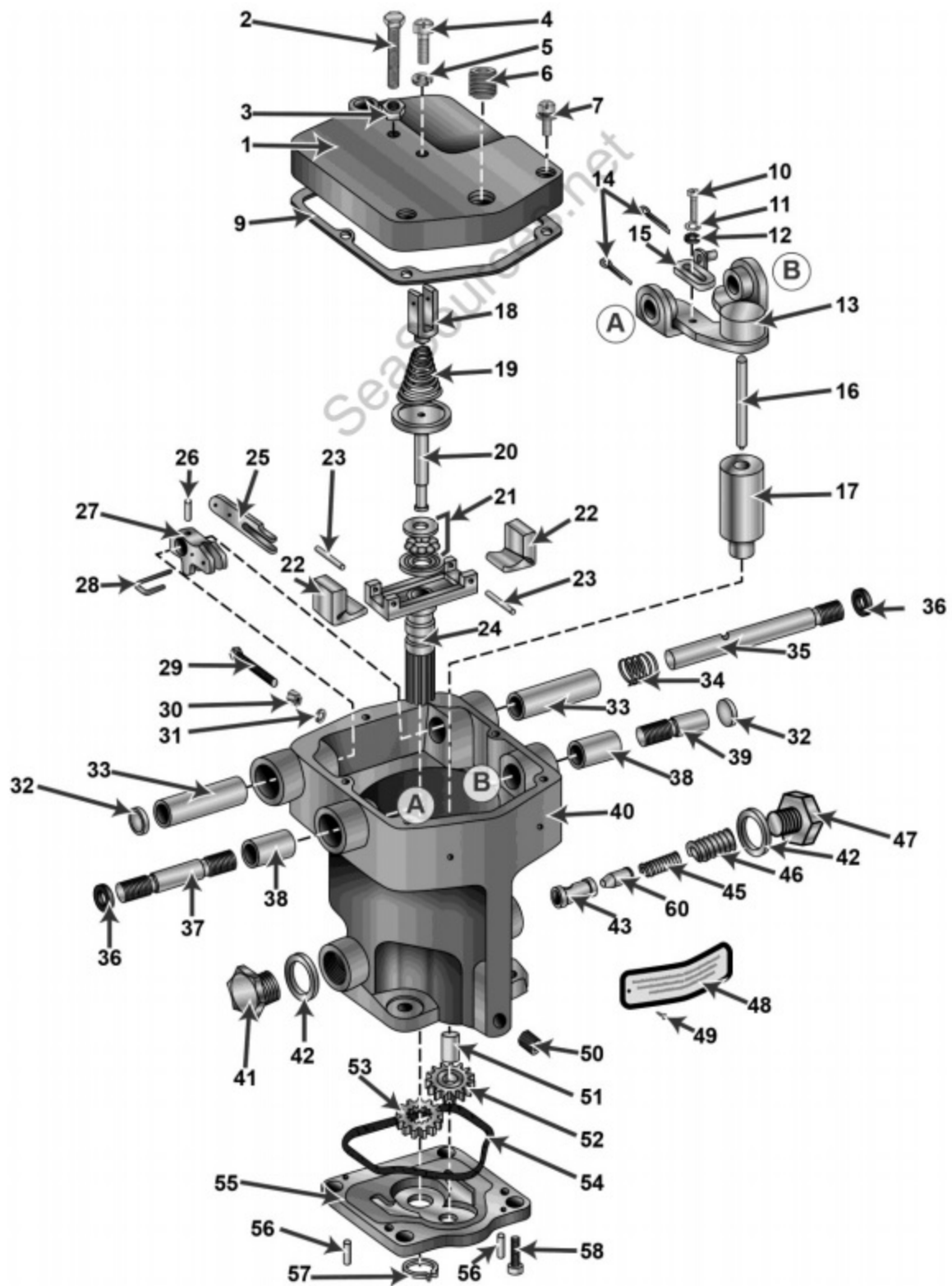




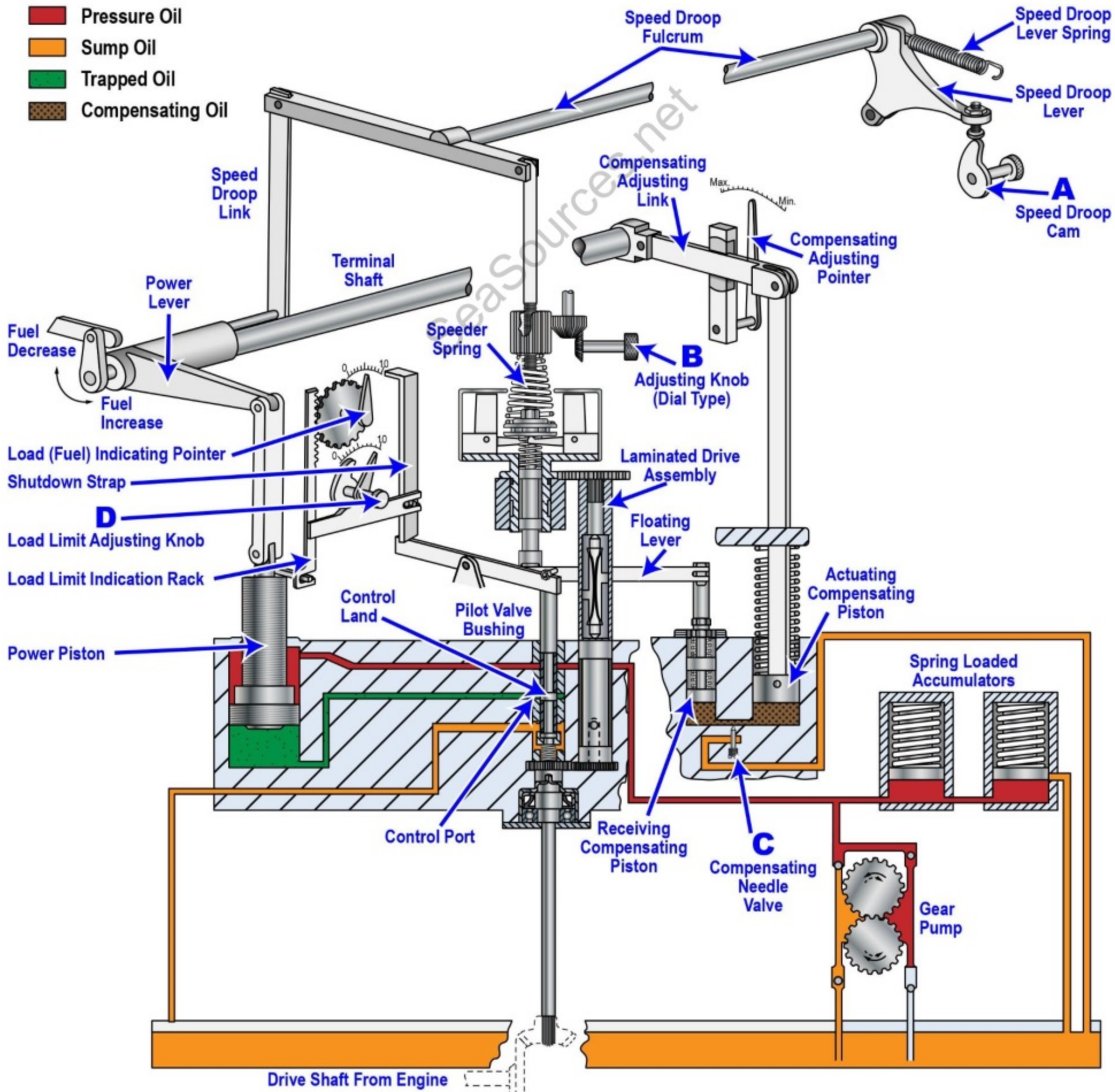
# MO-0094



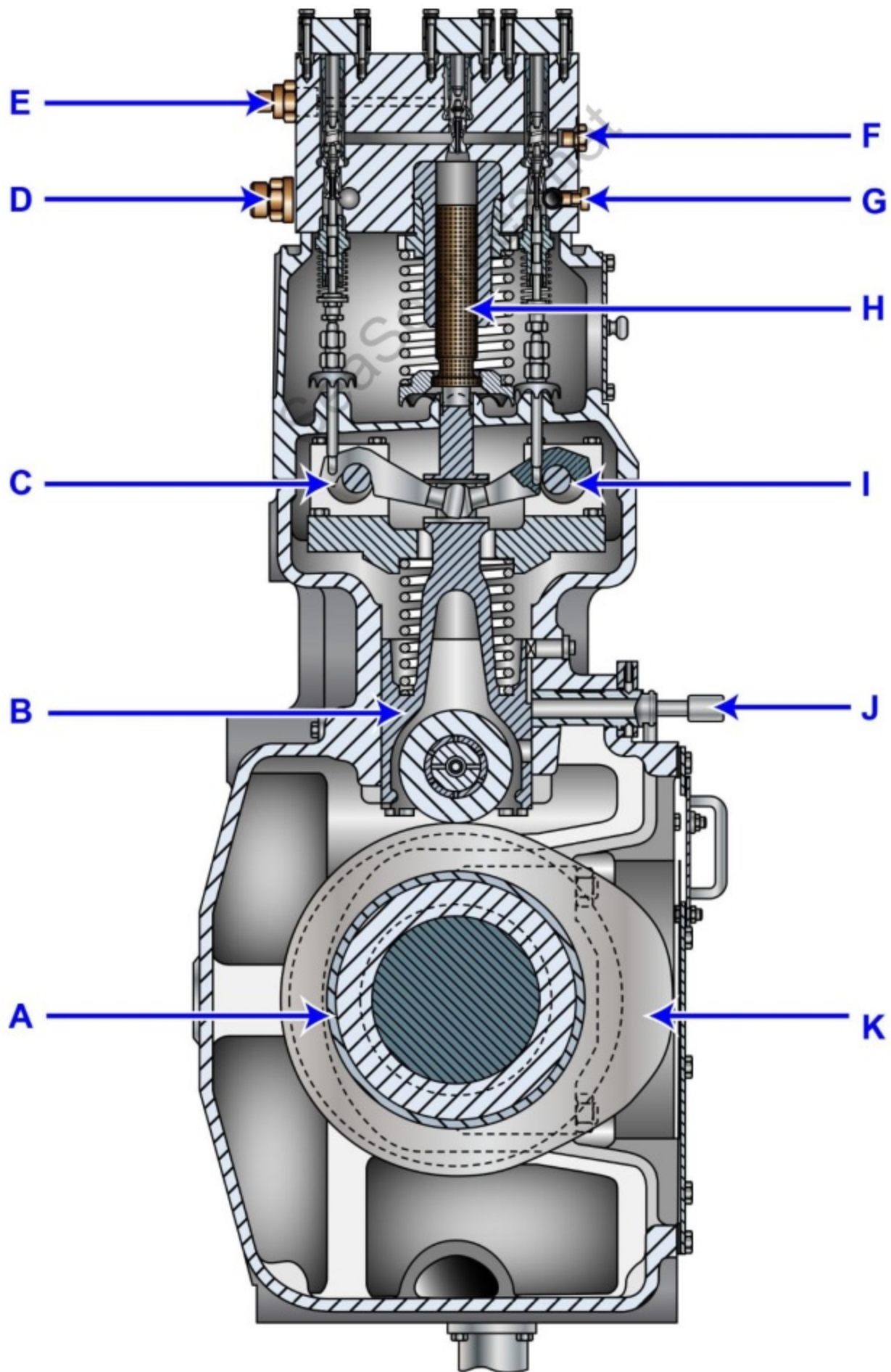
# MO-0095



# MO-0096

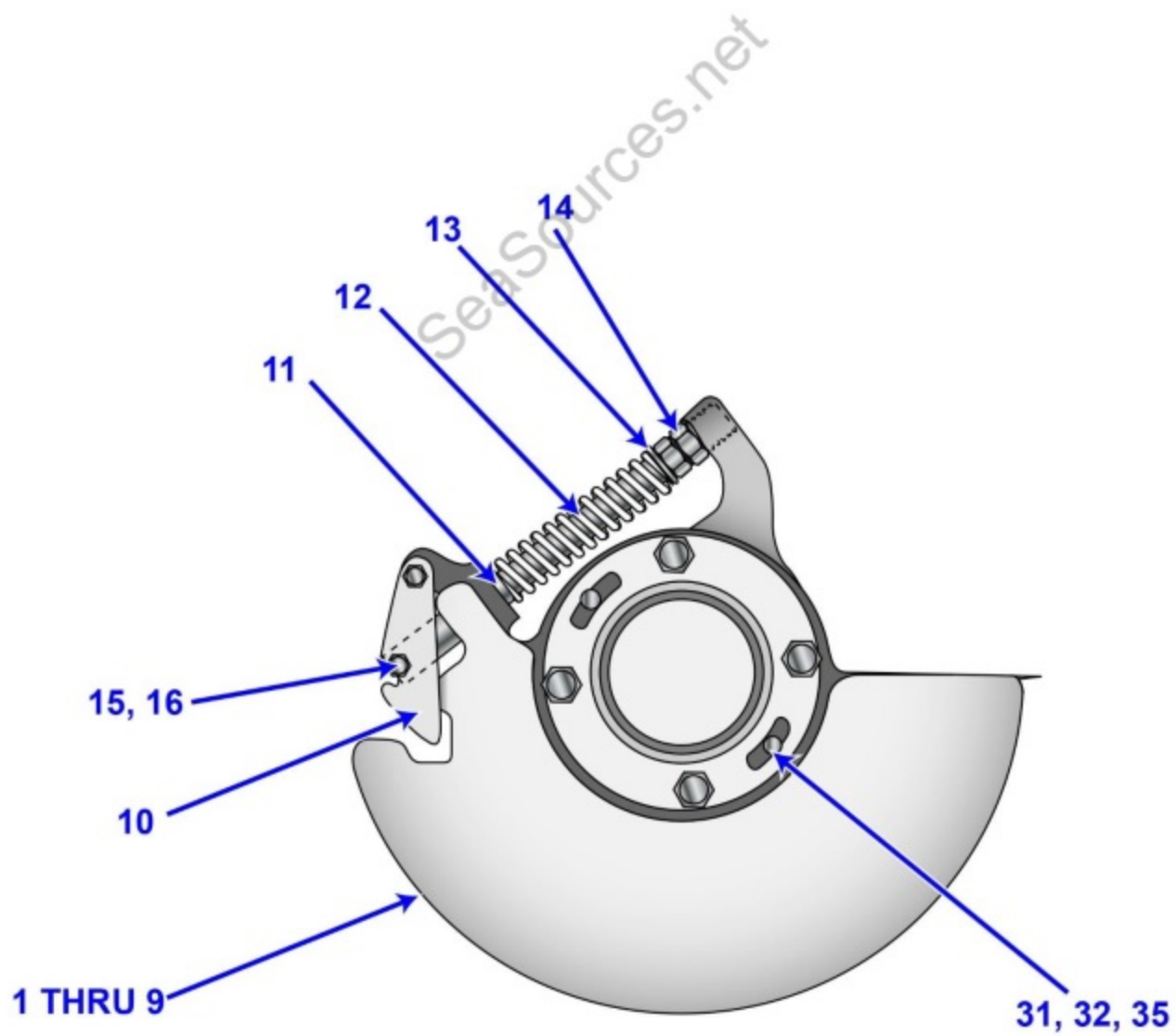


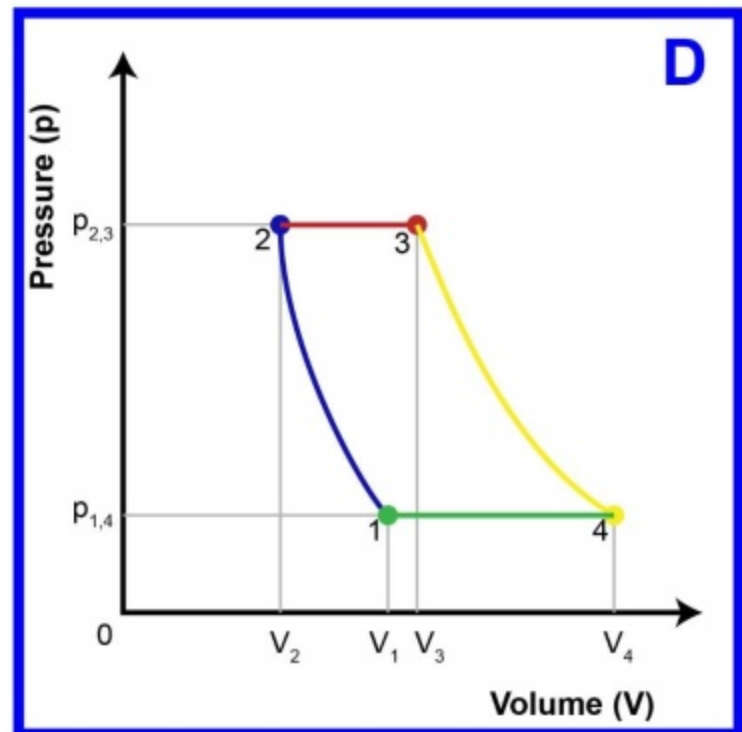
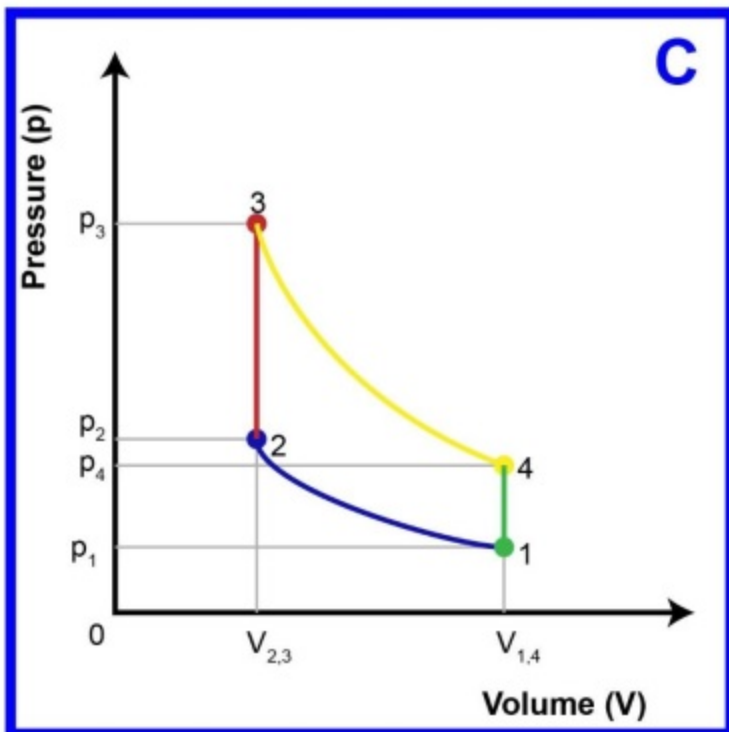
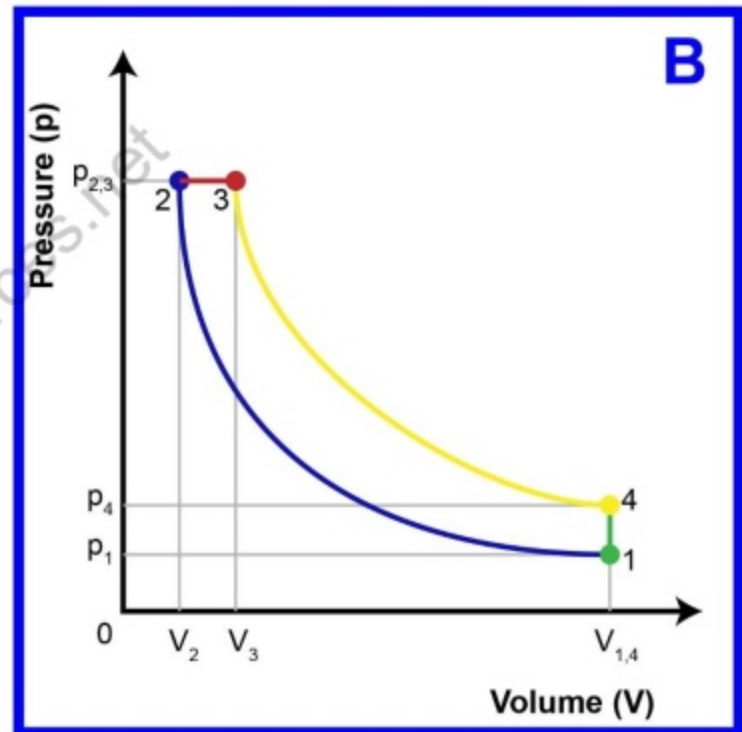
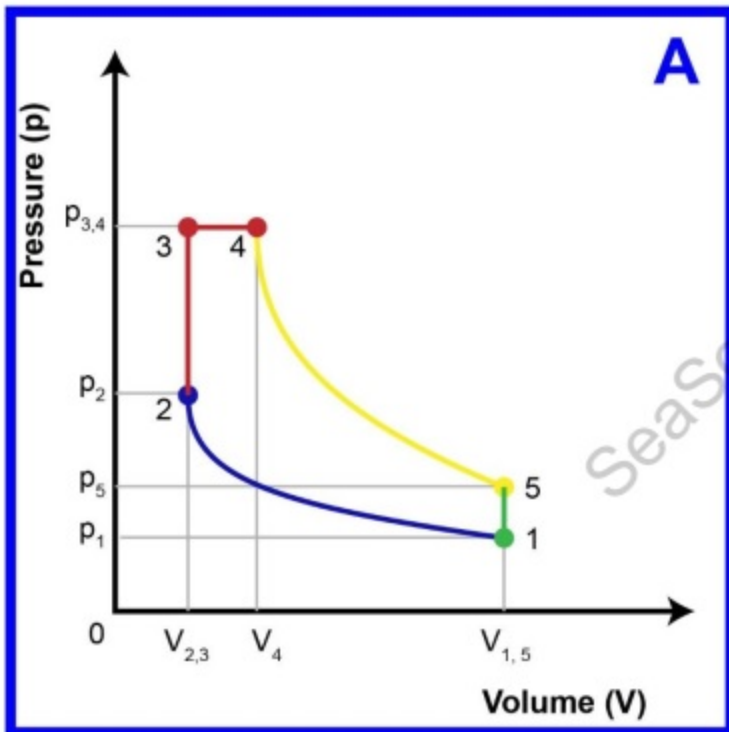
MO-0097



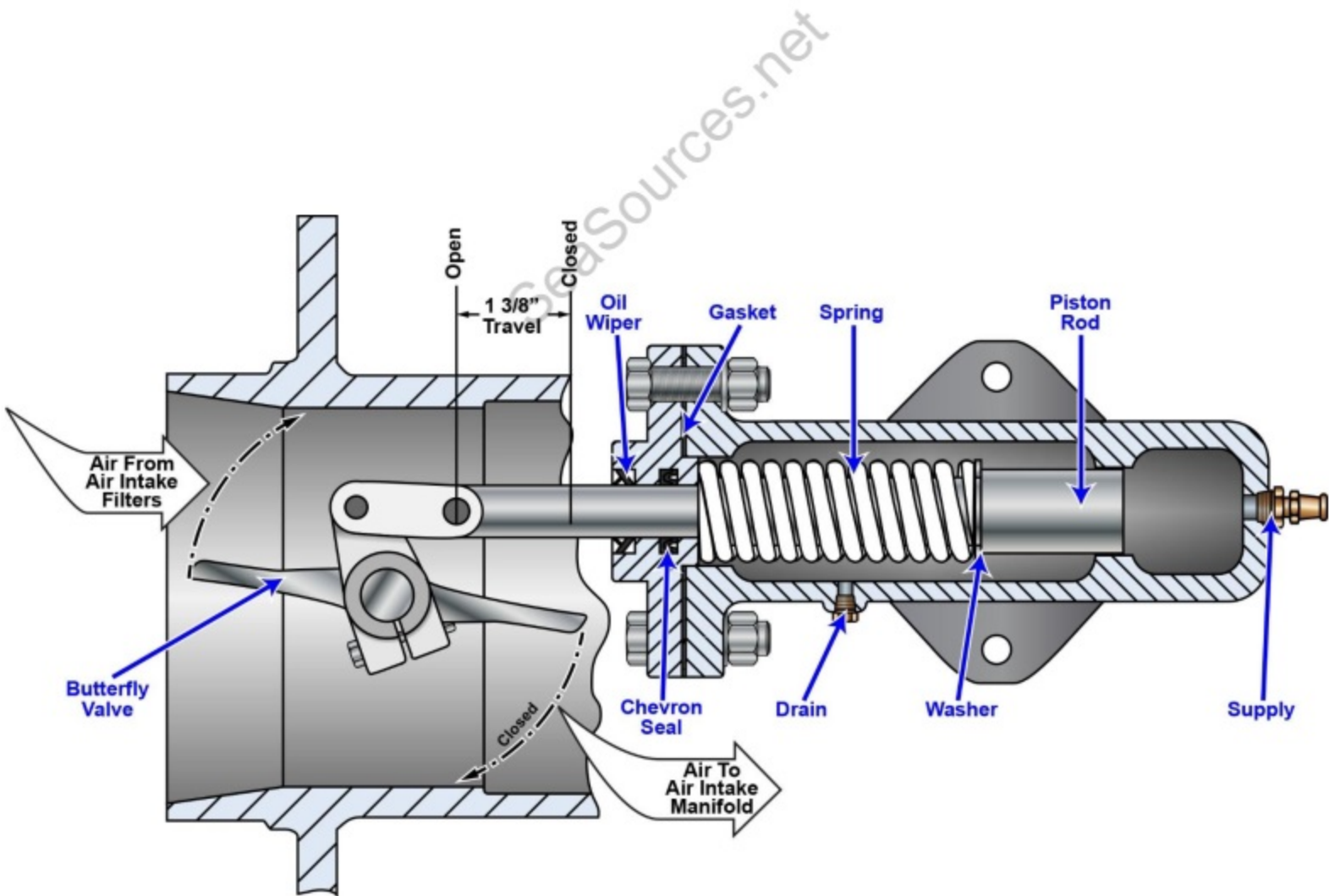


# MO-0101



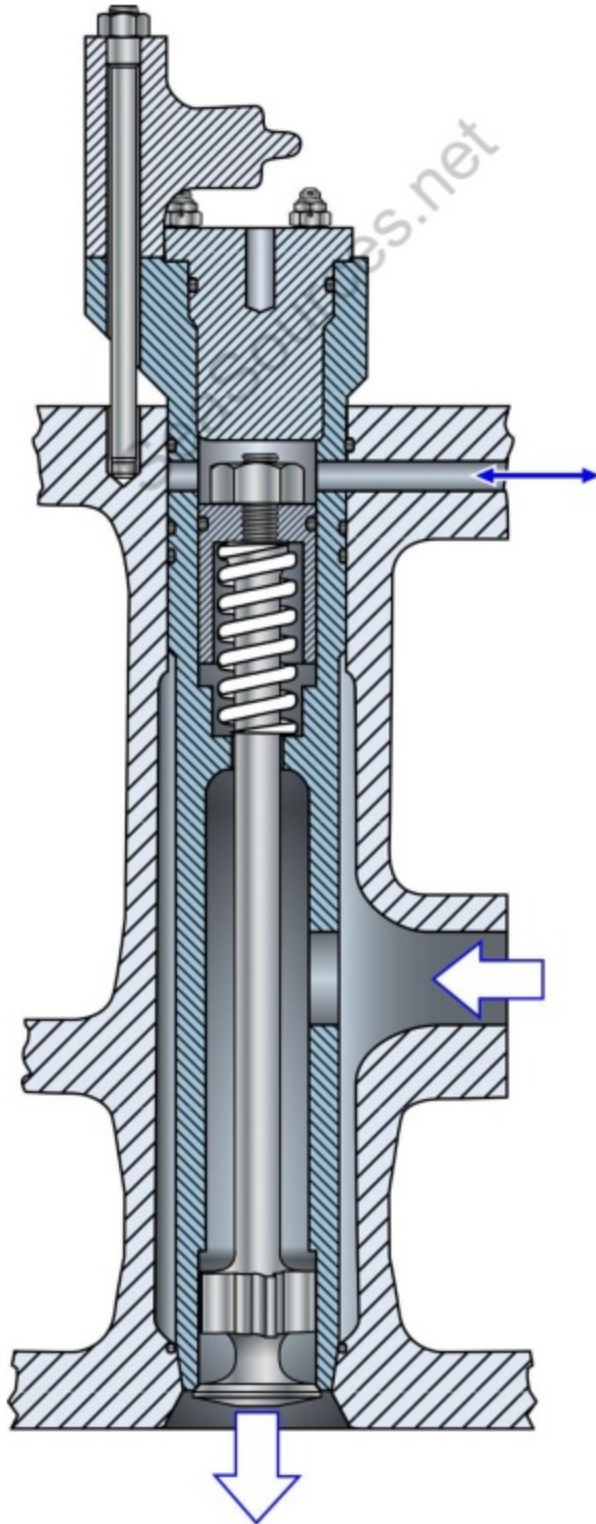


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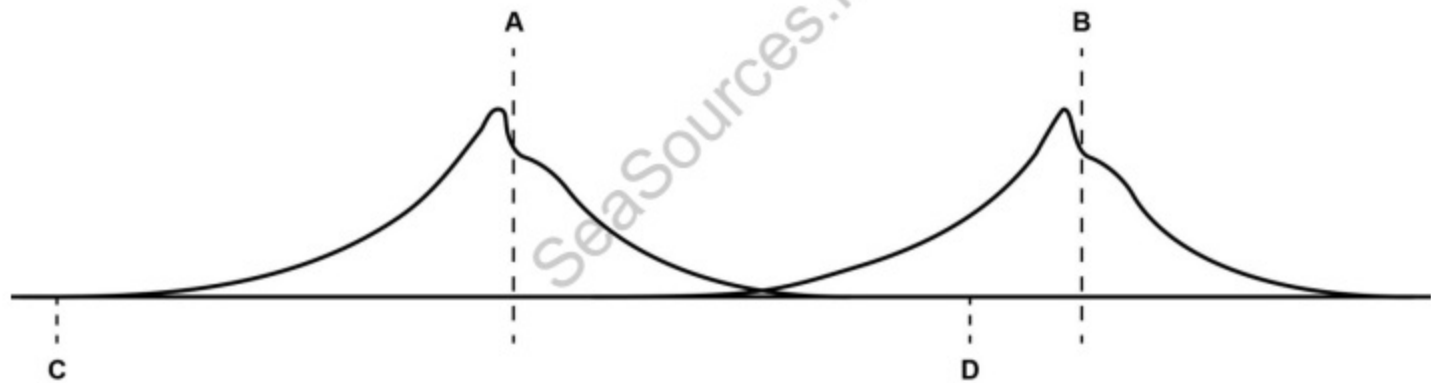




