

M-55

# HYUNDAI-MAN B&W DIESEL ENGINE INSTRUCTION BOOK

6S50MC-C Mk7

## CODE BOOK

HYUNDAI MIPO DOCKYARD

H. No. HMD0106

 **HYUNDAI**  
HEAVY INDUSTRIES CO.,LTD.

7594023-03

**INSTRUCTIONS  
HYUNDAI-MAN B&W DIESEL ENGINES  
COMPONENTS NO. 1  
(CODE BOOK)**

**This book must in no case be wholly or partially copied and published or passed to unauthorized persons without the permission of HYUNDAI HEAVY INDUSTRIES CO., LTD. ENGINE & MACHINERY DIVISION.**

# Instructions for Main Engine

## Type S50MC-C

This book forms part of a set of books consisting of three volumes entitled:

- Vol. I OPERATION
- Vol. II MAINTENANCE
- Vol. III COMPONENTS AND DESCRIPTIONS

The purpose of these books is to provide general guidance on operation and maintenance and to describe the constructional features of a standard version of the above engine type. Deviations may be found in a specific plant. In addition, the books can be used for reference purposes, for instance in correspondence and when ordering spare parts.

It is essential that the following data is stated in spare parts orders as it is used by us to ensure the supply of the correct parts for the individual engines:

1. Name of vessel
2. Engine No.        built by
3. Plate No.
4. Part No.
5. Quantity required (and description)

Example:    M/S Nybo - 7730 B&W - 90201 - 00 - 059  
              10 off (piston ring)

Furthermore, to ensure optimum efficiency, reliability and lifetime of the engine and its components, only original spare parts should be used.

The designation 'D' used in texts and illustrations refers to the information given on the data-sheets inserted in the respective books.

As reliable and economical operation of the diesel engines is conditional on correct operation and maintenance, it is essential that the engine-room personnel is fully acquainted with the contents of this book.

*This book is subject to copyright protection. The book must not, either wholly or partly, be copied, reproduced, made public or in any other way made available to a third party without the written consent of this effect from MAN B&W Diesel A/S.*

**HYUNDAI HEAVY INDUSTRIES CO., LTD**  
**ENGINE & MACHINERY DIVISION**  
**1, Cheonha-Dong, Ulsan, Korea**  
**Telephone: (052)230-7411**  
**Telex: HHI EMD K53815.52191**  
**Telefax:(052)230-7210**

# **CONTENTS**

## **A. EXPLANATION & CODE BOOK**

**CYLINDER COVER**

**PISTON WITH ROD AND STUFFING BOX**

**CYLINDER LINER AND CYLINDER LUBRICATION**

**CROSSHEAD WITH CONNECTING ROD**

**CRANKSHAFT, THRUST BEARING AND TURNING GEAR**

**MECHANICAL CONTROL GEAR**

**STARTING AIR COMPONENTS**

**EXHAUST VALVE**

**FUEL OIL SYSTEM**

**TURBOCHARGER SYSTEM**

**SAFETY EQUIPMENT**

**ASSEMBLY OF LARGE PARTS**

**GENERAL TOOLS**

## **B. OVERSEAS NETWORK**

## **A. EXPLANATION & CODE BOOK**

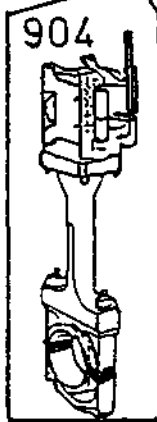
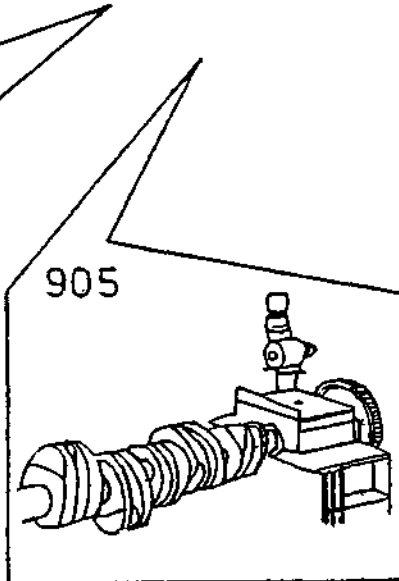
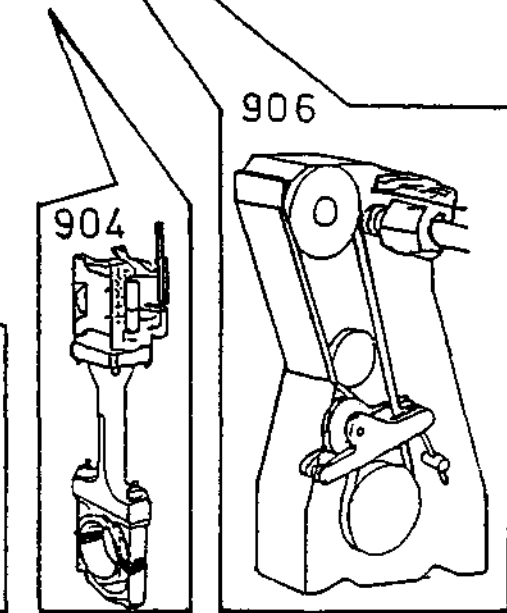
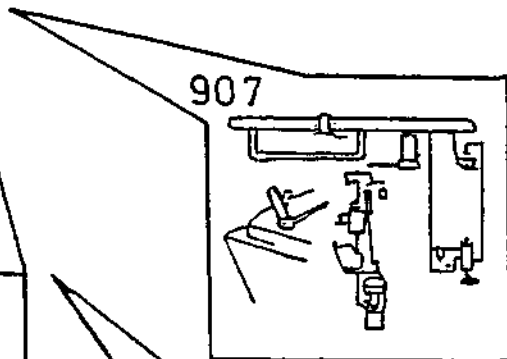
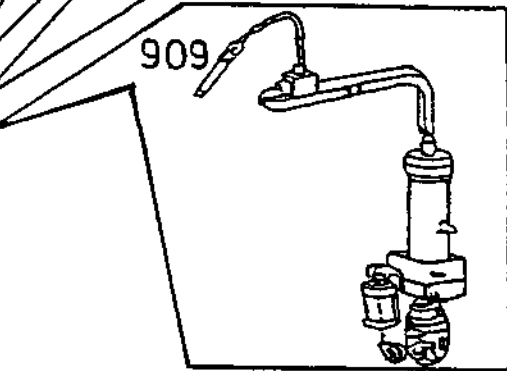
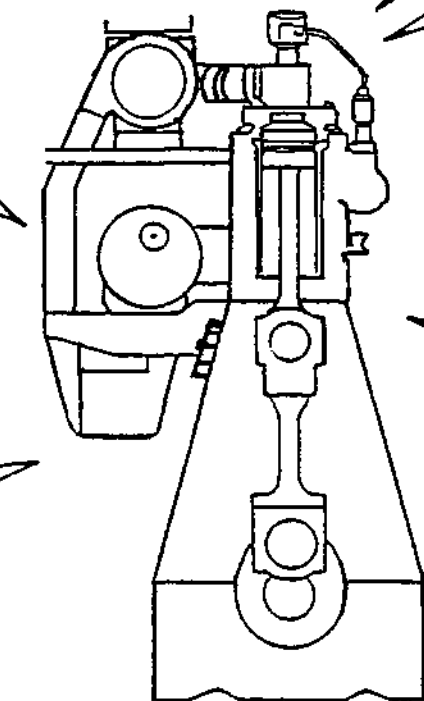
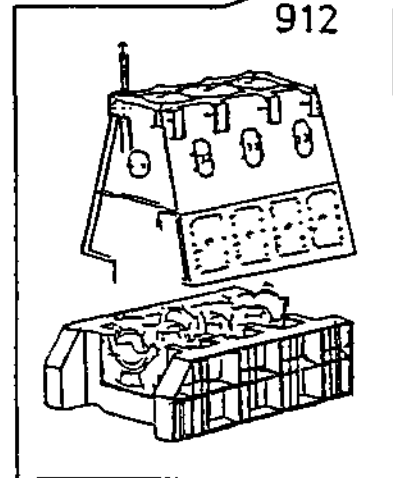
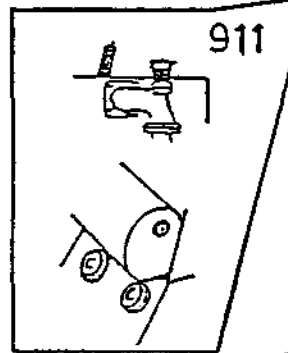
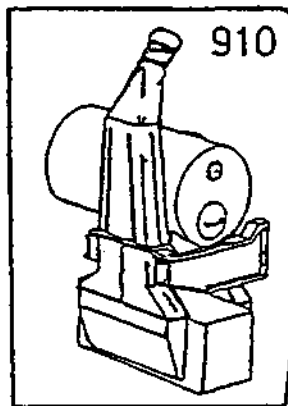
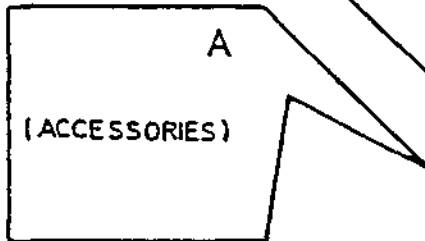
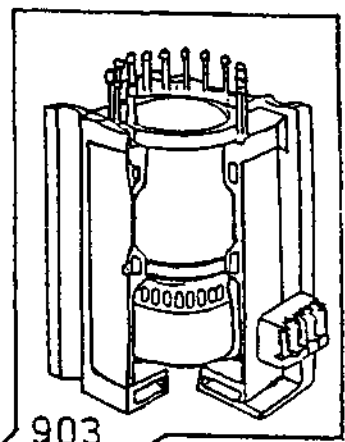
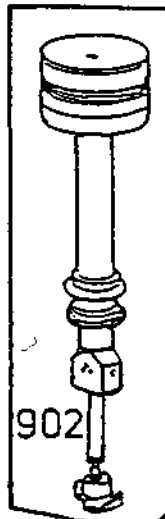
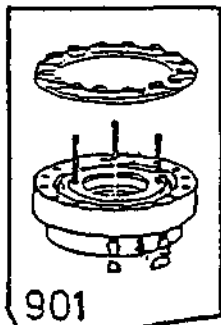
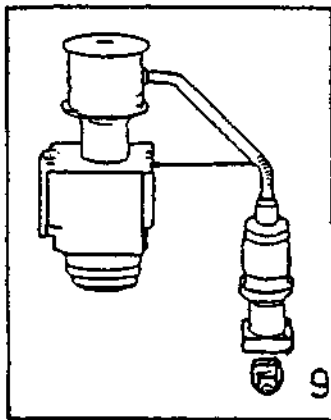
## **INDEX**

<b>CYLINDER COVER .....</b>	<b>901</b>
<b>PISTON WITH ROD AND STUFFING BOX .....</b>	<b>902</b>
<b>CYLINDER LINER AND CYLINDER LUBRICATION .....</b>	<b>903</b>
<b>CROSSHEAD WITH CONNECTING ROD .....</b>	<b>904</b>
<b>CRANKSHAFT, THRUST BEARING AND TURNING GEAR .....</b>	<b>905</b>
<b>MECHANICAL CONTROL GEAR .....</b>	<b>906</b>
<b>STARTING AIR COMPONENTS .....</b>	<b>907</b>
<b>EXHAUST VALVE .....</b>	<b>908</b>
<b>FUEL OIL SYSTEM .....</b>	<b>909</b>
<b>TURBOCHARGER SYSTEM .....</b>	<b>910</b>
<b>SAFETY EQUIPMENT .....</b>	<b>911</b>
<b>ASSEMBLY OF LARGE PARTS .....</b>	<b>912</b>

# CYLINDER COVER

901





## Cylinder Cover

### General

The cylinder cover is made of steel and has a central bore for the exhaust valve, which is attached by means of four studs. The cover furthermore has bores for the fuel valves, which are mounted with tubular spacers and nuts. Other bores have been provided for starting valve, starting air inlet, safety valve and indicator cock.

A cooling jacket is mounted on the lower part of the cylinder cover, whereby a cooling water space is formed.

Another cooling water space is formed around the exhaust valve seat, when the exhaust valve is installed. These two spaces communicate through a large number of oblique/radial cooling bores in the cover.

The water is supplied from the cooling jacket surrounding the cylinder liner and passes through water transitions to the cooling jacket surrounding the cylinder cover and, further on, through the cooling bores, to the space around the exhaust valve seat.

From here the water is discharged to the main cooling water outlet pipe.

The cylinder cover is tightened against the top of the cylinder liner by means of nuts and long studs fitted in the cylinder frame. The nuts are tightened by means of hydraulic jacks.

Sealing between the cylinder cover and cylinder liner is obtained by means of a sealing ring, made of mild steel.

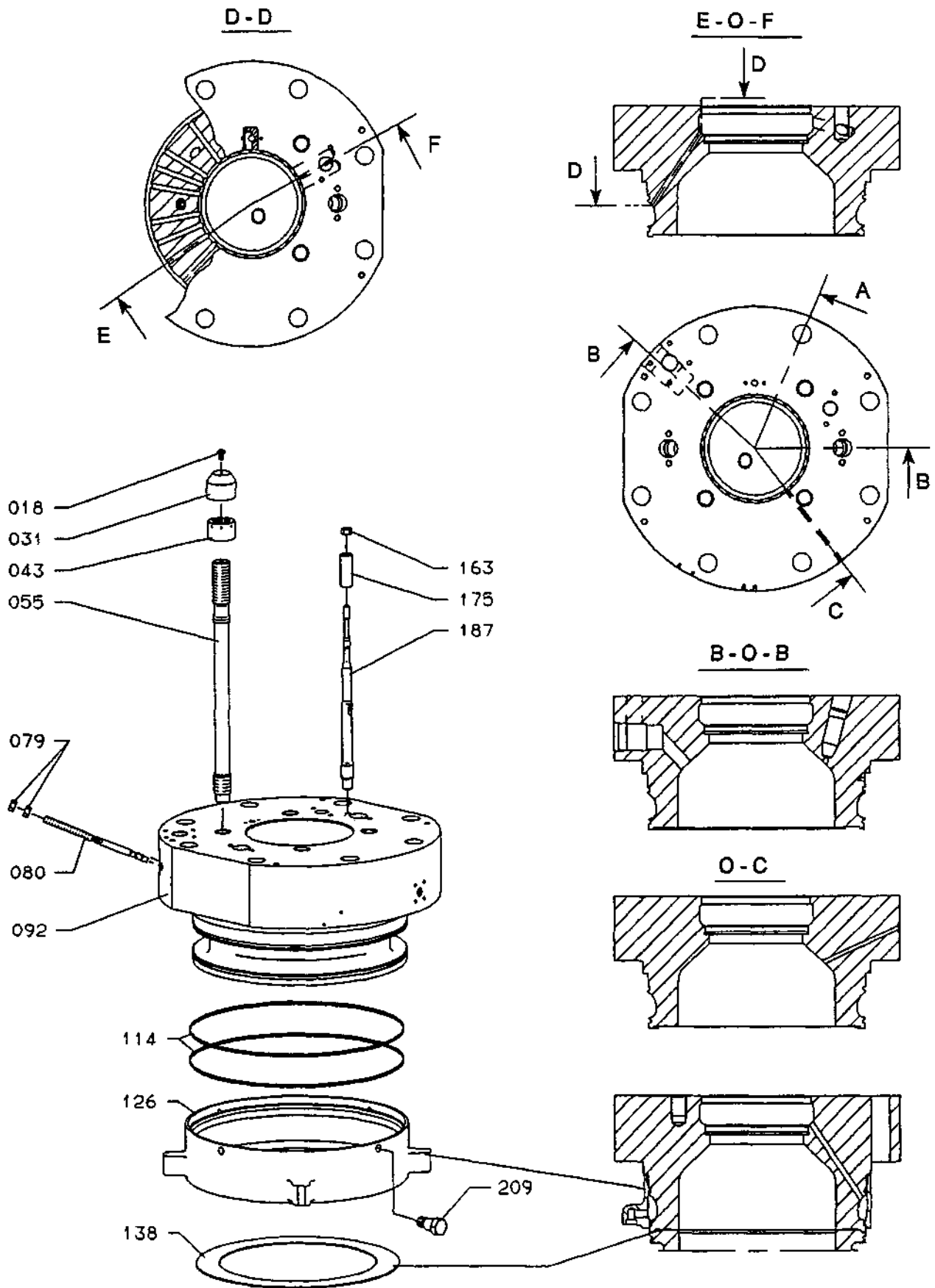


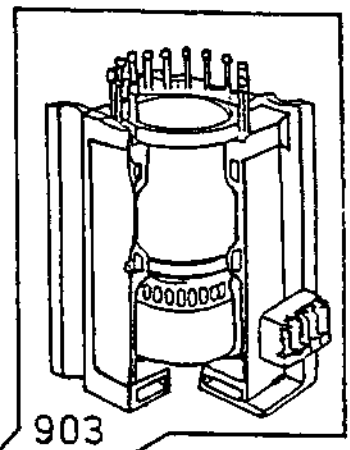
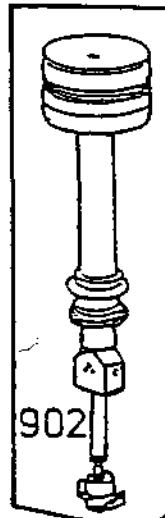
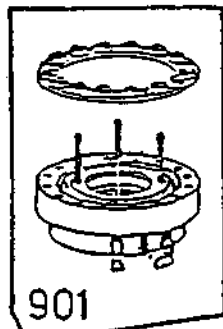
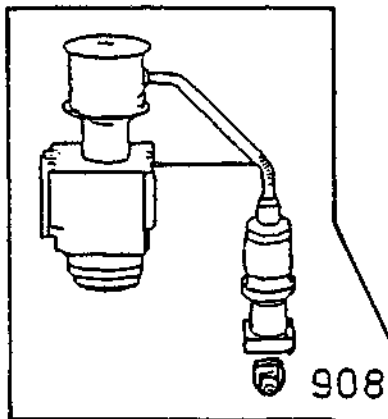
Plate 90101-104 Cylinder Cover

Item No.	Part Description
018	Screw
031	Protective cap
043	Nut
055	Stud for exhaust valve
079	Nut
080	Stud for starting valve
092	Cylinder cover
114	O-ring
126	Cooling jacket
138	Gasket
163	Nut
175	Distance pipe
187	Stud for fuel valve
209	Screw