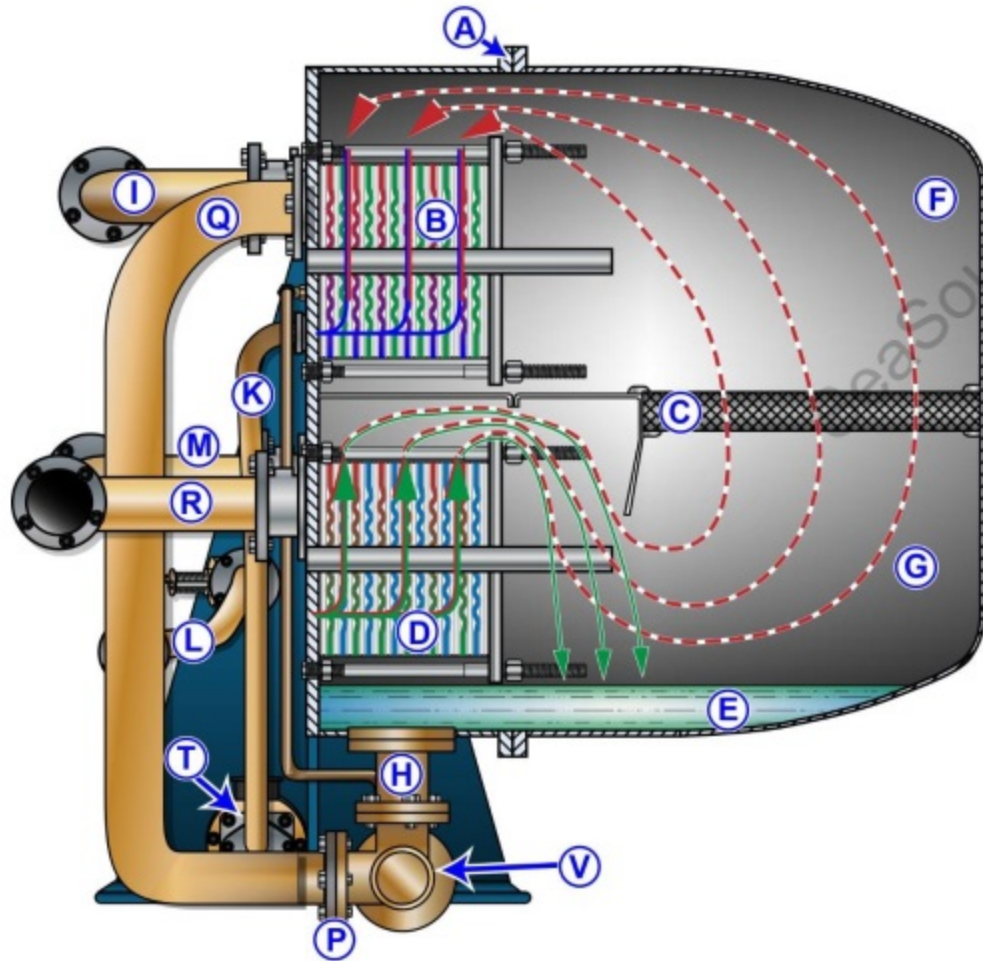
MO-0107



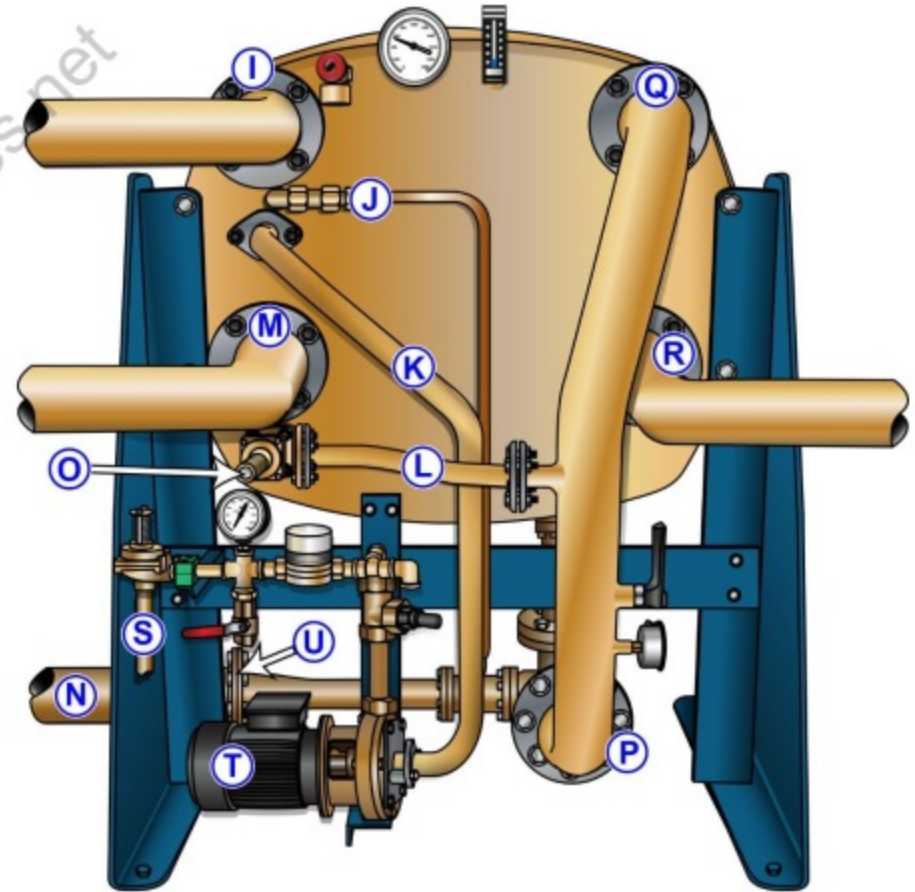
MO-0108

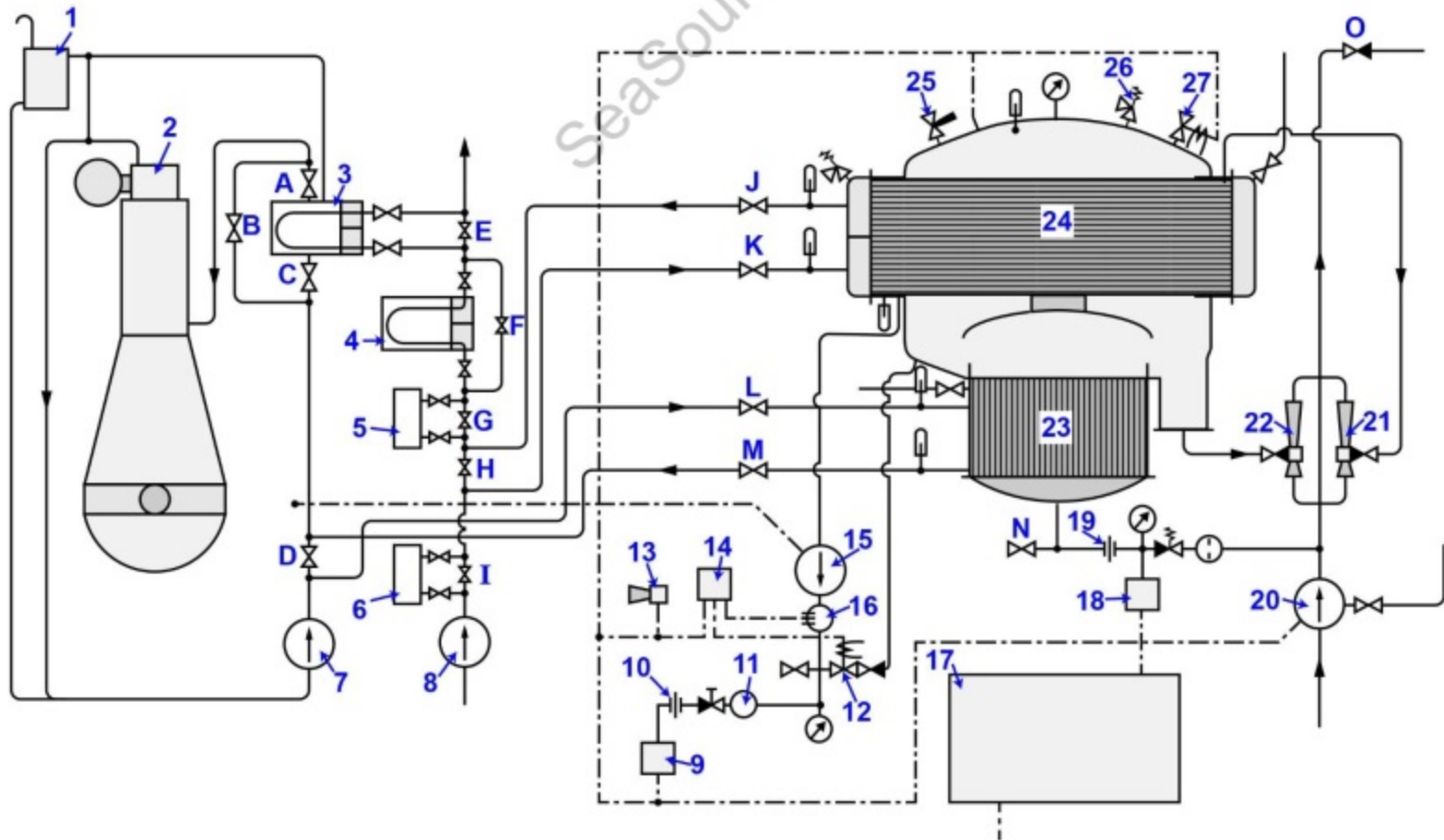


Side View

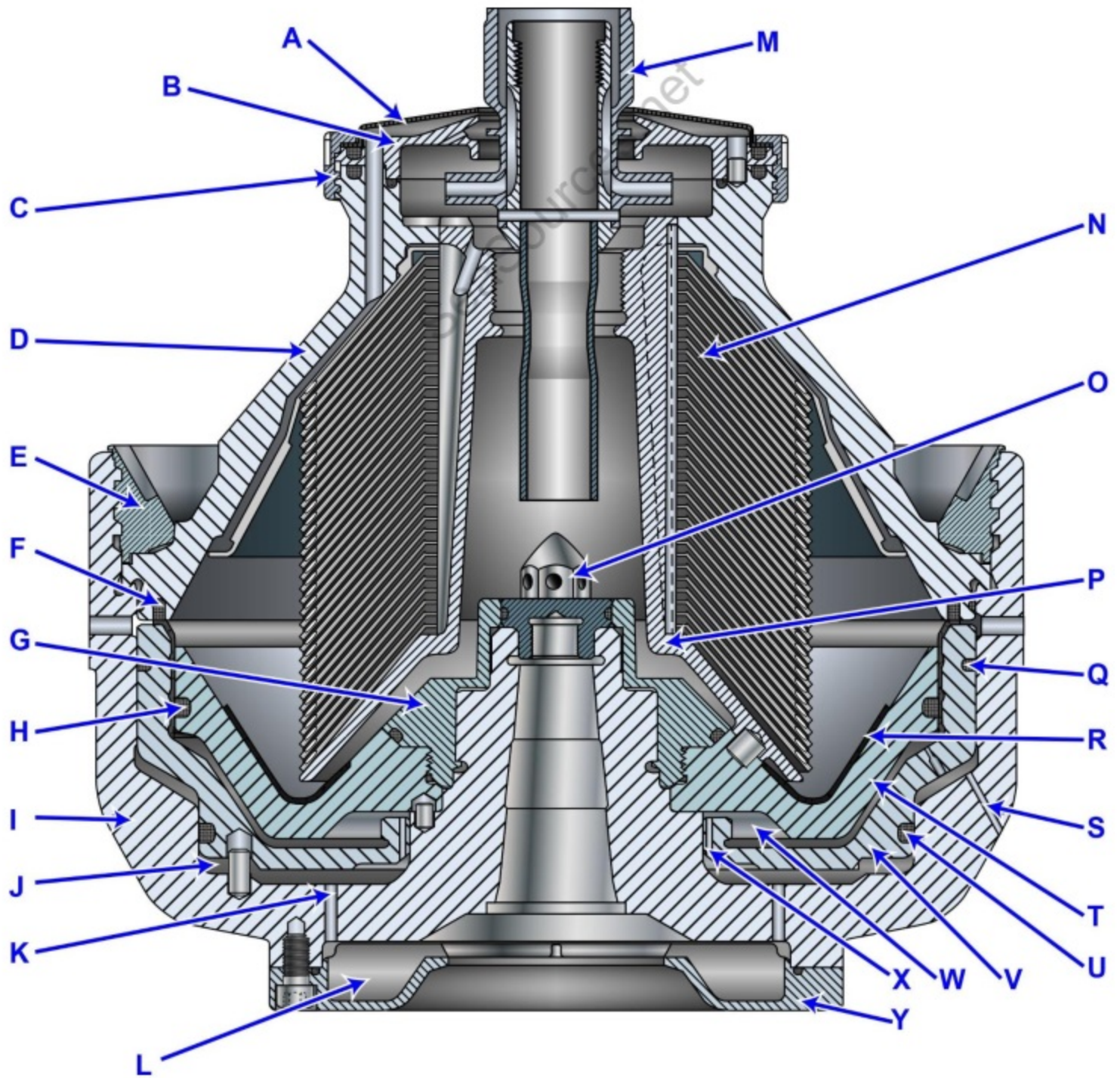


Rear View



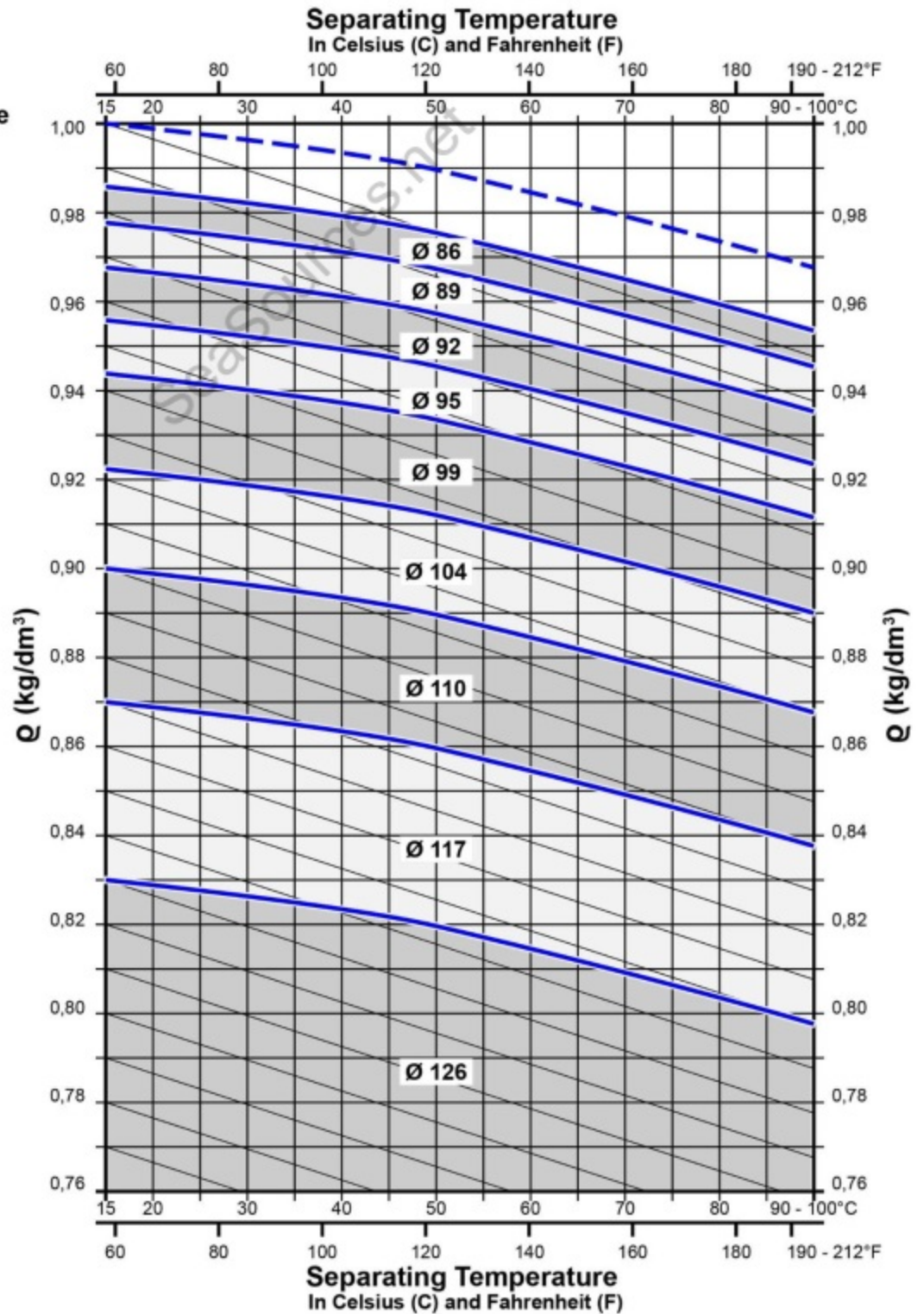


# MO-0112



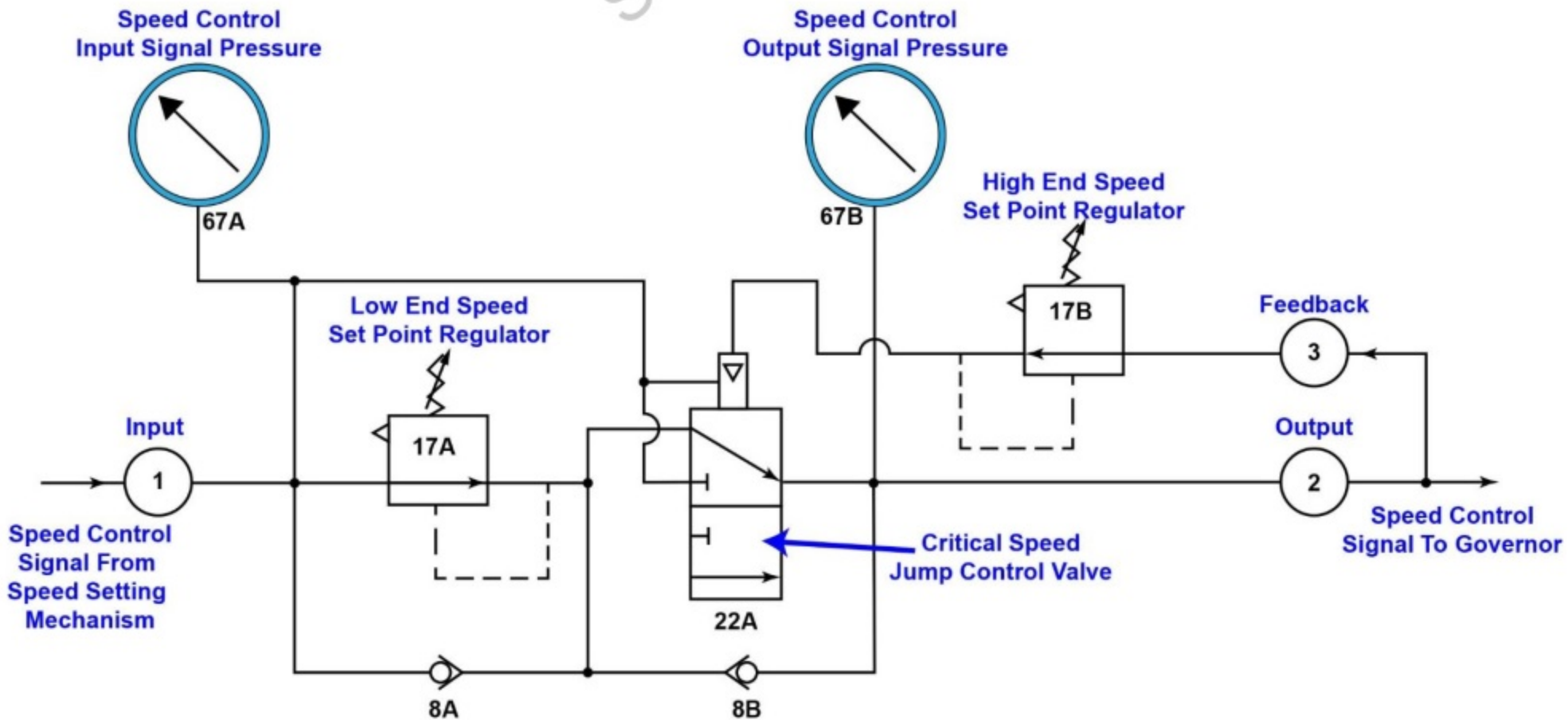
# MO-0113

- - -  $\rho$  - Water
- $\rho$  - Oil
- Ø - Regulating Ring Size

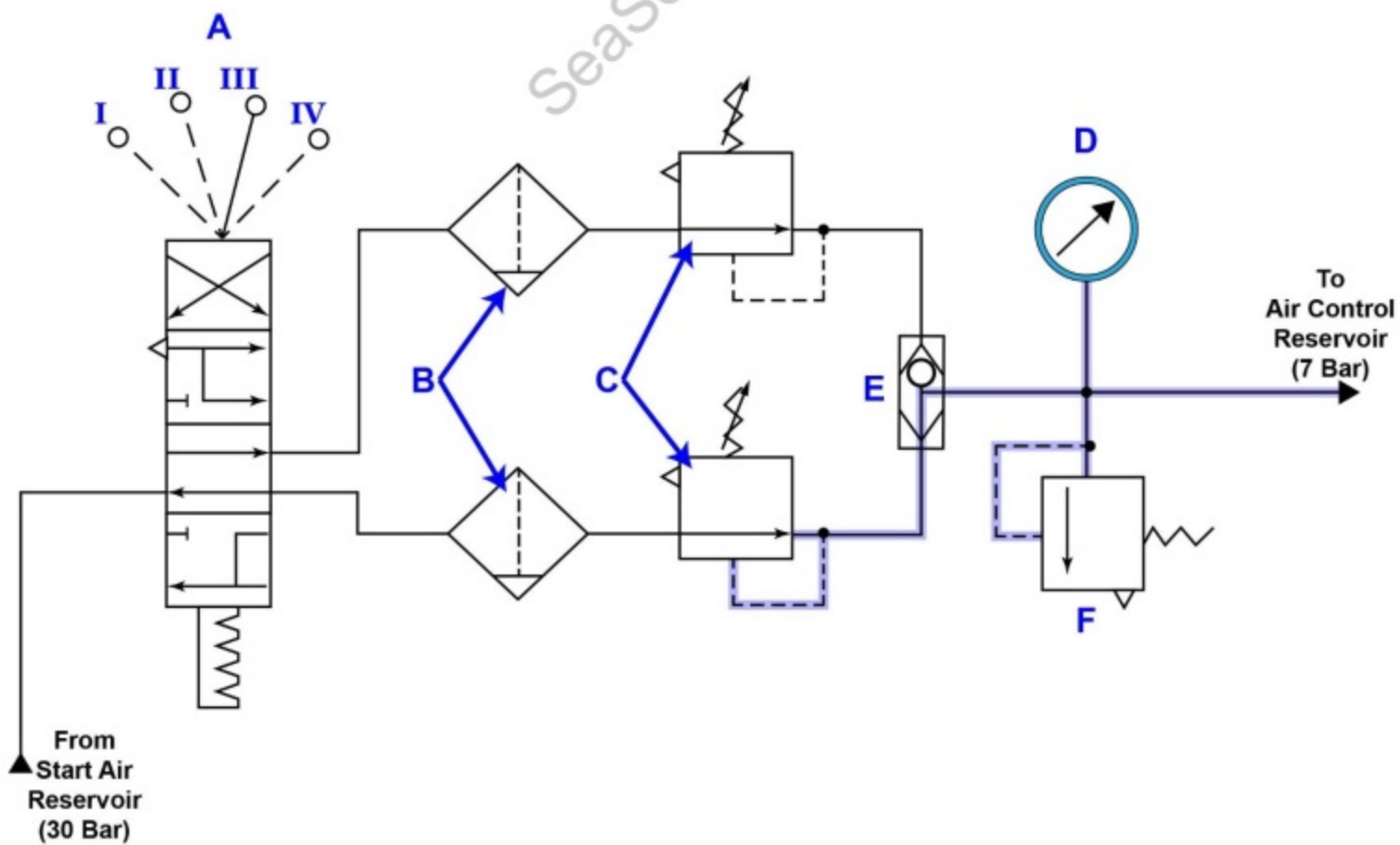


# MO-0114

## Critical Speed Jump Valves Group

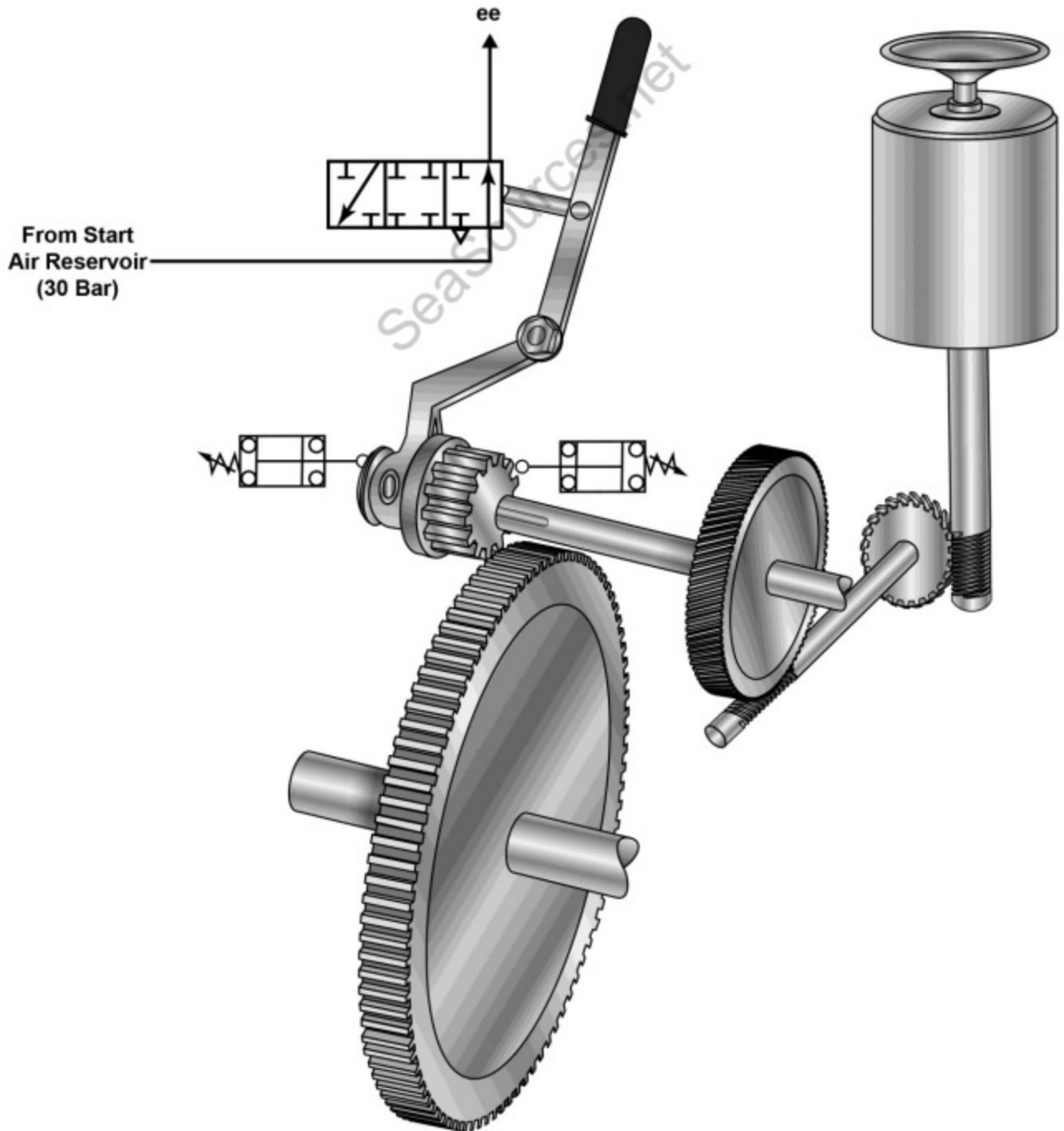


Control Air Pressure-Reducing Unit  
Valves Group

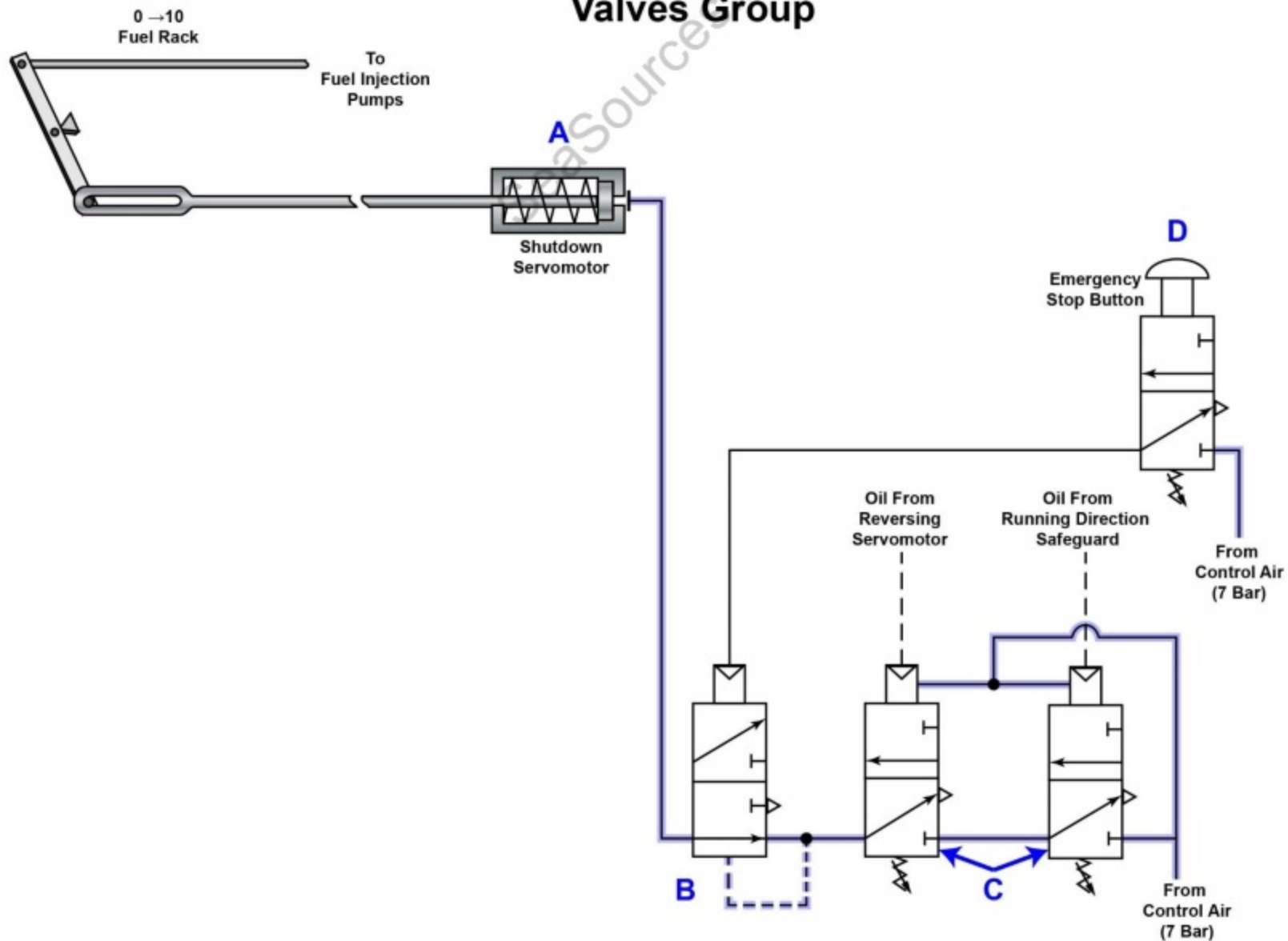




# MO-0116

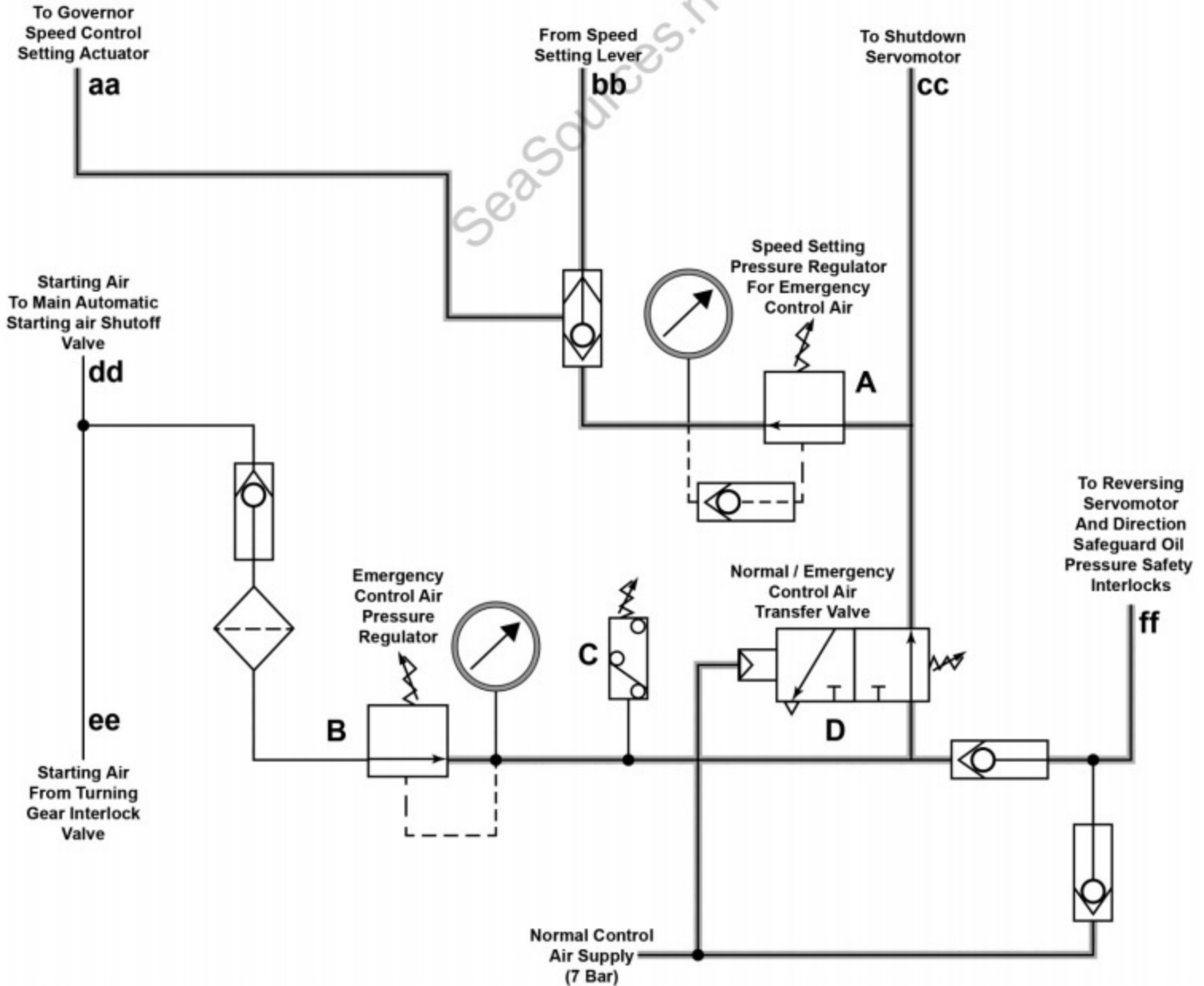


## Fuel Blocking Valves Group



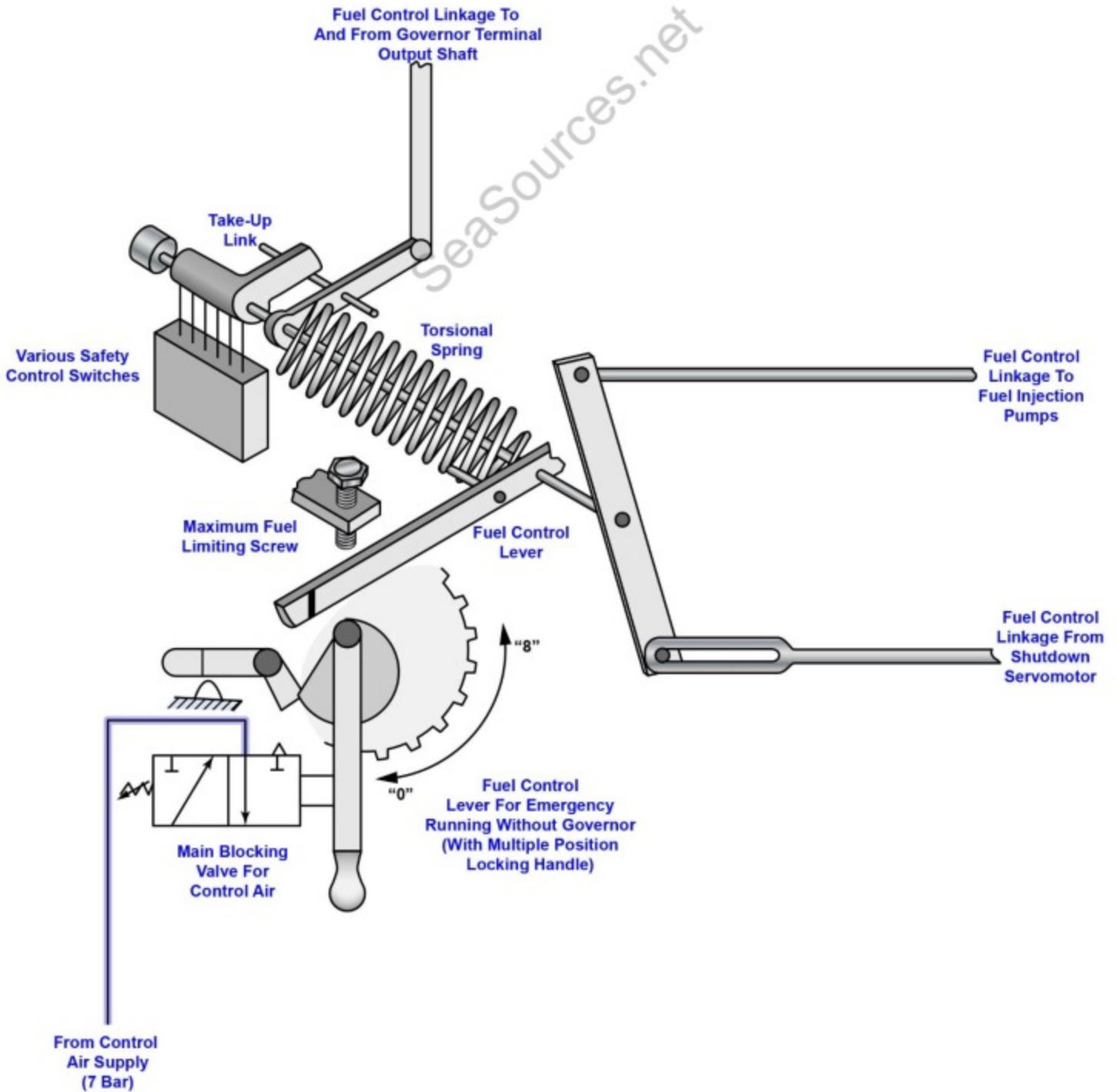
# MO-0118

## Emergency Control Air Valves Group

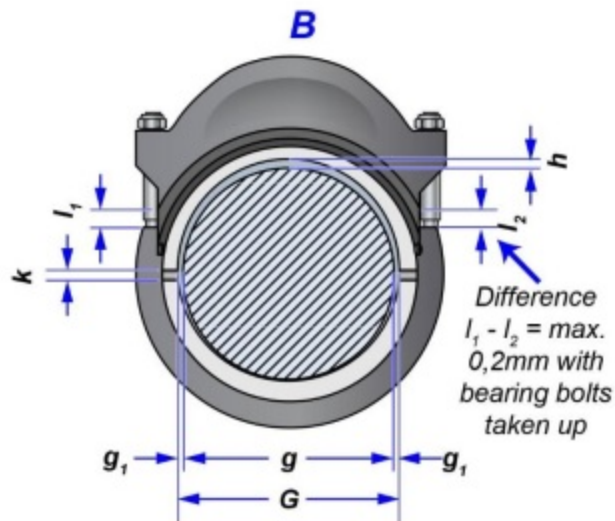
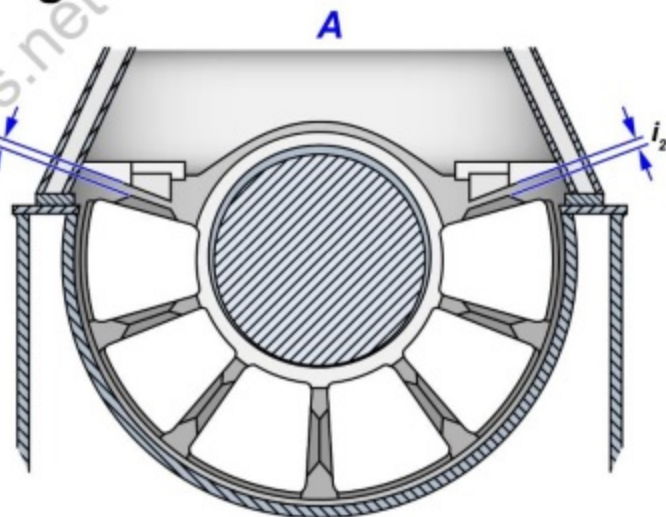
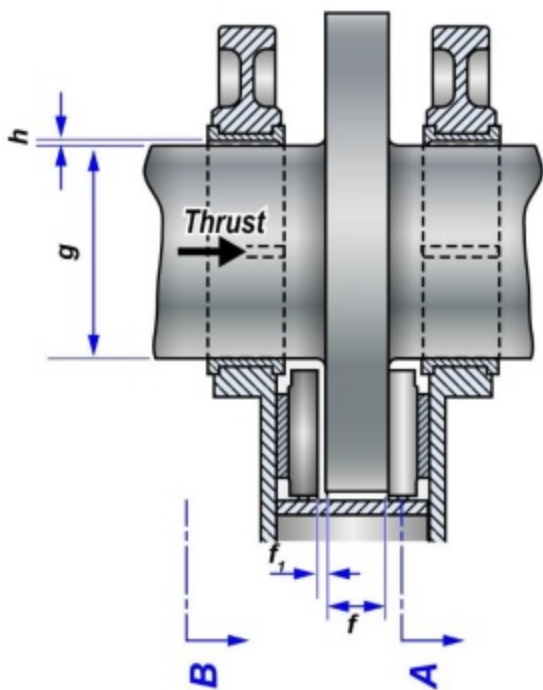