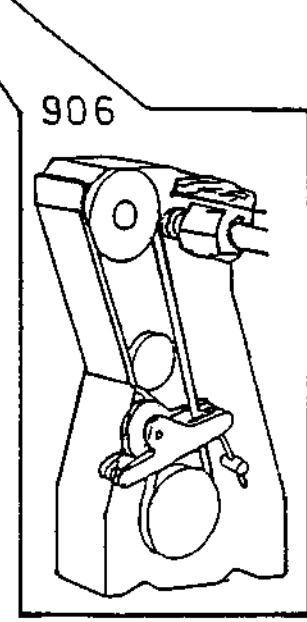
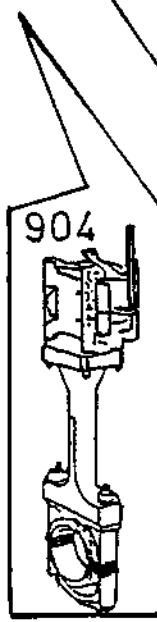
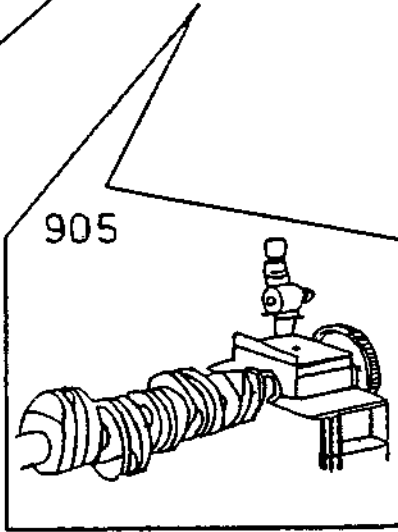
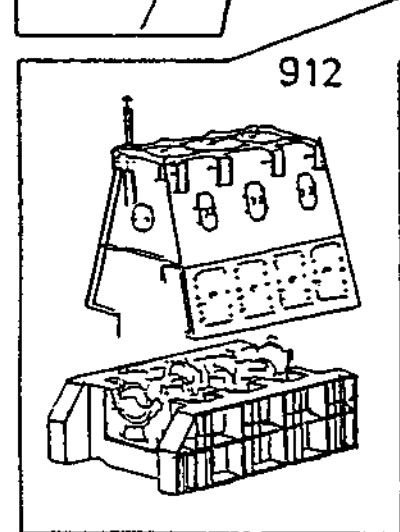
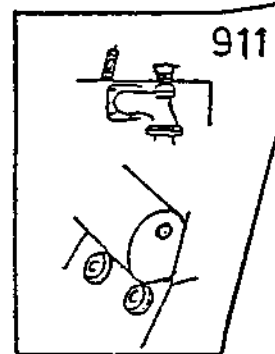
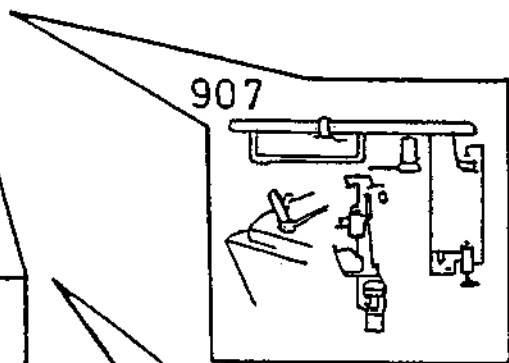
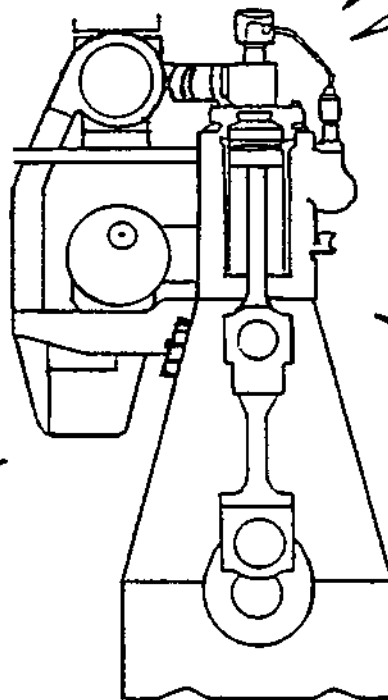
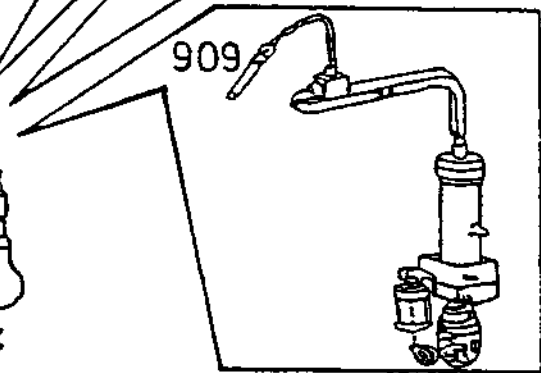
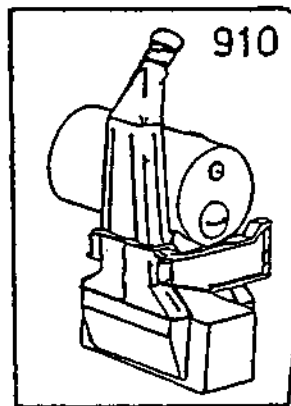
Item No.	Part Description
----------	------------------

**PISTON WITH ROD AND  
STUFFING BOX**

**902**



A  
(ACCESSORIES)



## Piston with Rod and Stuffing Box

### Piston and Piston Rod

*Plate 90201*

The piston consists of two main parts:

- Piston Crown
- Piston Skirt

The piston crown is tightened to the upper end of the piston rod by means of screws. The screws are locked with locking wire.

The piston skirt is tightened to the piston crown by means of flanged screws. The screws are locked with locking wire.

The piston crown is provided with chromium-plated grooves for four piston rings. The two uppermost rings have increased height.

Piston ring No. 1 is a Controlled-Pressure Relief ring (CPR). CPR rings may have been coated on the external surface. Handle with care, as impact may cause the coating to crack and peel off.

The piston rings Nos. 2, 3 and 4 have oblique cuts:

- piston ring No. 3, has right-hand cut,

and

- piston rings Nos. 2 and 4, have left-hand cuts.

At the top, the piston crown has a groove for the fitting of lifting tools.

The piston rod has a through-going bore for the cooling oil pipe, which is secured to the piston rod top by means of flanged screws.

Cooling oil is supplied through a telescopic pipe connection on the crosshead and passed through a bore in the piston rod foot and, through the cooling oil pipe in the piston rod, to the piston crown.

The oil is passed on through a number of bores in the thrust part of the piston crown and to the space around the cooling oil pipe in the piston rod.

From the bore in the piston rod foot, the oil is led through the crosshead to a discharge spout and to a slotted pipe inside the engine frame as well as through a control device for checking the flow and temperature.

The piston rod foot rests on a face cut-out in the crosshead pin and is guided by a pipe in the crosshead.

A shim is inserted between the piston rod and the crosshead. The thickness of the shim is calculated for each engine, in order to match the actual engine layout.

The rod is fastened to the crosshead pin by means of four screws. The screws are locked with locking wire.

### Piston Rod Stuffing Box

The bore for the piston rod in the bottom of the scavenge air box is fitted with a piston rod stuffing box, which is designed to prevent the lubricating oil in the crankcase from being drawn up into the scavenge air space.

The stuffing box also prevents scavenge air (in the scavenge air space) from leaking into the crankcase.

The stuffing box is mounted on a flange which is bolted to the bottom of the scavenge air space.

The stuffing box is removed together with the piston rod during piston inspection, but can also be dismantled for inspection in the crankcase while the piston remains mounted in the engine.

The stuffing box housing consists of two parts, which are bolted together.

The housing is provided with seven machined ring grooves:

- The uppermost groove is provided with a four-part scraper ring with oblique edges, which serves to prevent sludge from the scavenge box from being drawn down to the other rings.

Furthermore, an eight-part sealing ring is located below the scraper ring to prevent scavenge air from passing downwards along the piston rod.

The scraper ring and the sealing ring are guided by two cylindrical pins.

- The next two ring grooves are each provided with a four-part sealing ring and an eight-part sealing ring below. The rings are guided by two cylindrical pins.
- The four lowermost ring grooves are fitted with three-part scraper rings which scrape the lubricating oil off the piston rod.

Each of the three parts consists of a base ring with two machined grooves, each containing a pressed-in lamella, with a scraping edge facing the piston rod.

From the three lowermost grooves, the oil is returned to the crankcase, through bores in the stuffing box housing.

Through bores in the housing and a pipe, the uppermost scraper ring groove communicates with a control funnel on the outside of the engine.

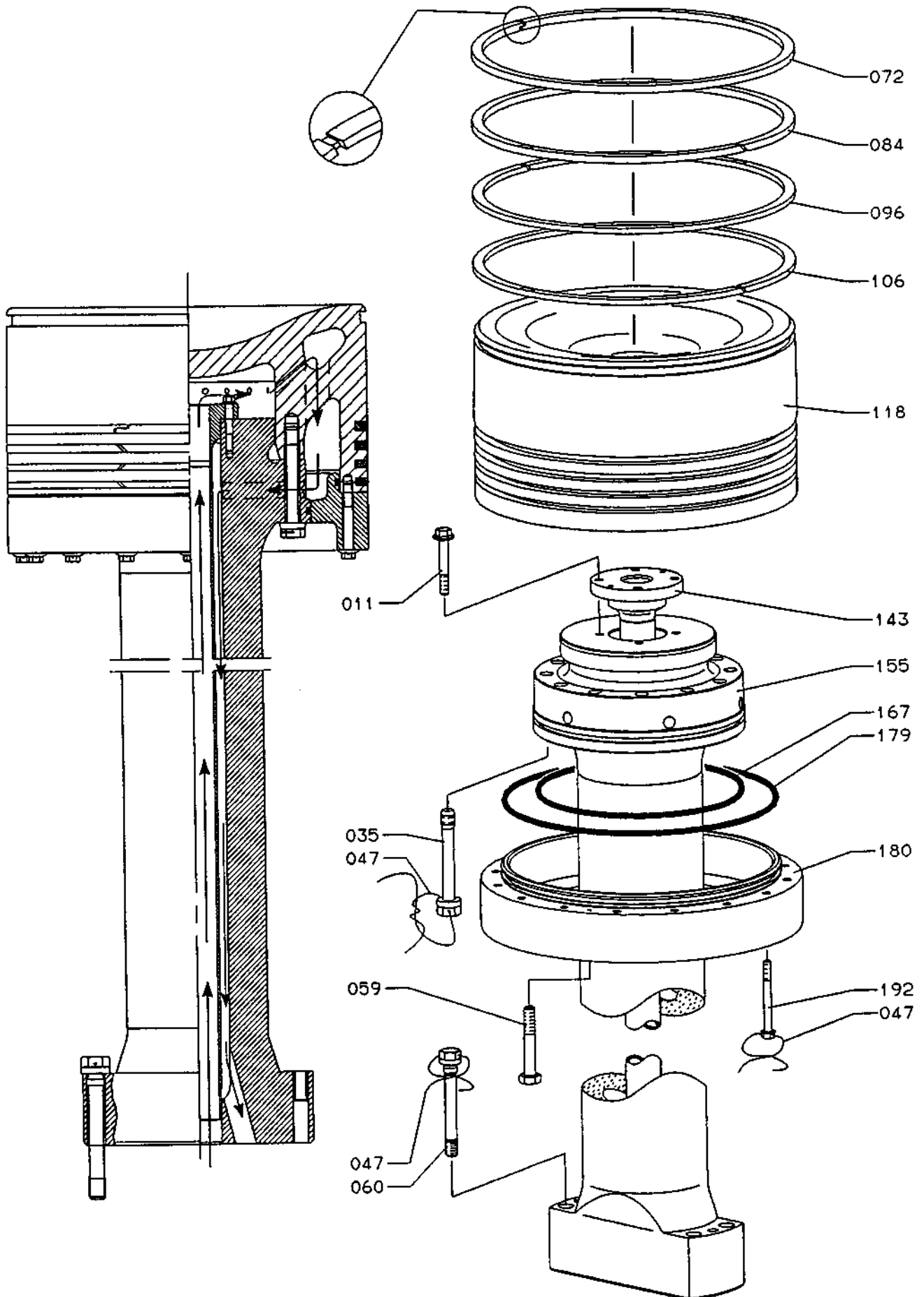
This funnel provides a means of checking that the sealing rings and scraper rings are functioning correctly:

- Blow-by of air indicates defective sealing rings, while excessive oil indicates defective scraper rings.

The parts are held in place round the piston rod by means of helical springs, which are located in machined grooves on the outside of the scraper rings and sealing rings.

Gaps at the end of the ring segments ensure that the rings will bear against the piston rod even in worn condition.





**Plate 90201-144 Piston and Piston Rod**

Item No.	Part Description
011	Screw
035	Screw
047	Locking wire
059	Screw
060	Screw
072	Piston ring, no.1
084	Piston ring, no.2
096	Piston ring, no.3
106	Piston ring, no.4
118	Piston crown
143	Cooling oil pipe
155	Piston rod
167	D-ring
179	D-ring
180	Piston skirt
192	Screw

Item No.	Part Description
----------	------------------

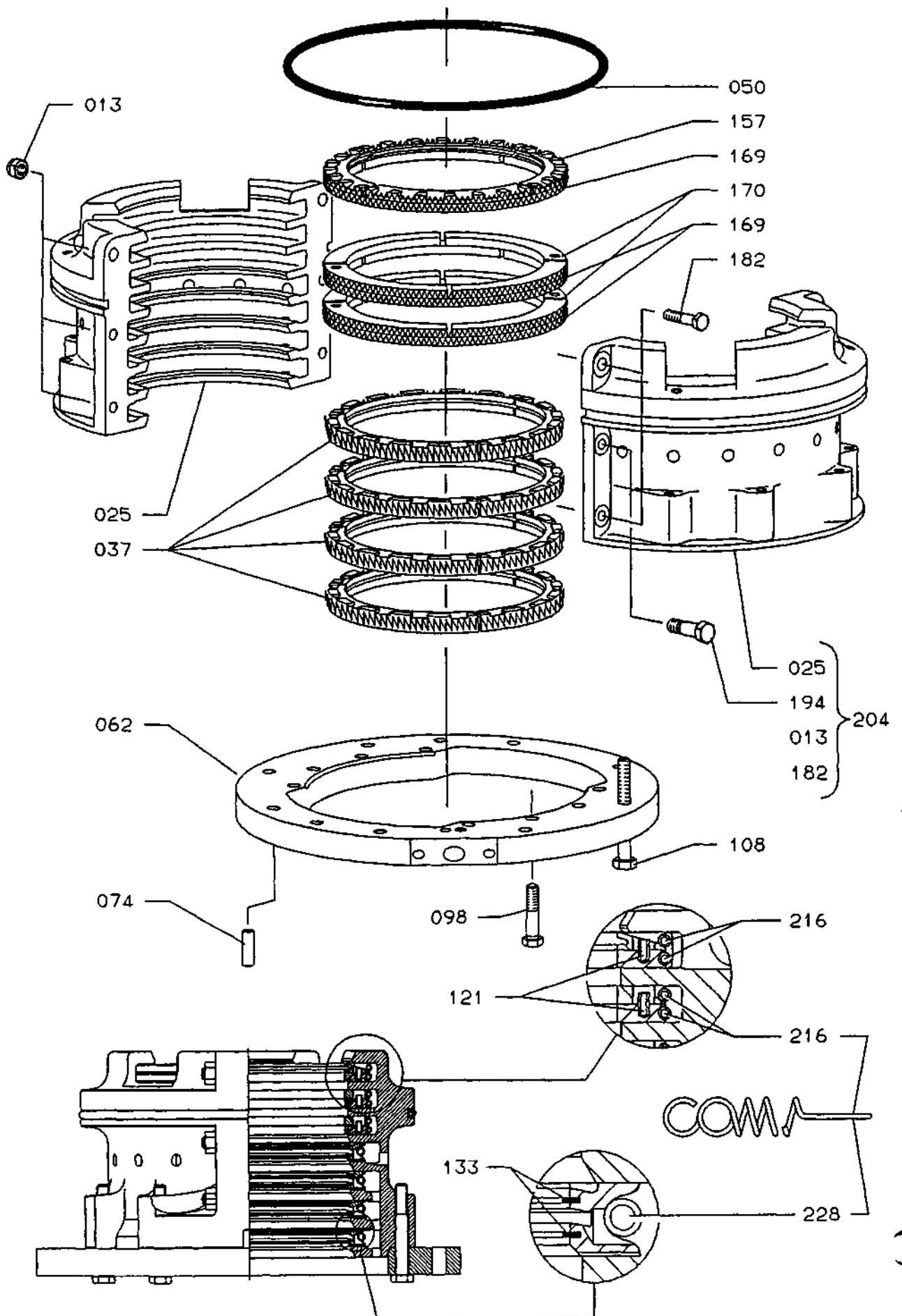


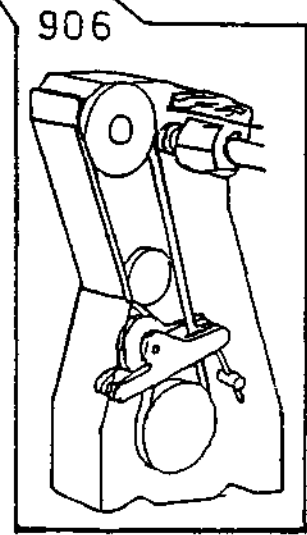
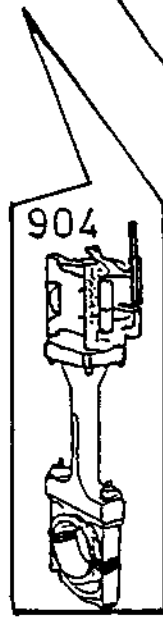
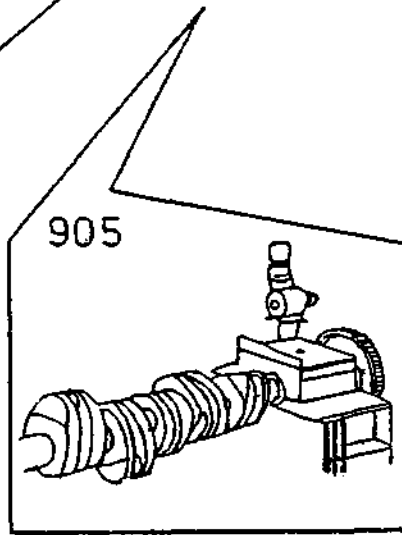
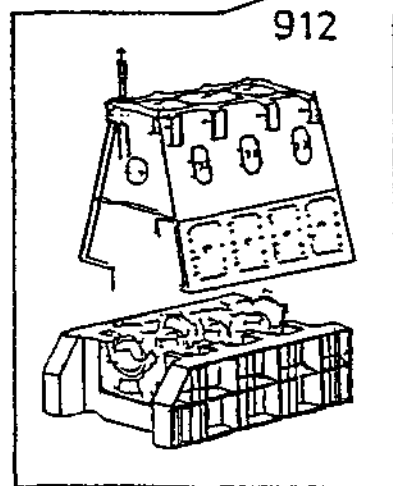
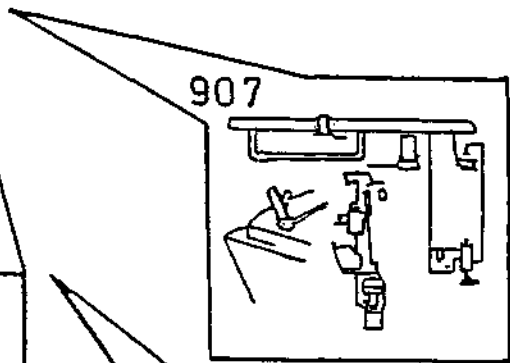
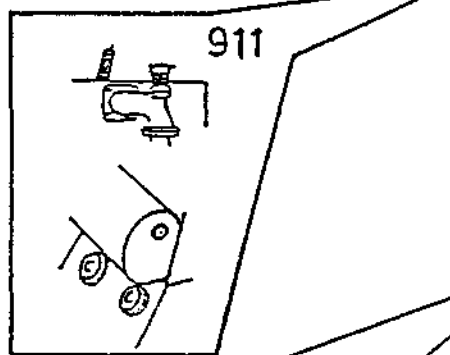
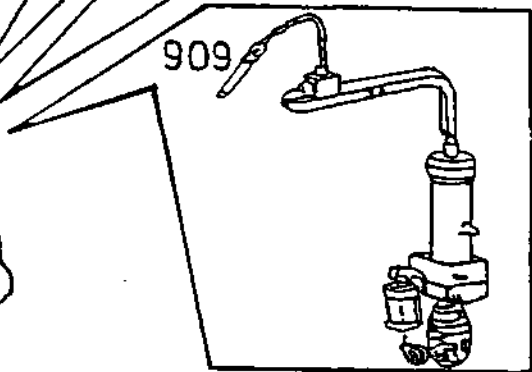
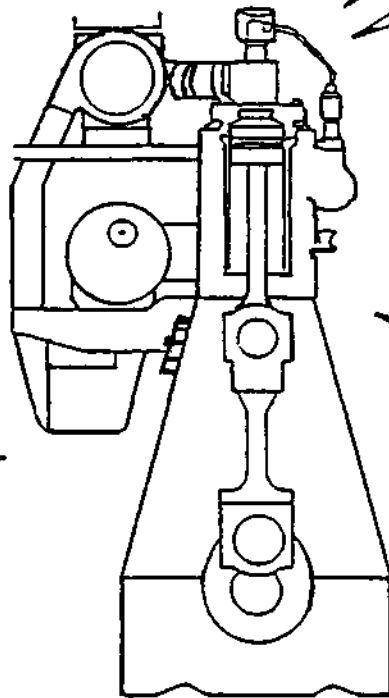
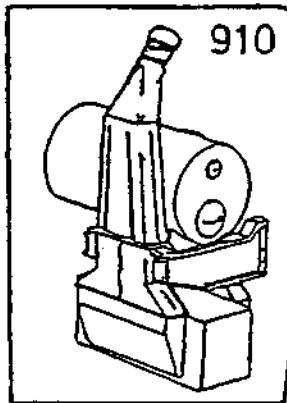
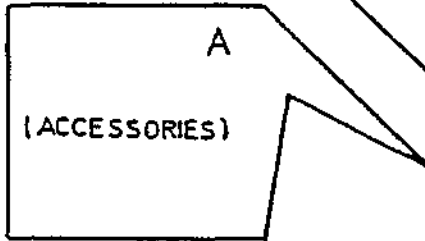
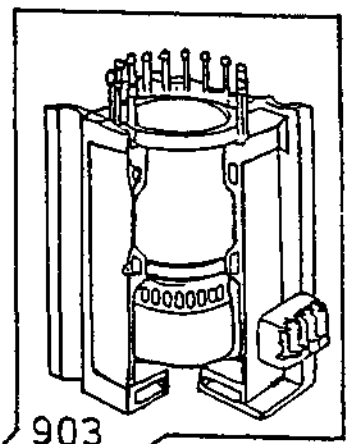
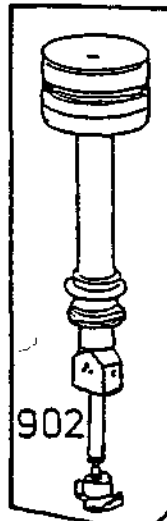
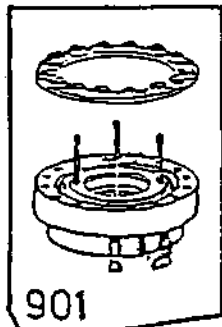
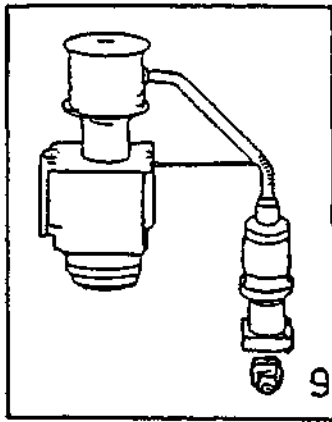
Plate 90205-95 Piston Rod Stuffing Box

Item No.	Part Description
013	Nut
025	Stuffing box housing in 2/2
037	Scraper ring
050	O-ring
062	Flange
074	Guide pin
098	Screw
108	Screw
121	Spring pin
133	Lamella for scraper ring
157	Top scraper ring
169	Pack sealing ring
170	Cover sealing ring
182	Screw
194	Fitted bolt
204	Stuffing box housing, complete
216	Spring
228	Spring

Item No.	Part Description
----------	------------------

# CYLINDER LINER AND CYLINDER LUBRICATION

903



## Cylinder Liner and Cylinder Lubrication

### Cylinder Frame

The cylinder section of the engine consists of a cast cylinder frame, which is tightened together with the framebox and the bed-plate by means of stay bolts, the bottom end of which is screwed into the bedplate.