# MO-0119

## Fuel Control Linkage Arrangement



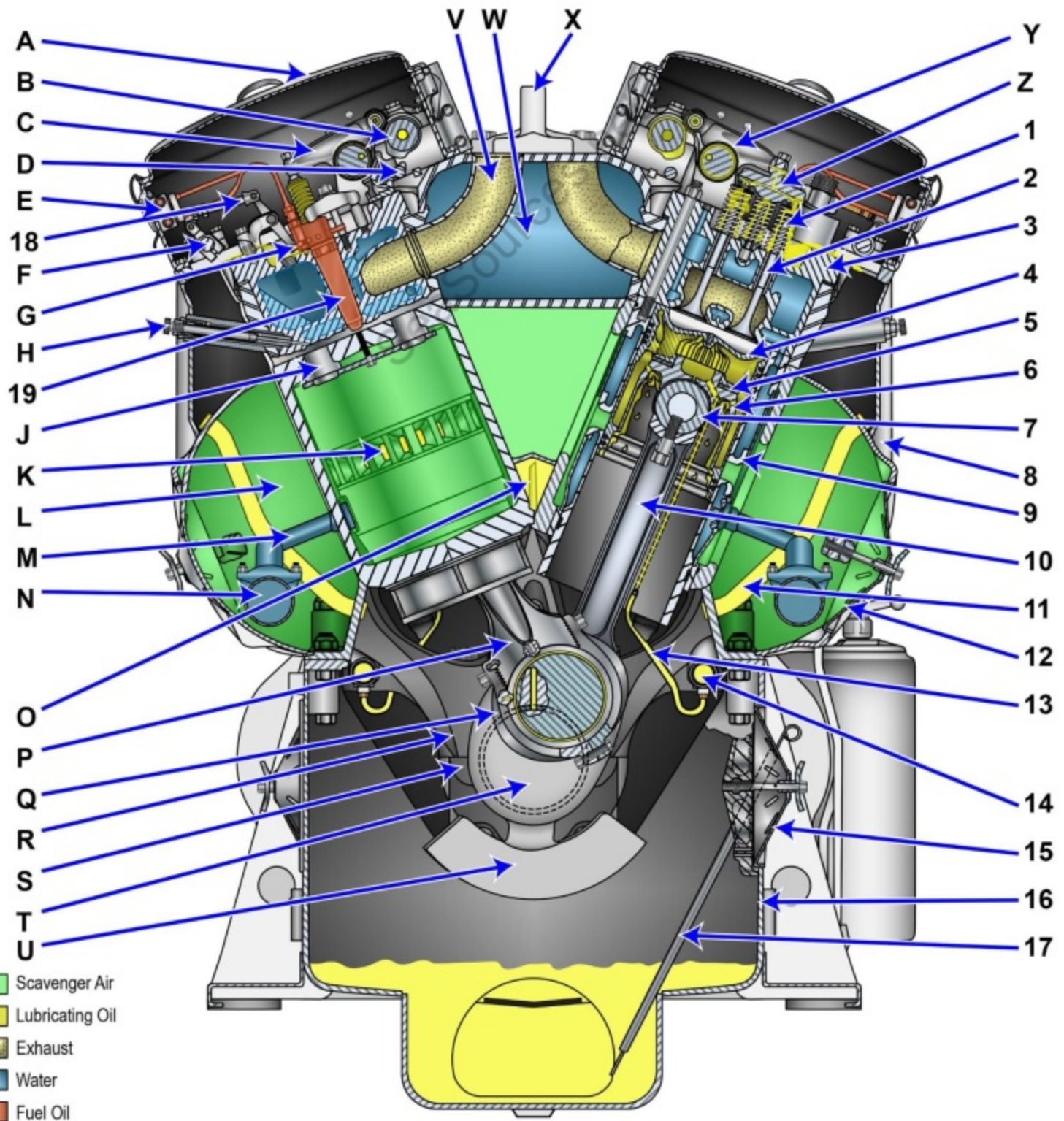
# Thrust Bearing



Nominal dimension	Normal play	Max. play (worn)
$f = 200$	$f_1 = 1,0$	2,0
$g = 540 \begin{matrix} +0 \\ -0,08 \end{matrix}$	$g_1 = \text{min. } 0,10$	
$G = 540 \begin{matrix} +0,38 \\ +0,30 \end{matrix}$	$h = \begin{matrix} +0,46 \\ +0,30 \end{matrix}$	0,8
	$i_1, i_2 = 5$	
$k = 20$		

<b>RND 68</b>	<b>Principal Clearances Crankshaft and Thrust Bearing</b>	All dimensions in mm	<b>7 354 366 - E</b>
---------------	---	-------------------------	----------------------

# MO-0122



MO-0125

A

FRONT

B

C

H

I

D

E

F

G

TOP

D

E

F

G

SIDE

J

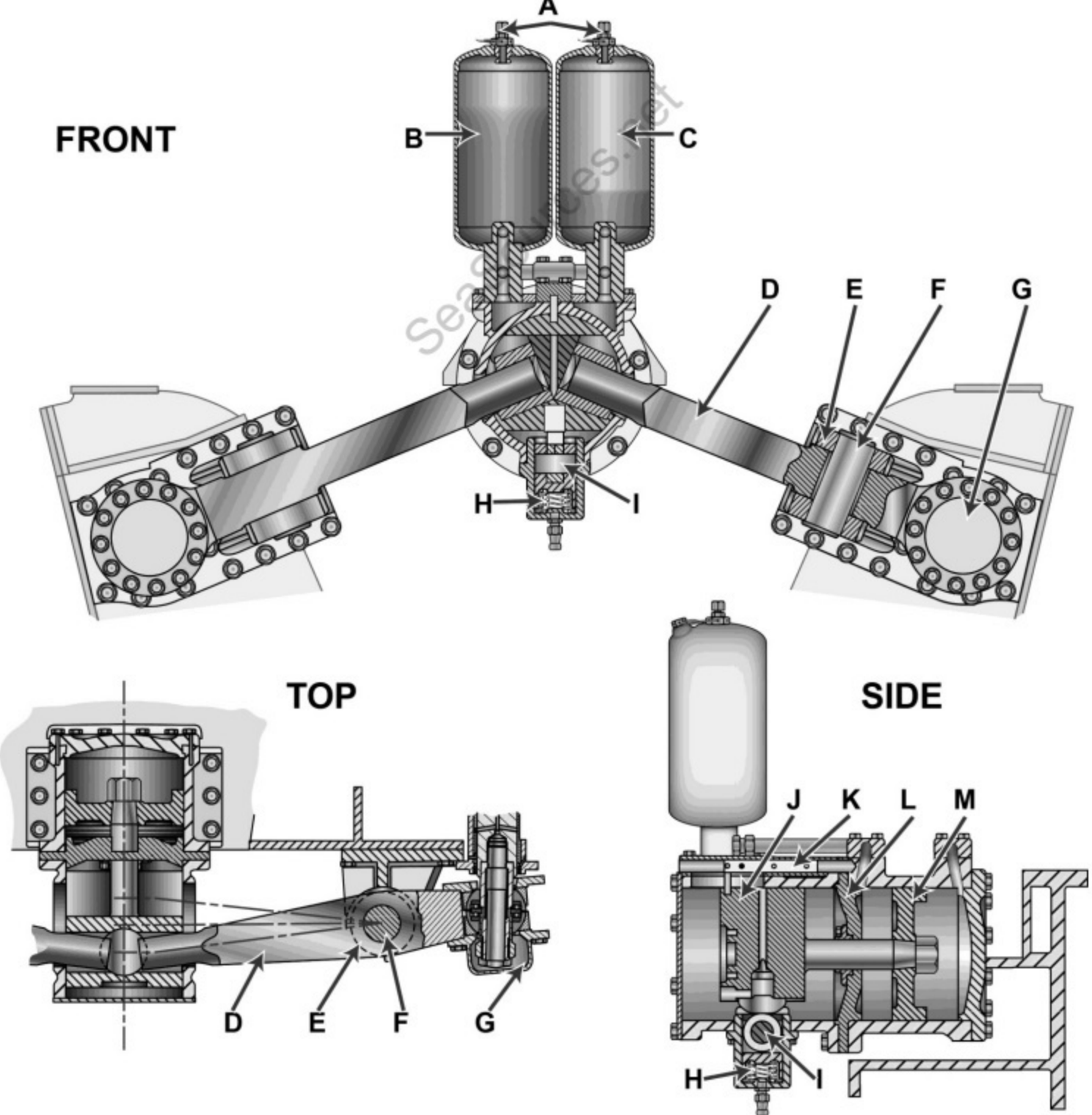
K

L

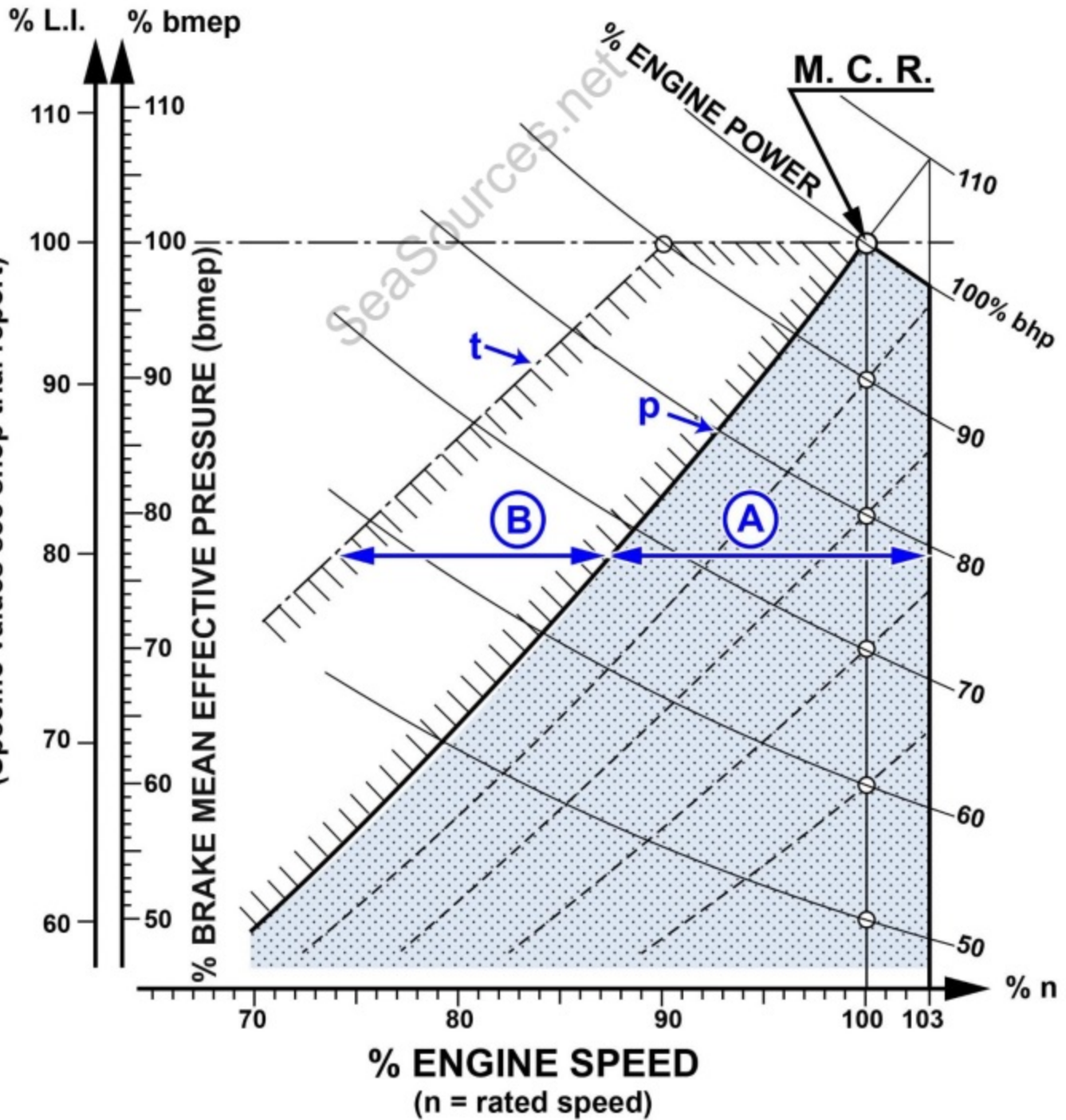
M

H

I











**APPROXIMATE POSITION OF LOAD INDICATOR (L. I.)  
IN % OF POSITION AT M. C. R.**  
(Specific values see shop trial report)

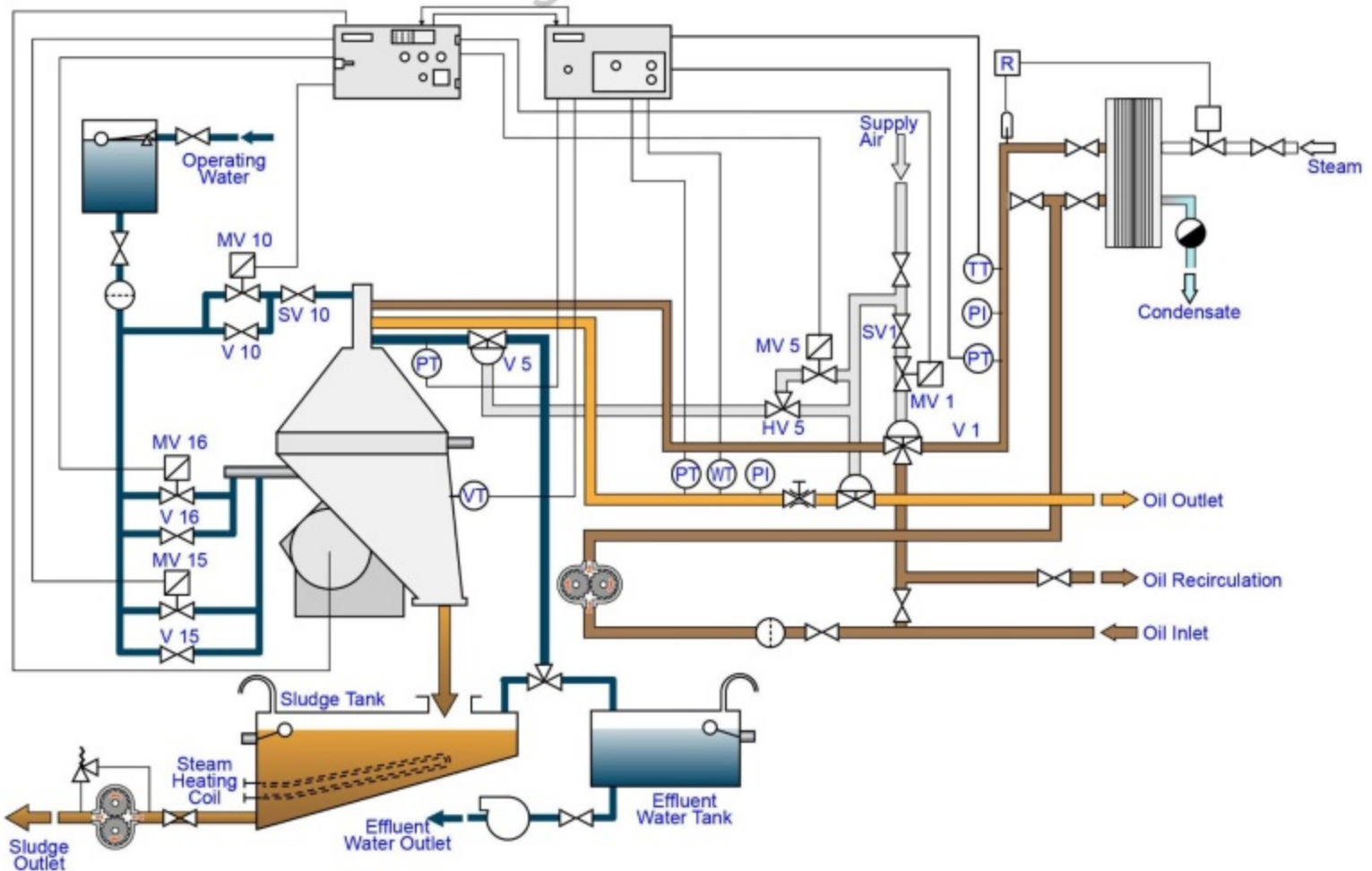




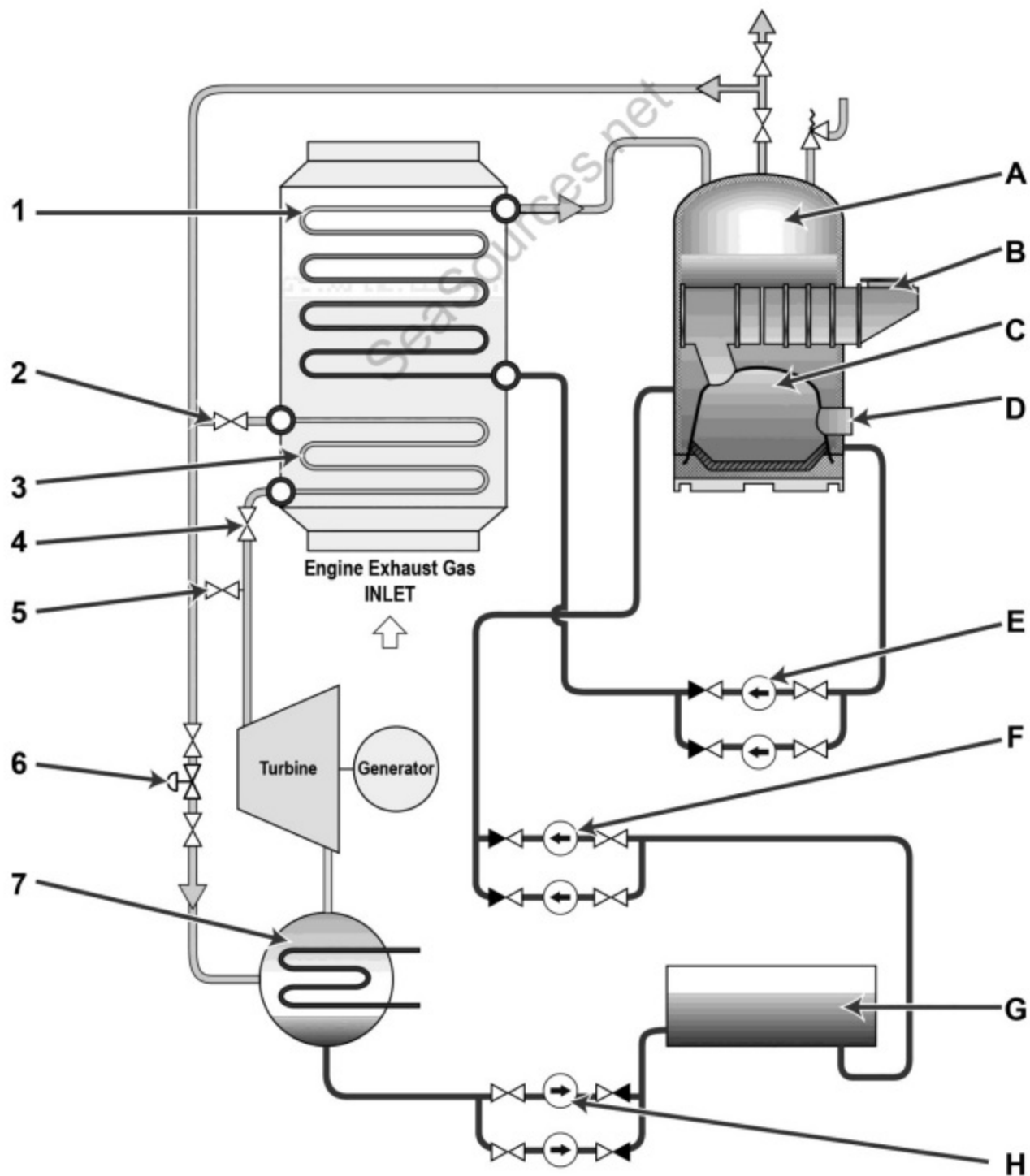
# MO-0127

EPC Alarm Indications Program Unit			
			
Alarm from MARST1	Low pressure in oil outlet	High oil temperature after preheater	Low oil temperature after preheater
			
Emergency stopping or vibrations	No discharge	Logically wrong signal from 1st separator	Remote alarm signal only

MARST1 Alarm Indications Program Unit			
A01	A02	A03	A04
Abnormal water content	Transducer signal minimum value	No discharge feedback signal	Drain valve insufficient
A05	A06	A07	
Micro-processor error	Liquid indication	Transducer fault	



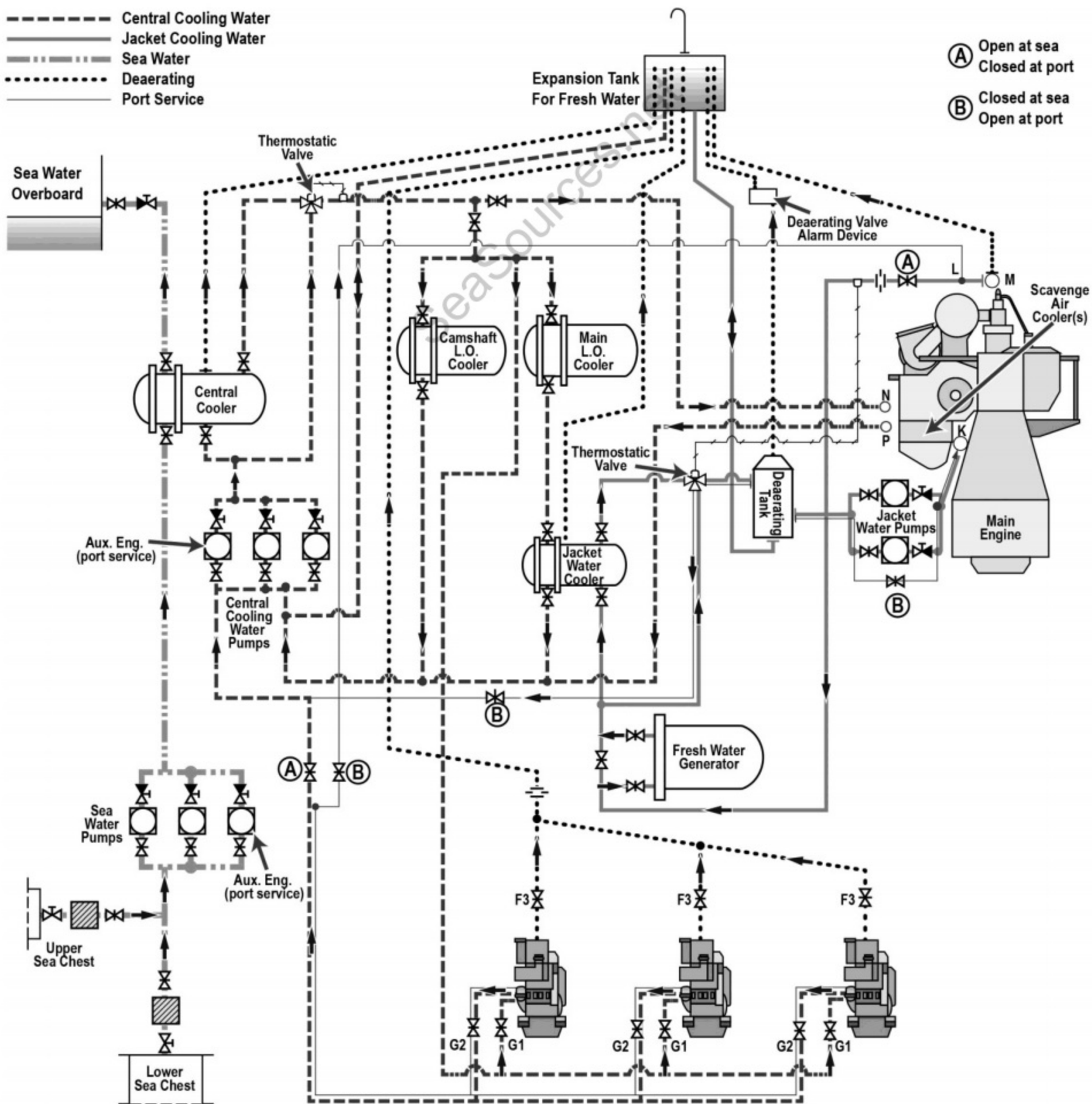
# MO-0128



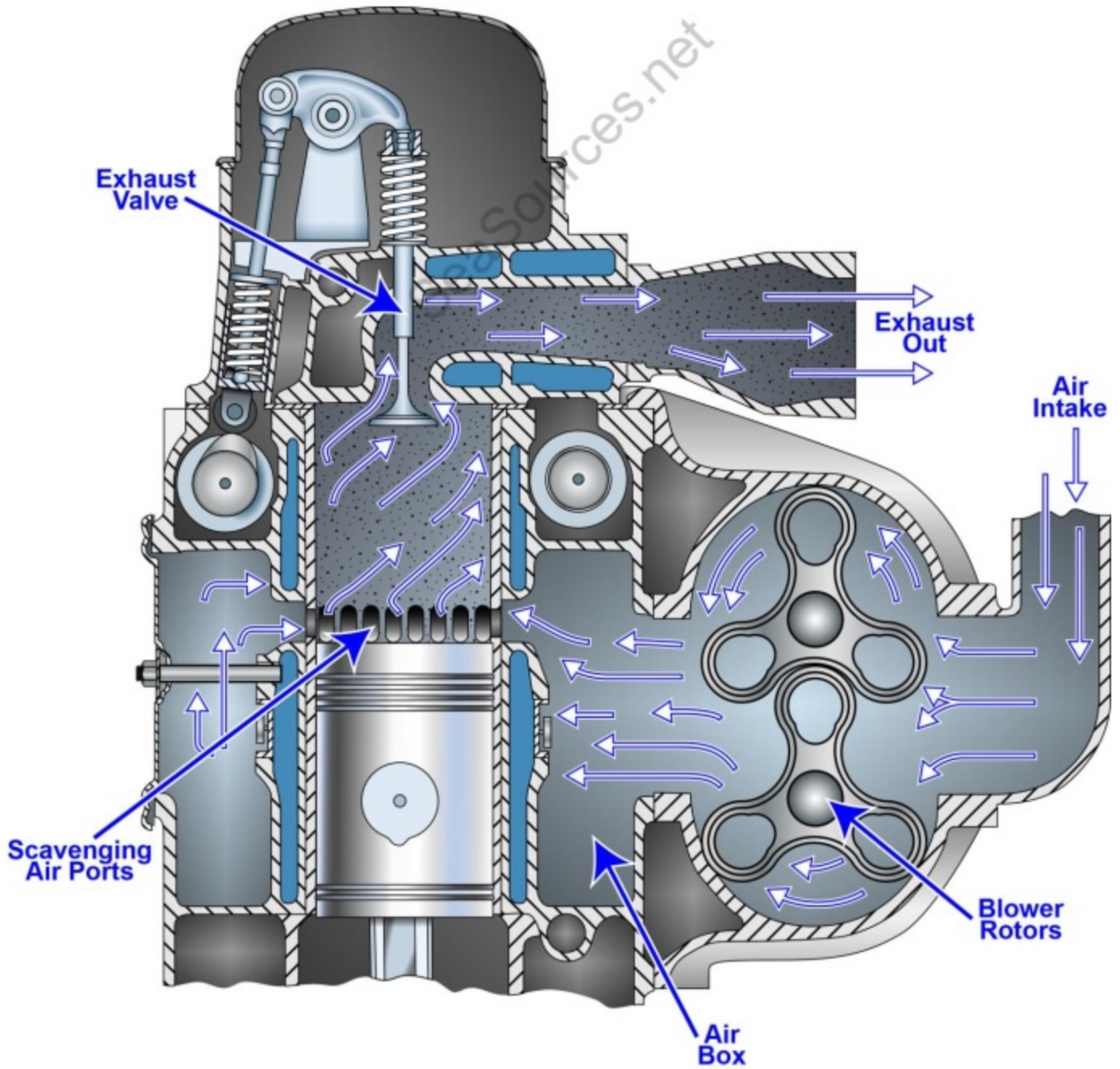
# MO-0129

- Central Cooling Water
- Jacket Cooling Water
- · - · - Sea Water
- Deaerating
- Port Service

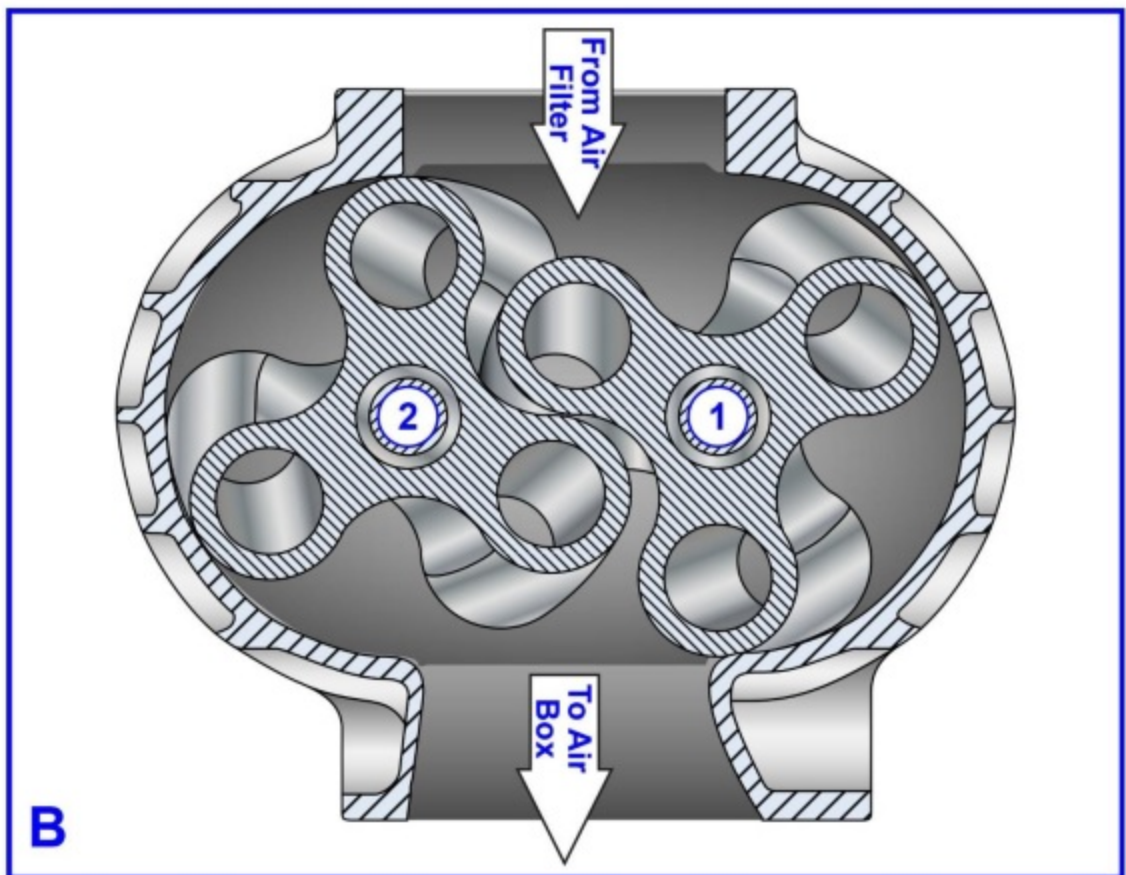
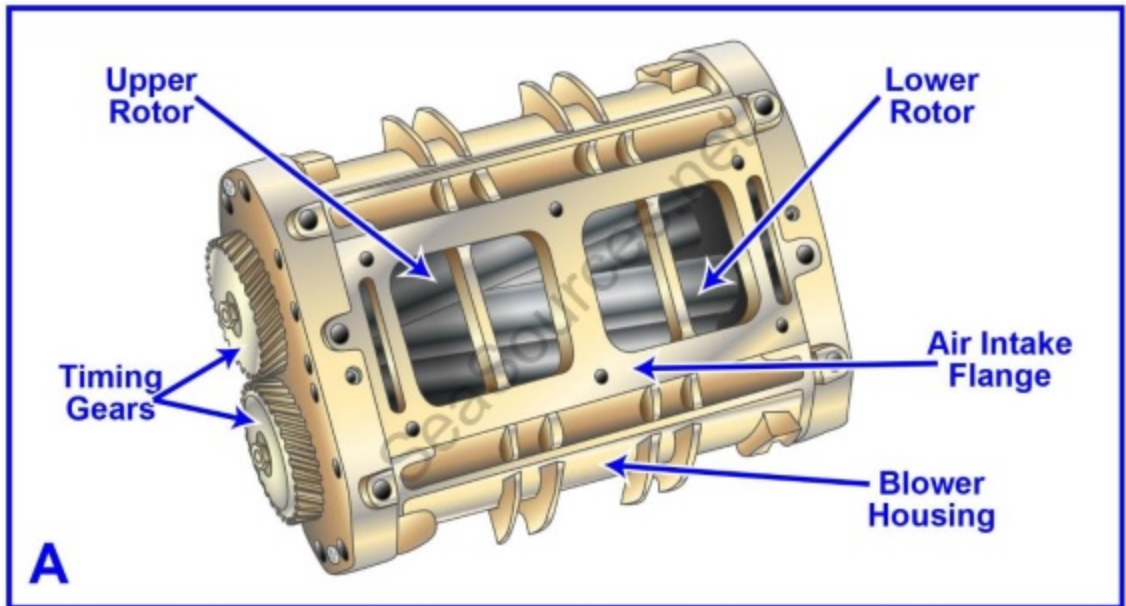
- (A) Open at sea  
Closed at port
- (B) Closed at sea  
Open at port