If the cylinder frame consists of more than one part, these parts are tightened together in the vertical joints.

A central bore for each cylinder, at the top of the cylinder frame, encloses the cylinder liners.

A central bore for each cylinder, at the bottom of the cylinder frame, encloses the piston rod stuffing boxes.

On the exhaust side of the cylinder frame there are openings which connect the scavenge air spaces around the cylinder liners with the longitudinal scavenge air receiver of the engine.

Furthermore, there are inlet pipes for cooling and lubricating oil.

The cylinder frame is provided with cleaning and inspection covers giving access to the scavenge air spaces.

Studs for fastening the cylinder covers are mounted in the cylinder frame.

### Cylinder Liner

The cylinder liner is tightened against the top of the cylinder frame by the cylinder cover, so that it can expand freely downwards when heated during the running of the engine.

A rubber ring is located in a machined groove on the external diameter of the cylinder liner, in order to guide the liner in the cylinder frame.

The cylinder liner is surrounded by a cooling jacket.

Rubber rings located in machined grooves in the cylinder liner ensure cooling water sealing.

The part of the cylinder liner which is located in the scavenge air space of the cylinder frame is provided with a number of scavenge air ports, which are uncovered by the piston when this is in its bottom position. The scavenge air ports are bored at an oblique angle to the axis of the cylinder liner so as to give the scavenge air a rotary movement in the cylinder.

In the free part of the cylinder liner, between the cooling jacket and the cylinder frame, there are a number of bores with non-return valves for supply of lubricating oil to the cylinder.

On the working surface of the cylinder the bores are connected to a lubricating groove to ensure an even distribution of the oil.

### Cylinder Lubricators

*Plate 90305*

The cylinder frame is fitted with two cylinder lubricators. The lubricators incorporate a number of oil pumps, corresponding to the number of lubricating orifices in cylinder liners.

The lubricators are inter-connected by means of shafts with couplings which are rigid in the direction of rotation.

The lubricators are driven through a gear transmission from the end of the camshaft.

For fixed pitch propeller plants (FPP), the lubricators are speed-dependent, where the cylinder oil dosage follows the engine speed. For controllable pitch propeller plants (CPP), the lubricators are mean indicated pressure (MEP)-dependent, where the cylinder oil dosage follows the engine load.

The lubricators are of the load-change dependent (LCD) type.

For engines fitted with a Woodward governor, the LCD lubricators are controlled by an electronic unit, which monitors the position of the fuel regulating shaft.

For engines fitted with an electronic governor, the LCD lubricators are controlled directly by the governor.

The LCD lubricators can operate in two modes:

- LCD mode:  
The lubricators supply the pre-set extra amount of cylinder oil during STARTING, manoeuvring and sudden load changes. This reduces the liner wear rate.
- Fixed-position mode:  
The lubricators supply the pre-set extra amount of cylinder oil per revolution continuously.

*Regarding the cylinder lubricators proper, reference is made to the special instruction manuals supplied.*

*See also Vol. I, OPERATION Chapter 707.*



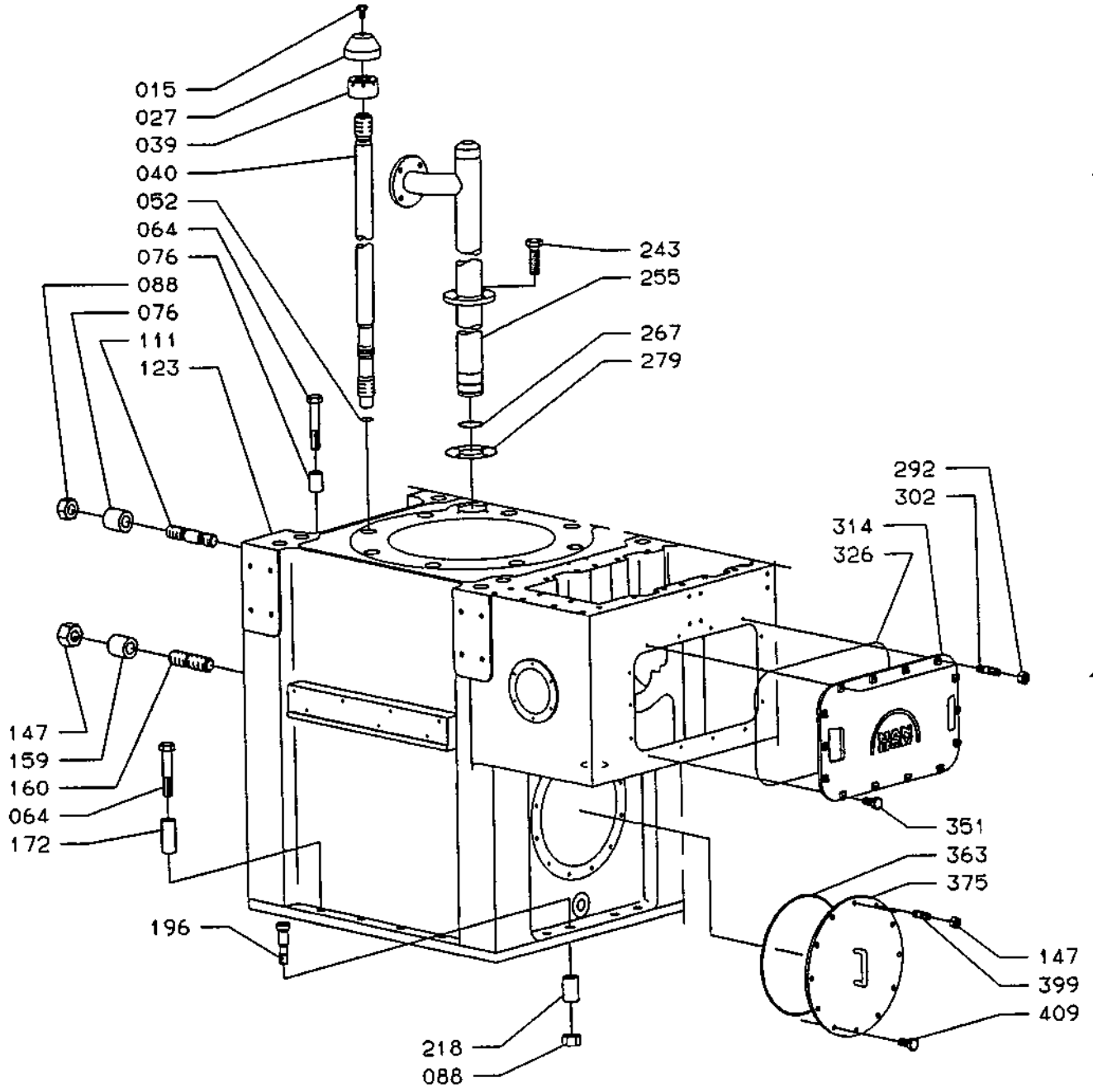


Plate 90301-112 Cylinder Frame

Item No.	Part Description
015	Screw
027	Protective cap
039	Nut
040	Stud for cylinder cover
052	O-ring
064	Screw
076	Distance pipe, L=70
088	Nut
111	Stud
123	Cylinder frame
147	Nut
159	Distance pipe, L=50
160	Stud
172	Distance pipe, L=115
196	Fitted bolt
218	Distance pipe, L=40
243	Screw
255	Protective pipe
267	O-ring
279	Packing
292	Nut
302	Stud
314	Cover
326	O-ring
351	Screw
363	O-ring
375	Cleaning cover
399	Stud
409	Screw

Item No.	Part Description

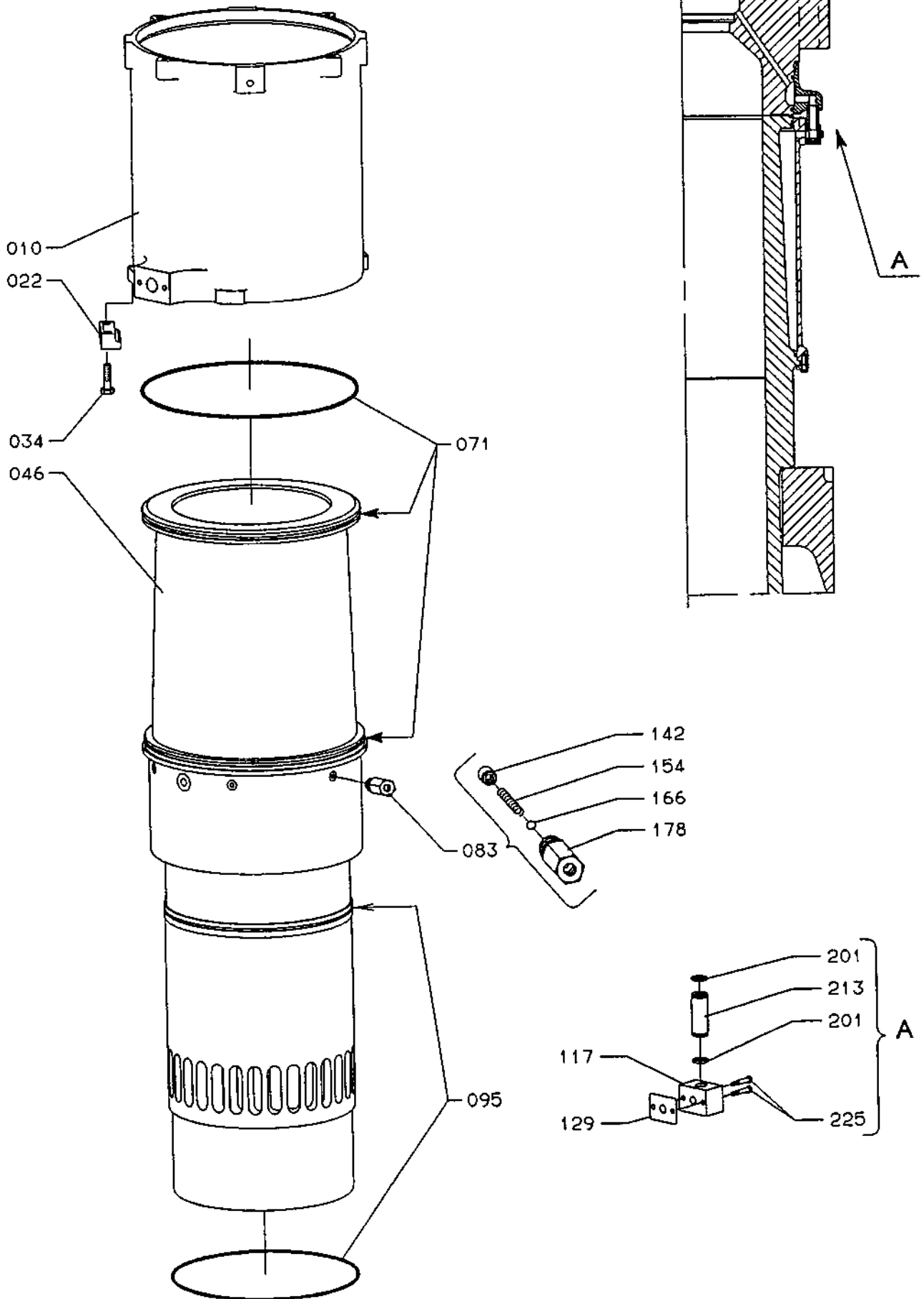
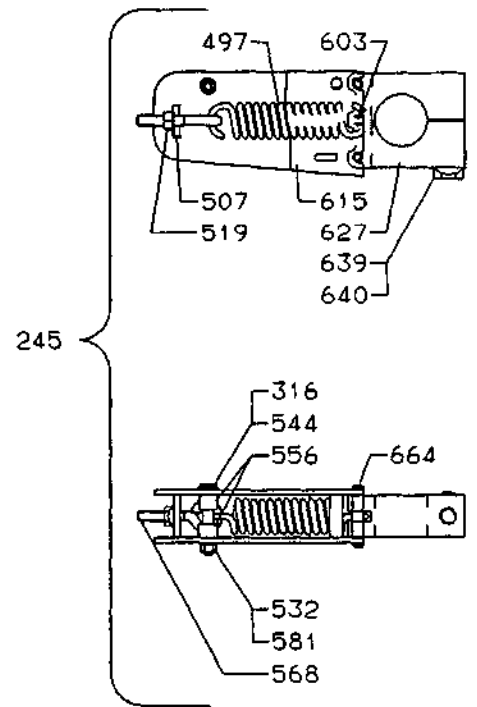
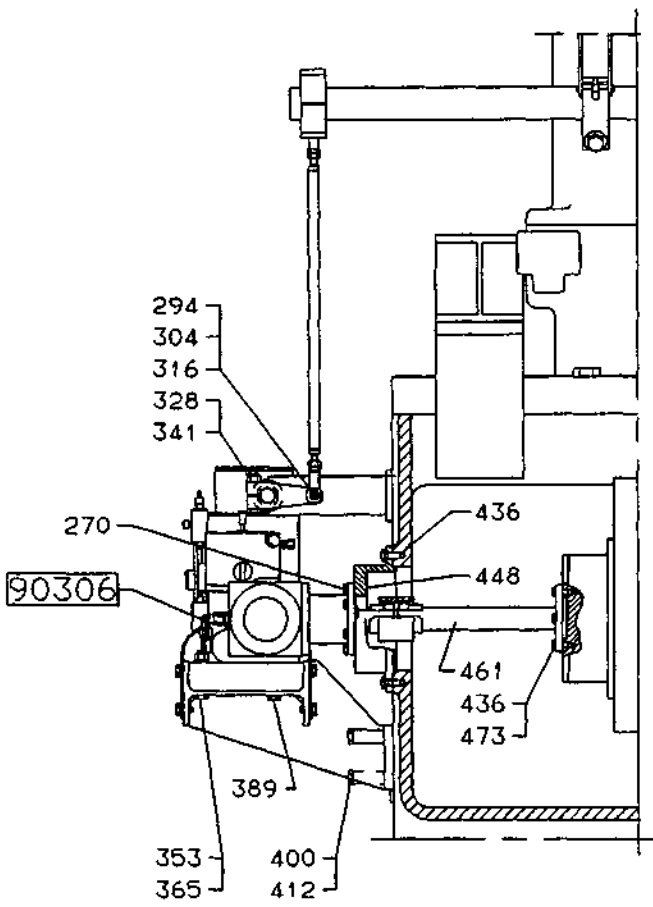
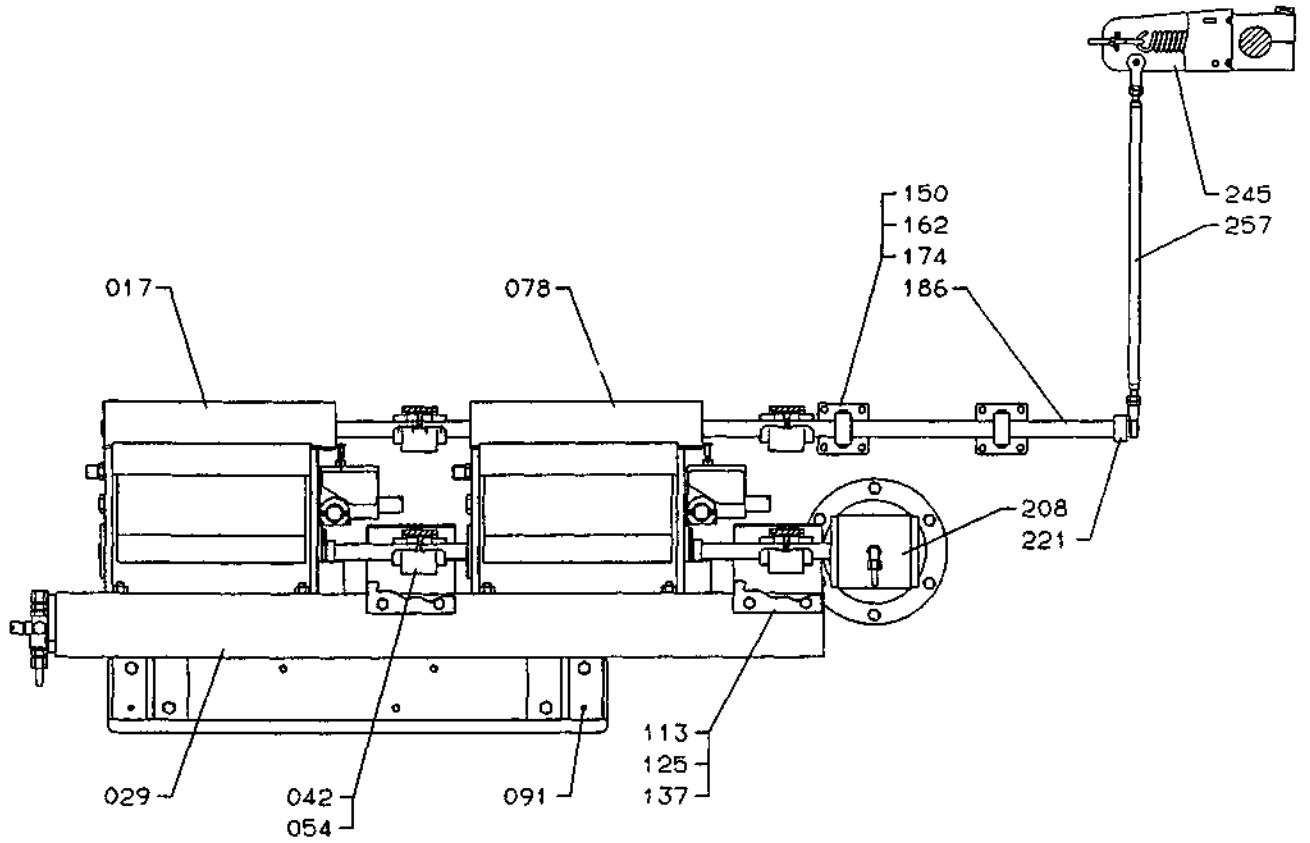


Plate 90302-122 Cylinder Liner and Cooling Jacket

Item No.	Part Description
010	Cooling jacket
022	Clamp
034	Screw
046	Cylinder liner
071	O-ring
083	Non-return valve, complete
095	O-ring
117	Cooling water connection
129	Packing
142	Thrust piece
154	Spring
166	Steel ball
178	Valve housing
201	O-ring
213	Pipe
225	Screw

Item No.	Part Description
----------	------------------



**Plate 90305-88 Cylinder Lubricator Drive**

Item No.	Part Description
017	Lubricator
029	Bracket
042	Coupling
054	Key
078	Lubricator
091	Guide pin
113	Guard
125	Screw
137	Spring lock
150	Bearing, complete
162	Screw
174	Pin
186	Shaft
208	Gear
221	Clamping arm
245	Spring loaded lever, complete
257	Pull rod
270	Screw
294	Self-locking nut
304	Fitted bolt
316	Washer
328	Screw
341	Self-locking nut
353	Fitted bolt
365	Nut
389	Screw
400	Screw
412	Distance pipe, L=50
436	Screw
448	Flange
461	Shaft
473	Locking plate
497	Spring
507	Lock washer
519	Nut
532	Washer
544	Fitted bolt
556	Distance pipe
568	Eye bolt
581	Self-locking nut
603	Spring pin
615	Lever
627	Clamping arm
639	Screw
640	Lock washer
664	Spring pin

Item No.	Part Description

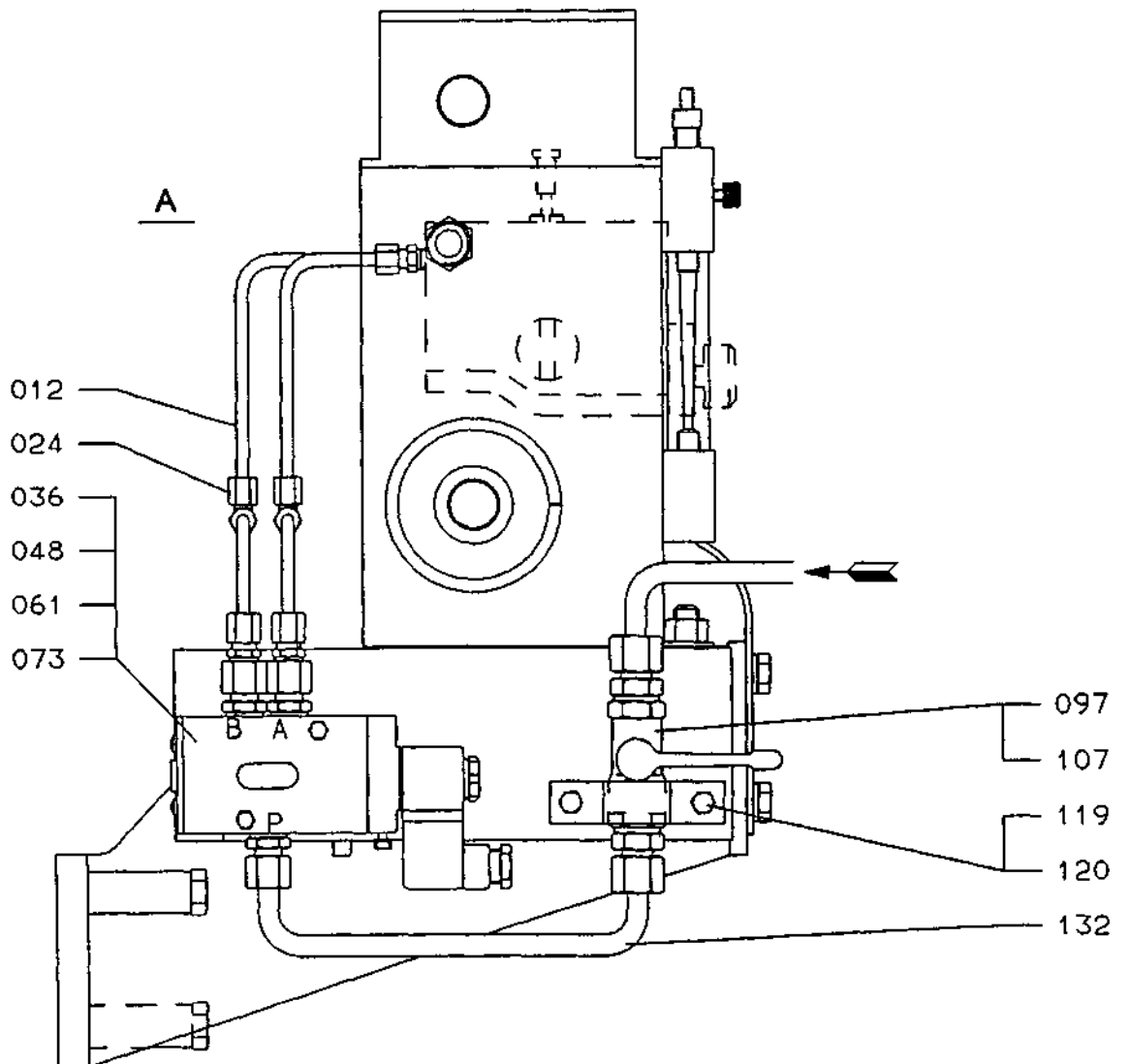
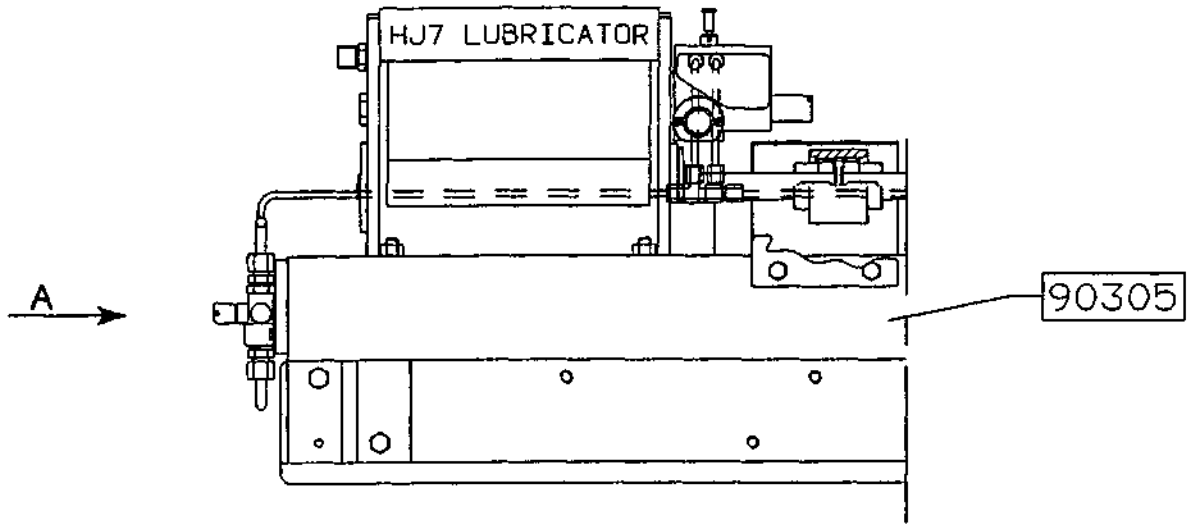


Plate 90306-10 Load Change Device

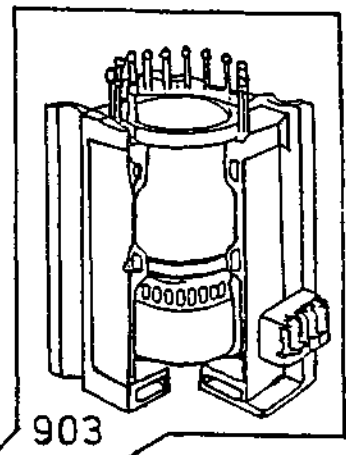
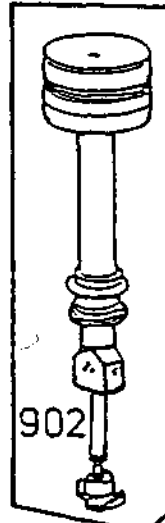
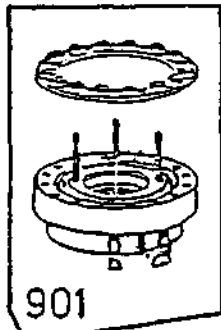
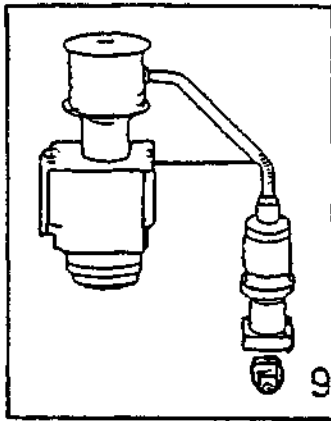
Item No.	Part Description
012	Copper pipe, L=3300
024	Coupling
036	5/2-way solenoid valve
048	Coupling
061	Connection
073	Screw
097	Ball valve
107	Coupling
119	Pipe holder
120	Screw
132	Copper pipe, L=250

Item No.	Part Description
----------	------------------

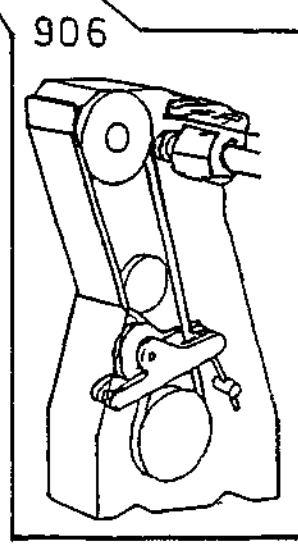
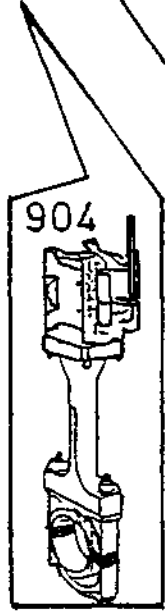
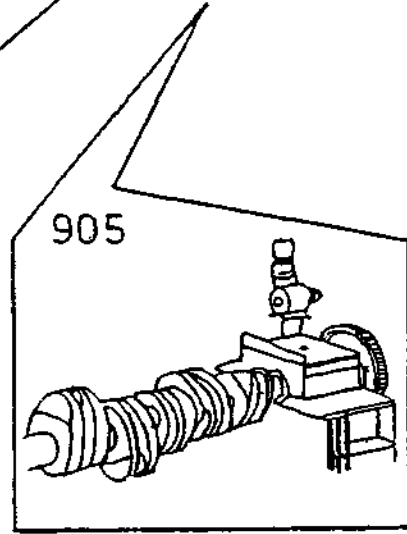
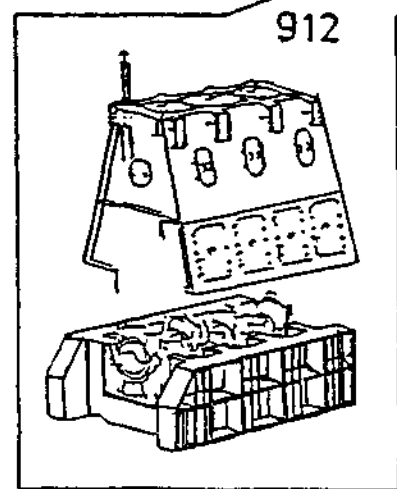
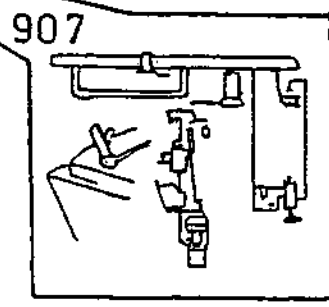
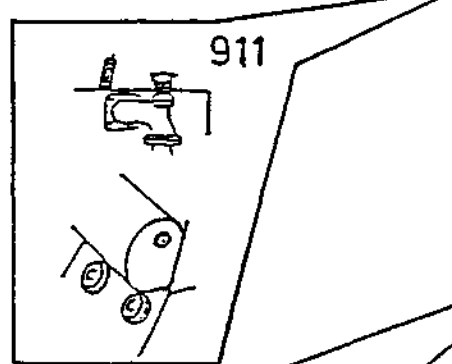
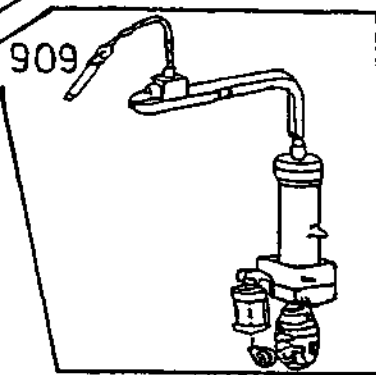
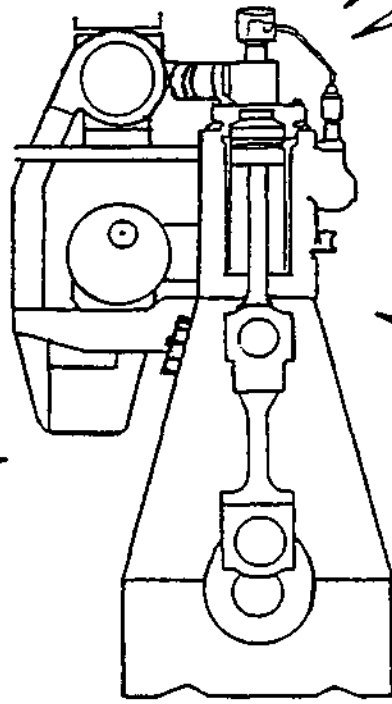
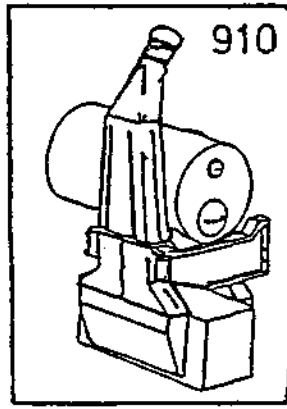


# CROSSHEAD WITH CONNECTING ROD

904



A  
(ACCESSORIES)



## Crosshead with Connecting Rod

The crosshead is provided with two guide shoes fitted floating on the crosshead ends.

The centre part of the crosshead is housed in the crosshead bearing.

The crosshead bearing cap is provided with a cut-out enabling the piston rod to be assembled with the crosshead journal.

The crosshead bearing is equipped with two lower bearing steel shells, which are lined with tin-aluminium. Furthermore, the lower shells have an overlayer coating of lead, tin and copper, and a flash-layer of tin.

*See also Vol. 1, OPERATION, Chapter 708.*

There is no upper bearing shell, as white metal has been applied directly onto the inner diameter of the crosshead bearing cap.

The piston rod foot rests on the crosshead, and is guided by a guide ring in the crosshead.

A shim is inserted between the piston rod and the crosshead. The thickness of the shim is calculated for each engine, in order to match the actual engine layout.

The piston rod is fastened to the crosshead by means of four screws, which are locked with locking wire.

The telescopic pipe, which supplies lubricating and cooling oil to the crosshead, crankpin and piston, is mounted on top of one of the guide shoes.

The guide shoe is also fitted with a counterweight in order to balance the weight of the telescopic pipe.

The outlet pipe for piston cooling oil is mounted on top of the other guide shoe. The outlet pipe slides within a slotted pipe inside the engine framebox, and from there the oil is led through a control device for each cylinder for the purpose of checking the temperature and flow before the oil is passed on to the lube oil tank.

The crosshead block is provided with bores for distributing the oil supplied through the telescopic pipe, partly as cooling oil for the piston, partly as lubricating oil for the crosshead bearing and guide shoes and – through a bore in the connecting rod – for lubricating the crankpin bearing.

The two sliding faces of the guide shoes are lined with cast-on white metal.

The crosshead is guided by crosshead guides in the engine framebox and properly secured against displacement by guide strips fastened to the guide shoes.

The crosshead pin and guide shoes are tightened together by means of plates and screws, located at the lower part of the pin.

The crosshead bearing is assembled by means of four studs and nuts. The nuts are tightened by means of hydraulic tools.

The crankpin bearing is fitted with bearing shells lined with tin-aluminium and a flash-layer of tin, and assembled by means of two studs and nuts. The nuts are tightened by means of hydraulic tools.

Both the crosshead bearing shells and the crankpin bearing shells are retained in position by means of screws fitted in the bearing housings.

Furthermore, the bearing assemblies are guided into position by guide pins.

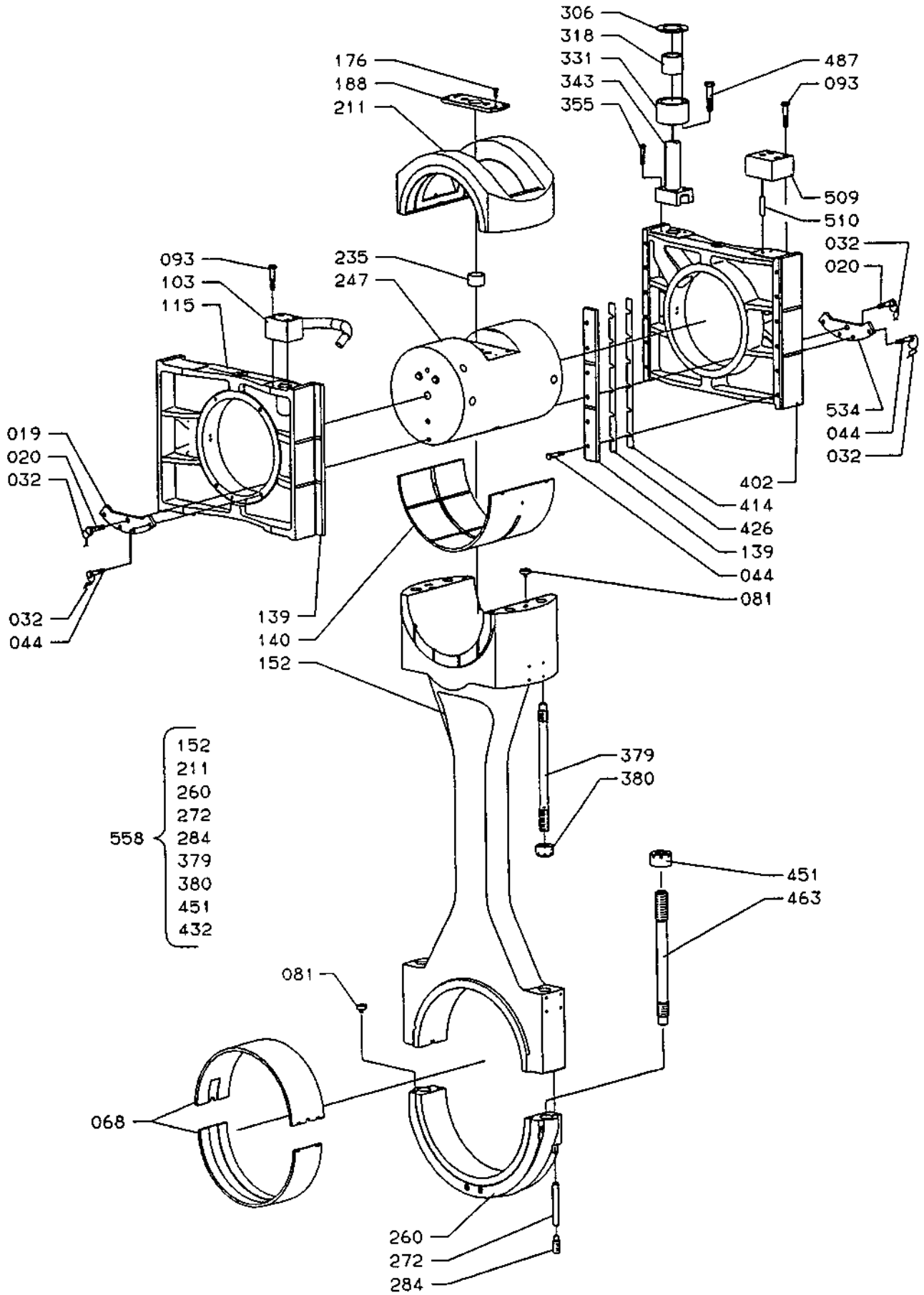


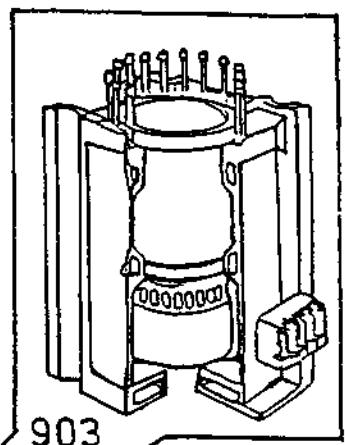
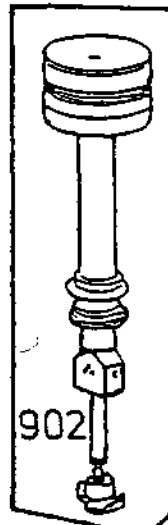
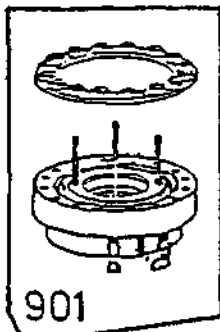
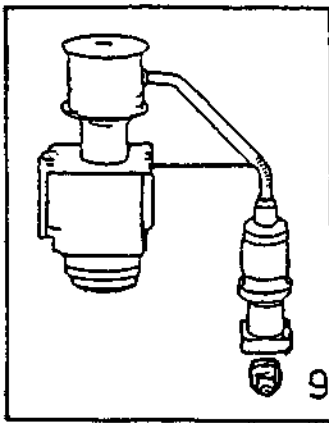
Plate 90401-106 Connecting Rod and Crosshead