MO-0134

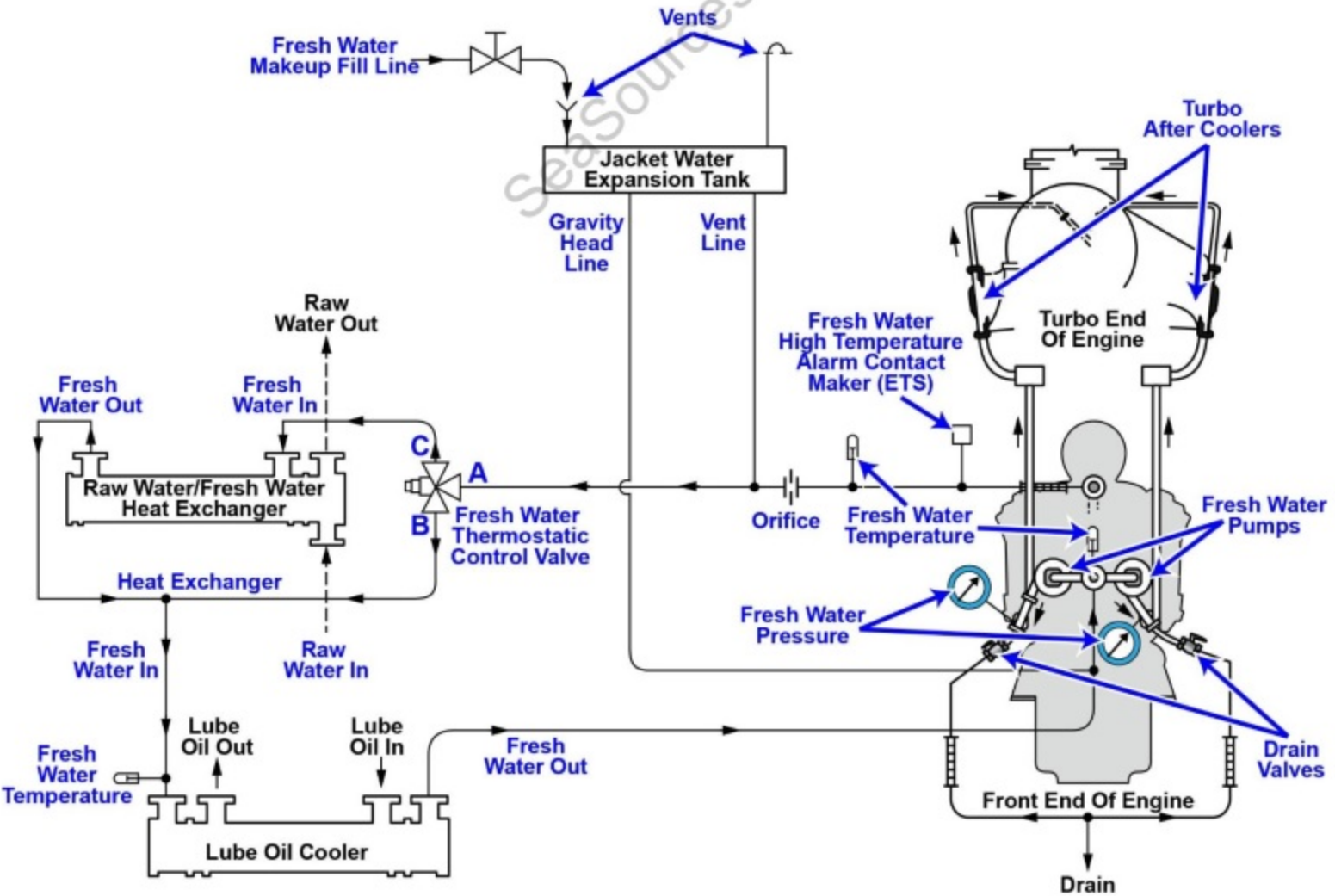


# MO-0135



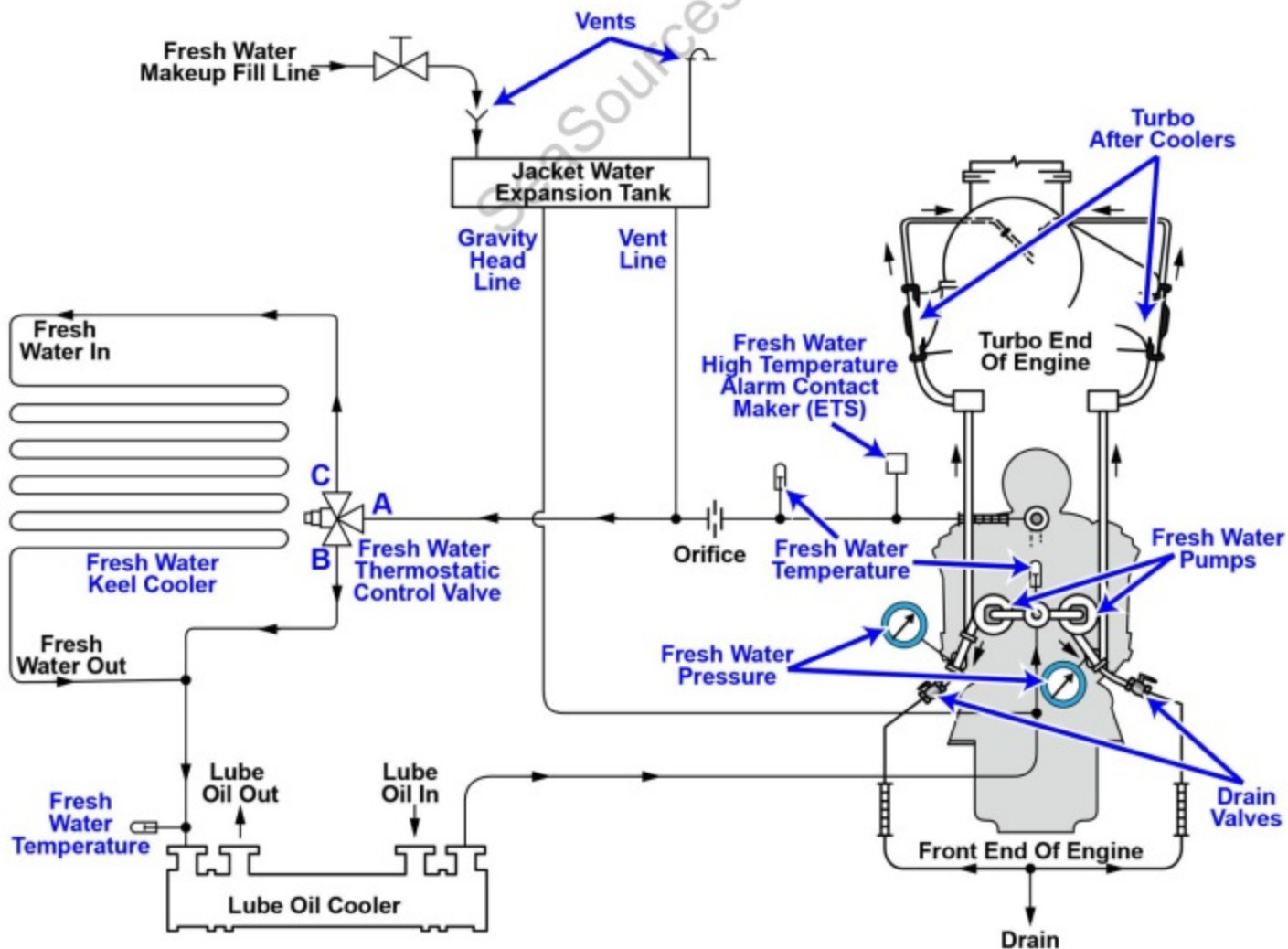
# MO-0137

## EMD Engine Fresh Water Cooling System with Heat Exchanger



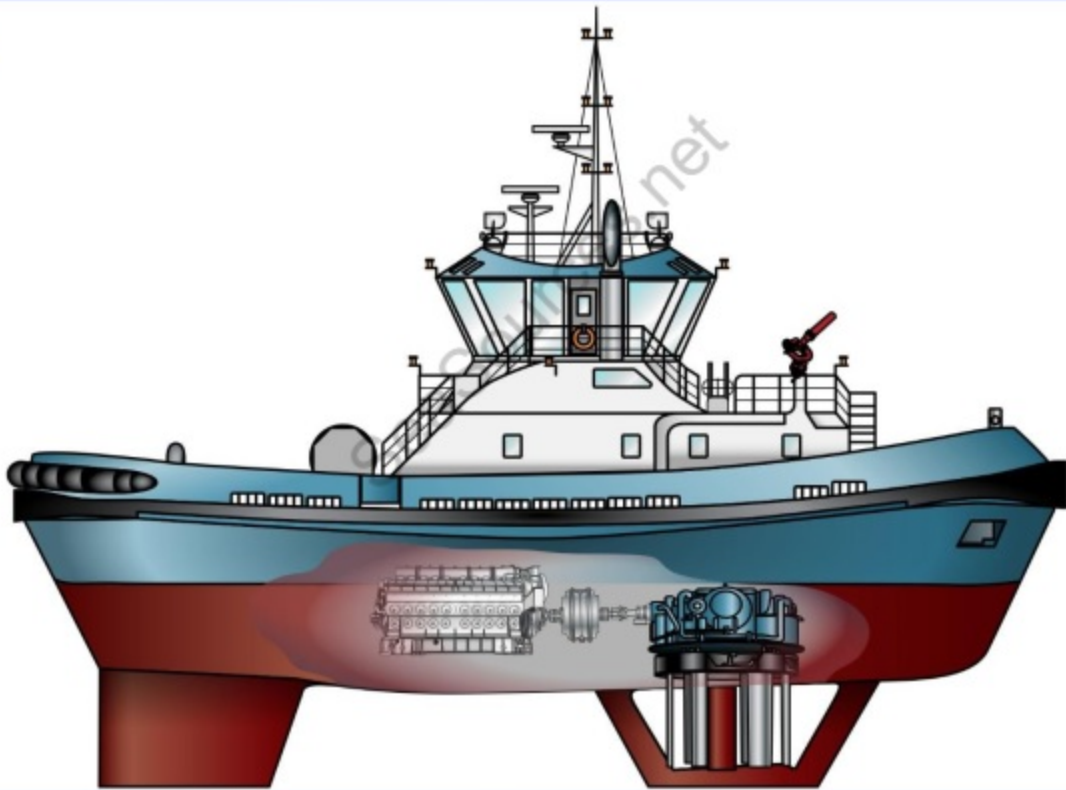
# MO-0138

## EMD Engine Fresh Water Cooling System with Keel Cooler

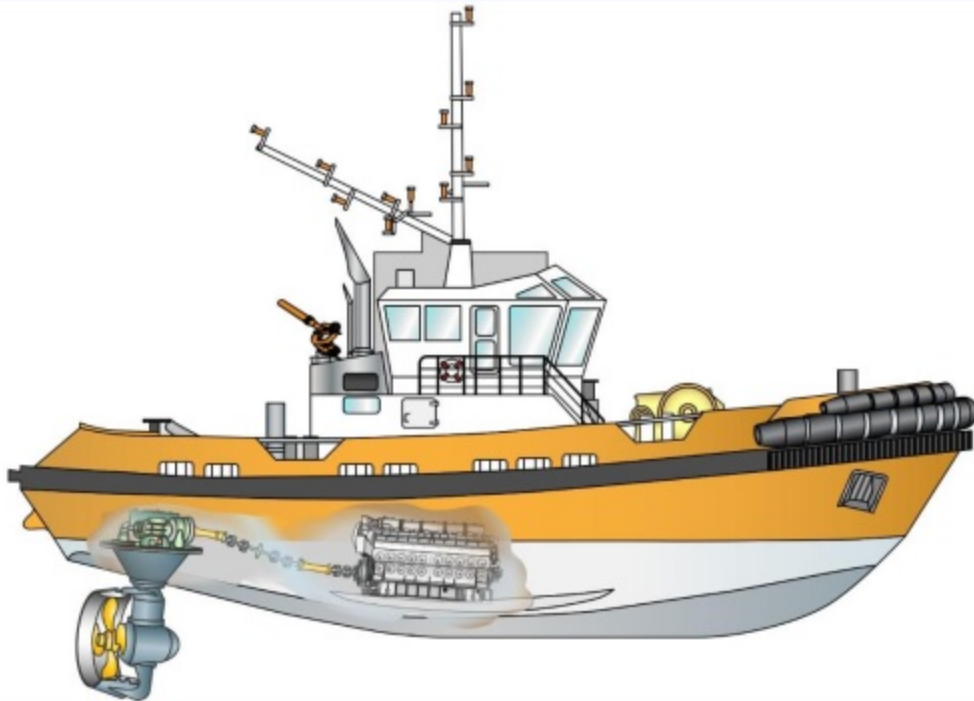


# MO-0140

A



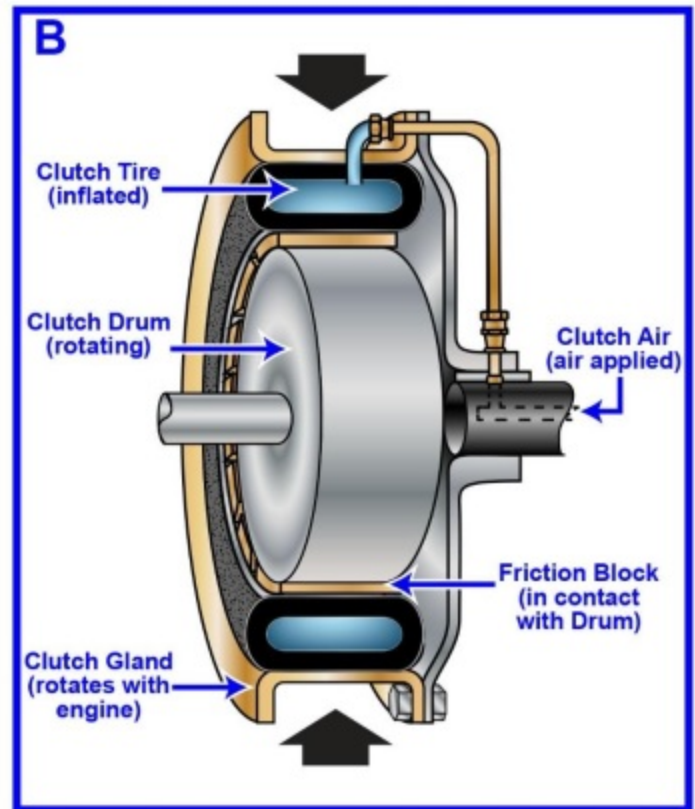
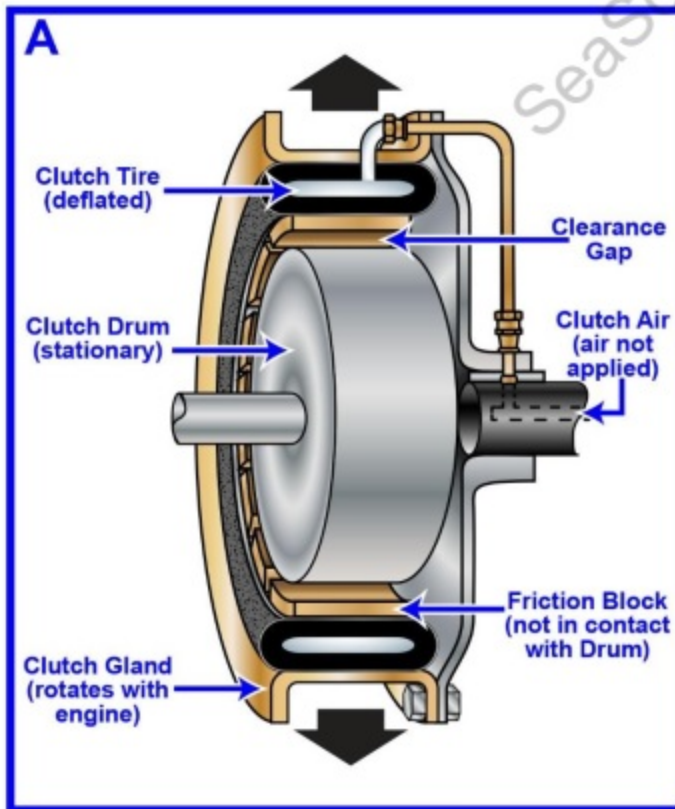
B





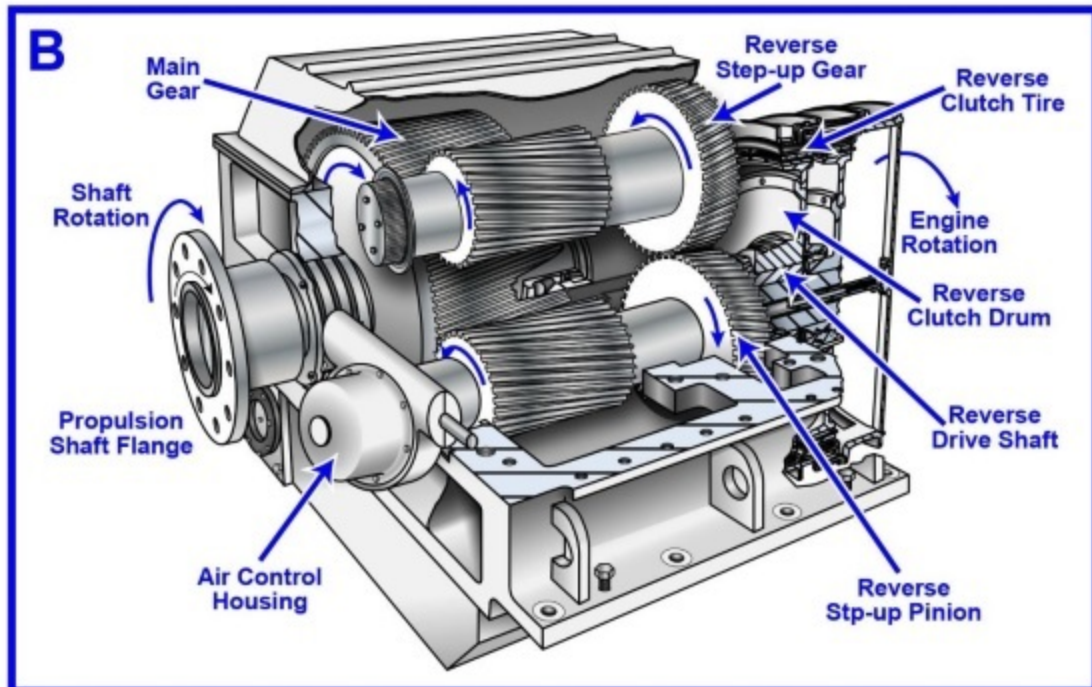
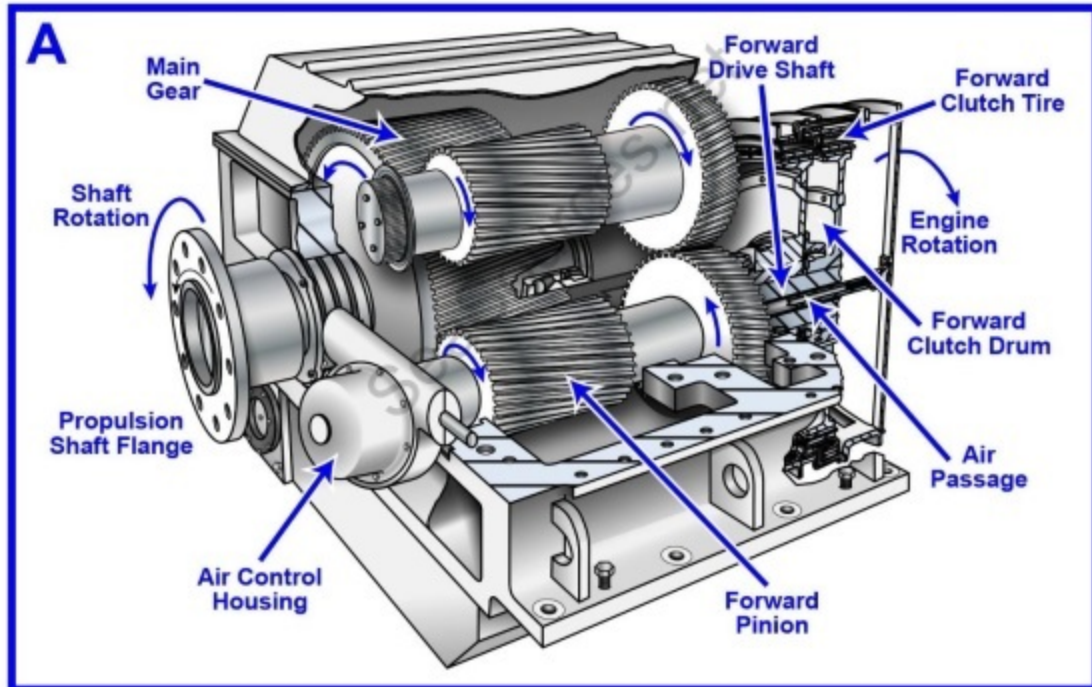
# MO-0141

## Pneumatic Airflex Clutch Operation



# MO-0142

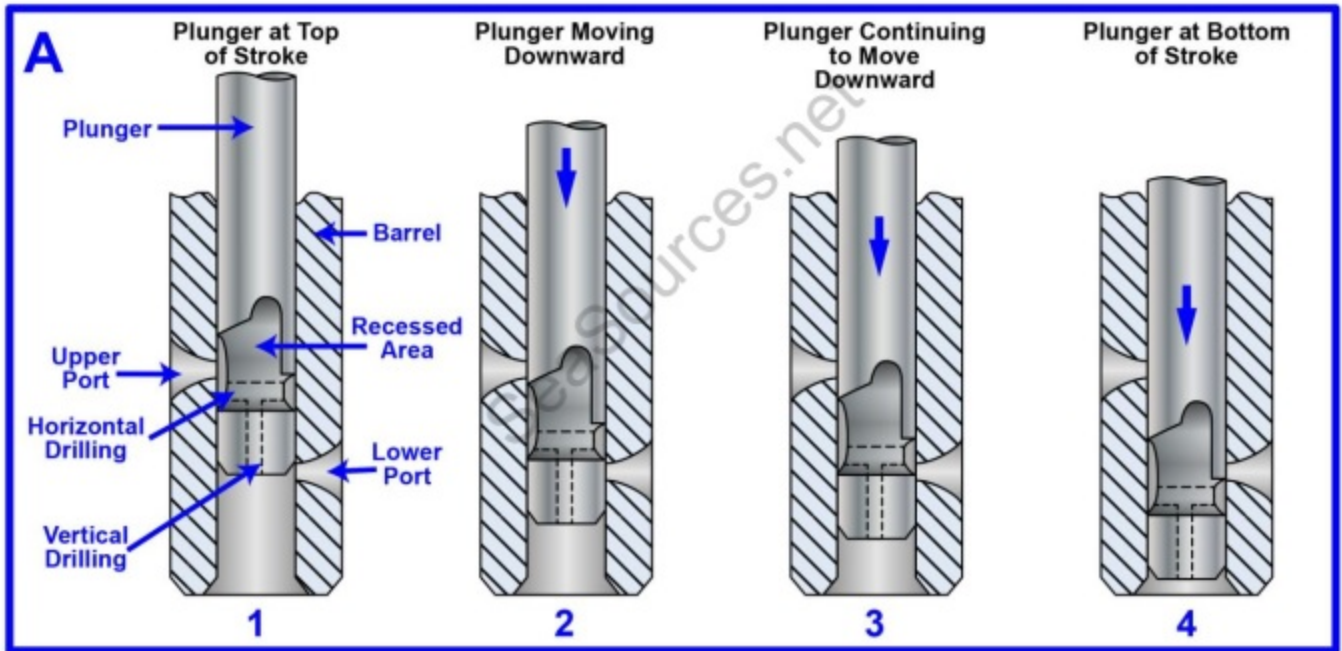
## Reversing Reduction Gear Operation



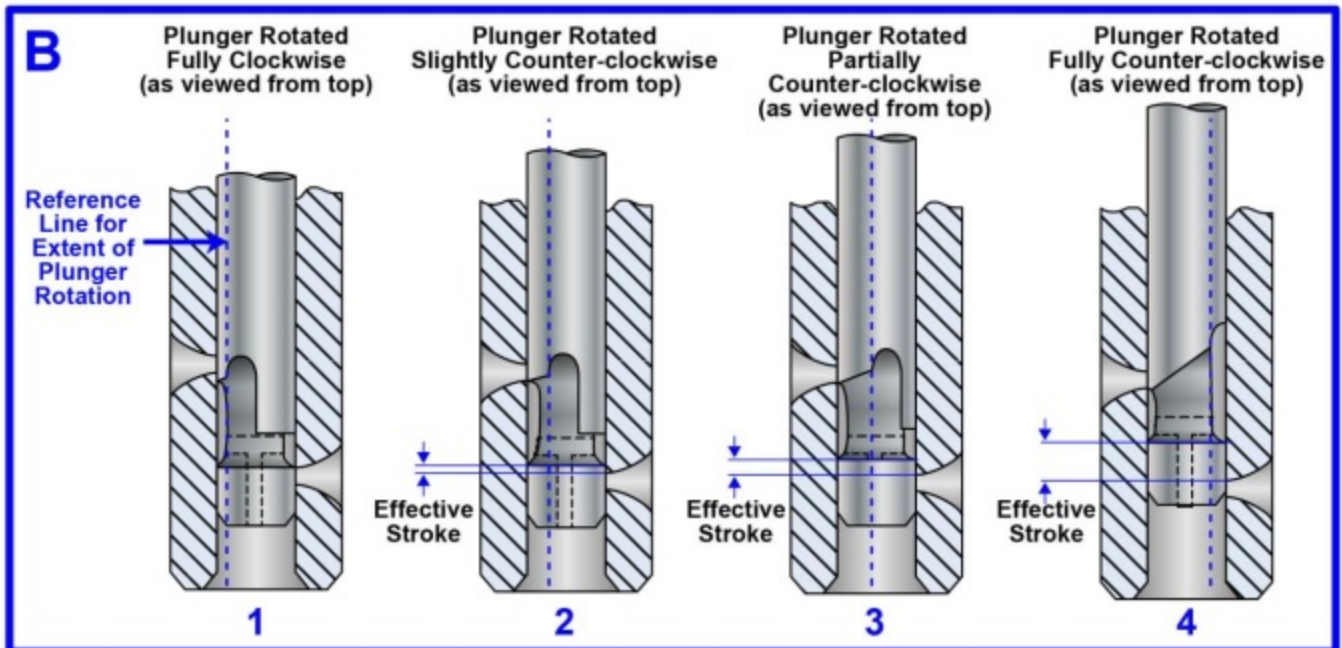


# MO-0144

## Detroit Diesel 71 Series Engine Unit Injector



Injector Operation as a Function of Vertical Plunger Travel

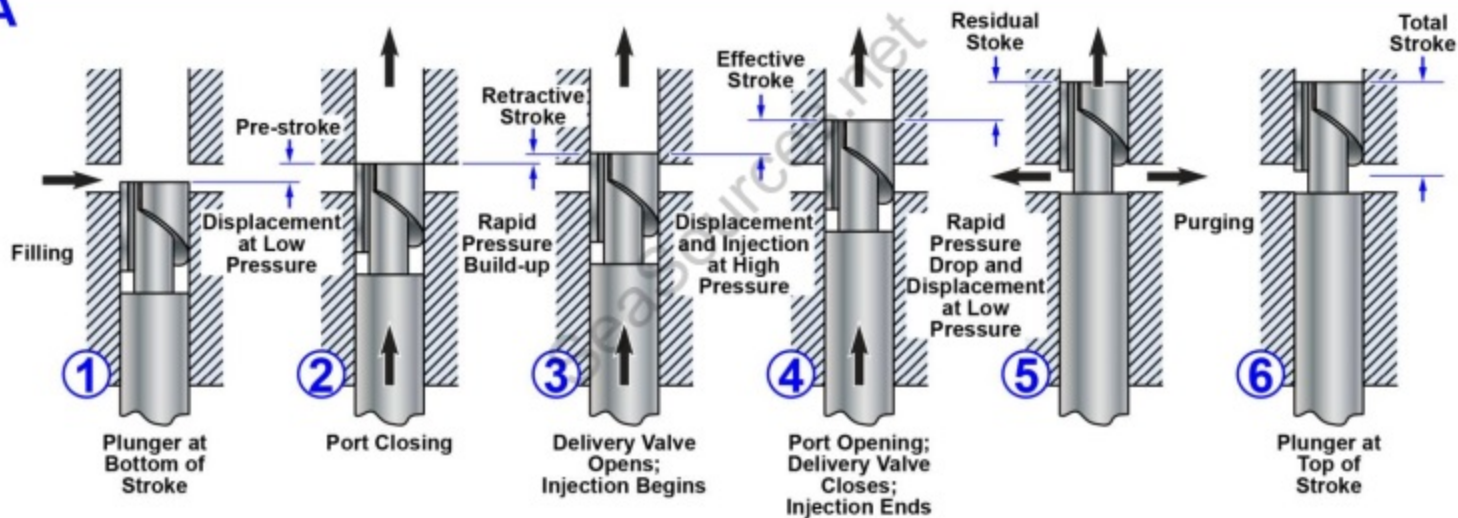


Injector Operation as a Function of Extent of Plunger Rotation

# MO-0145

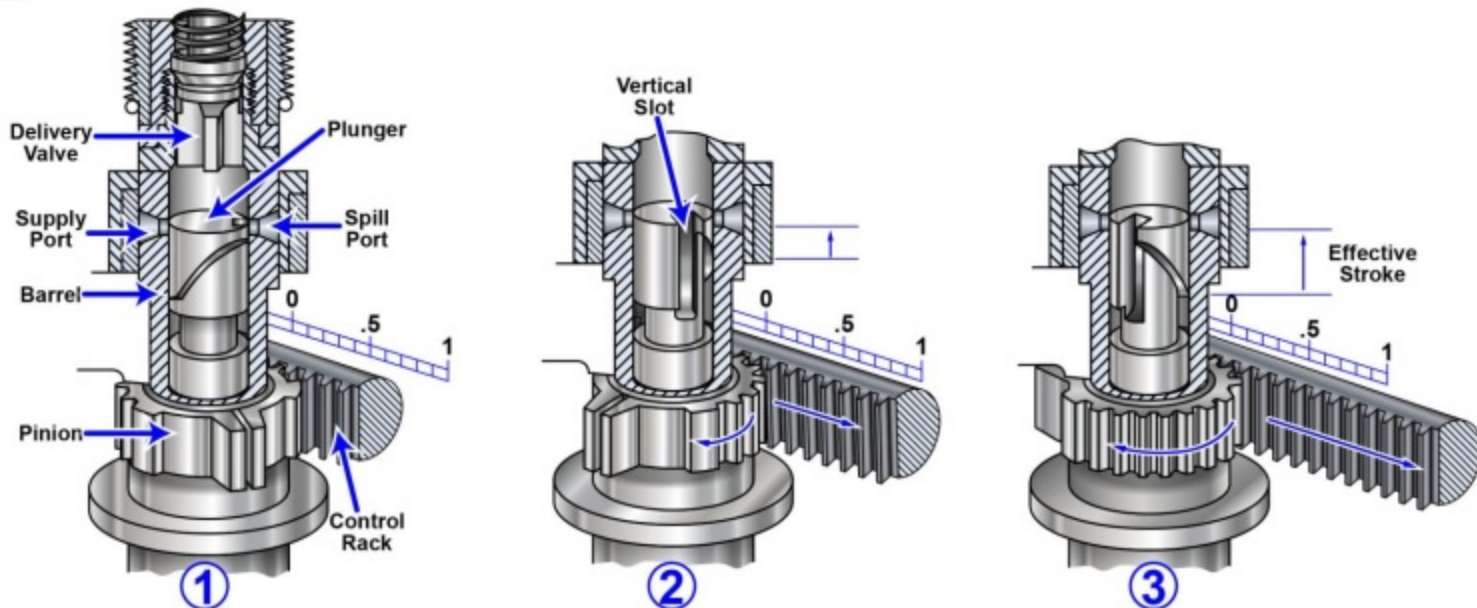
## Plunger Type Fuel Injection Pump with Port and Helix Metering