Item No.	Part Description
019	Plate
020	Screw
032	Lock wire
044	Screw
068	Crankpin bearing shell, complete
081	Screw
093	Screw
103	Outlet pipe
115	Guide shoe
139	Guide strip
140	Crosshead bearing shell, lower part
152	Connecting rod
176	Screw
188	Shim *)
211	Crosshead bearing cap
235	Guide pipe
247	Crosshead
260	Crankpin bearing cap
272	Guide pin
284	Screw
306	Distance piece
318	Bushing
331	Housing for stuffing box
343	Telescope pipe
355	Screw
379	Stud
380	Nut
402	Guide shoe
414	Shim, 0.25 mm
426	Shim, 0.50 mm
451	Nut
463	Stud
487	Screw
509	Counterweight
510	Spring pin
534	Plate
558	Connecting rod, complete
	*For engines with shims - please state thickness of shims

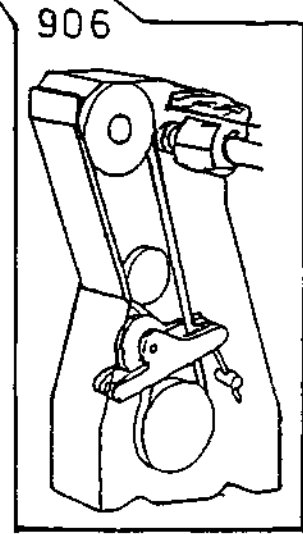
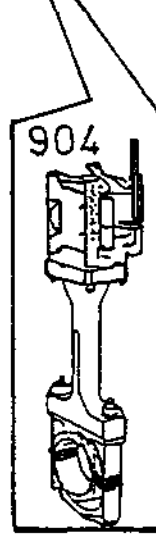
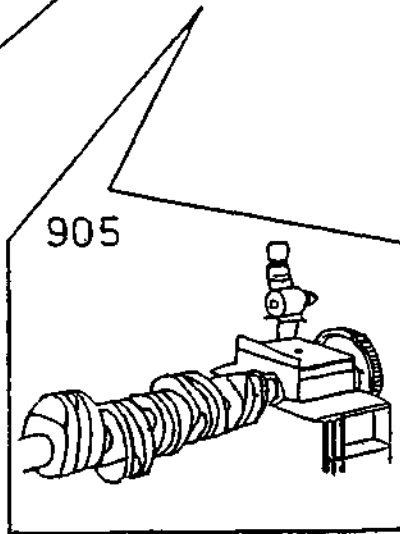
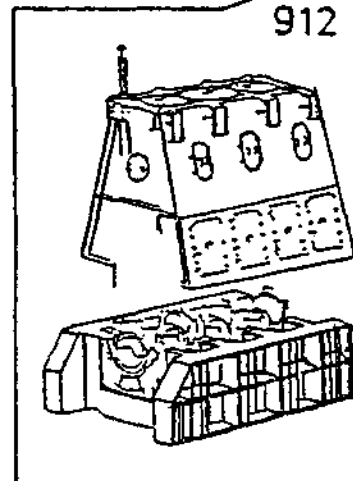
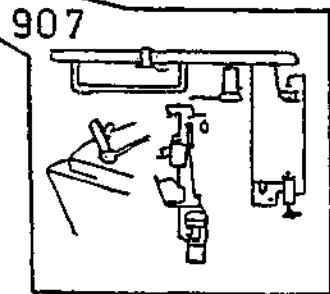
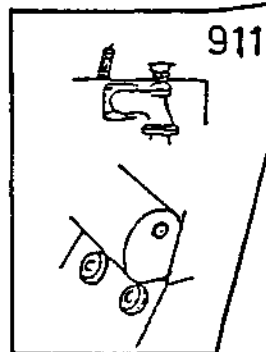
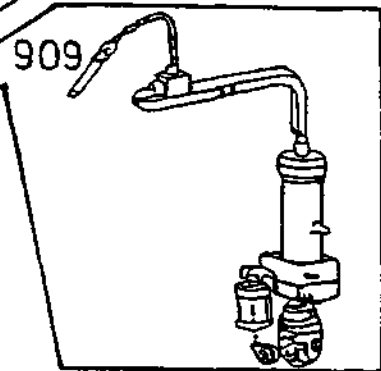
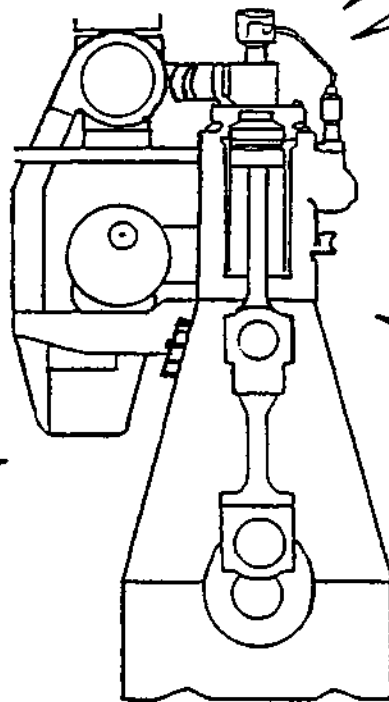
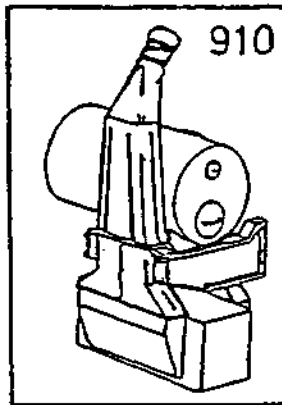
Item No.	Part Description

# CRANKSHAFT, THRUST BEARING AND TURNING GEAR

905



A  
(ACCESSORIES)



## Crankshaft, Thrust Bearing and Turning Gear

### Crankshaft

*Plate 90501*

The crankshaft is semi-built, i.e. the parts are either shrunk or welded together.

The main bearings are lubricated via a main lubricating oil pipe that branches off to the individual bearings, whereas oil for lubricating the crankpin bearings is supplied from the crossheads through bores in the connecting rods.

At the aftmost end of the crankshaft a turning wheel and a thrust collar for the thrust bearing is fitted.

The chainwheel for the camshaft drive is fitted on the thrust collar.

At the foremost end of the crankshaft, a tuning wheel, a torsional vibration damper and a chain wheel drive for the 2nd order moment compensator may be installed.

### Axial Vibration Damper

In order to counteract heavy axial vibrations, and any resultant adverse forces and vibrations, the engine is provided with an axial vibration damper on the foremost end of the crankshaft, *see Plate 91211*.

The damper consists of a 'piston' and a slit-type housing located in front of the foremost main bearing. The 'piston' is made as an integrated collar on the foremost main bearing journal, and the housing is mounted on the foremost main bearing support.

The axial movement is damped due to the 'restrictions' incorporated in the bores which interconnect the oil-filled chambers on the two sides of the 'piston'.

Lubricating oil is supplied to both sides of the 'piston' from the main system.

### Thrust Bearing

*Plate 90505*

The thrust bearing serves the purpose of transmitting the axial thrust of the propeller through propeller shaft and intermediate shafts to the ship's hull.

The thrust bearing is incorporated in the aftermost part of the engine bedplate.

The crankshaft is provided with a thrust collar which transmits the thrust to a number of segments mounted in a thrust shoe on either side of the thrust collar.

The thrust shoes rest on surfaces in the thrust bearing housing and are held in place by means of four stoppers. The segments have white metal cast on the wearing faces against the thrust collar.

*See also Vol. 1, OPERATION, Chapter 708.*

The thrust bearing is lubricated from the pressure lubrication system of the engine. The oil is supplied between the segments through spray pipes and spray nozzles.

The thrust bearing is provided with alarm, slow-down, and shut-down devices for low lube oil pressure and high segment temperature. *See also Vol. 1, OPERATION, Chapter 701.*

### Turning Gear

*Plate 90510*

The turning gear is attached to the engine bedplate and is driven by an electric motor incorporating a disc brake.

Through a belt drive and a planetary gearing, the motor drives a horizontal shaft equipped with a gear wheel which can be axially displaced by means of a hand wheel, so as to engage with the turning wheel of the engine.



The turning gear is provided with a safety arrangement consisting of a lever which must be lifted before the gear wheel of the turning gear can be made to engage with the turning wheel.

Immediately this lever is lifted away from the **disengaged** position, an interlock valve inserted in the starting air system of the engine is actuated. This interlock prevents starting air from being supplied to the engine as long as the turning gear is in the **engaged** position.

*See also Vol. I, OPERATION, Chapter 703.*

When the safety lever is in its bottom position, it prevents the gear wheel of the turning gear from engaging with the turning wheel.

<b>Warning !</b>	
<b>Dismantling of working parts:</b>	<p>During any dismantling of working parts of the engine, the turning gear must be in the <b>engaged</b> position in order to prevent outside forces from turning the engine, thus causing injuries to personnel or damage to the machinery.</p> <p><i>See Vol. II, MAINTENANCE, 'DATA' pages.</i></p>
<b>Pressure testing of starting valves:</b>	<p>The turning gear must be in the <b>disengaged</b> position during pressure testing of starting valves, as a leaky valve may cause the engine to rotate, and damage the turning gear.</p> <p><i>See Vol. I, OPERATION, Chapter 703.</i></p>

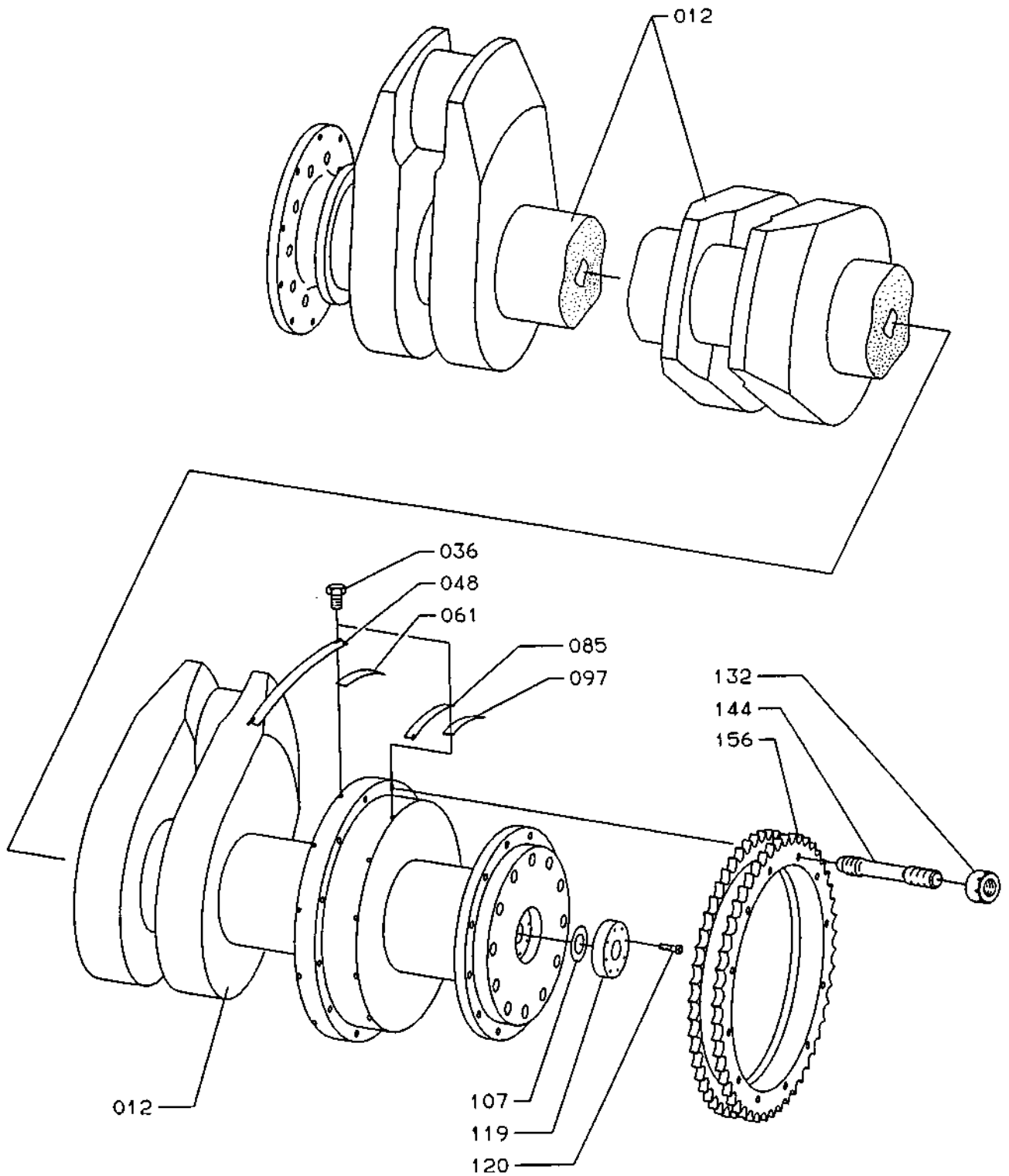


Plate 90501-122 Crankshaft

Item No.	Part Description
012	Crankshaft
036	Screw
048	Guard
061	Guard
085	Guard
097	Guard
107	Gasket
119	Cover
120	Screw
132	Nut
144	Stud
156	Chain wheel

Item No.	Part Description
----------	------------------

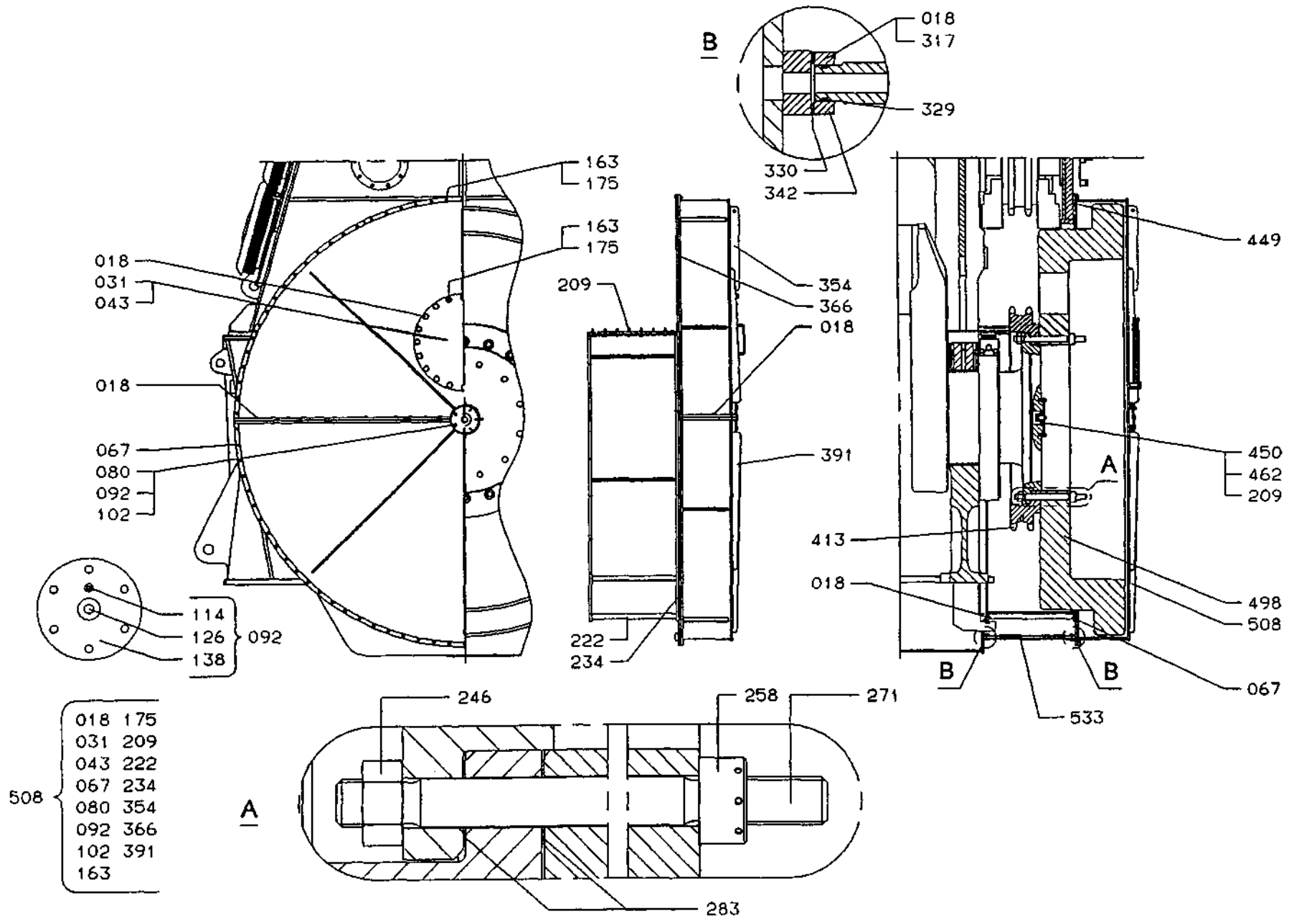
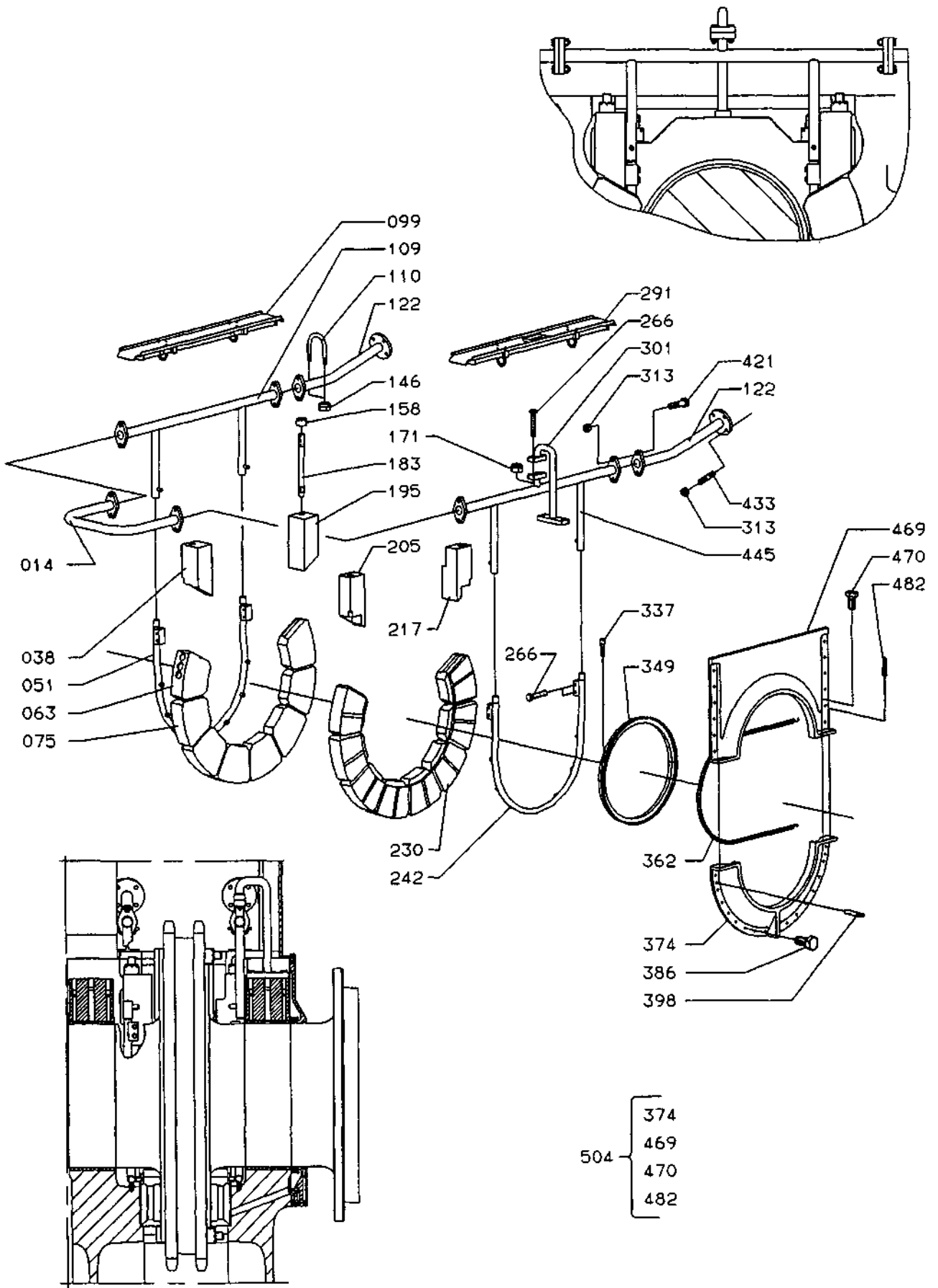


Plate 90502-22 Arrangement of Fore End

Item No.	Part Description
018	Screw
031	Gasket
043	Cover
067	Screw
080	Screw
092	Cover, complete
102	Gasket
114	Plug screw
126	Plug screw
138	Cover
163	Stud
175	Nut
209	Screw
222	Shield
234	Lower flange for shield
246	Nut
258	Nut for hydraulic tightening
271	Stud
283	Disc
317	Washer
329	O-ring
330	Gasket
342	Flange
354	Shield - upper
366	Upper flange for shield
391	Shield - lower
413	Chain wheel
449	Gasket
450	Flange
462	Glue for metal
498	Tuning wheel
508	Shield-fore, complete
533	Outlet pipe

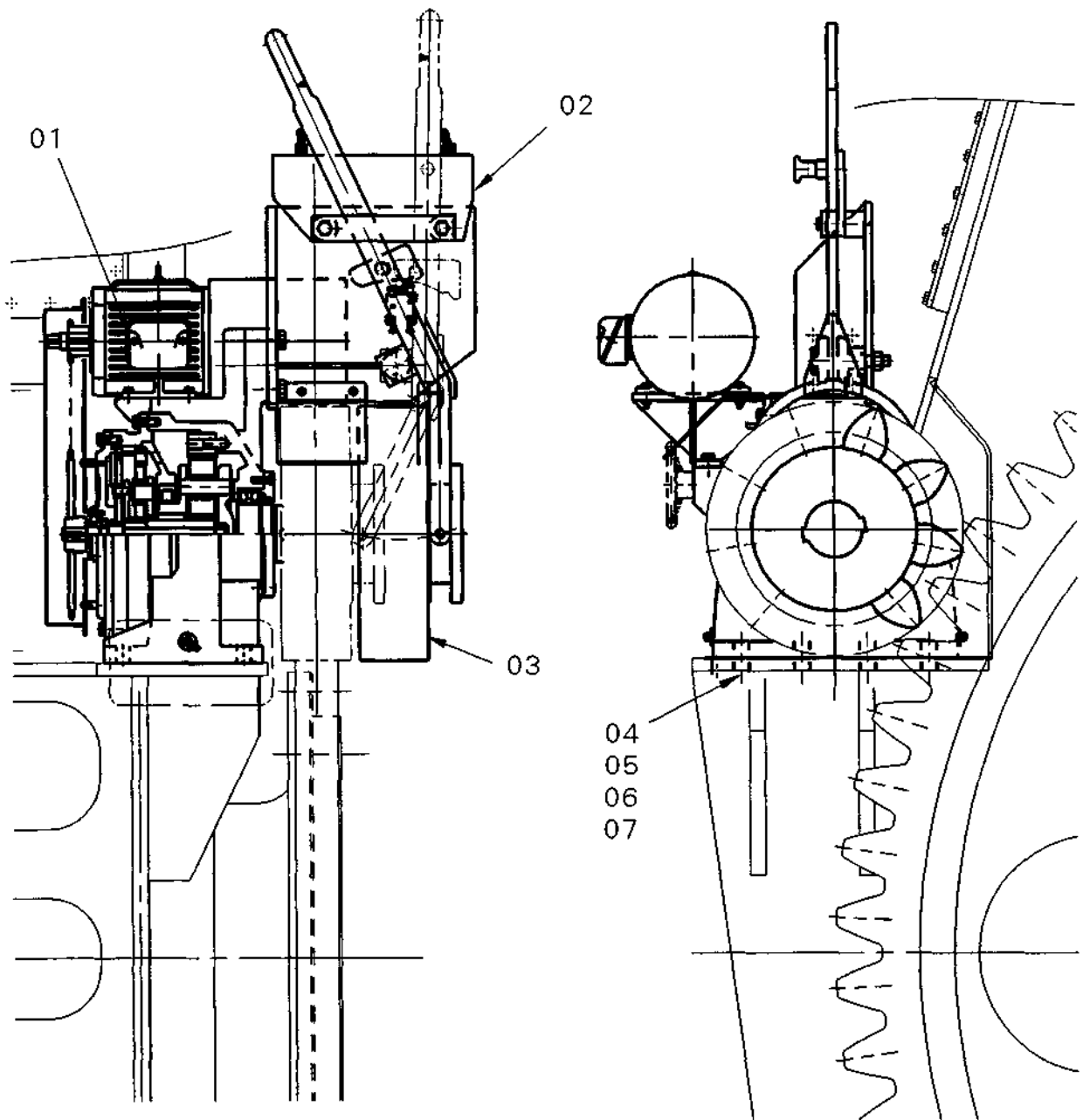
Item No.	Part Description



**Plate 90505-94 Thrust Bearing**

Item No.	Part Description
014	Lub.oil pipe
038	Segment stopper
051	Spray pipe
063	Segment with sensor pockets
075	Segment "Ahead"
099	Cover
109	Lub.oil pipe
110	Clamp
122	Lub.oil pipe
146	Self-locking nut
158	Nut
171	Self-locking nut
183	Stud
195	Segment stopper
205	Segment stopper
217	Segment stopper
230	Segment "Astern"
242	Spray pipe
266	Screw
291	Cover
301	Lub.oil pipe
313	Self-locking nut
337	Screw
349	Oil throw ring
362	Spring
374	Housing, lower half
386	Screw
398	Guide pin
421	Screw
433	Stud
445	Lub.oil pipe
469	Housing, upper half
470	Screw
482	Guide pin
504	Scraper ring housing, complete

Item No.	Part Description



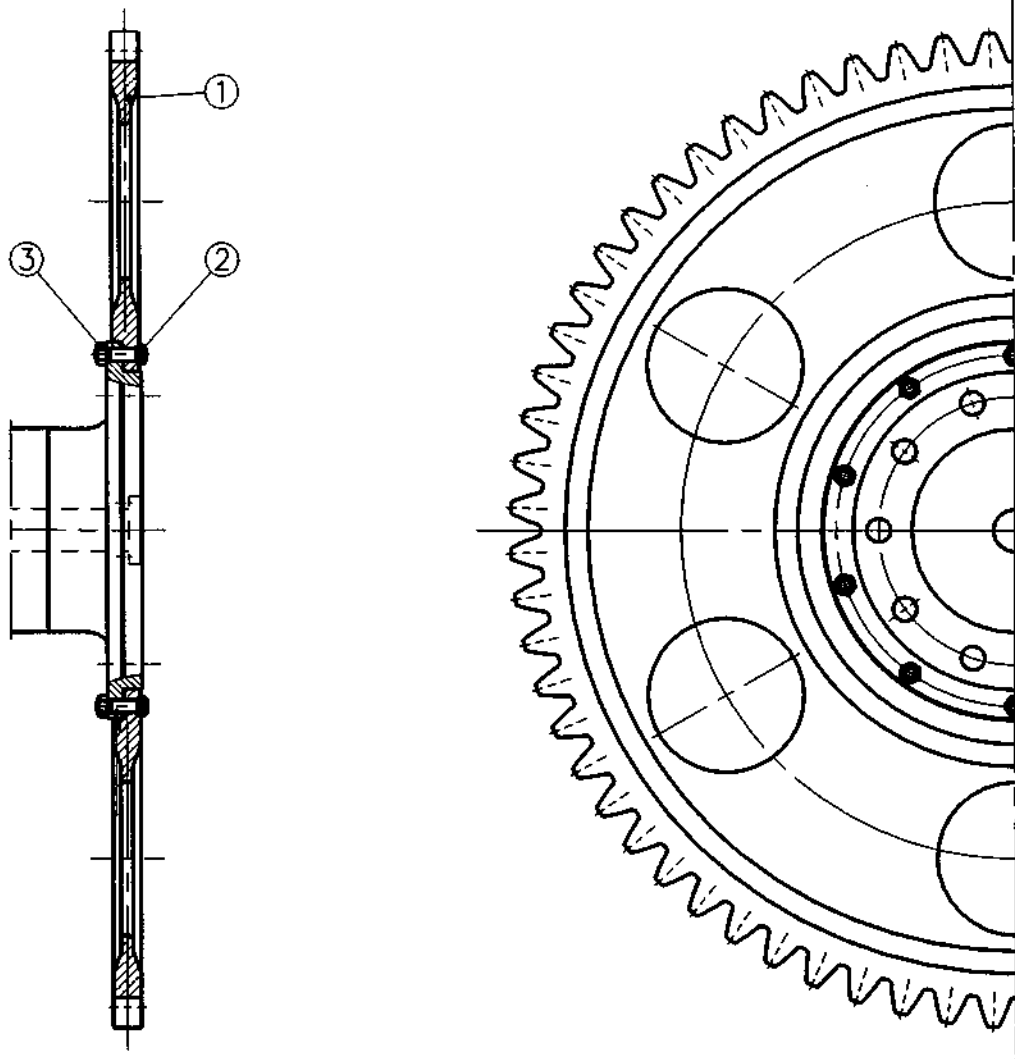


**Plate 90510-84 Turning Gear**

Item No.	Part Description
01	Planet gear
02	Disengaging device
03	Pin
04	Bolt
05	Distance pipe
06	Distance pipe
07	Nut

Item No.	Part Description
----------	------------------

S50MC-C



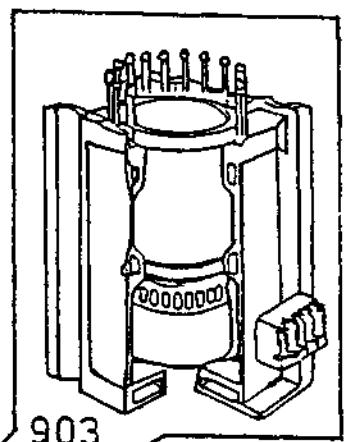
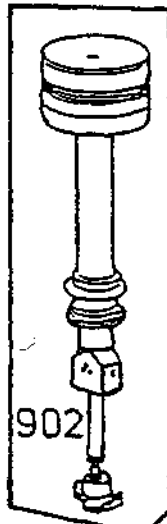
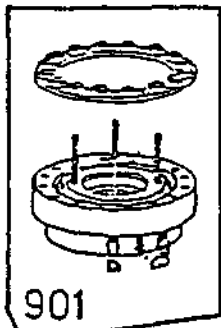
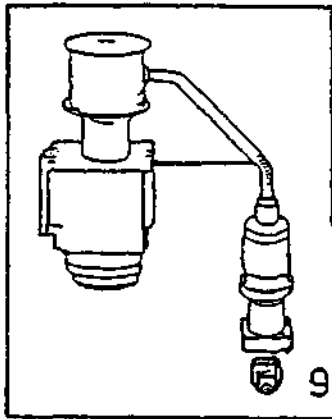
**Plate 90510-85 Turning Wheel**

Item No.	Part Description
01	Turning wheel
02	Fitted bolt
03	Nut

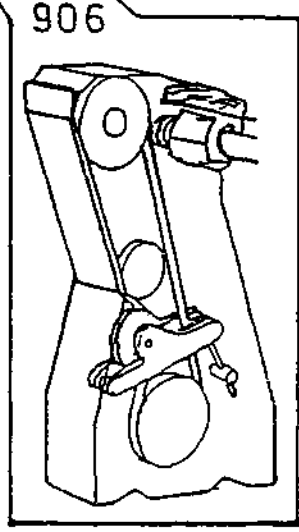
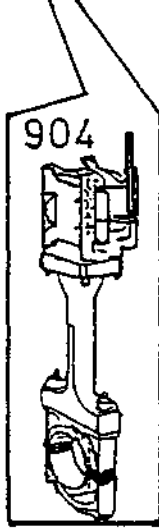
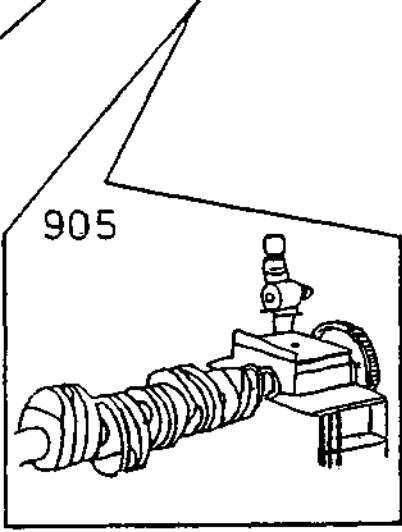
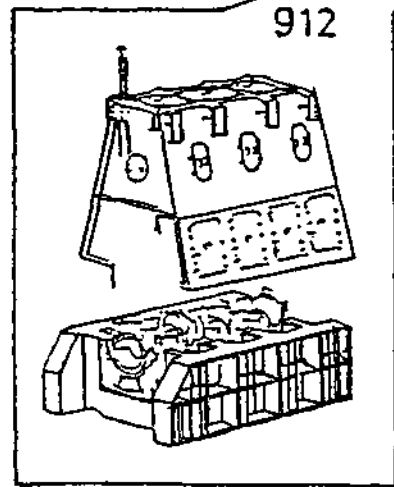
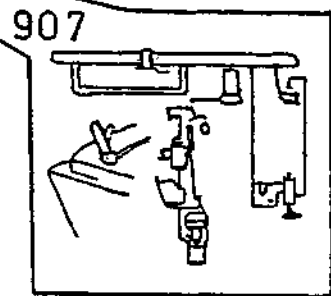
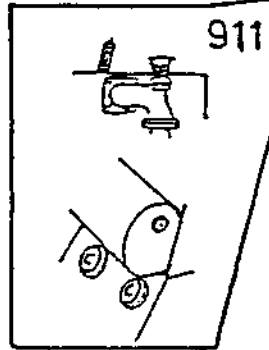
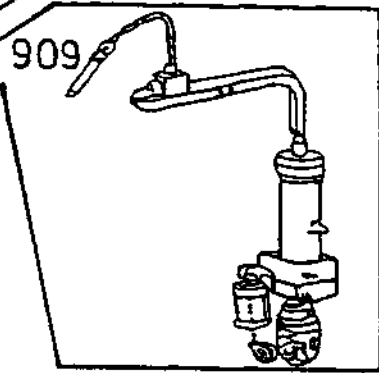
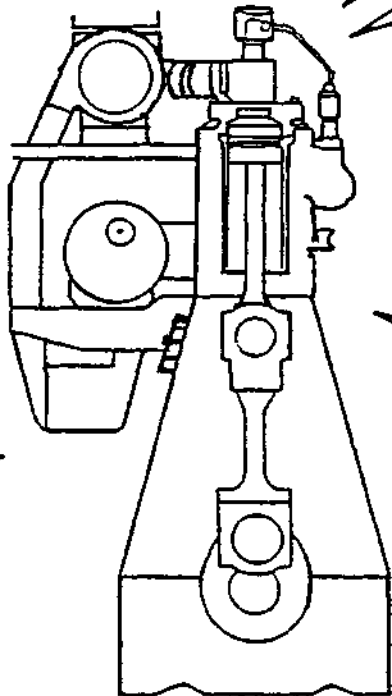
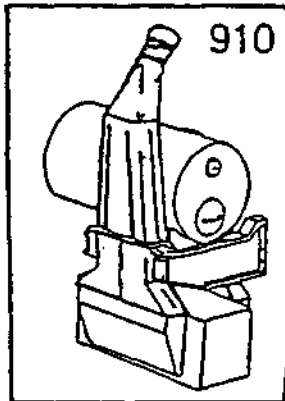
Item No.	Part Description
----------	------------------

# MECHANICAL CONTROL GEAR

906



A  
(ACCESSORIES)



## Mechanical Control Gear

### Chain Drive

*Plate 90600*

The camshaft with cams for operating the fuel pumps, exhaust valves and indicator drives (option) is driven from the crankshaft through a chain drive located at the aft end of the engine.

The chain drive consists of two identical roller chains running on chain wheels fitted on the crankshaft and the camshaft. The chains are kept tightened by means of a chain tightener placed between the two chain wheels.

The long free lengths of the chains are guided by rubber-clad guide bars. Lubricating oil is supplied through spray pipes fitted at the guide bars and chain wheels.

The starting air distributor is driven directly from one end of the camshaft, and the cylinder lubricators are driven from the other end of the camshaft.

### Chain Tightener

The chain tightener consists of a chain tightener bracket which is pivoted on a shaft pin and a chain wheel.

The chain wheel has a shrunk-in bearing bushing and is mounted on a shaft between the side plates of the bracket.

The chain tightener is operated by a tightener bolt in the free end of the forked arm for the chain wheel. The tightener bolt extends through a pin that is free to turn in the chain casing.

#### Caution !

Before retightening the chain, the engine must be turned into such a position that the chain is slack at the side where the chain tightener wheel is fitted and the counterweights, if any, are hanging vertically downwards in order not to affect the chain.

*Regarding absolute wear of the chains, see Vol. II, MAINTENANCE, Procedure 906.*

### Camshaft

*Plates 90611 – 90613*

The camshaft is built together of a number of camshaft sections. The sections are assembled by means of flange couplings which are joined together with fitted bolts and nuts.

In addition to the coupling flanges, the camshaft sections have, for each cylinder:

- one cam for operation of the fuel pump
- one cam for the exhaust valve
- one cam for the indicator drive (option).

The cam for the indicator drive is in two parts, which are assembled by means of two fitted bolts.

The camshaft is carried in single-shell (lower shell) bearing assemblies, which are fitted in the roller guide housings between the cam discs for fuel pump and exhaust valve. The bearings are of the thin-shell type. The bearing caps are tightened against the camshaft housing by means of flanged screws.

*See also Vol. I, OPERATION, Chapter 708.*

The coupling flanges and the fuel pump and exhaust valve cams are shrunk onto the shaft by heating. Dismantling of flanges is effected by forcing lubricating oil in between the shaft and the flange, *see Volume II.*

The same procedure is used for turning the fuel cam with a view to adjusting the fuel cam top lift and also when adjusting the camshaft in case the chains have become worn and elongated following retightening.

The camshaft rotation constantly follows that of the crankshaft. When the engine is reversed, the position of the rollers of the individual fuel pump roller guides is being shifted in relation to the respective cam discs, thus altering the fuel pump timing to

suit the new direction of rotation.  
See Chapter 909.

After the engine has been testrun, the camshaft parts and the cylinder frame will be provided with pin gauge marks, and the necessary pin gauges are delivered together with the engine, enabling the camshaft timing to be checked and readjusted if the parts have been dismantled.

The pin gauges are marked with:

- engine type
- engine number
- point of application
- the distance in mm between the measuring points.

Furthermore, the length of the pin gauges is indicated in the relevant section of the maintenance book (*Volume II*) for the plant.

## Indicator Valve

*Plate 90612*

Each cylinder is fitted with an indicator valve, which communicates with the combustion chamber of the cylinder through a bore. The indicator valve is a double-seated valve with a spring-loaded closing face.

In order to prevent overstressing, close the valve with a light hand before starting the engine, and retighten the valve when the engine has reached its normal service temperature.

## Indicator Drive (option)

*Plate 90612*

An indicator cam is fitted for each cylinder. An indicator drive is arranged above this cam.

The indicator drive consists of a spring-loaded spindle which is able to move up and down, corresponding to the movement

of the main piston within the engine cylinder. This motion is transmitted from the indicator cam through a roller at the bottom of the spindle. At the top, the spindle has an eye to which the indicator cord is fastened after the indicator has been mounted on the indicator valve.

During normal running of the engine, the spring-loaded spindle is lifted clear of the indicator cam, the handle of the spindle being in the locked position.

When diagrams are to be taken, the handle is turned 90° whereby the spindle enters a keyway which enables the spindle to be lowered onto the indicator cam. The keyway will guide the spindle during its up-and-down movement.

*For use of the indicator, see Vol. I, OPERATION, Chapter 706.*

## Moment Compensators

### 2nd order moment

4, 5, and 6-cyl. engines have a 2nd order external moment which might excite vibration of the hull and deckhouse.

Based on calculations, these cylinder numbers may be provided with flyweights built into the main chain drive.

Flyweights may also be built into a second chain drive, which is driven from the fore end of the crankshaft. This chain drive is equipped with a spring-loaded chain tightener.

Optionally, an electrically driven compensator can be installed outside the engine.

### 1st order moment

4-cyl. engines may have a rather high 1st order external moment, and can, therefore, be provided with a 1st order moment compensator arranged as adjustable counterweights on the fore and aft ends of the crankshaft.

Alternatively, the 1st order moment compensator can be arranged in the main chain drive.

This moment compensator consists of a (new) chain-tightener wheel with an incorporated counterweight and a counterweight rotating with the crankshaft.

If the chain drives for the above compensators have been dismantled, the flyweights must be positioned correctly in relation to the crankshaft of the engine.