**A**



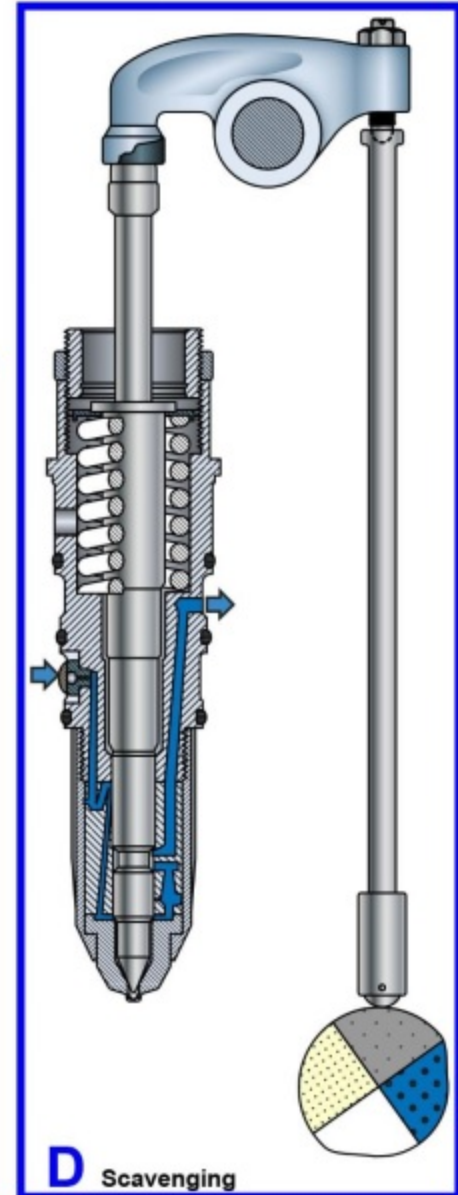
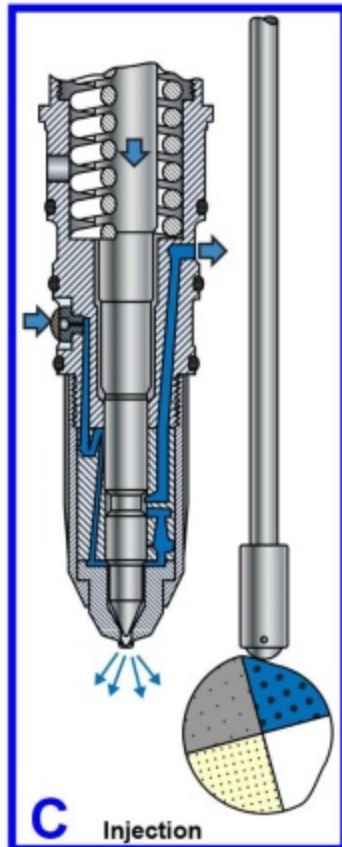
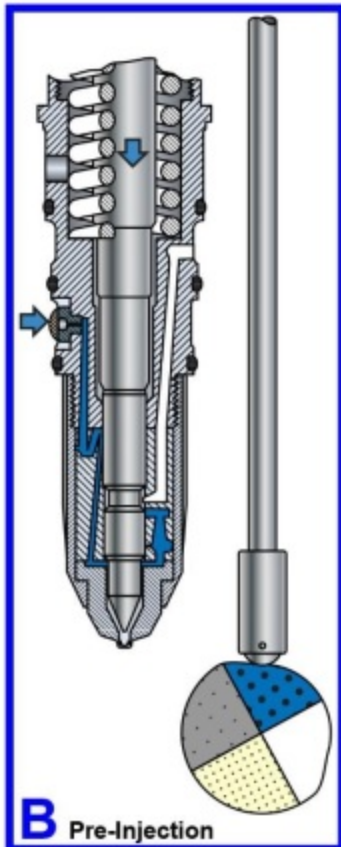
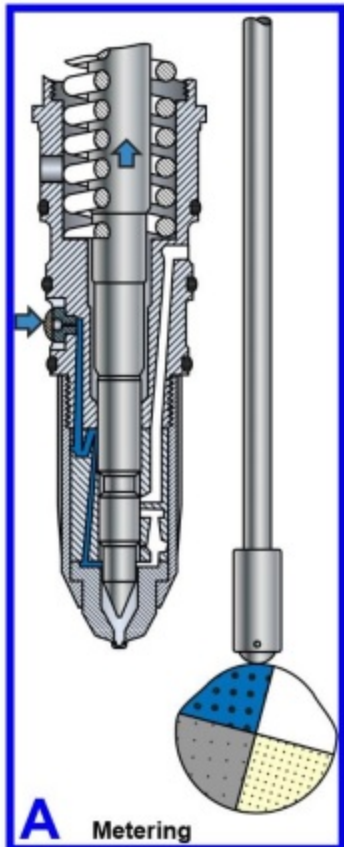
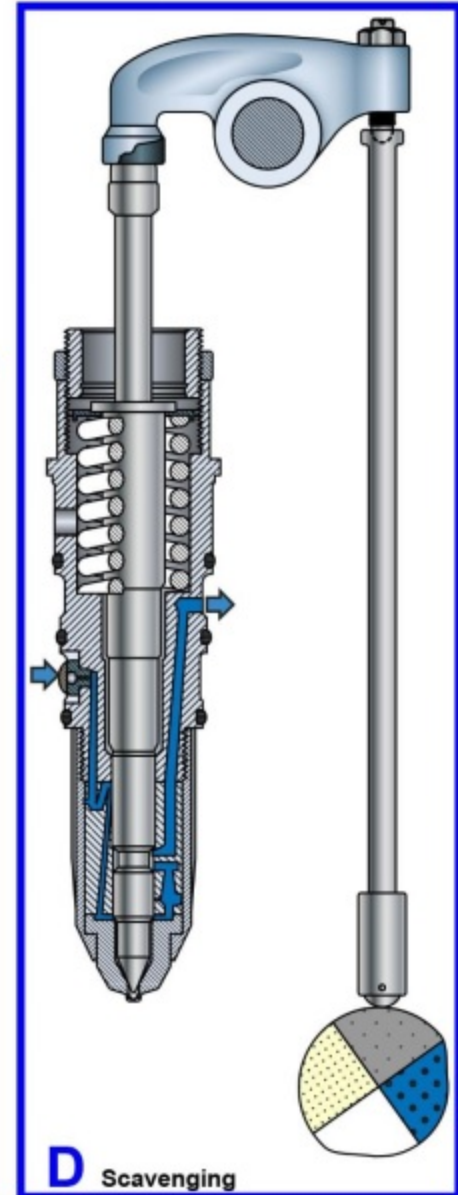
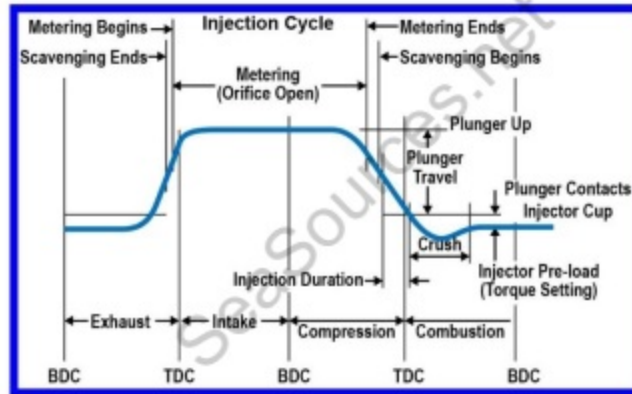
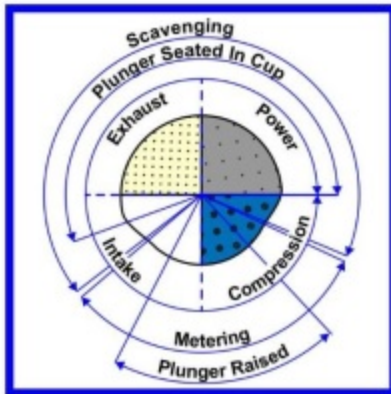
**Port and Helix Injection Pump Operation as a Function of Vertical Travel of Plunger**

**B**

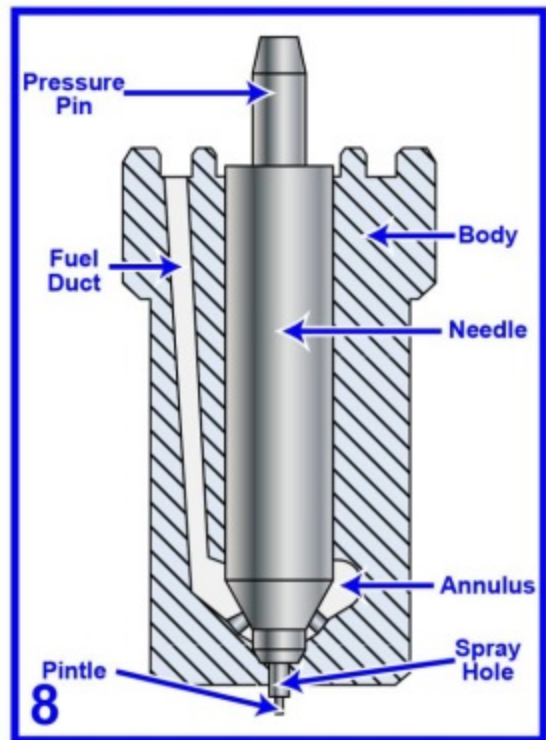
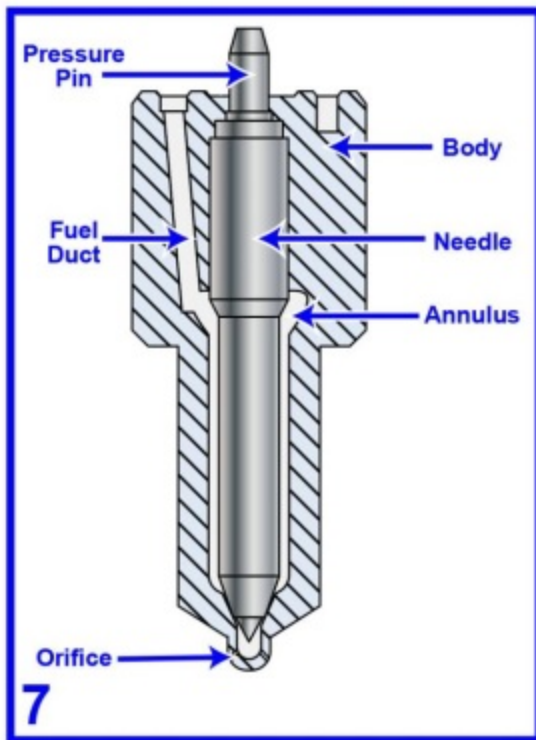
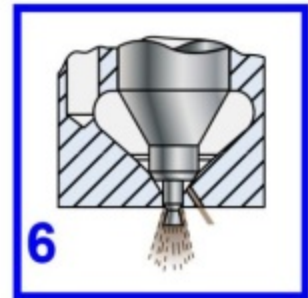
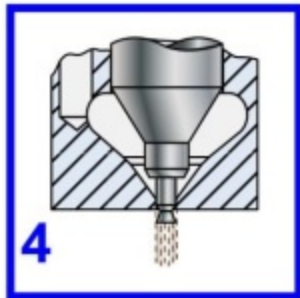
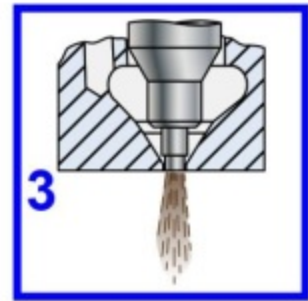
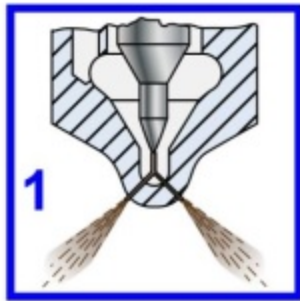


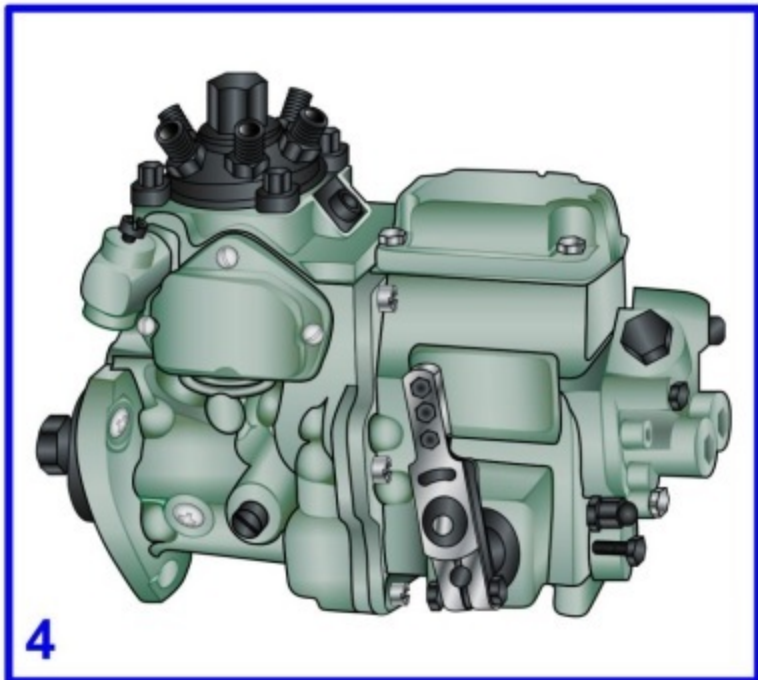
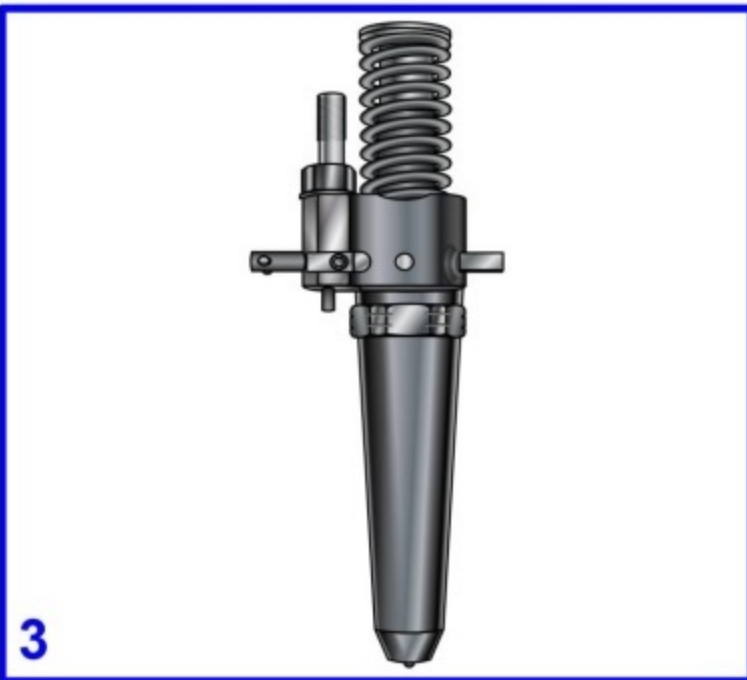
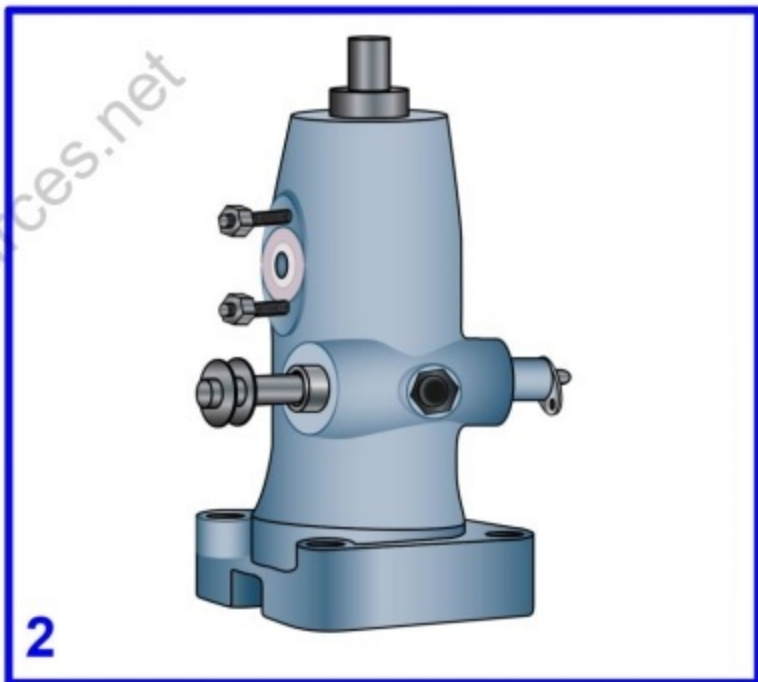
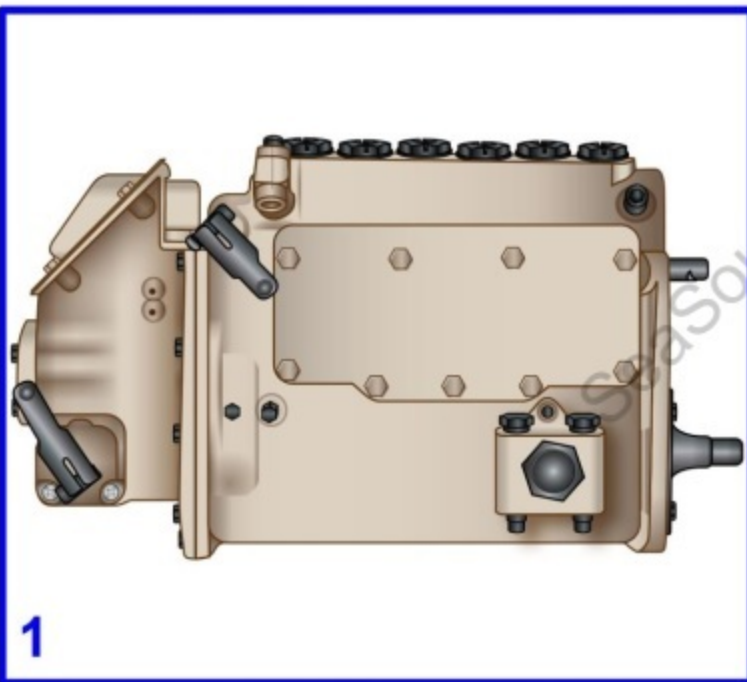
**Port and Helix Injection Pump Metering as a Function of Extent of Plunger Rotation**

# MO-0146 Cummins PT Injection System Injector



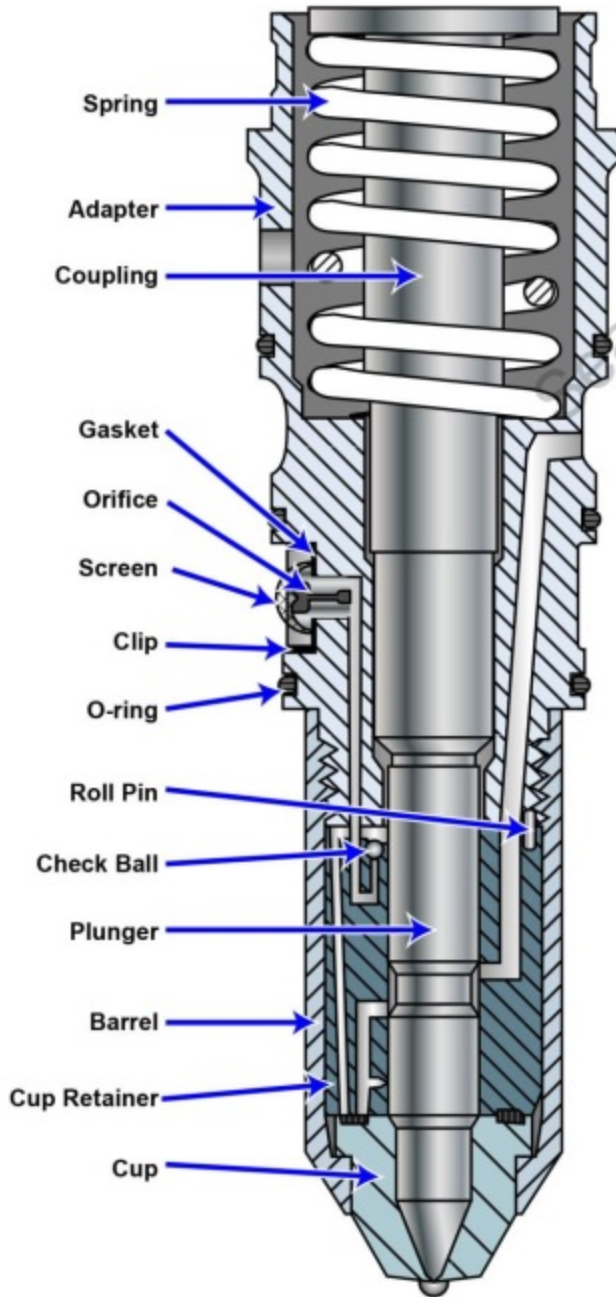
# MO-0148



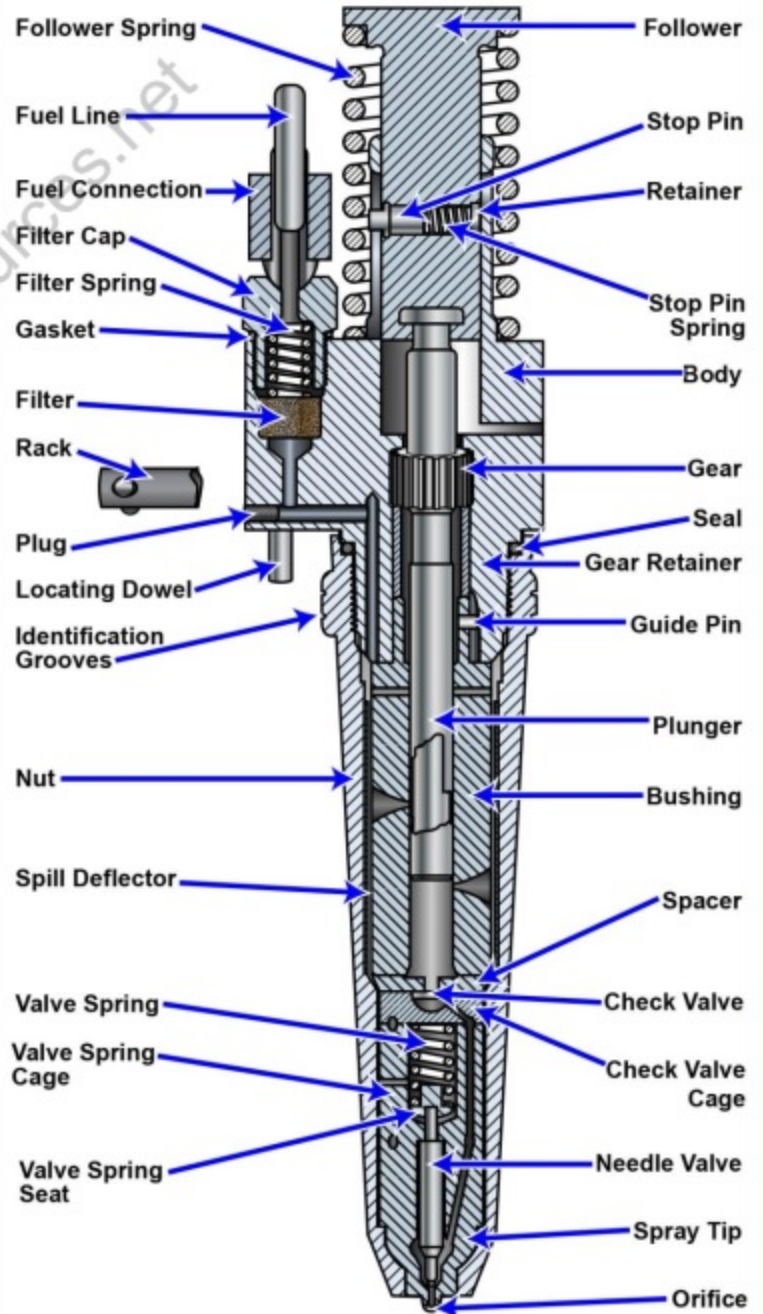




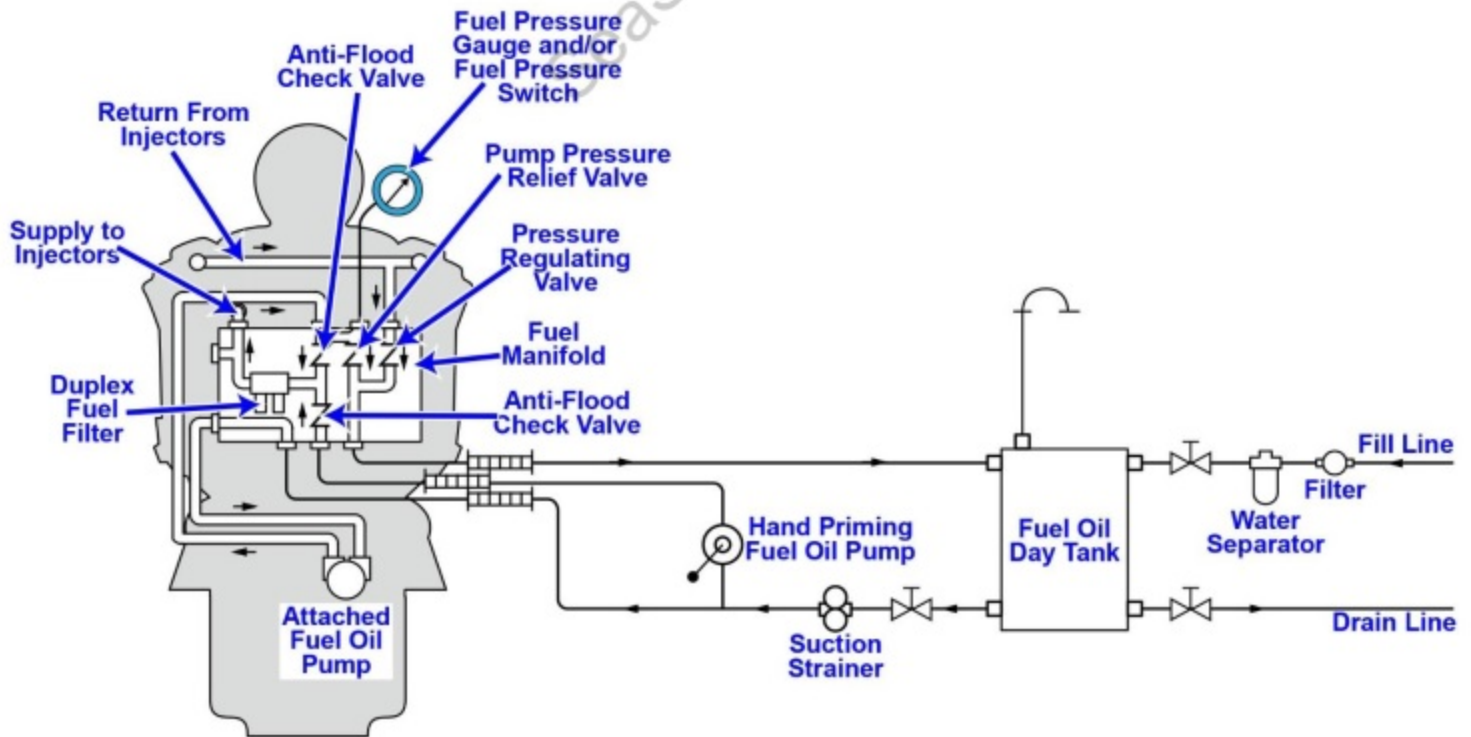
# MO-0150



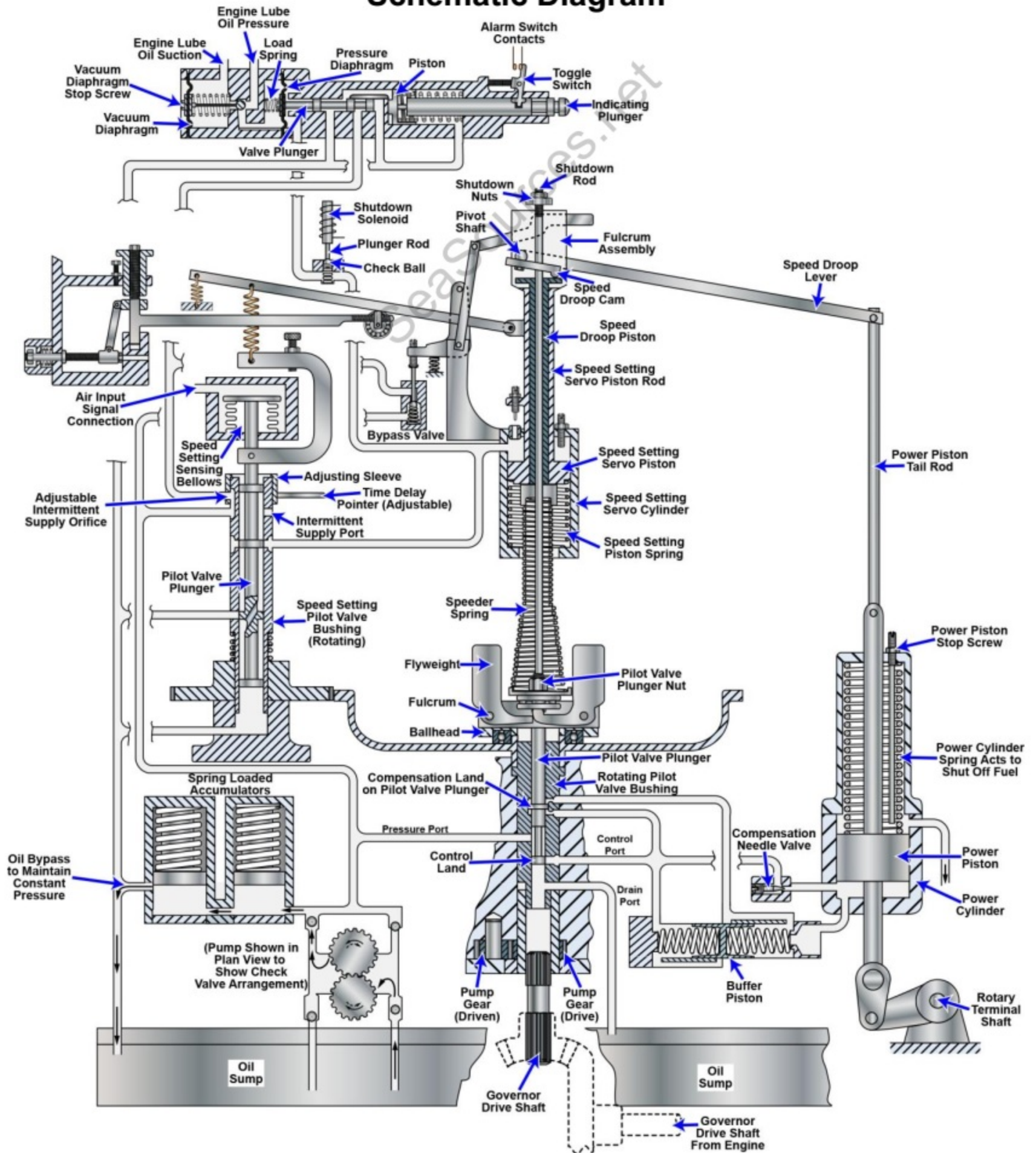
1



2



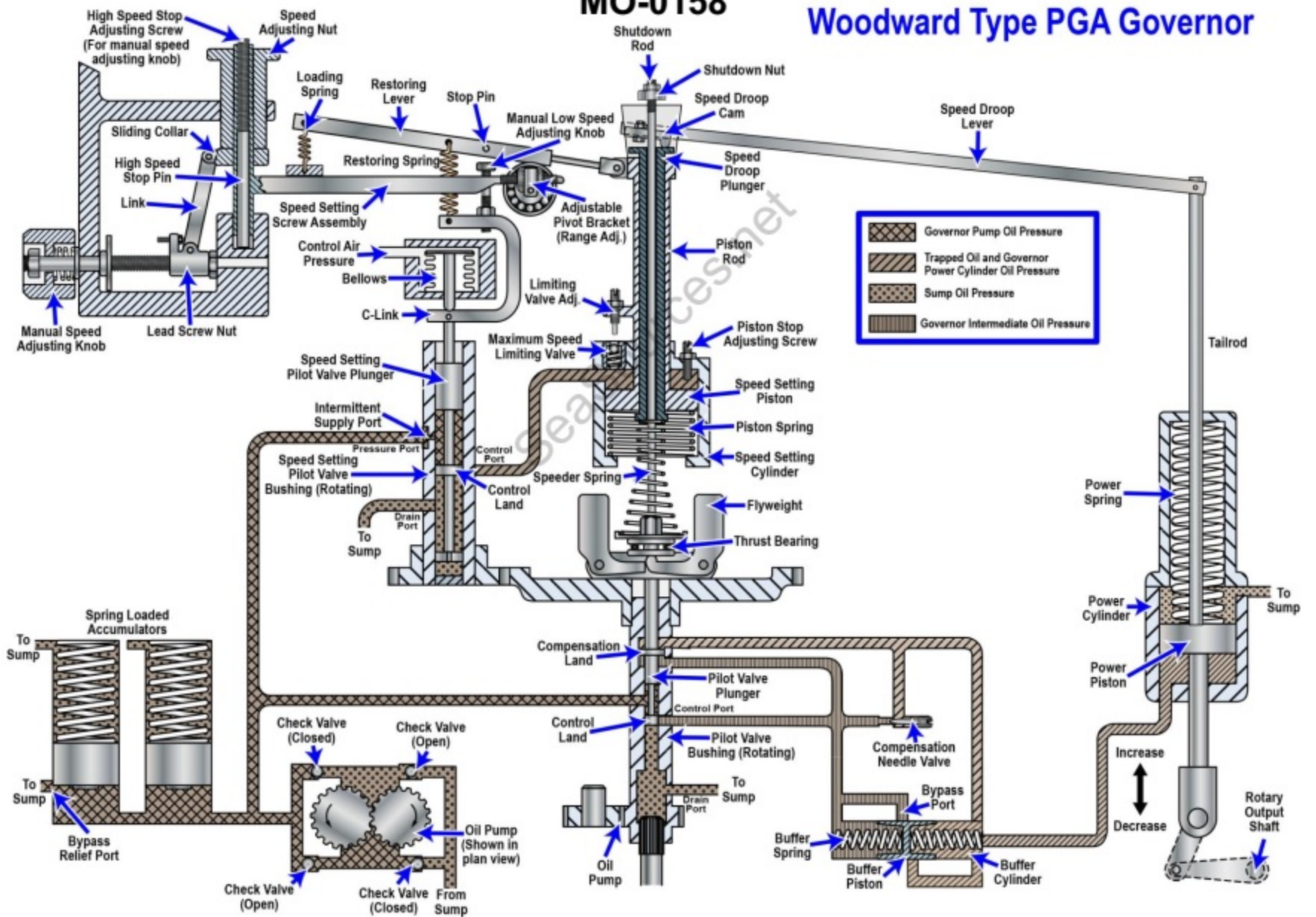
# MO-0156 Woodward Type PGA Governor Schematic Diagram