*See the instruction book, Vol. II, MAINTENANCE.*

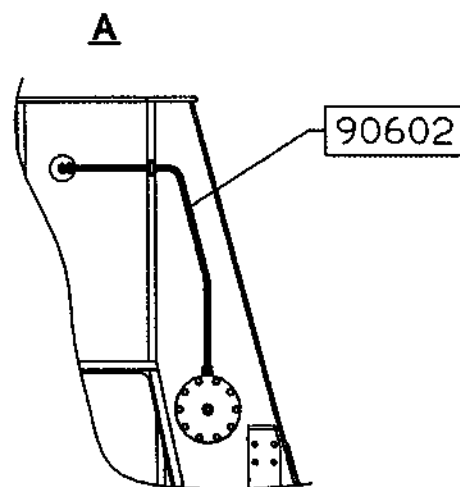
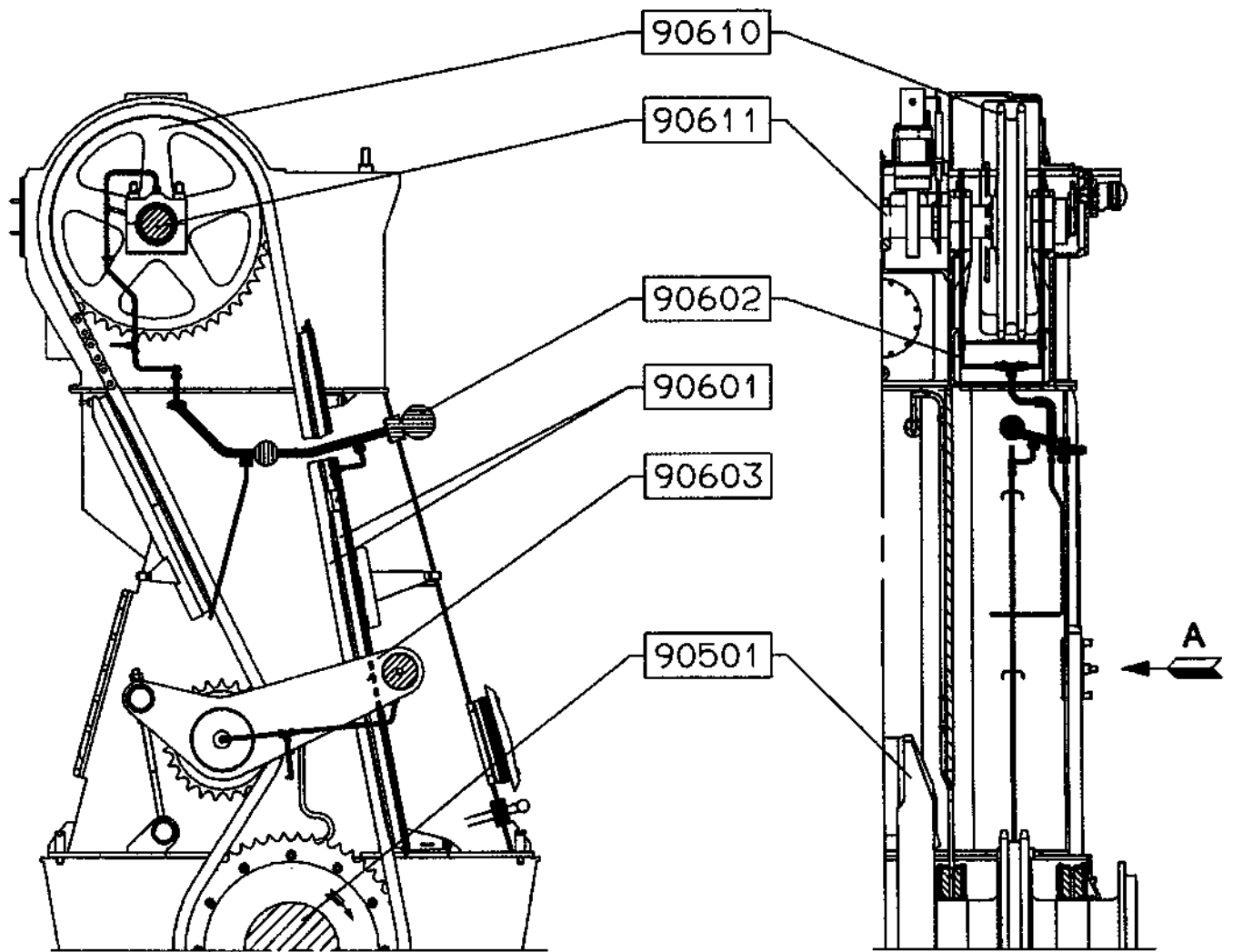
Incorrectly fitted moment compensators may excite heavy vibrations.

### **Load Transmitter**

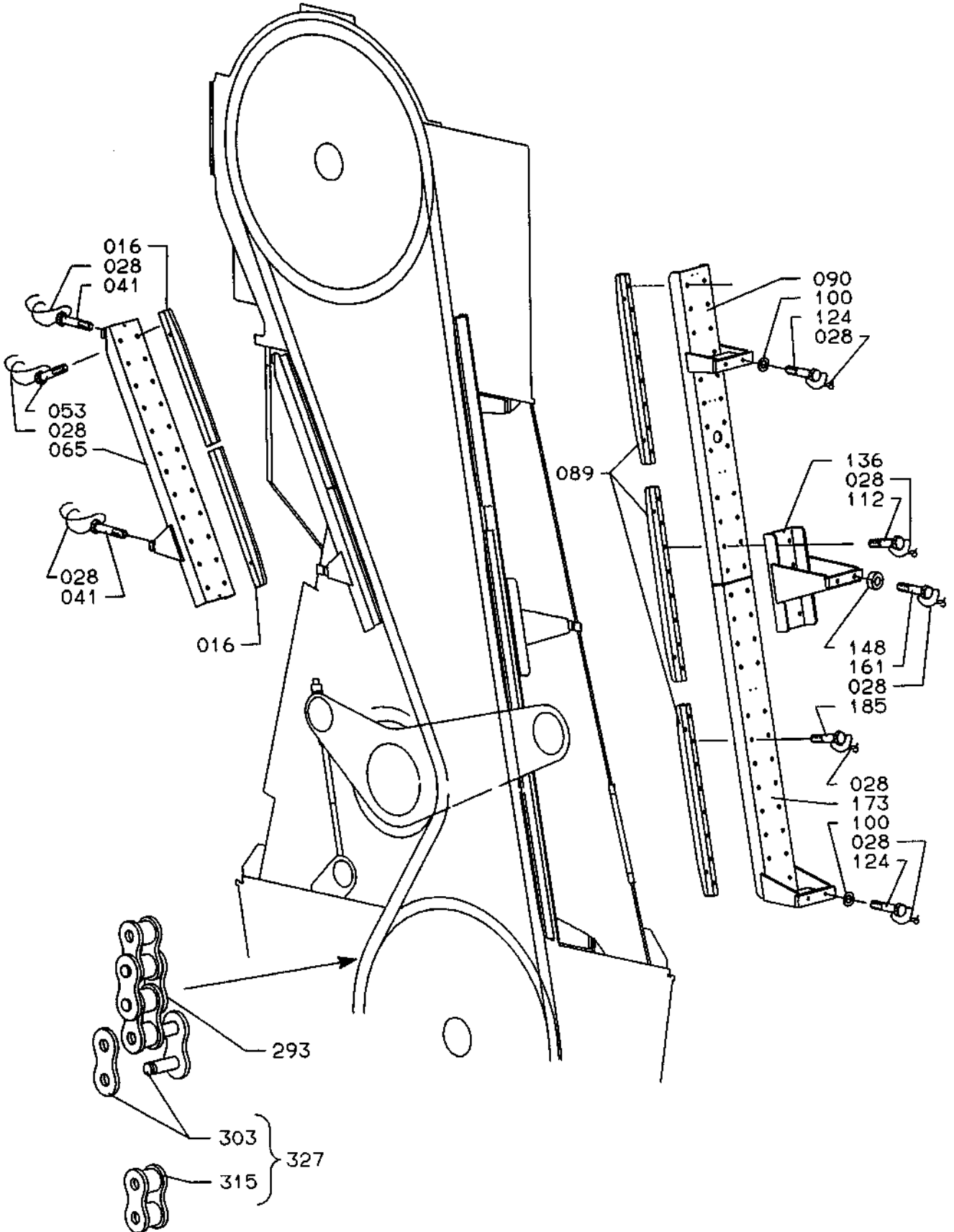
A load transmitter may be mounted on the fuel regulating shaft to give a remote indication of the fuel pump index.



S50MC-C



**S50MC-C**

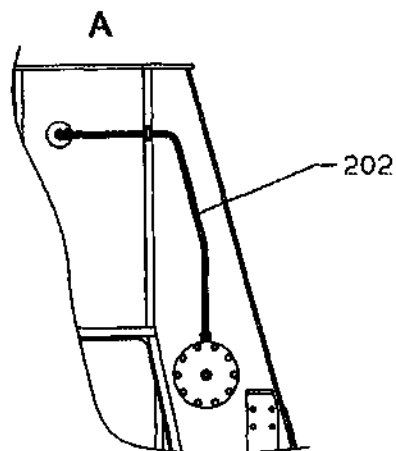
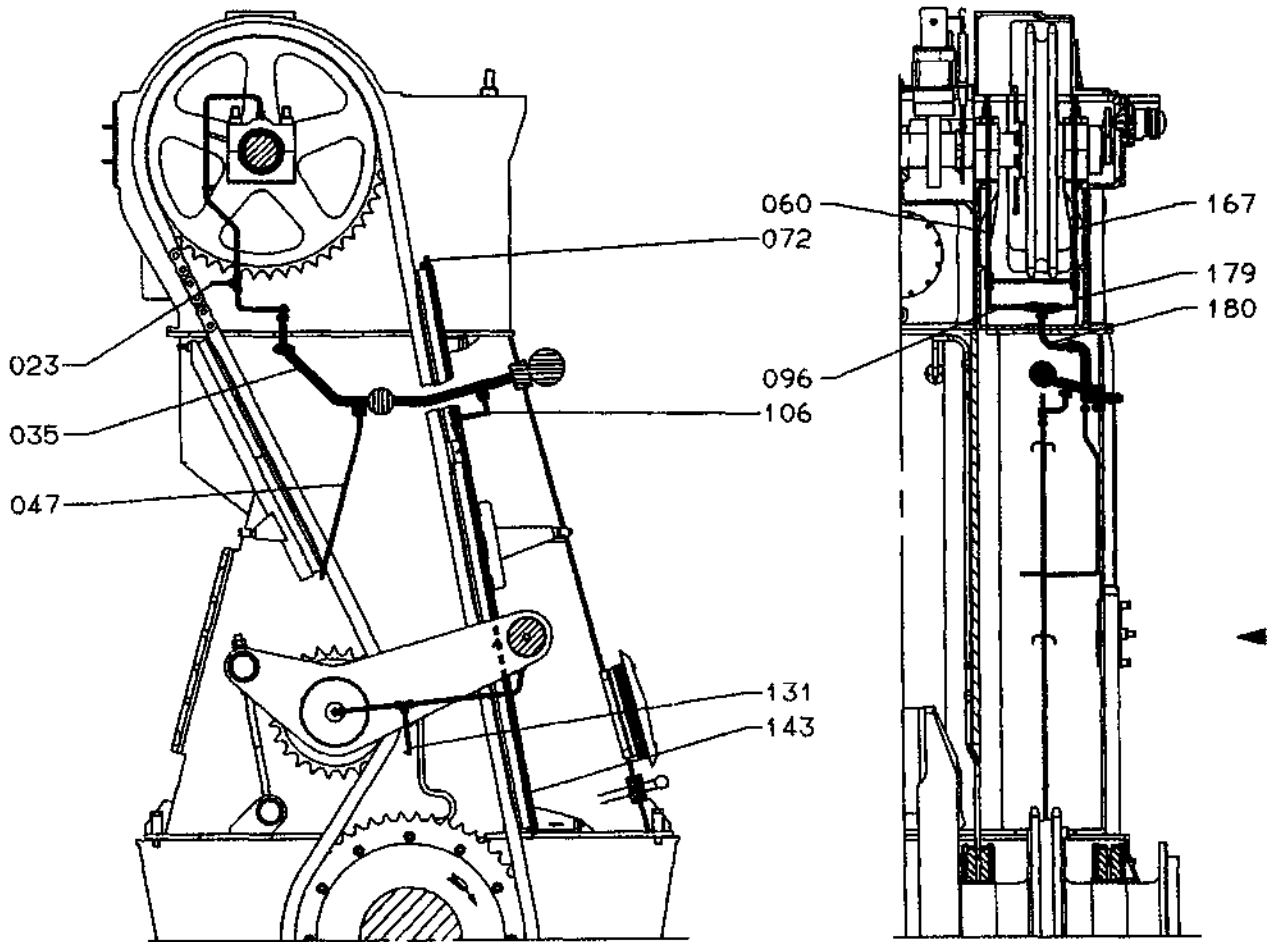


**Plate 90601-89 Chain Drive and Guide Bars**

Item No.	Part Description
016	Guidebar
028	Locking wire
041	Screw
053	Screw
065	Bracket for guidebar
089	Guidebar
090	Beam for guidebar
100	Washer
112	Screw
124	Screw
136	Bracket
148	Disc
161	Screw
173	Beam for guidebar
185	Screw
293	3½" Chain, complete
303	Chain link, complete
315	Outer link
327	Inner link

Item No.	Part Description

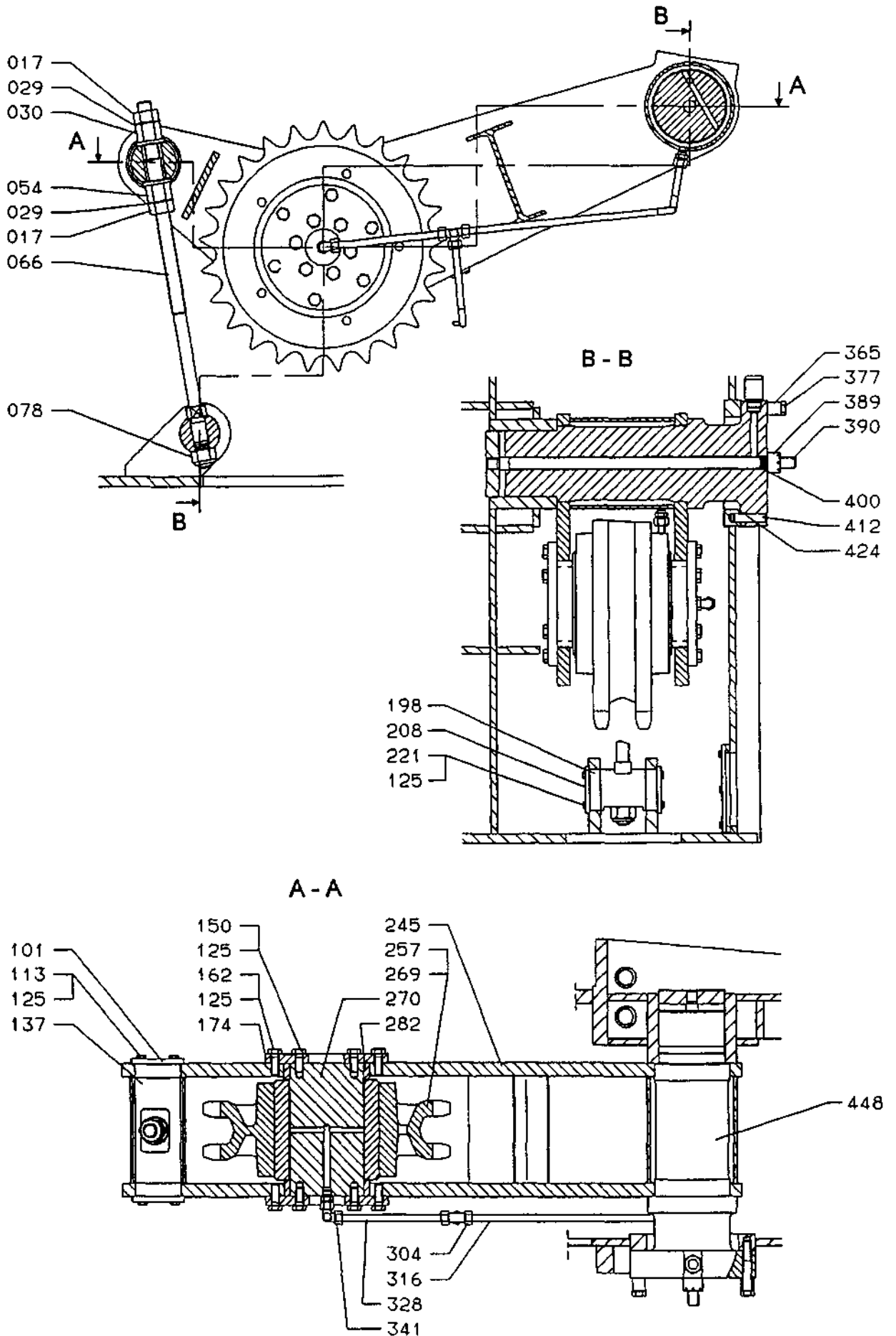
**S50MC-C**



**Plate 90602-111 Chain Drive - Lubrication**

Item No.	Part Description
023	Spray pipe
035	Lub.oil pipe
047	Spray pipe
060	Lub.oil pipe
072	Spray pipe
096	Lub.oil pipe
106	Lub.oil pipe
131	Spray pipe
143	Spray pipe
167	Lub.oil pipe
179	Lub.oil pipe
180	Lub.oil pipe
202	Steel pipe, L=1780

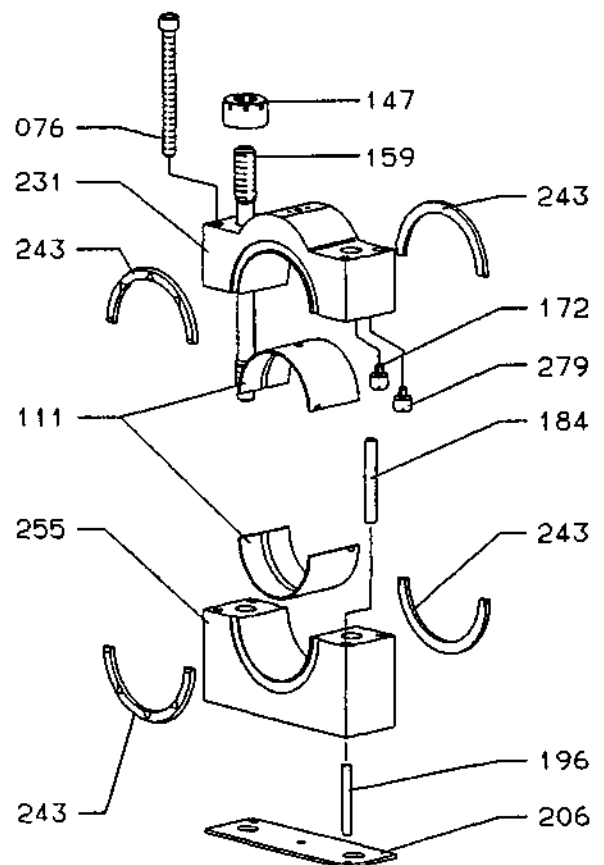
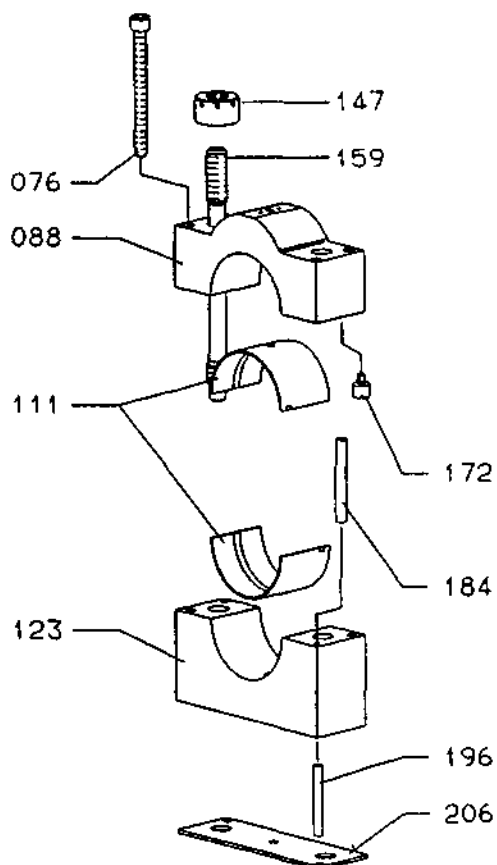
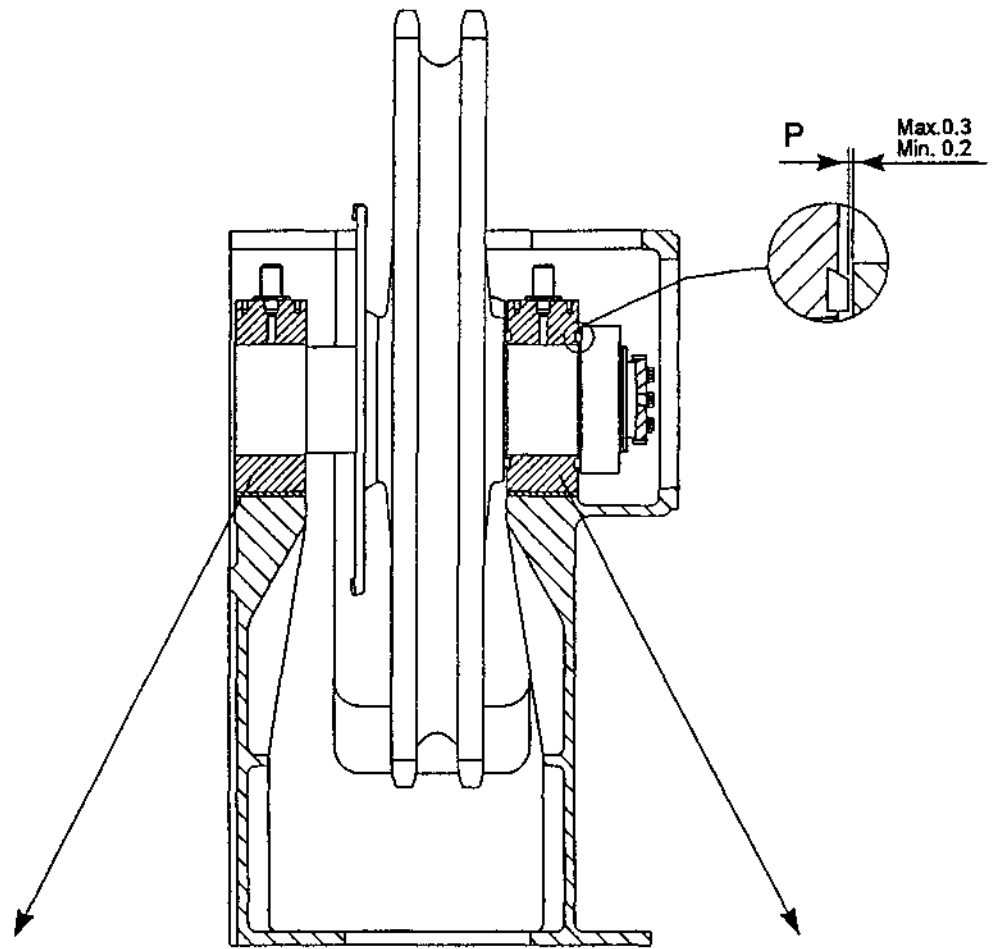
Item No.	Part Description
----------	------------------