MO-0158

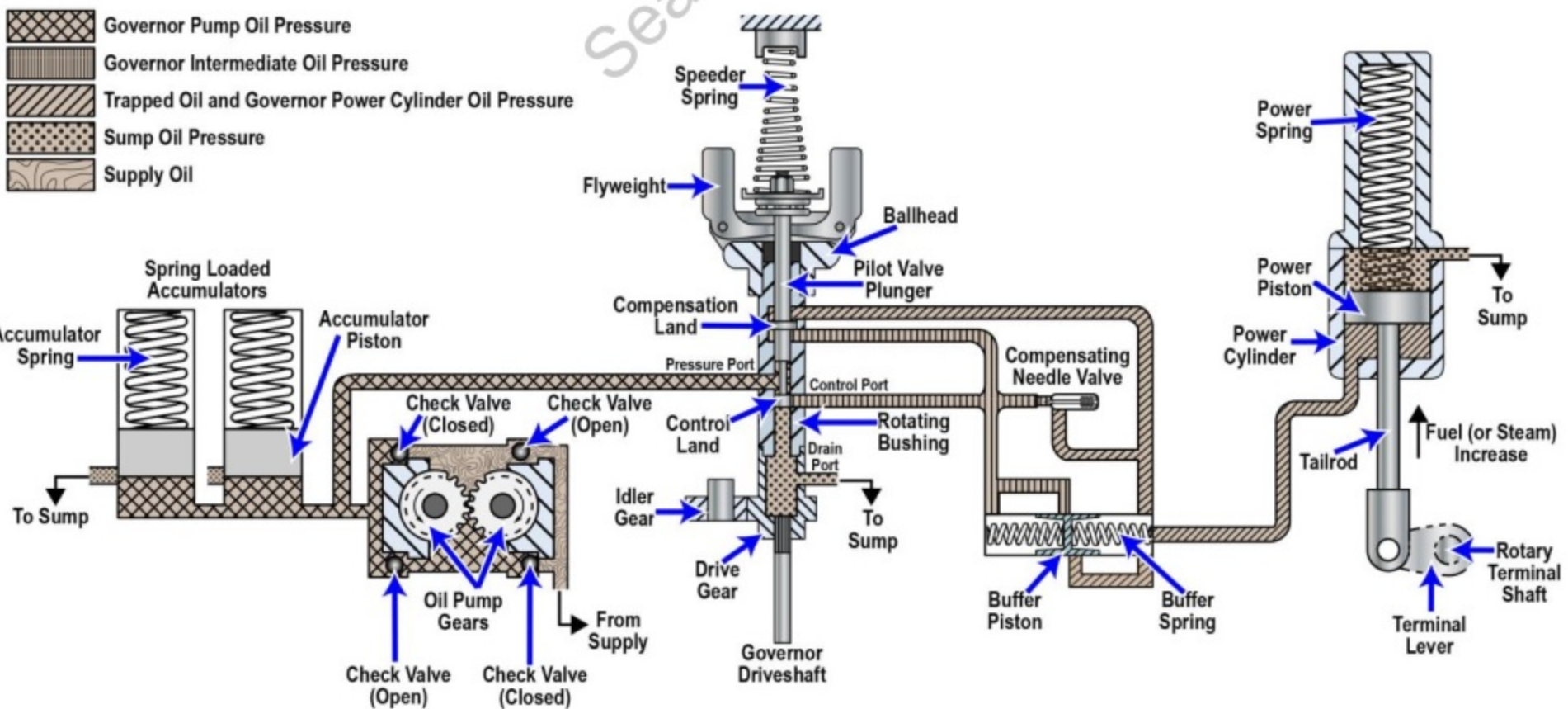
# Woodward Type PGA Governor



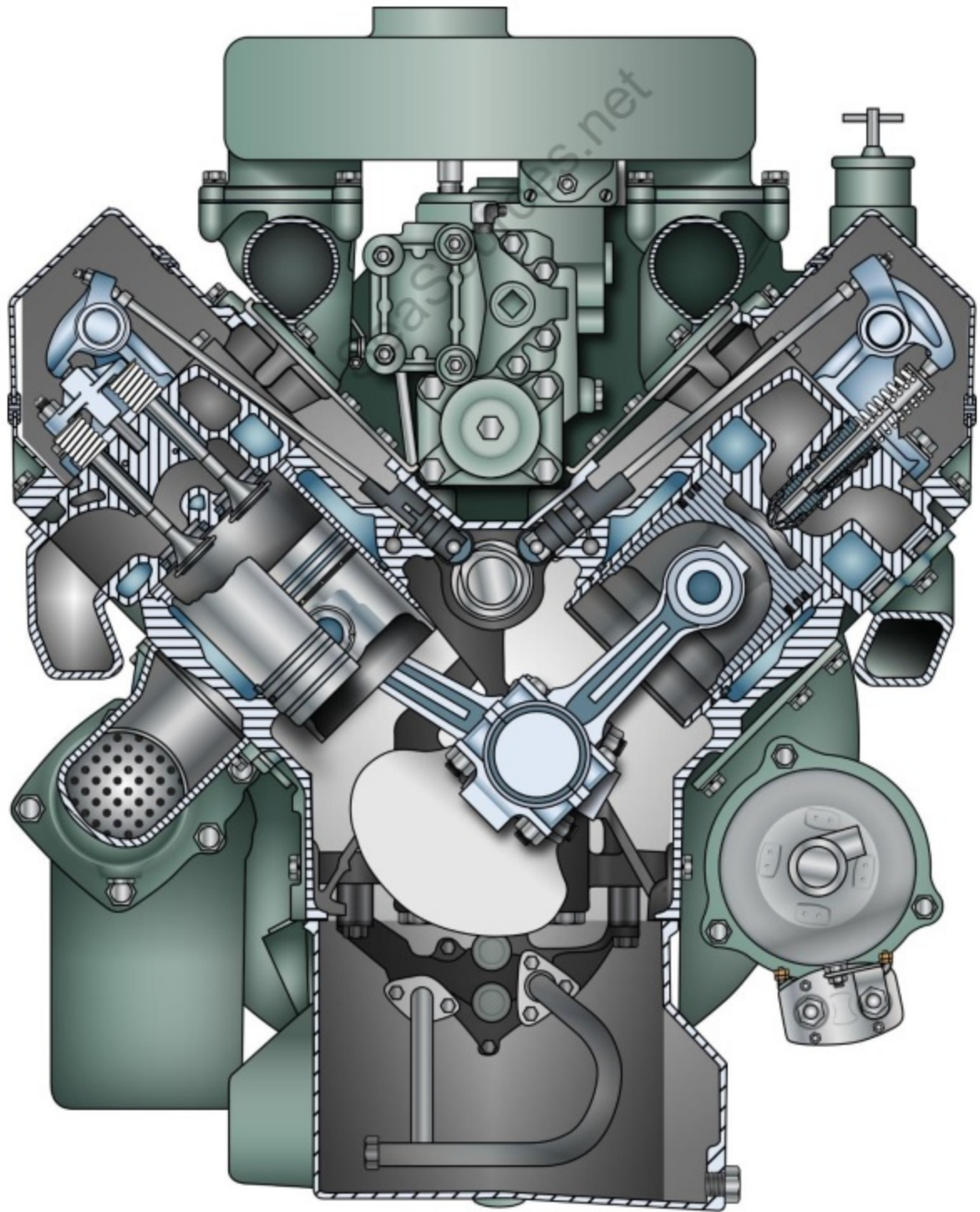
# MO-0159

## Basic Woodward Type PG Governor

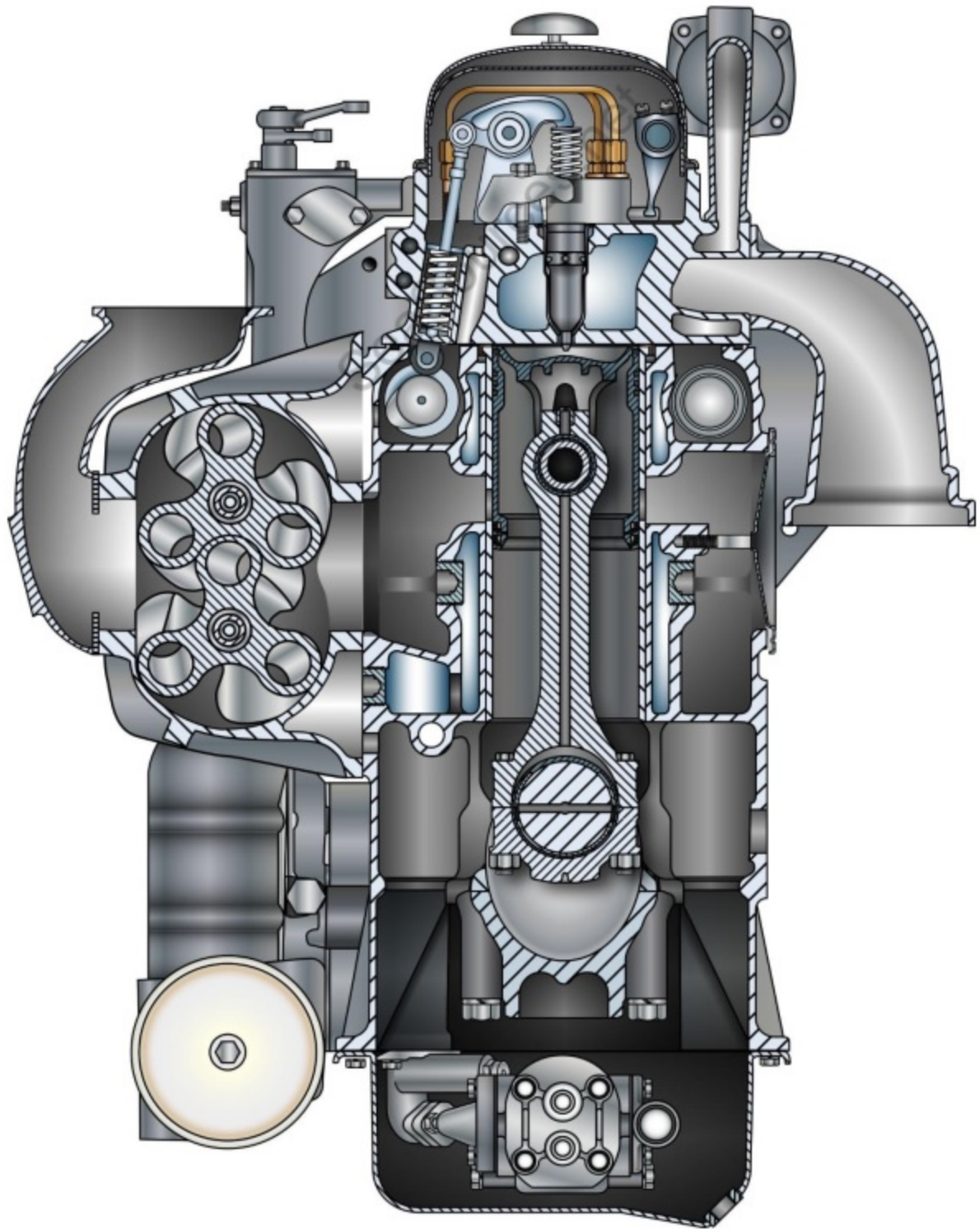
SeaSources.net



MO-0163

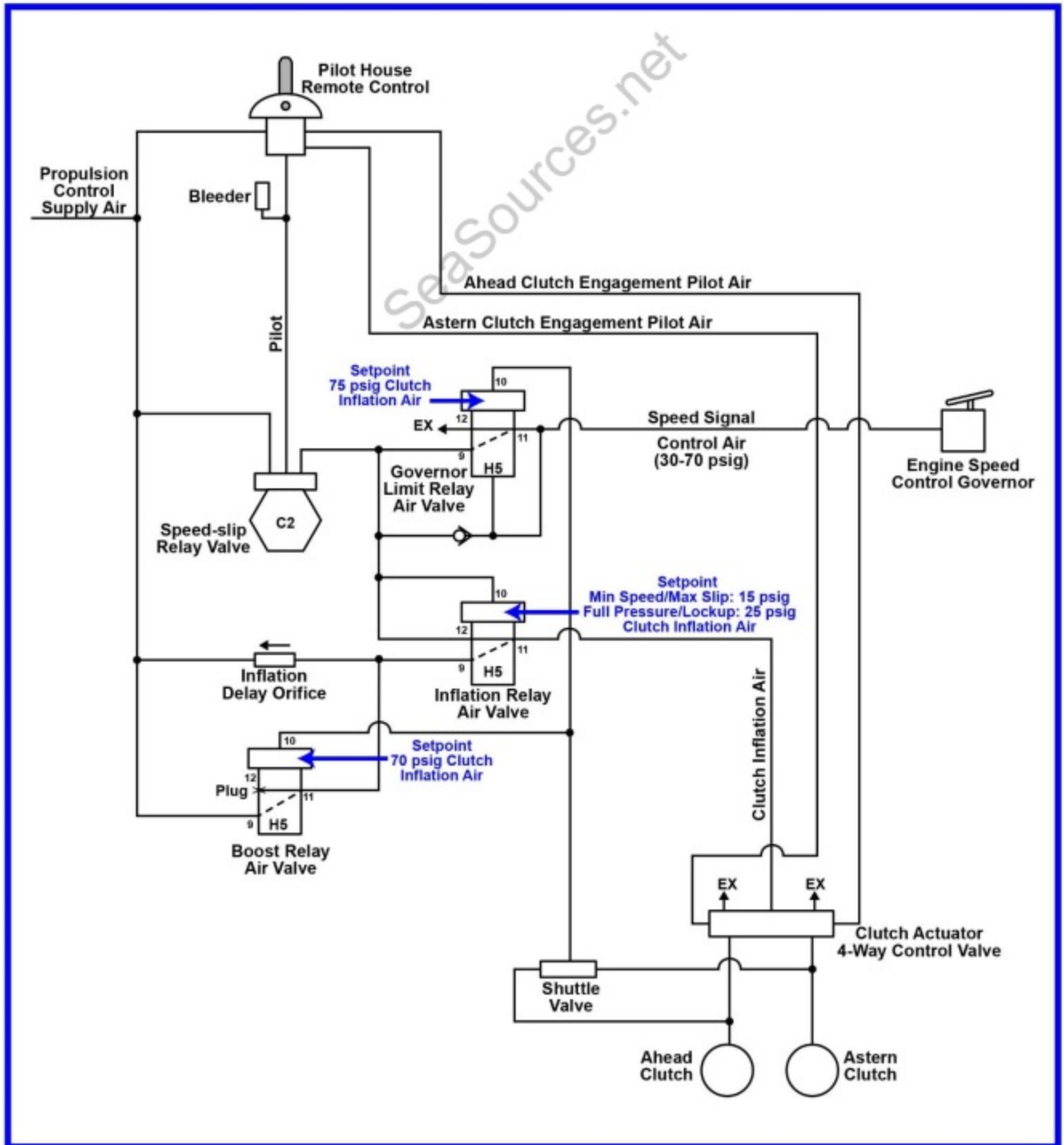


MO-0165

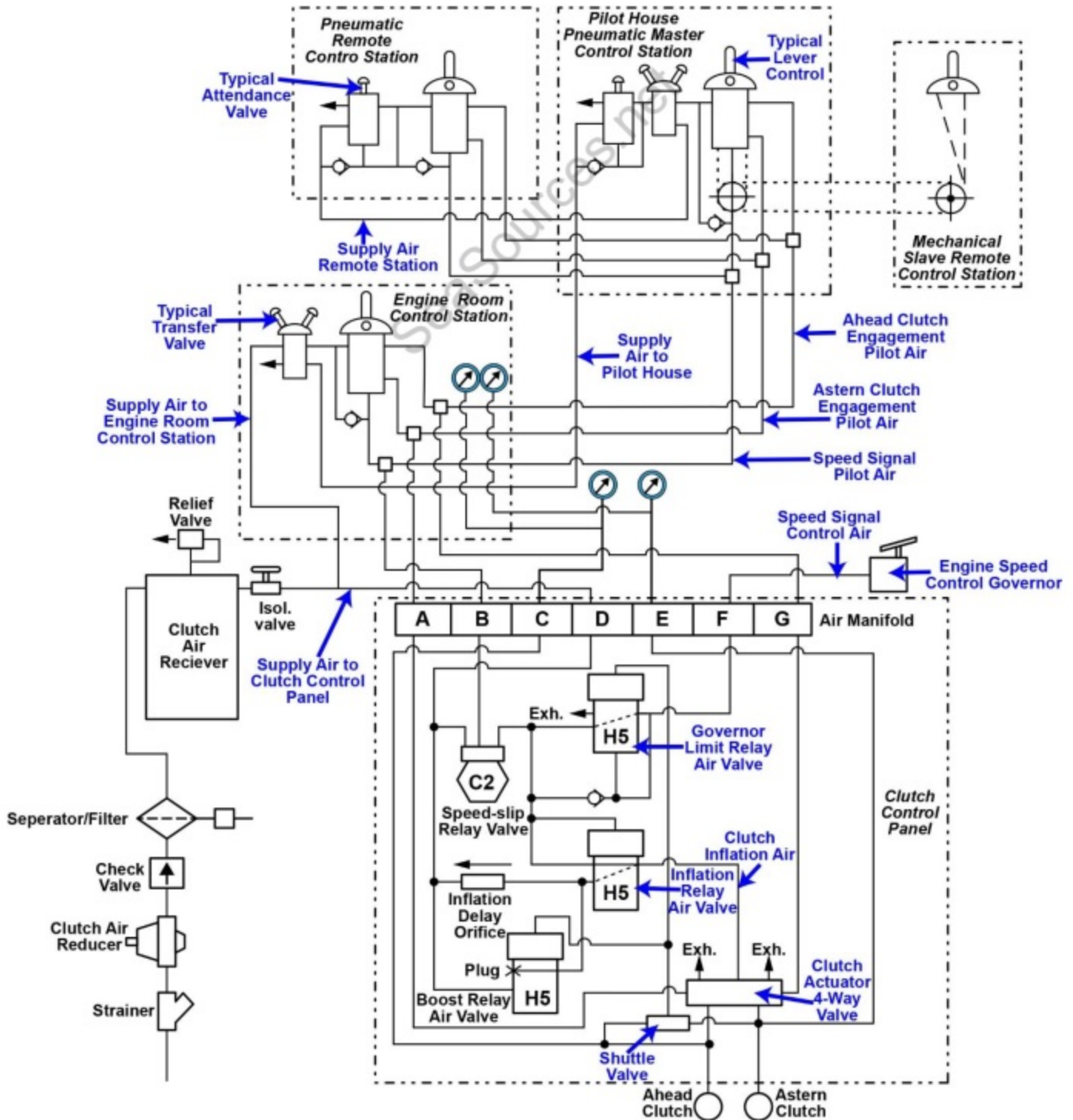




# MO-0167 Pneumatic Propulsion Control System with Single Lever Pilot House Control

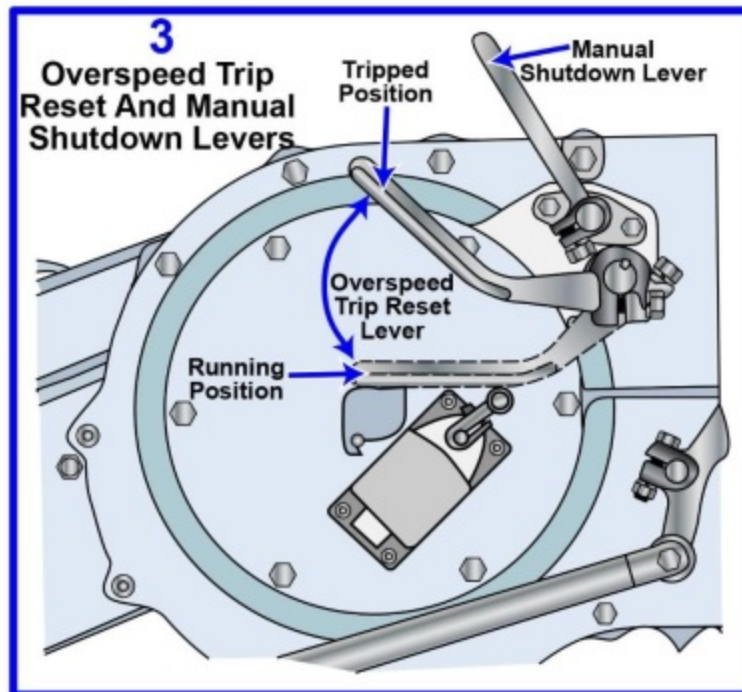
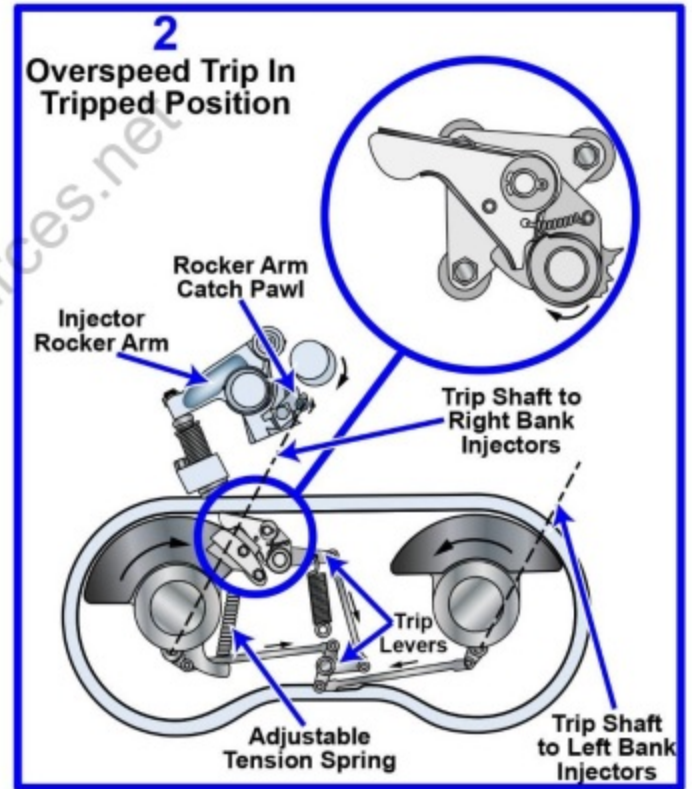
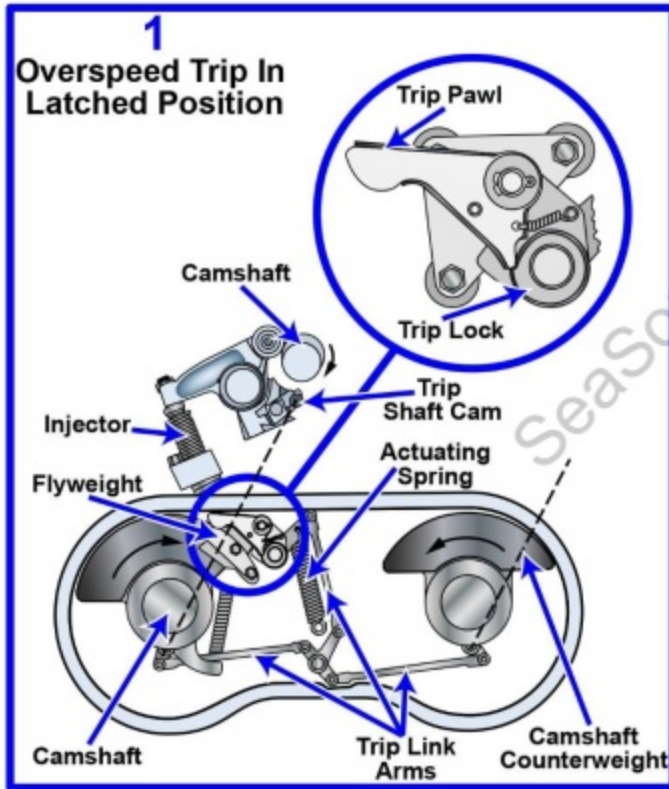


# MO-0168 Pneumatic Propulsion Control System

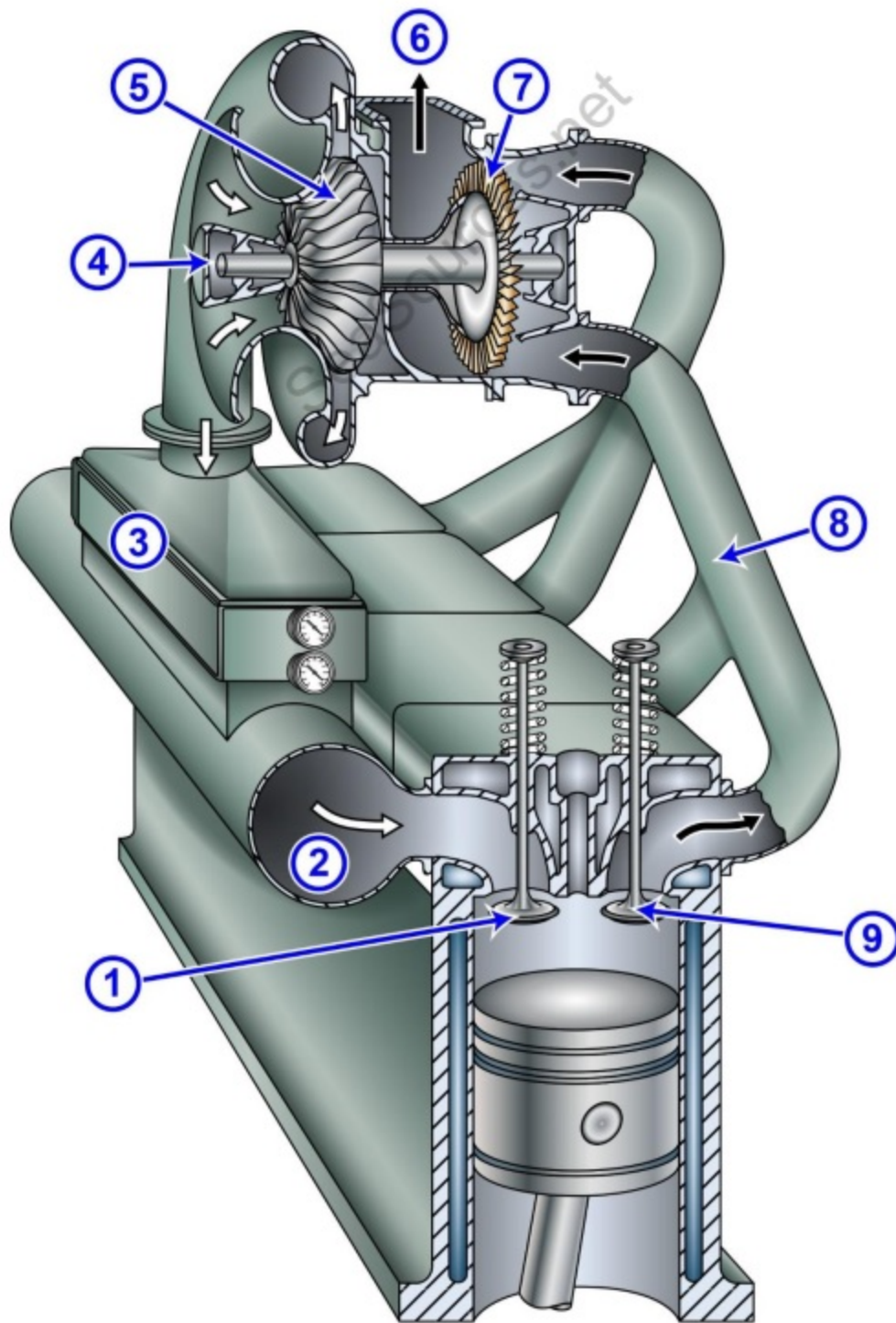


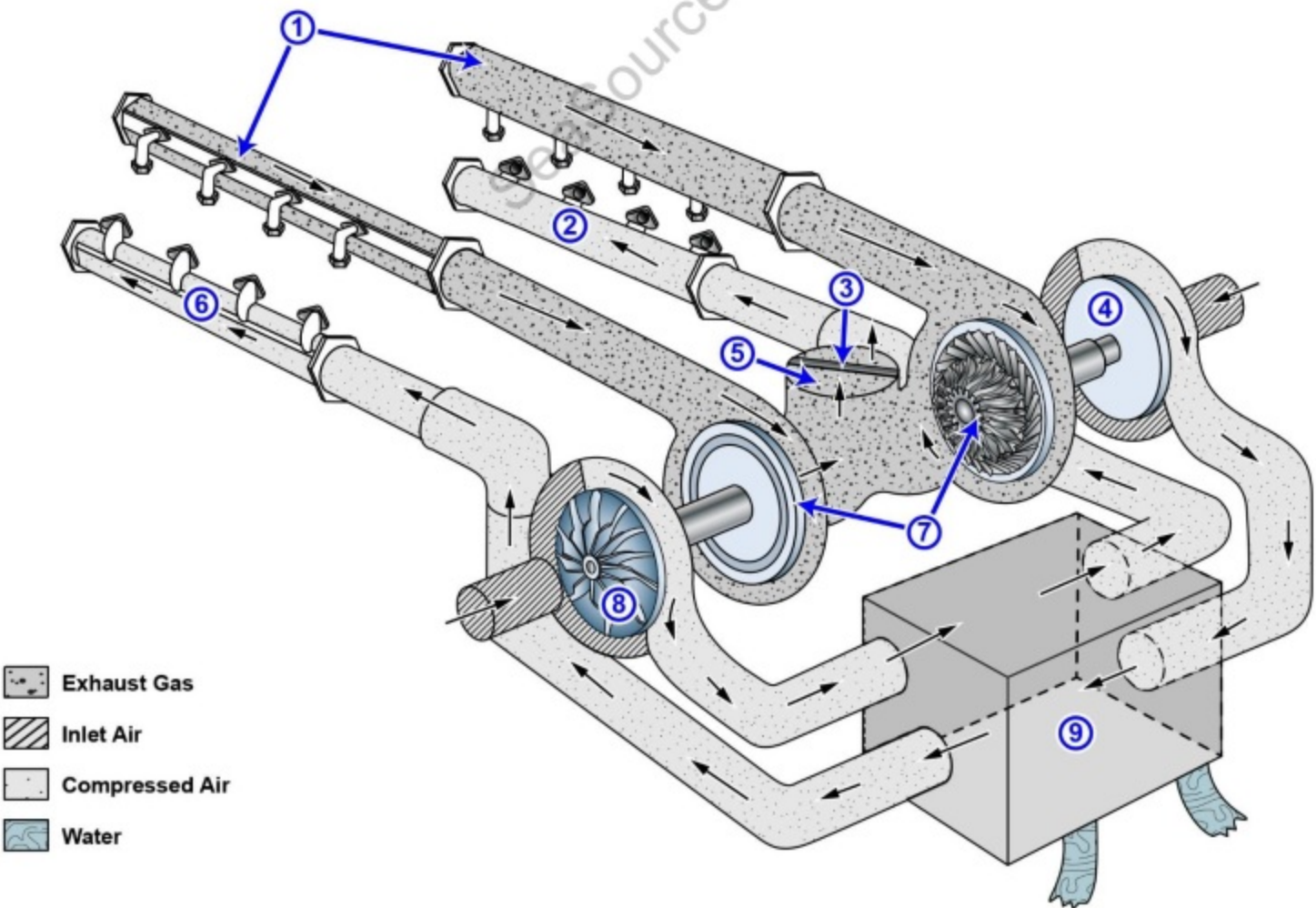


## EMD 645 Overspeed and Manual Trips

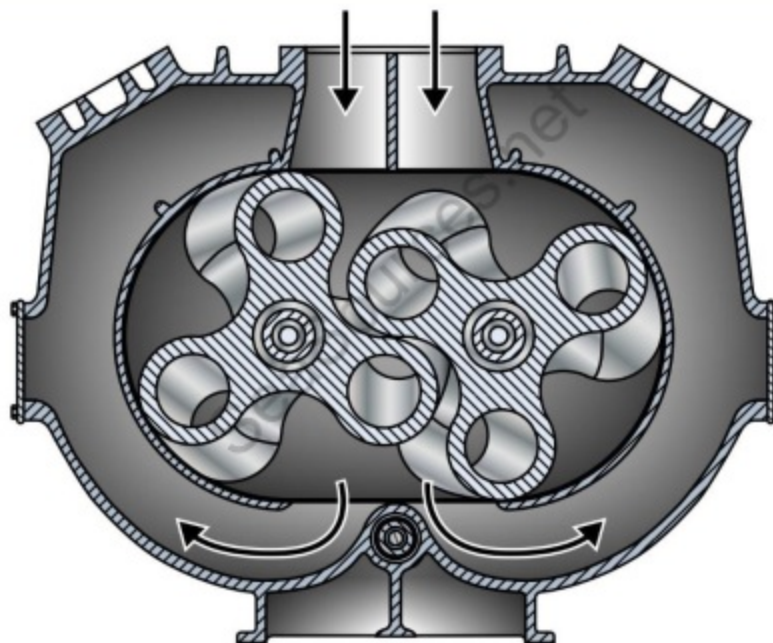


MO-0176

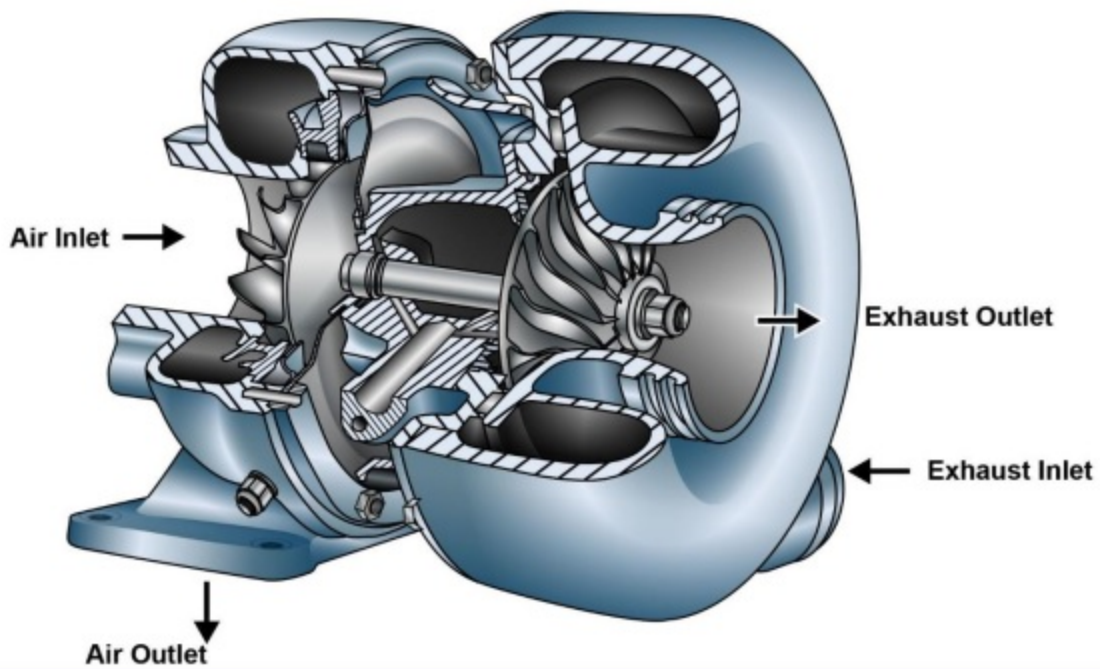




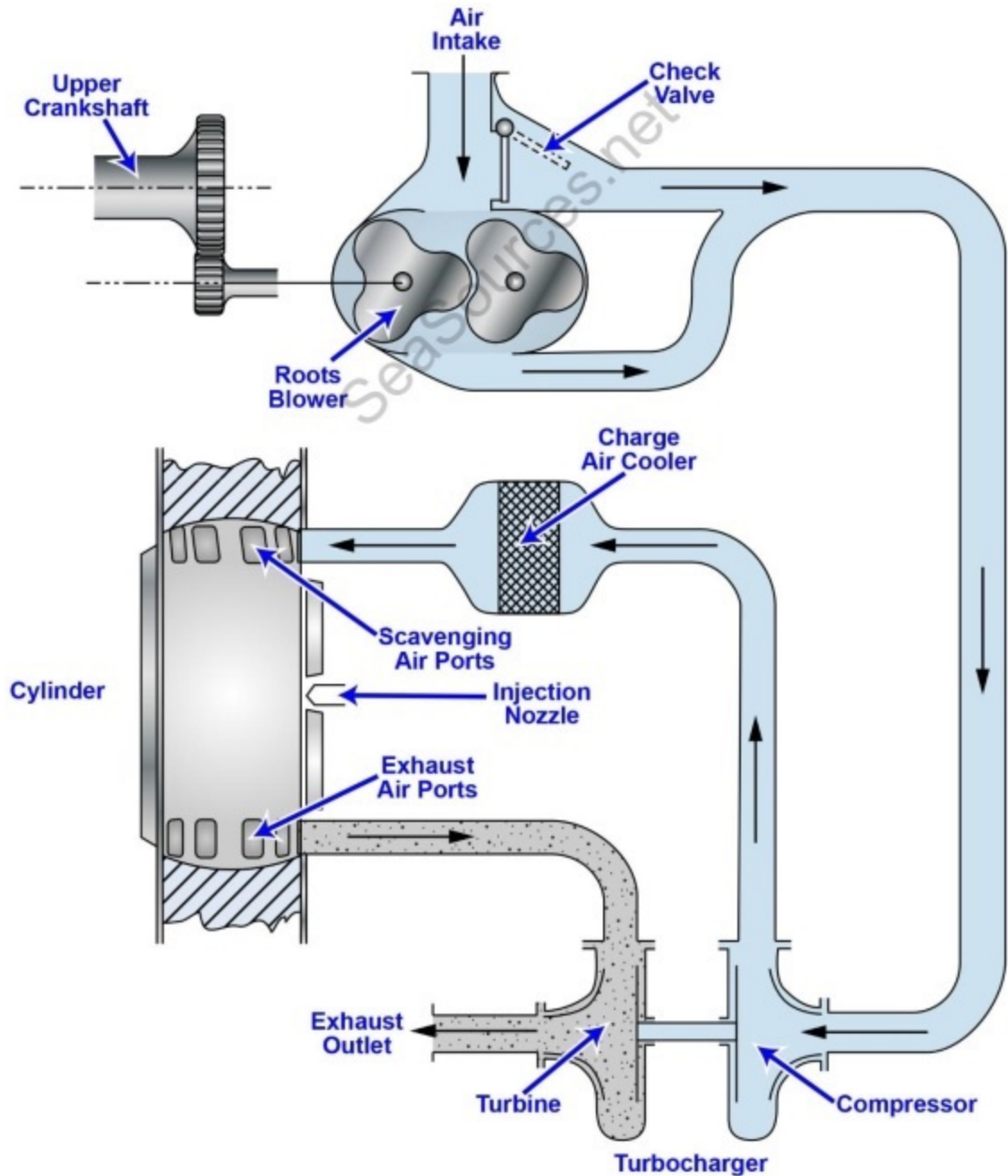
A



B

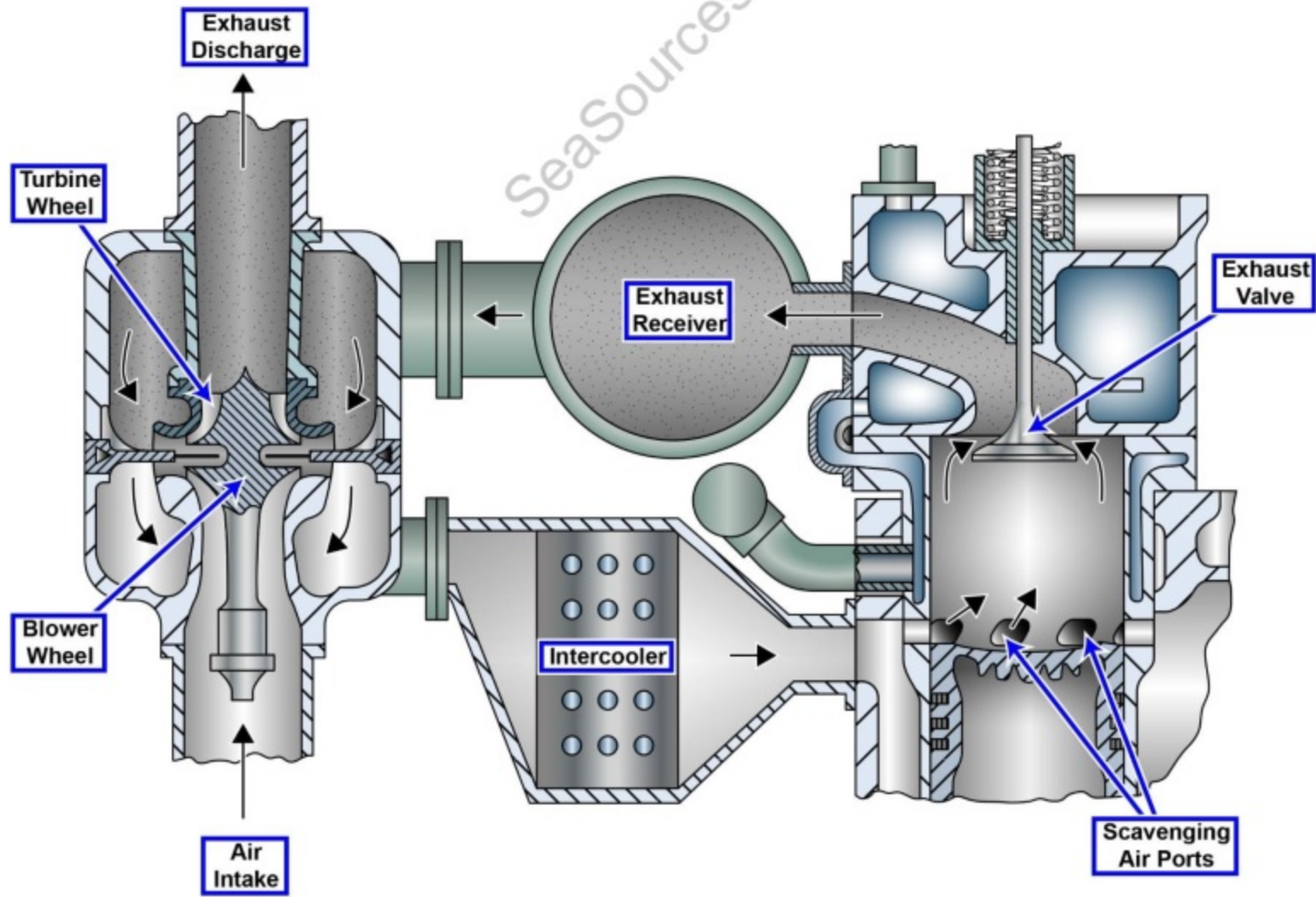


# MO-0179

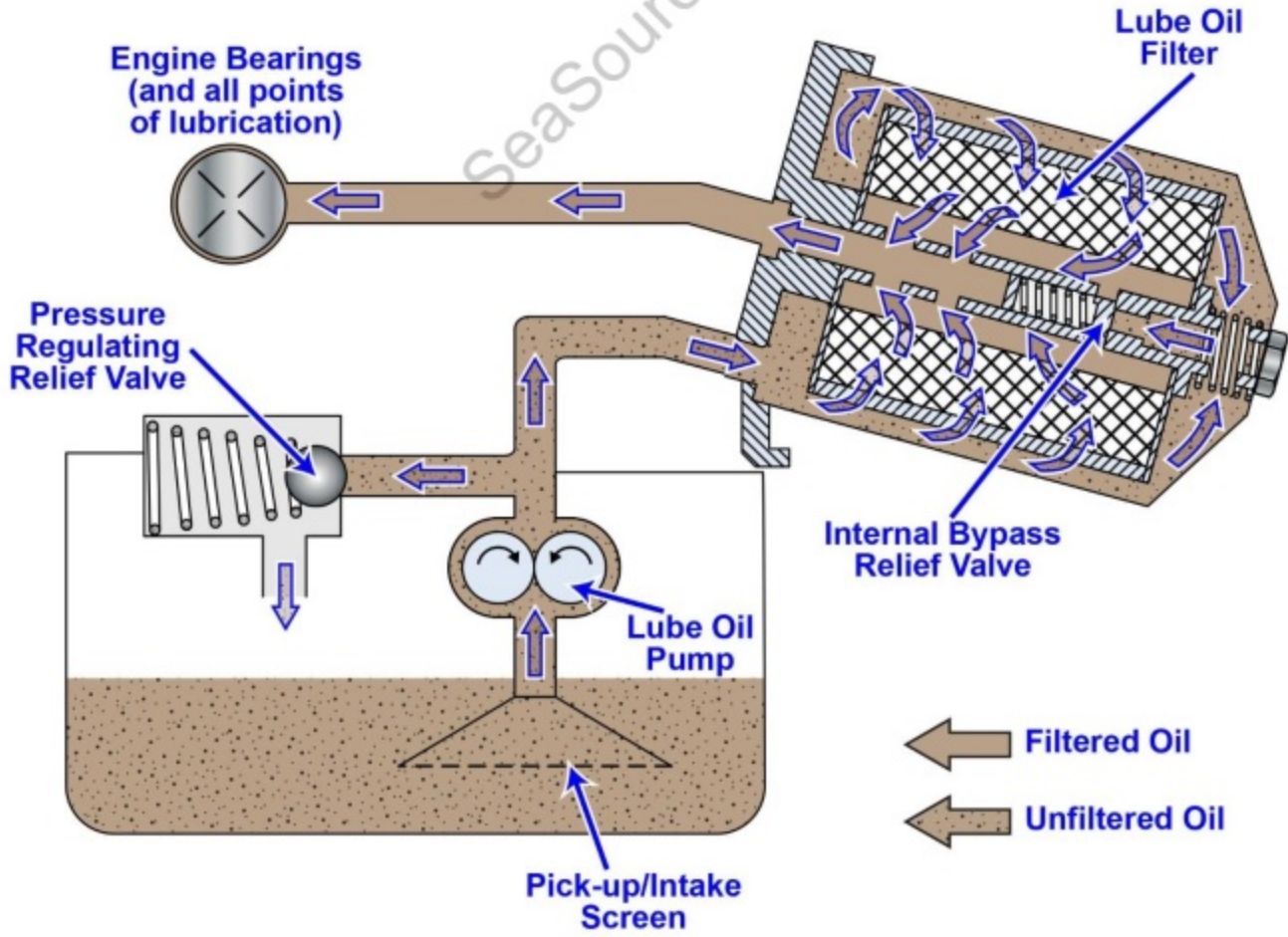




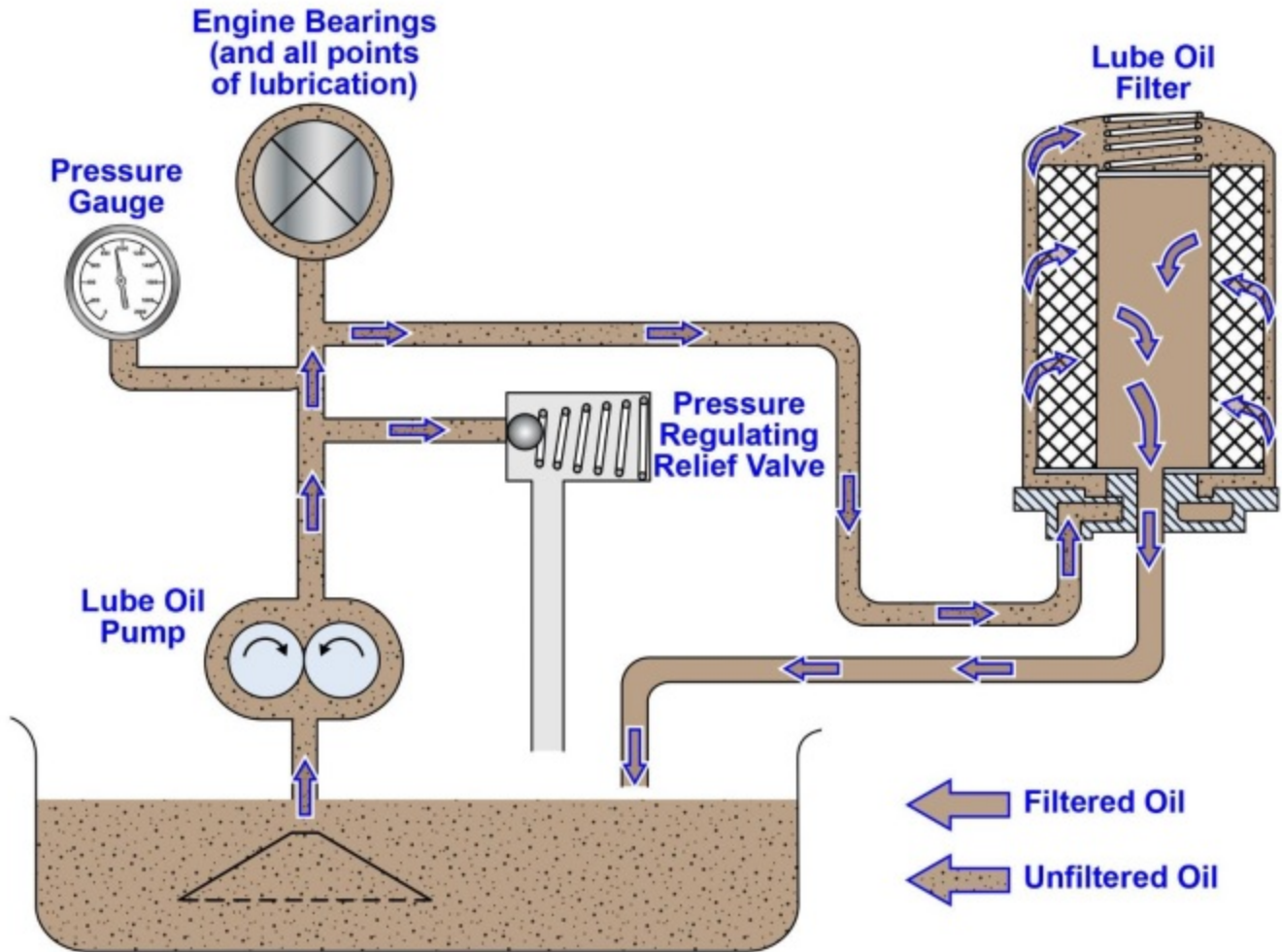
SeaSources.net

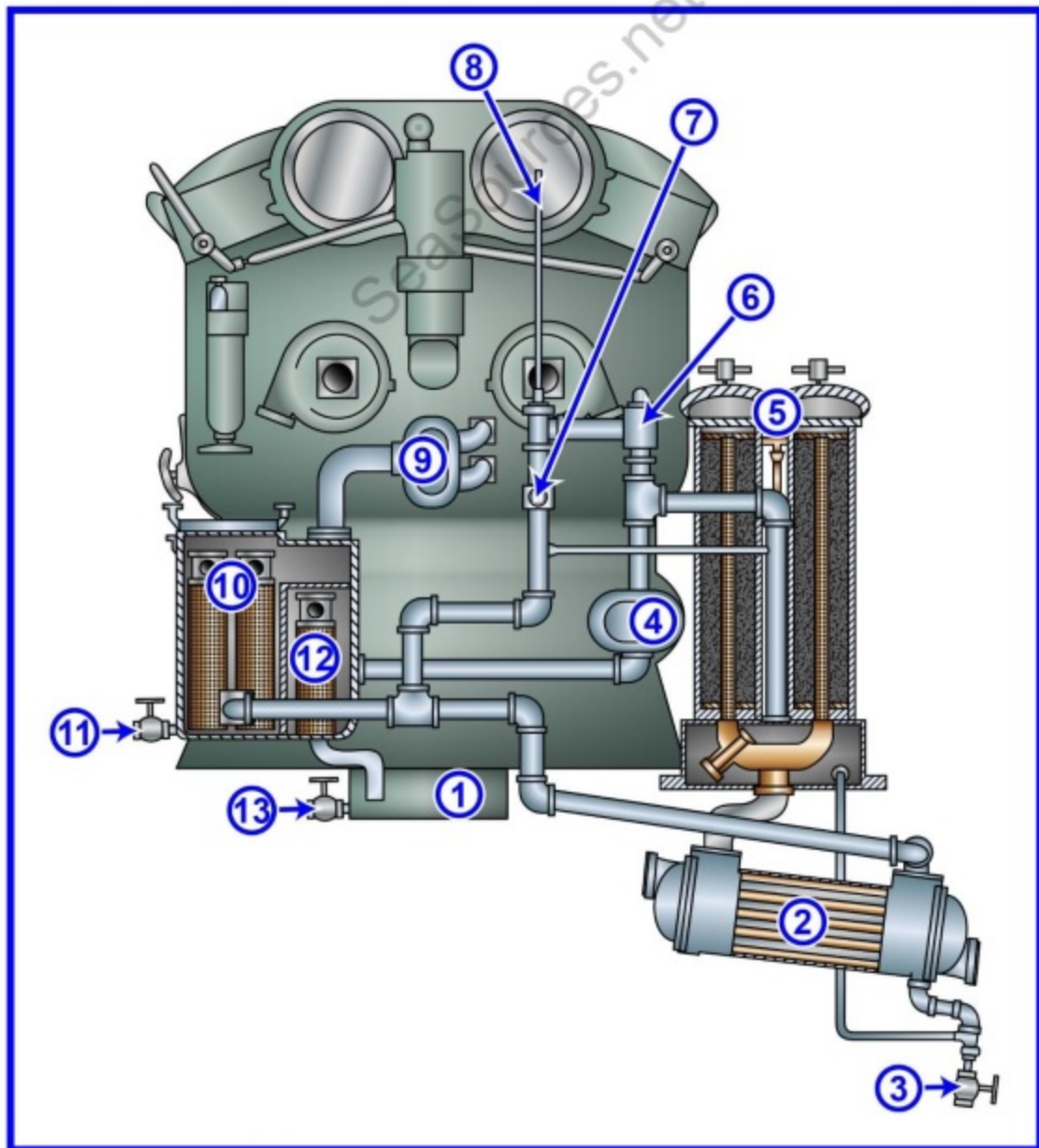


# MO-0181 Simplified Lube Oil Filtration System



# MO-0182 Simplified Lube Oil Filtration System

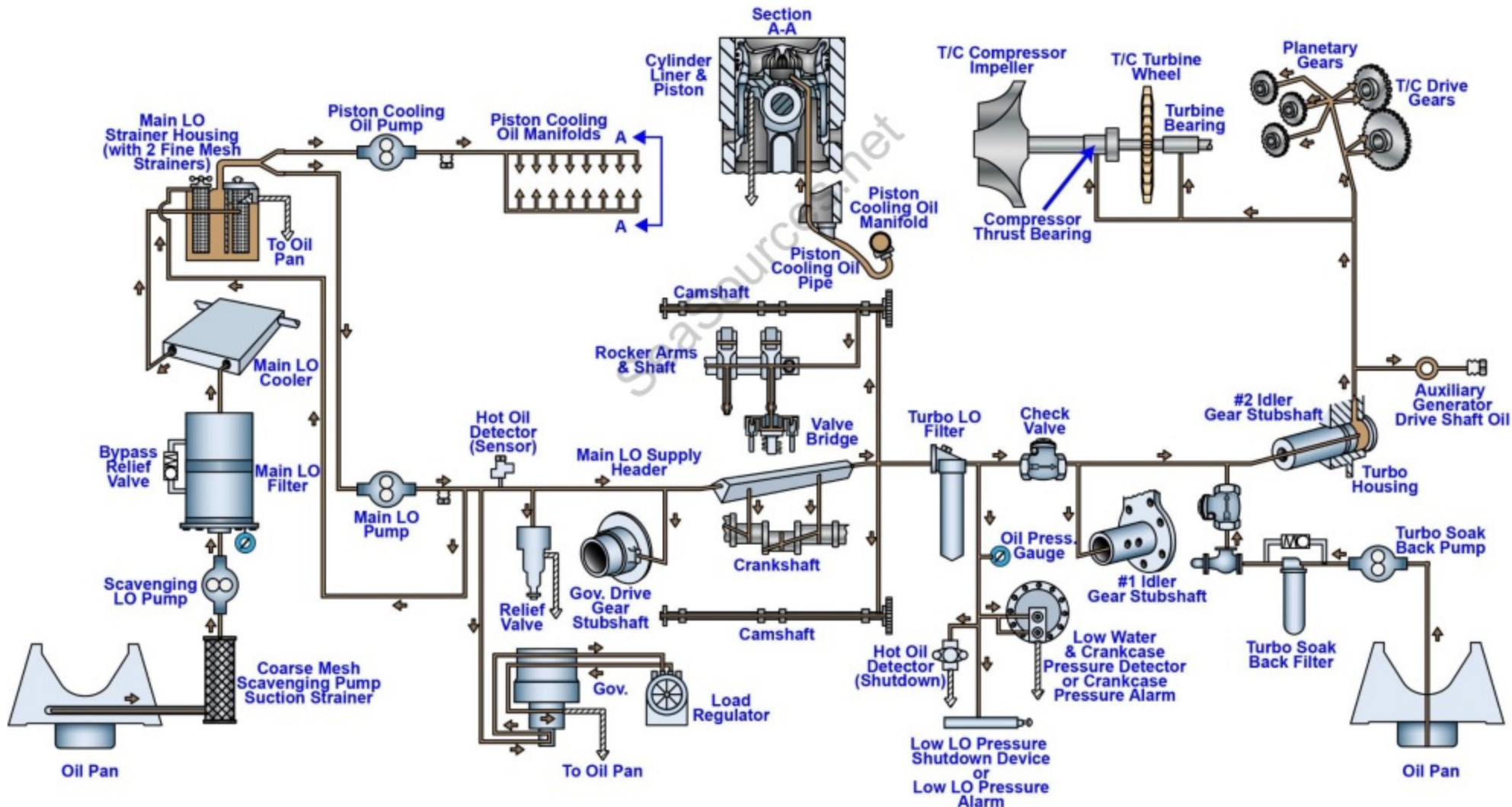


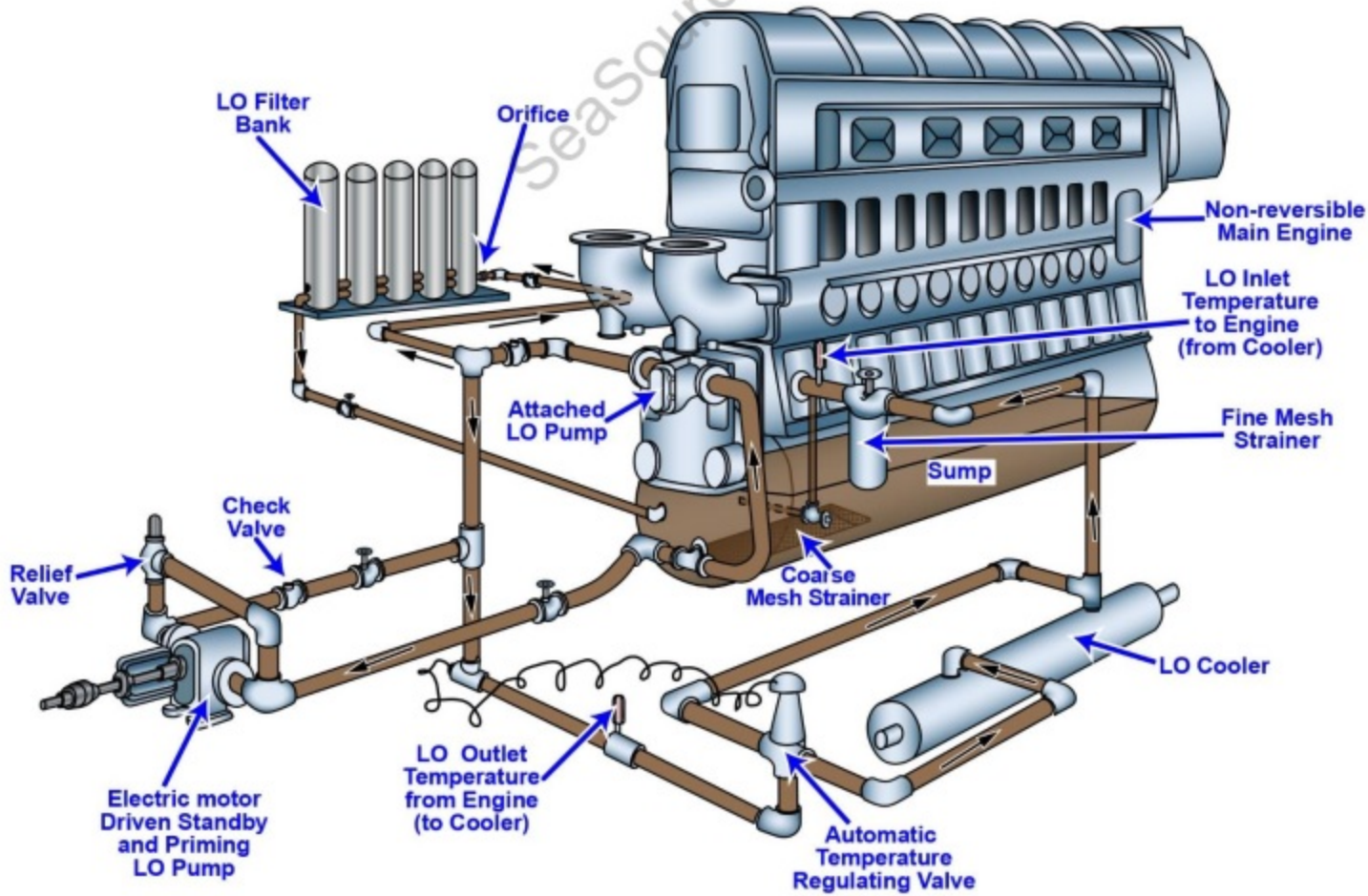




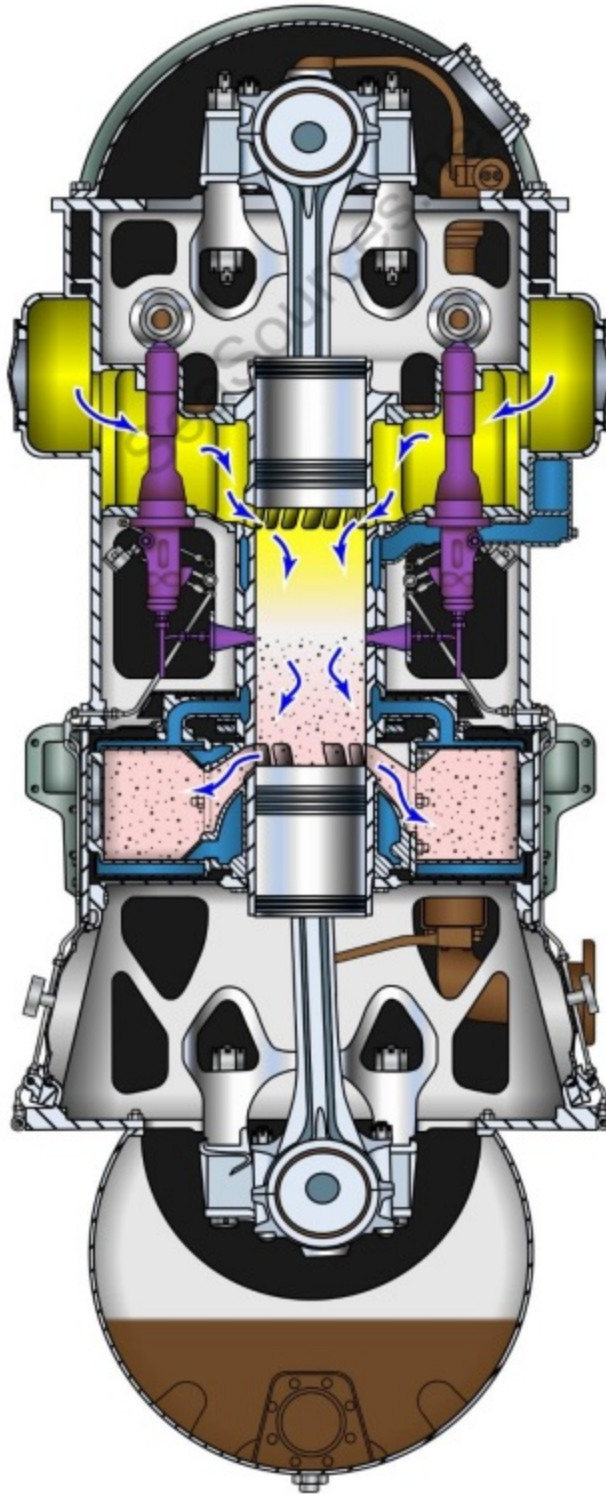
# MO-0186

## EMD 645 Series Engine Lubricating Oil System



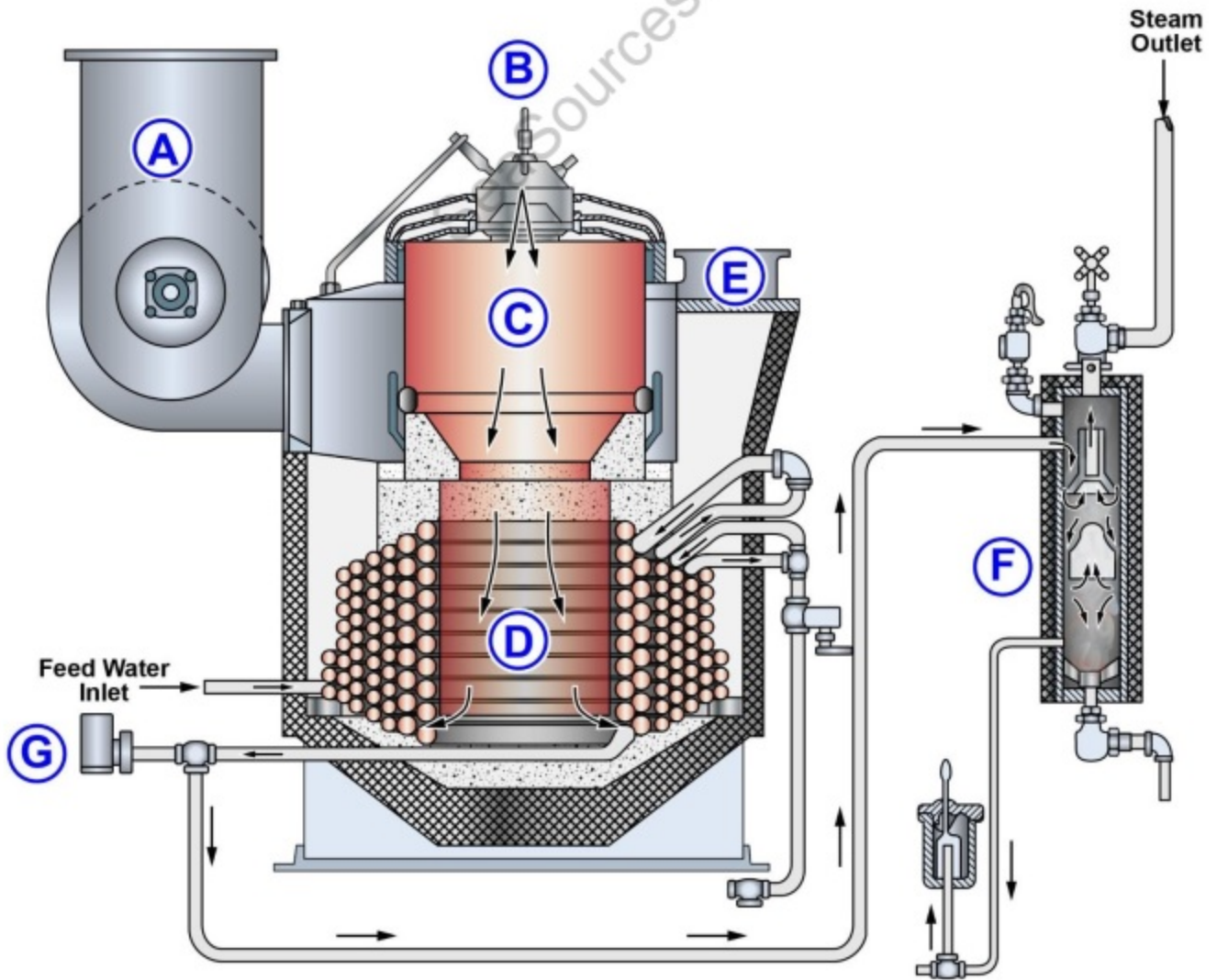


# MO-0191 Fairbanks Morse Diesel Engine

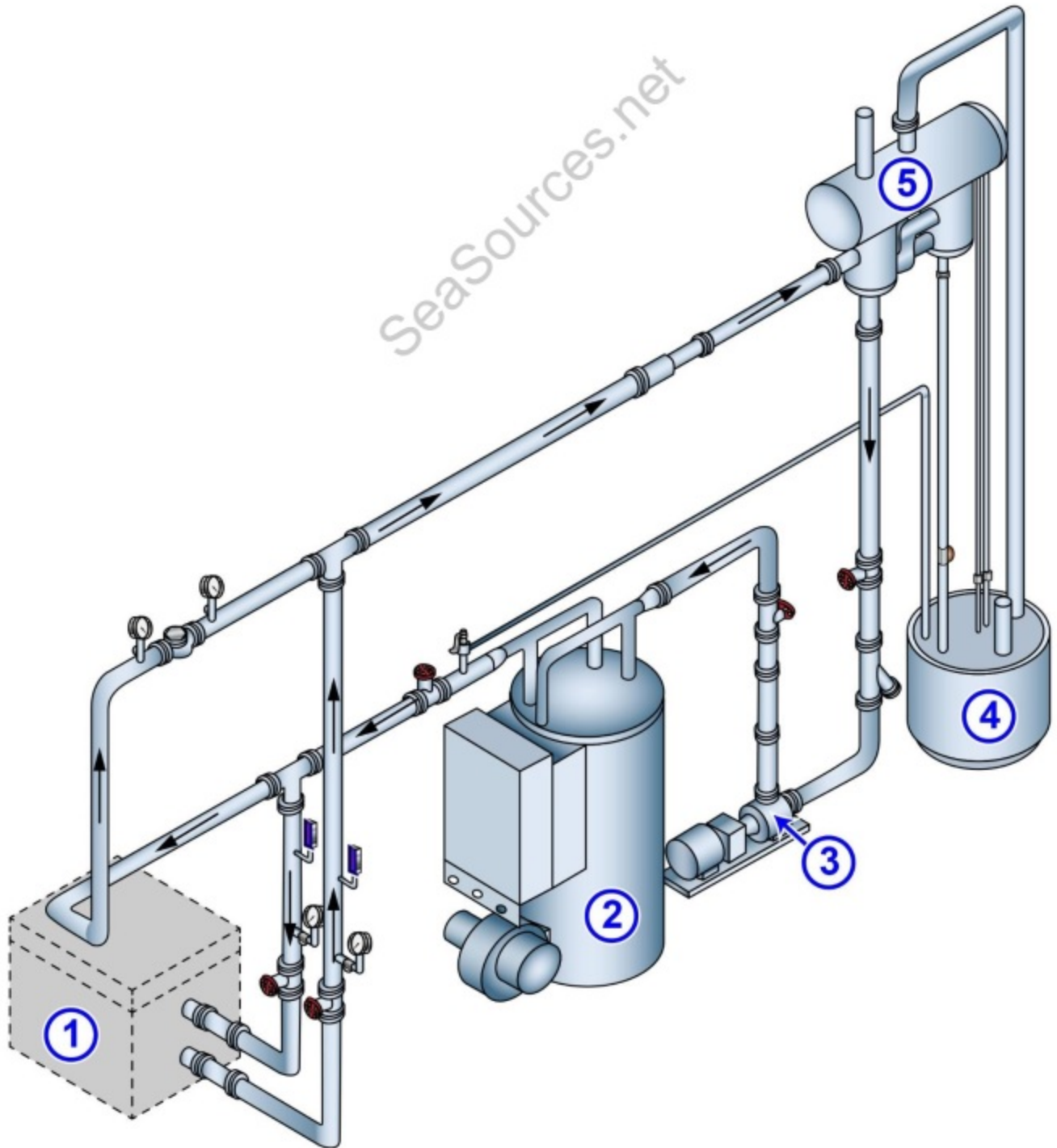




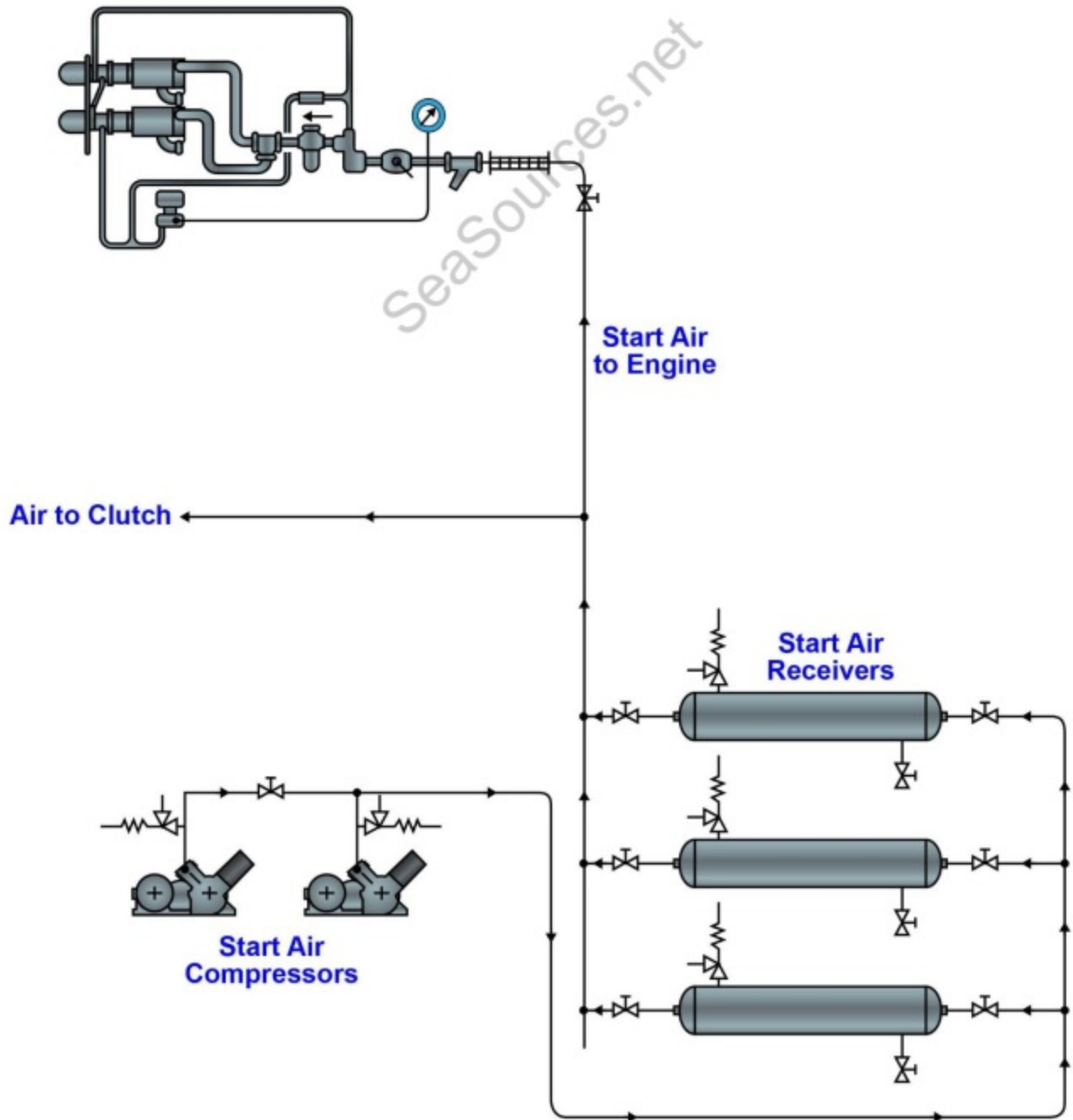
# MO-0195 Once-through Boiler



# MO-0198 Thermal Fluid Heating Oil System

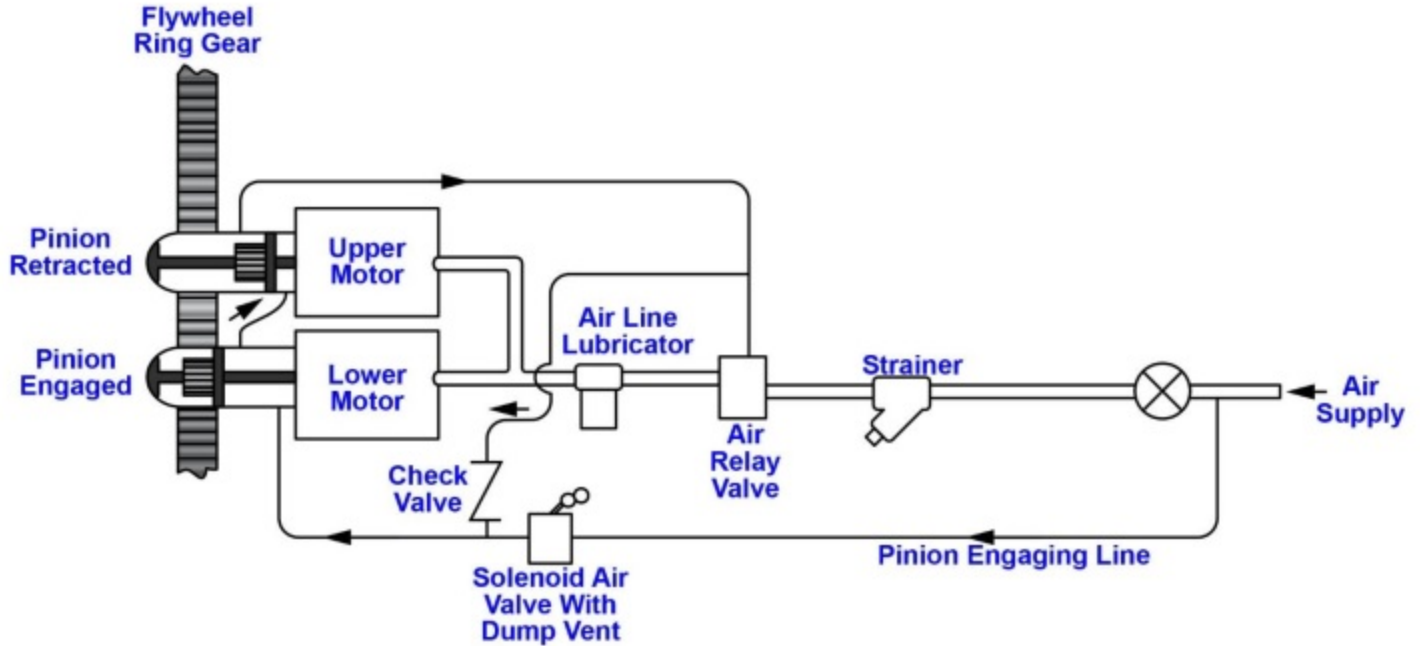


# MO-0199 EMD Air Start System



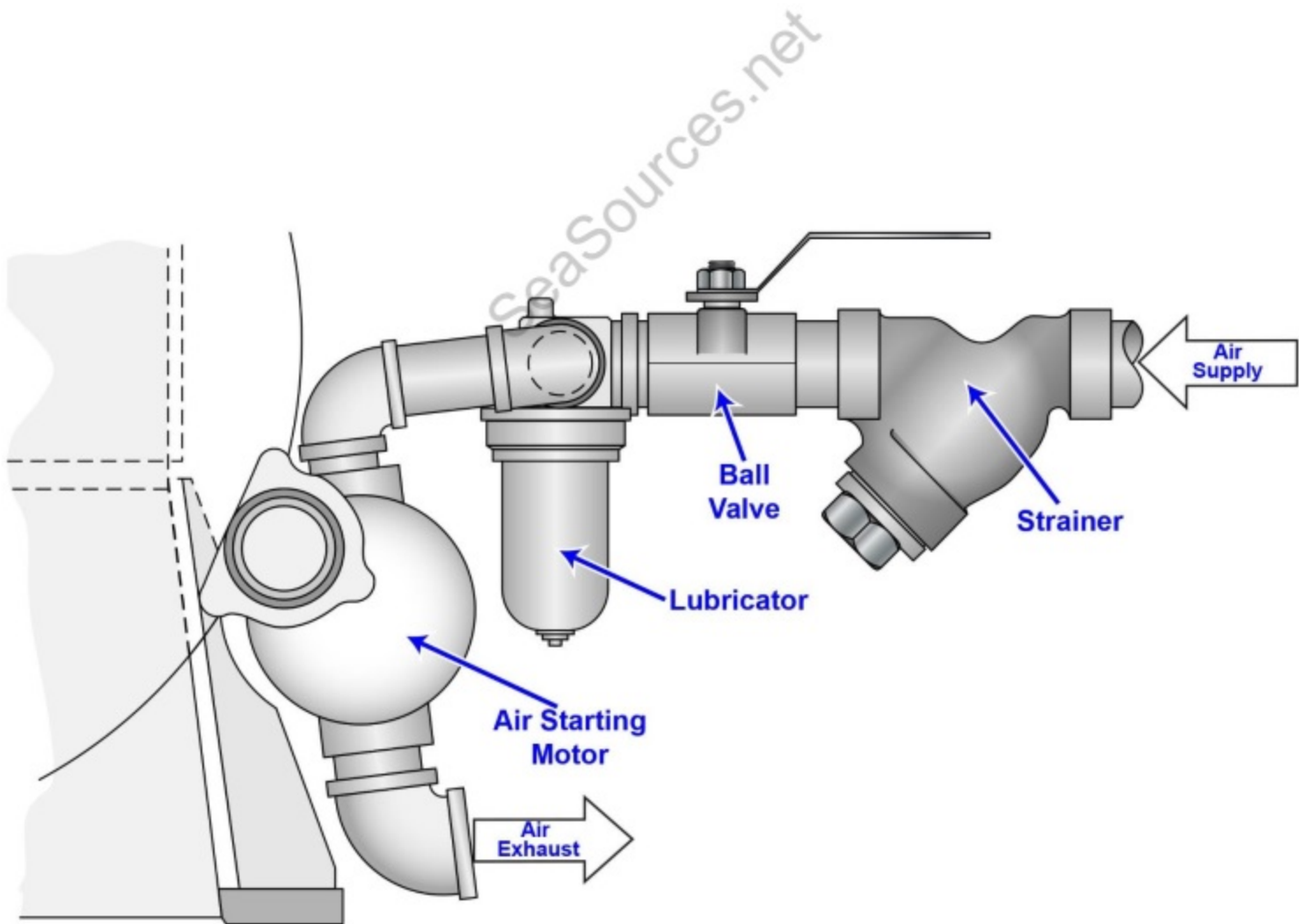
# MO-0200

## EMD Air Start System Piping at Engine



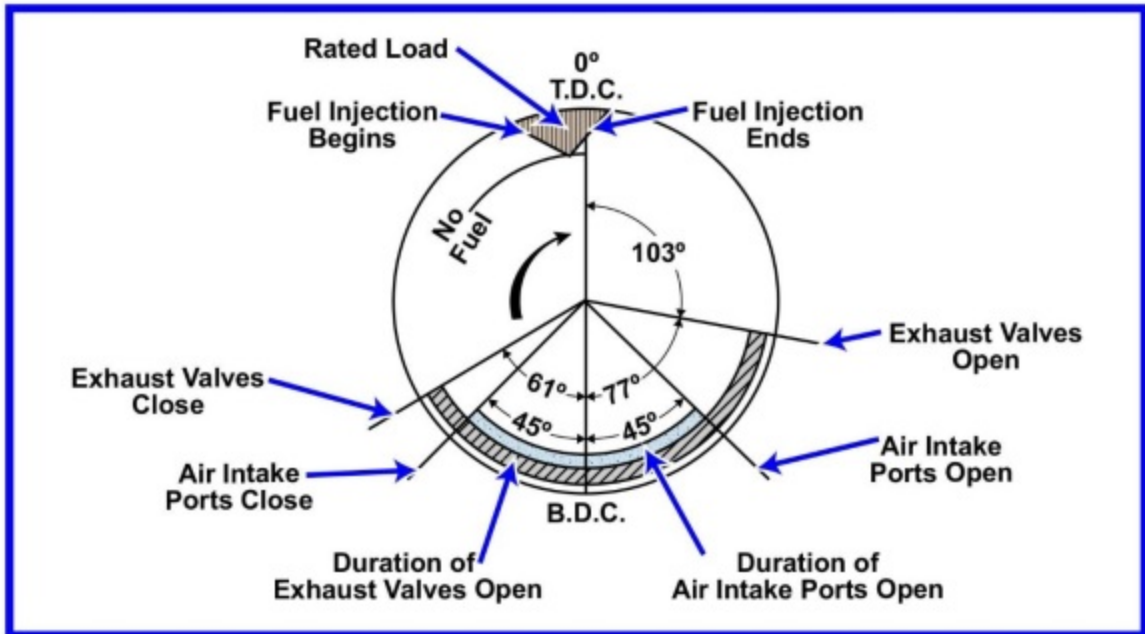
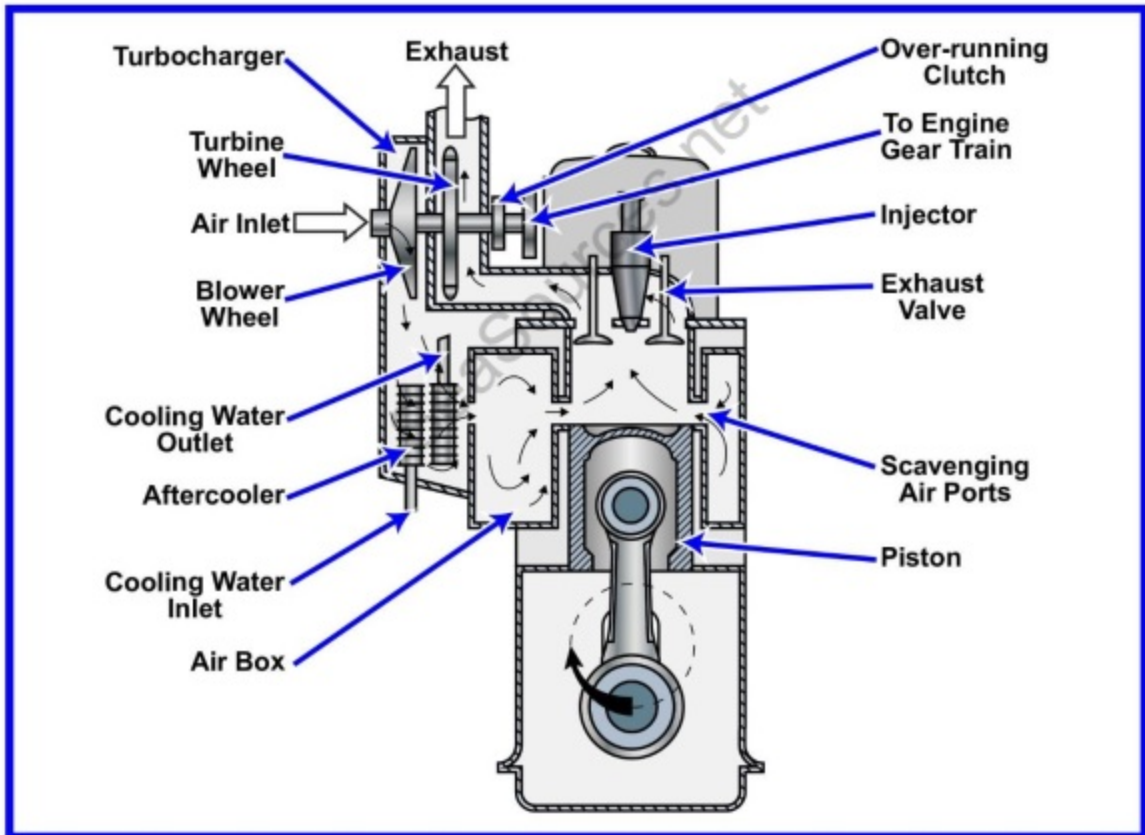


# MO-0203 Simplified Air Starting System



# MO-0206

## EMD 645 Engine Operating Cycle



## Hardness Unit Conversion Table

	mmol/L	ppm, mg/L	dGH, °dH	gpg	°e, °Clark	°fH
Mmol/L	1	0.009991	1.1783	0.171	0.1424	0.09991
ppm, mg/L	100.1	1	17.85	17.12	14.25	10
dGH, °dH	5.608	0.05603	1	0.9591	0.7986	0.5603
gpg	5.847	0.05842	1.043	1	0.8327	0.5842
°e, °Clark	7.022	0.07016	1.252	1.201	1	0.7016
°fH	10.01	0.1	1.785	1.712	1.425	1

For example: 1 mmol/L = 100.1 ppm and 1 ppm = 0.056 dGH

### Meaning of Abbreviations:

**mmol/L** = millimoles per liter

**ppm** = parts per million

**mg/L** = milligrams per liter

**dGH** = degrees of general hardness

**°dH** = German degrees

**gpg** = grains per gallon

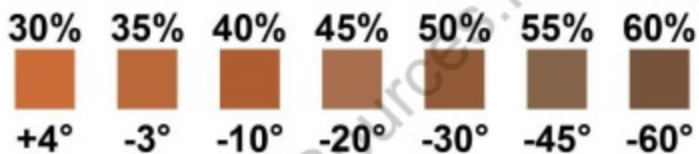
**°e, °Clark** = English degrees

**°fH** = French degrees



# MO-0211

1 % Glycol/Freezepoint (°F) (End Pad)



SCA Units per Gallon

2

Row 6	0.0	1.7	2.8	3.1	3.7	4.1	4.9	5.7
Row 5	0.0	1.7	2.3	2.7	3.1	3.5	4.3	5.1
Row 4	0.0	1.4	1.8	2.0	2.4	2.8	3.6	4.4
Row 3	0.0	1.2	1.5	1.7	2.1	2.5	3.3	4.1
Row 2	0.0	1.0	1.2	1.4	1.8	2.2	3.0	3.8
Row 1	0.0	0.6	0.9	1.1	1.5	1.9	2.7	3.5
Row 0	0.0	0.3	0.6	0.8	1.2	1.6	2.4	3.2

TEST

SERVICE

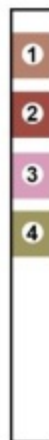
PRE-CHARGE

3 Nitrite

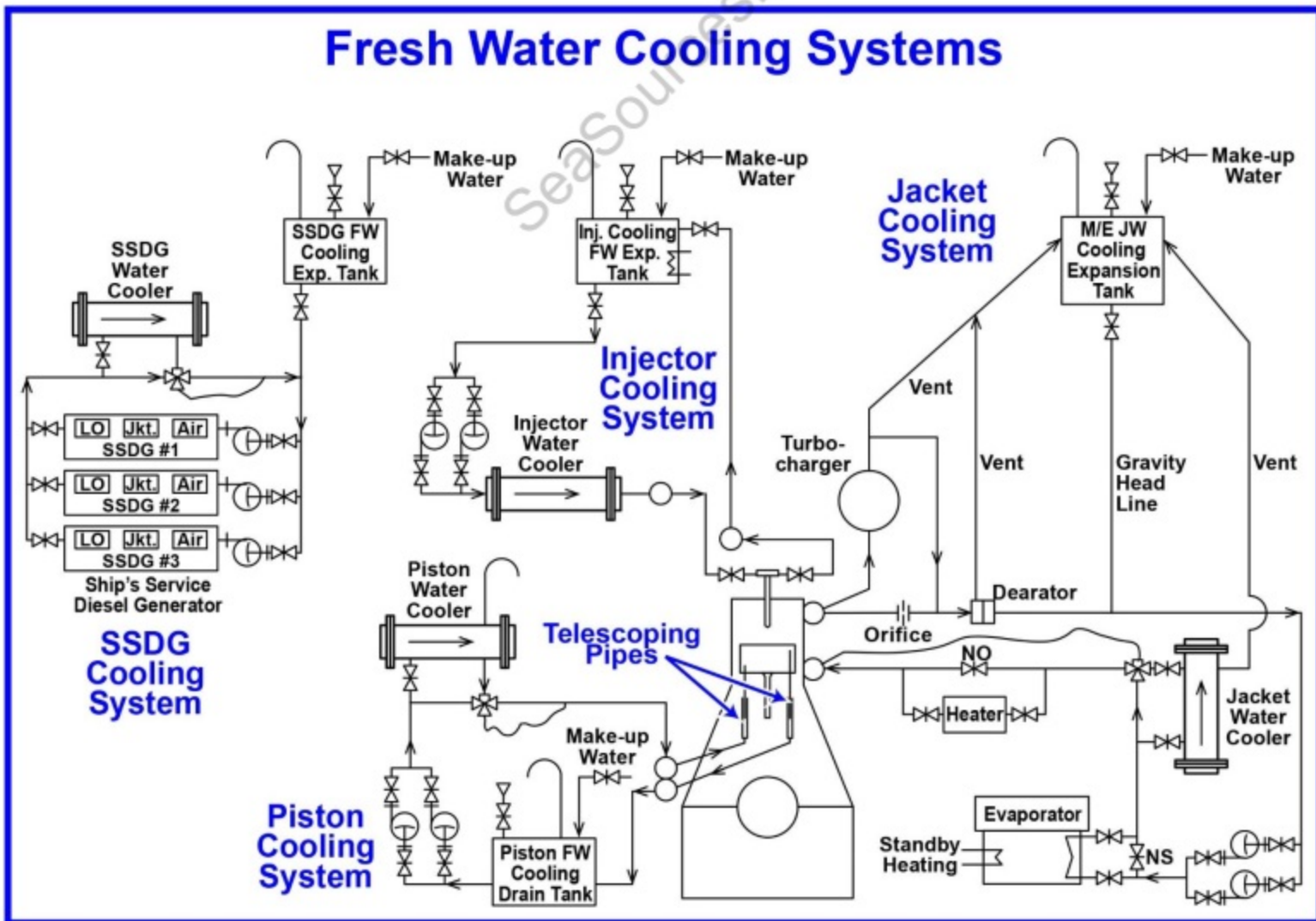
Col A	Col B	Col C	Col D	Col E	Col F	Col G	Col H



FAIL PASS FAIL



## Fresh Water Cooling Systems



MO-0215

Offshore Supply  
Vessel Drives

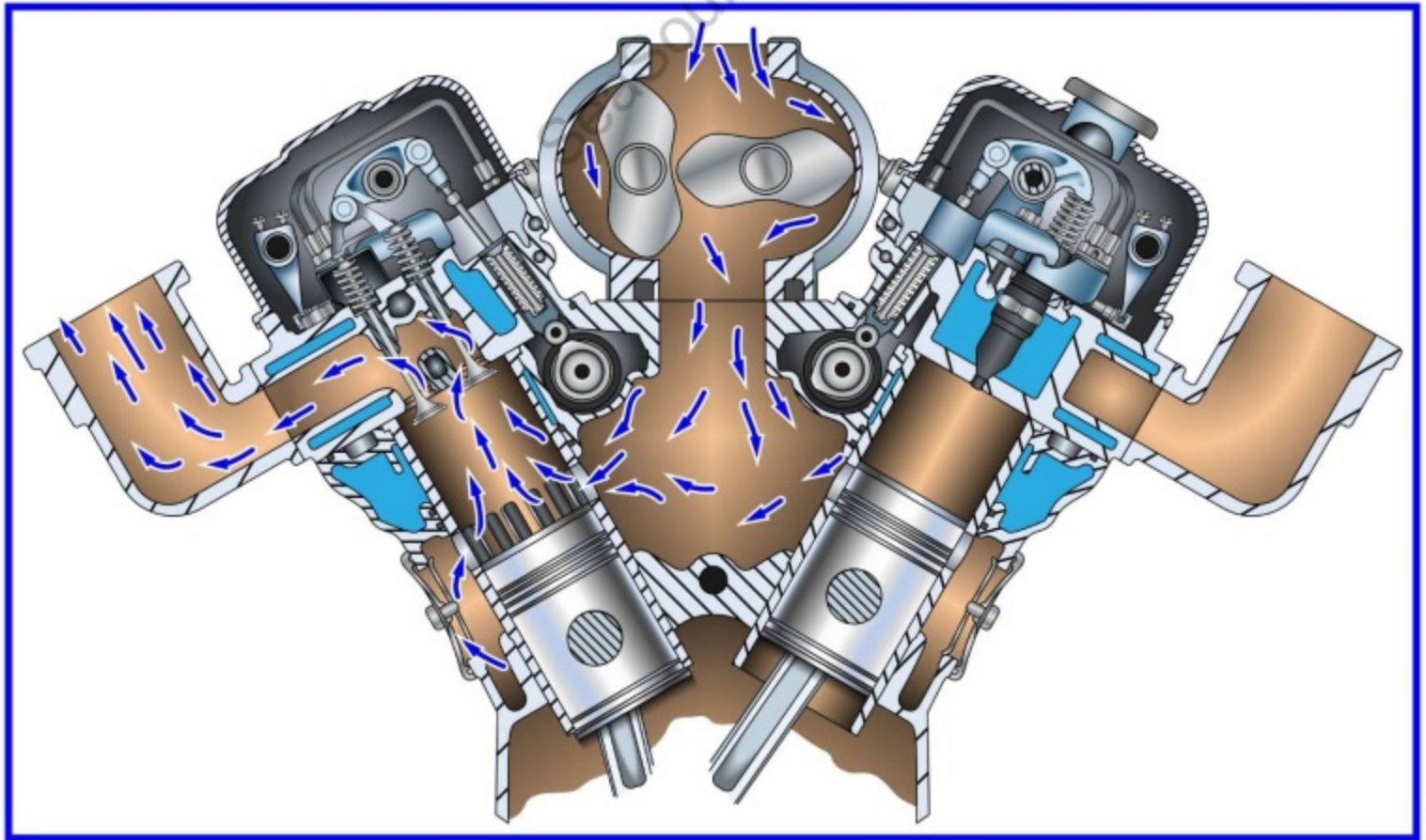
A



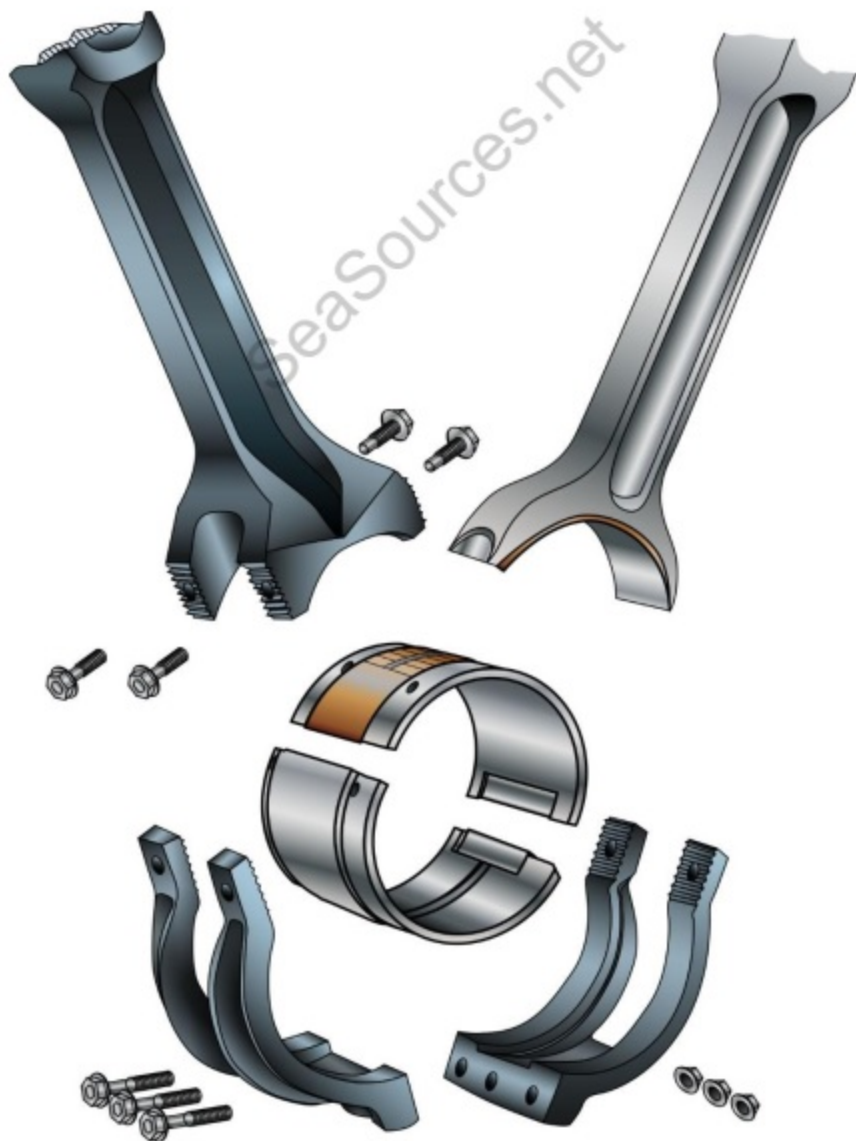
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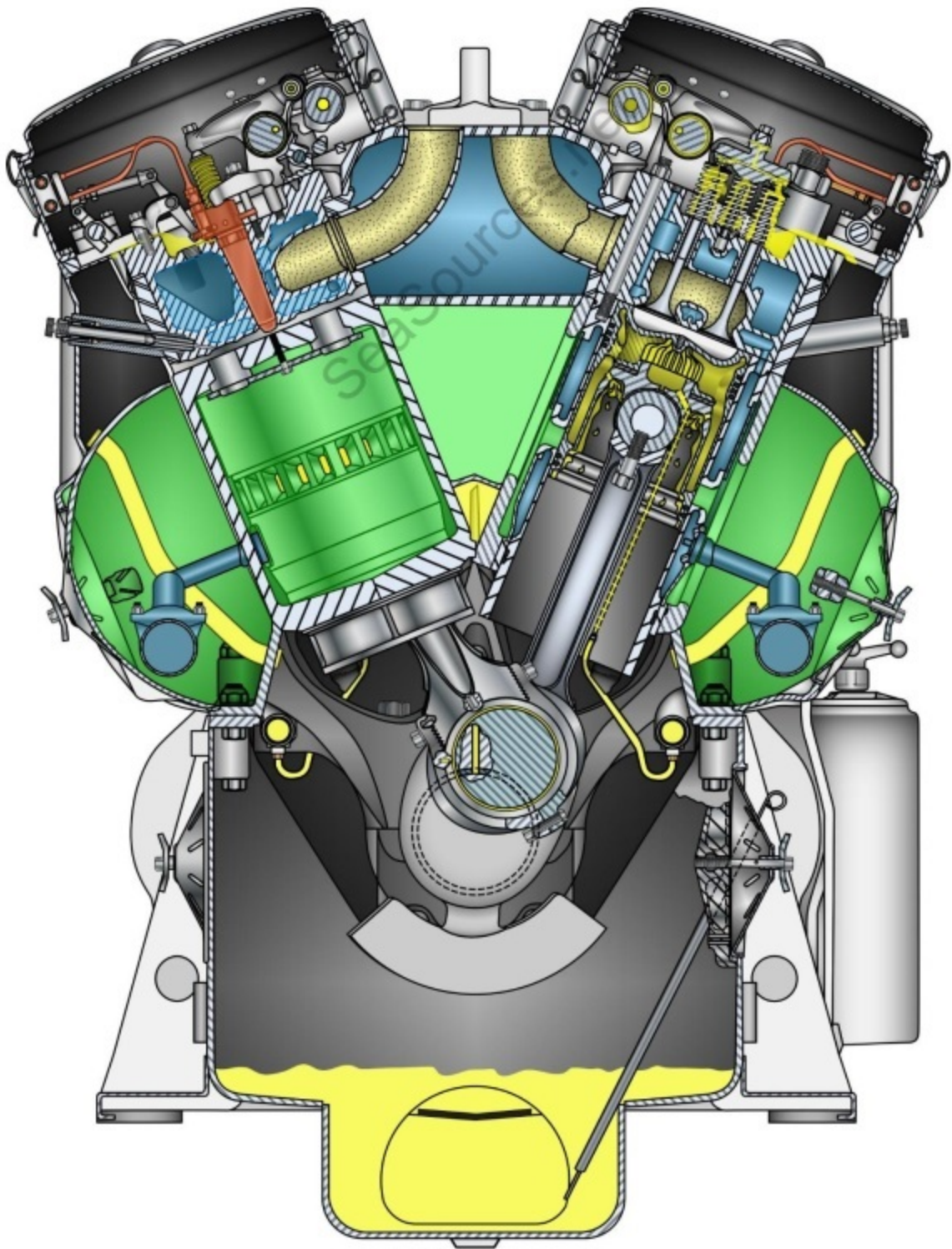
MO-0224

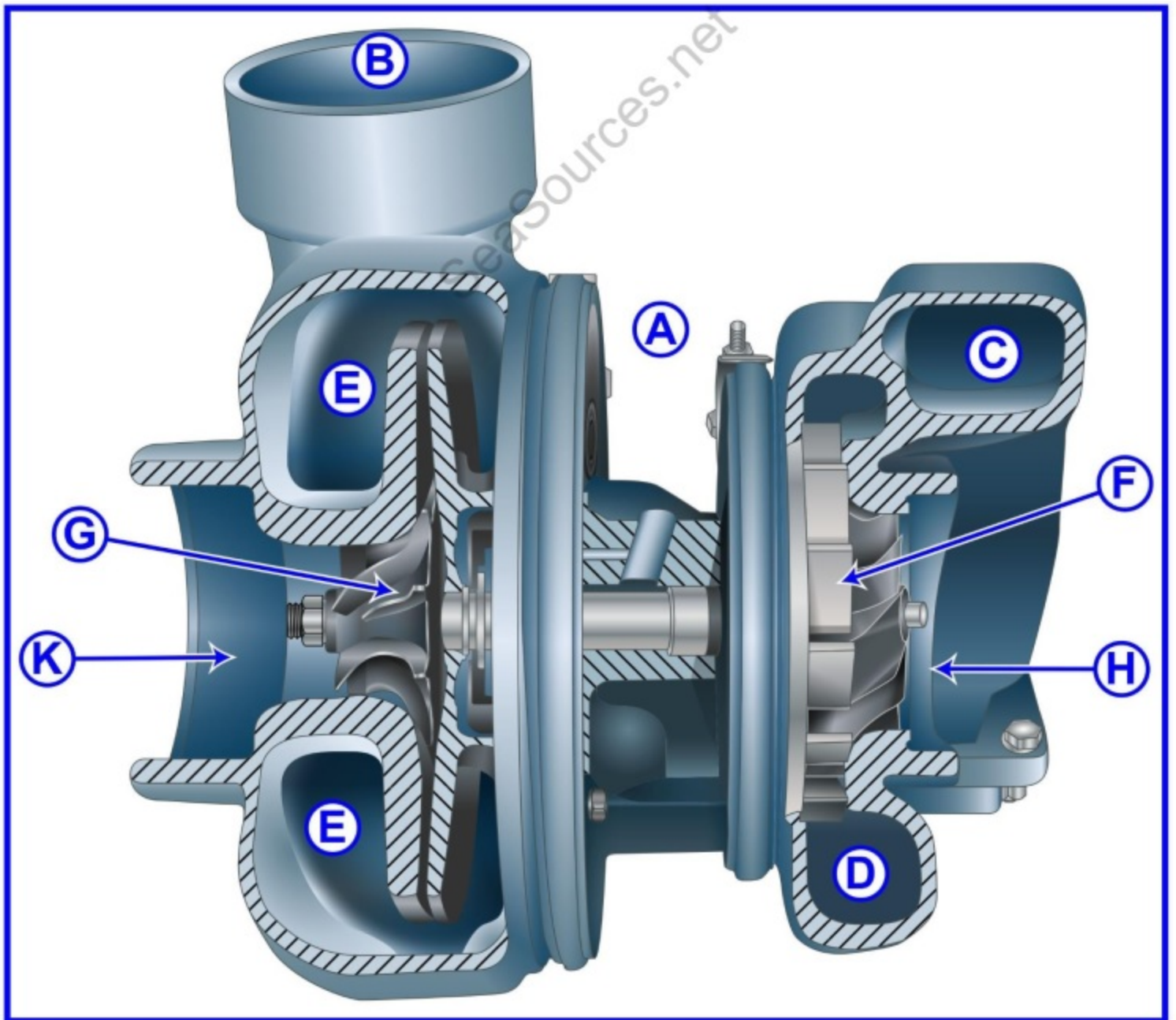


# MO-0226



MO-0227





# MO-0231