**Plate 90603-79 Chain Tightener**

Item No.	Part Description
017	Nut
029	Locking plate
030	Guide nut
054	Guide nut
066	Tightening bolt
078	Self-locking nut
101	Cover
113	Screw
125	Locking wire
137	Shaft
150	Screw
162	Screw
174	Flange
198	Shaft
208	Cover
221	Screw
245	Bracket
257	Chain wheel
269	Bushing
270	Shaft
282	Distance piece
304	Coupling
316	Lub.oil pipe
328	Lub.oil pipe, L=350
341	Coupling
365	Distance pipe, L=40
377	Screw
389	Nut
390	Stud
400	Sealing ring
412	Guide pin
424	O-ring
448	Shaft

Item No.	Part Description





**Plate 90610-E94 Chain Wheel on Camshaft**

Item No.	Part Description
076	Screw
088	Bearing, upper part
111	Bearing shell
123	Bearing, lower part
147	Nut
159	Stud
172	Screw
184	Guide pin
196	Guide pin
206	Shim
231	Bearing, upper part
243	Thrust ring
255	Bearing, lower part
279	Screw

Item No.	Part Description
----------	------------------

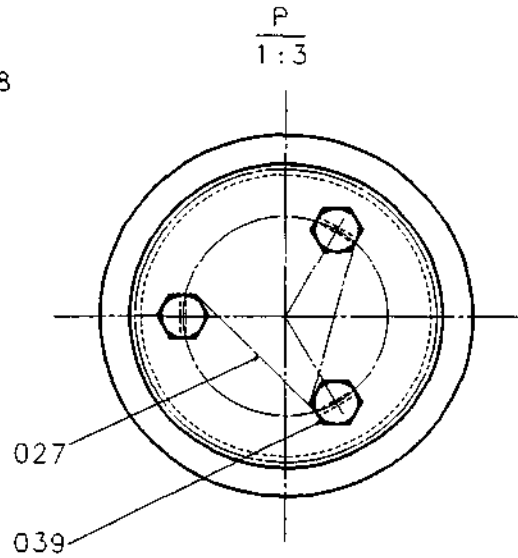
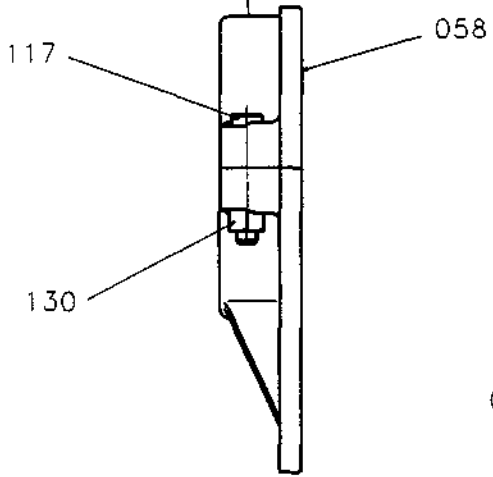
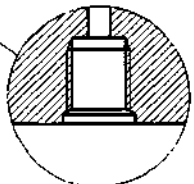
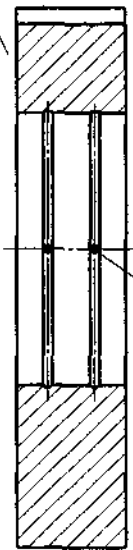
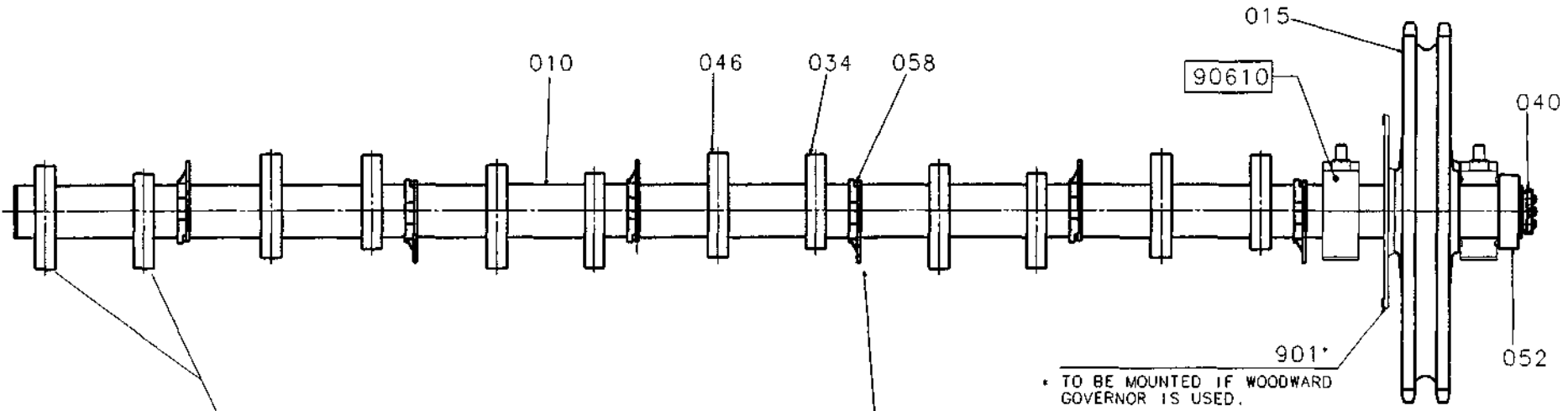
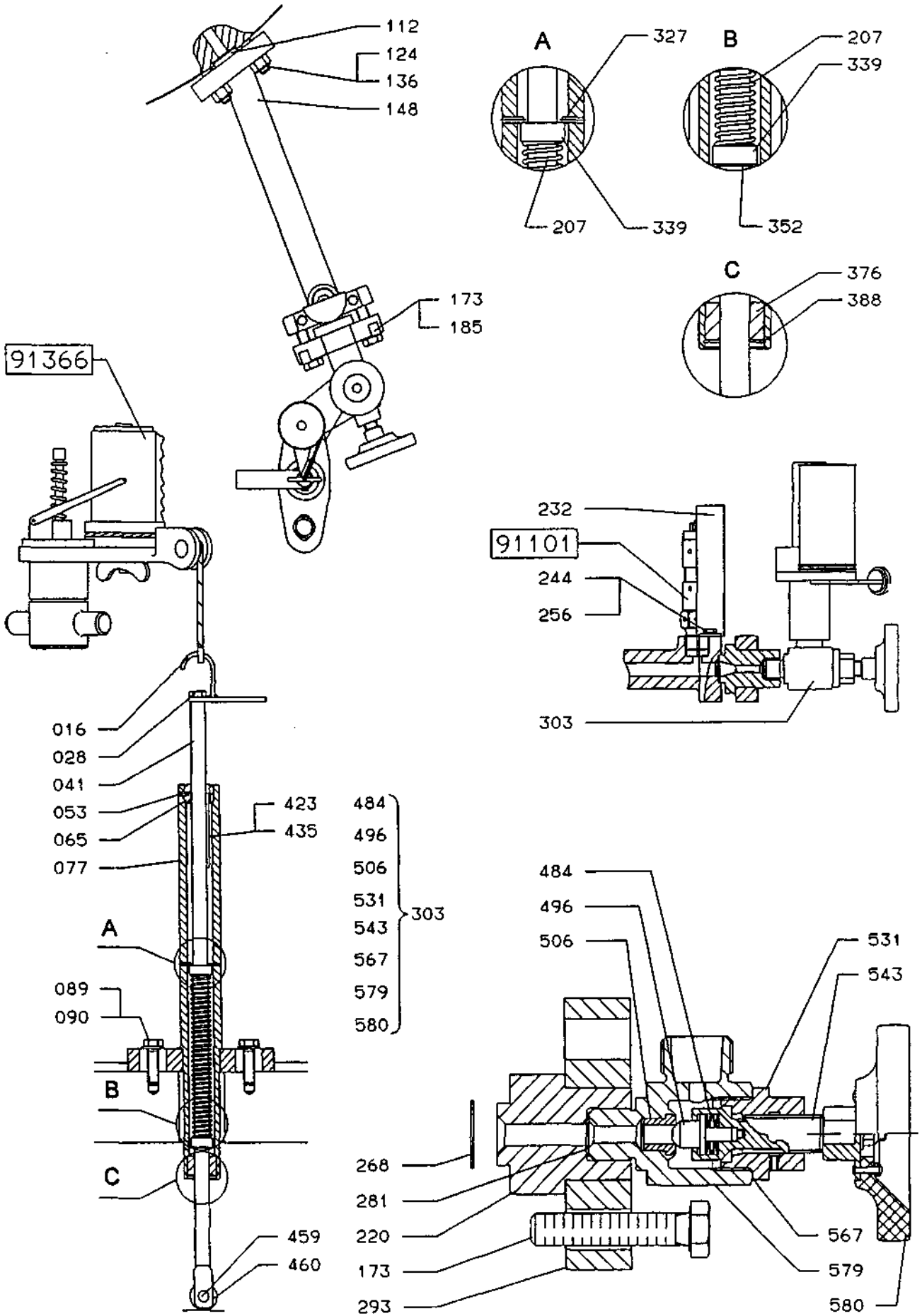


Plate 90611-E115 Camshaft

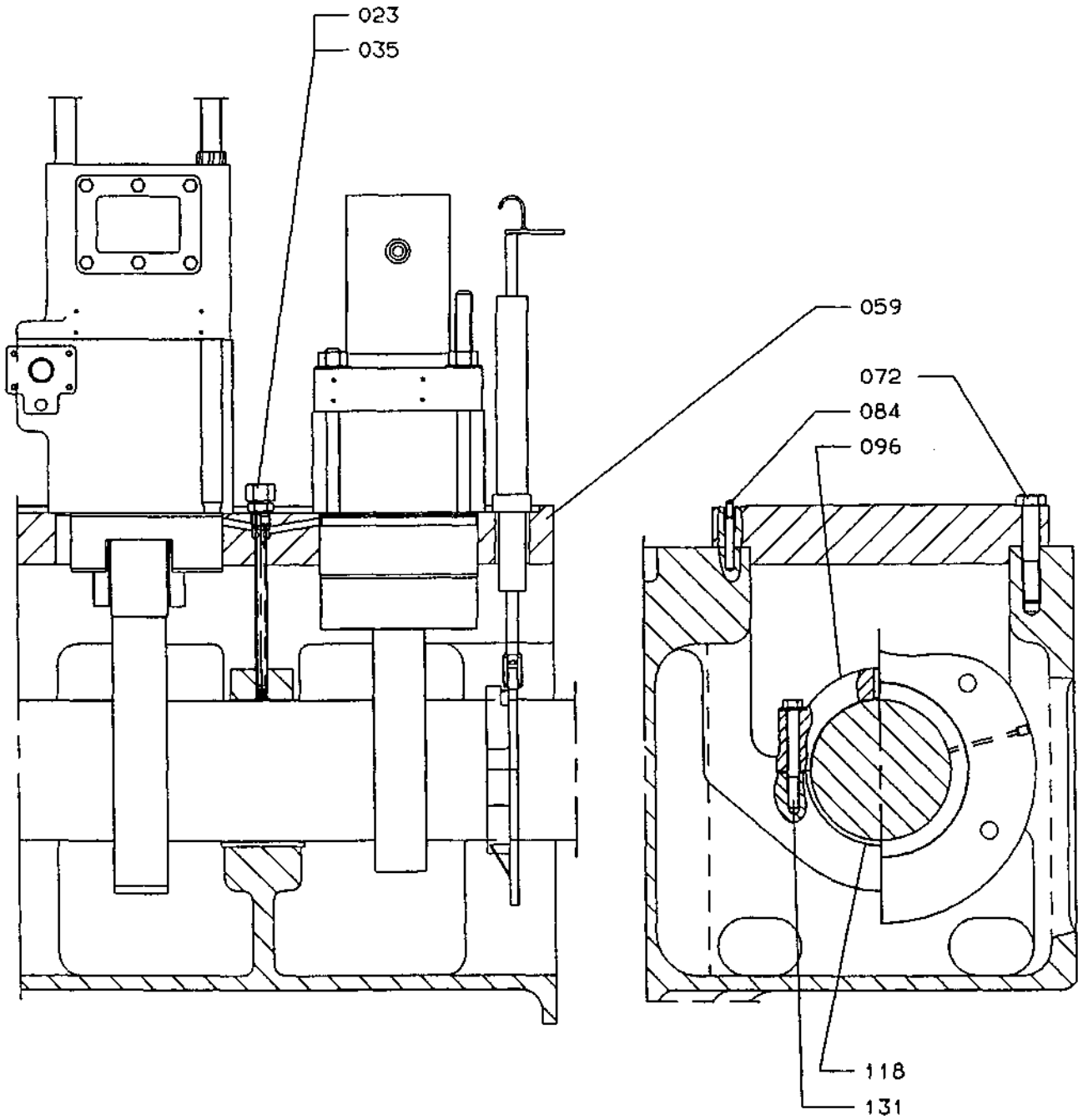
Item No.	Part Description	Item No.	Part Description
010	Camshaft		
015	Chain wheel		
027	Locking wire		
034	Exhaust cam		
039	Screw		
040	Gear wheel		
046	Fuel cam		
052	Thrust disc		
058	Indicator cam complete		
083	Plug		
117	Fitted bolt		
130	Self locking nut		
901	Gear wheel* * To be mounted if woodward governor is used.		



**Plate 90612-51 Indicator Drive**

Item No.	Part Description
016	Handle
028	Screw
041	Roller guide
053	Screw
065	Liner
077	Housing
089	Screw
090	Washer
112	Packing
124	Stud
136	Self-locking nut
148	Extension
173	Screw
185	Lock washer
207	Spring
220	Connecting piece
232	Guard
244	Screw
256	Lock washer
268	Packing
281	Packing
293	Flange
303	Indicator valve
327	Spring pin
339	Liner
352	Circlip
376	Liner
388	Circlip
423	Key
435	Screw
459	Shaft
460	Bearing
484	Disc spring
496	Valve cone
506	Valve seat
531	Spindle guide
543	Spindle
567	Gasket
579	Valve housing
580	Handwheel

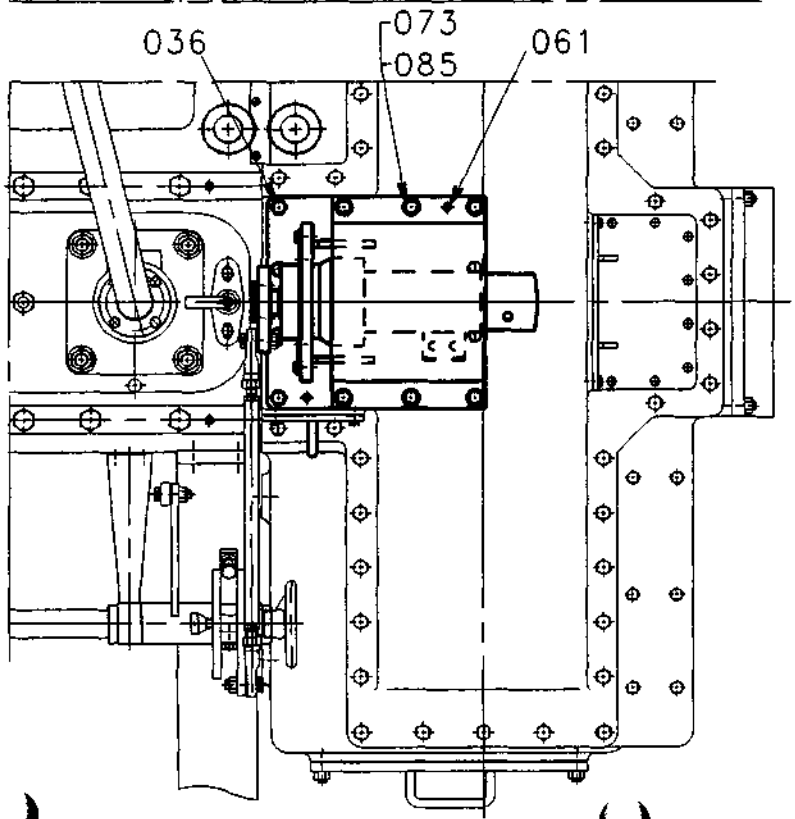
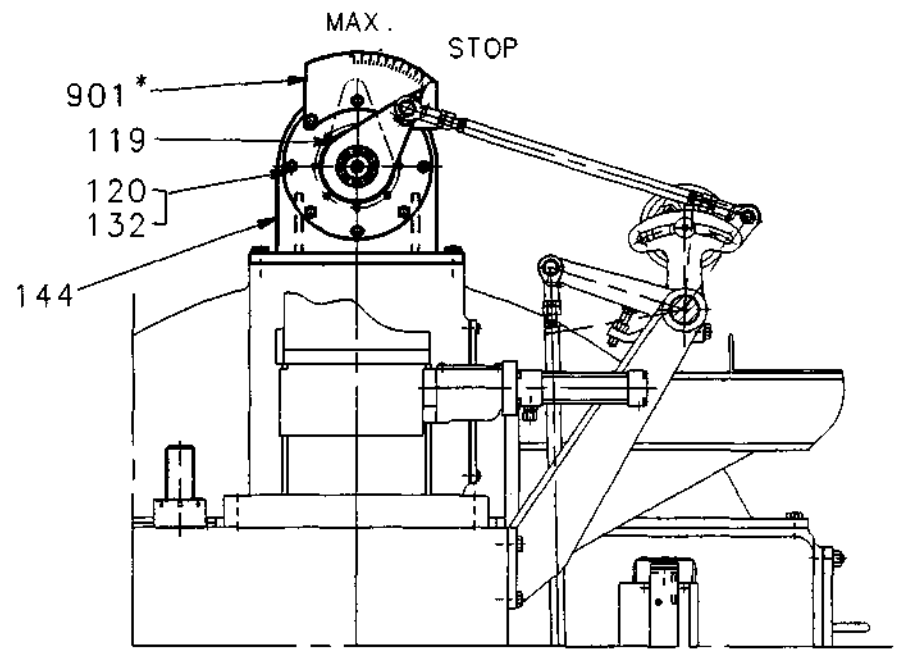
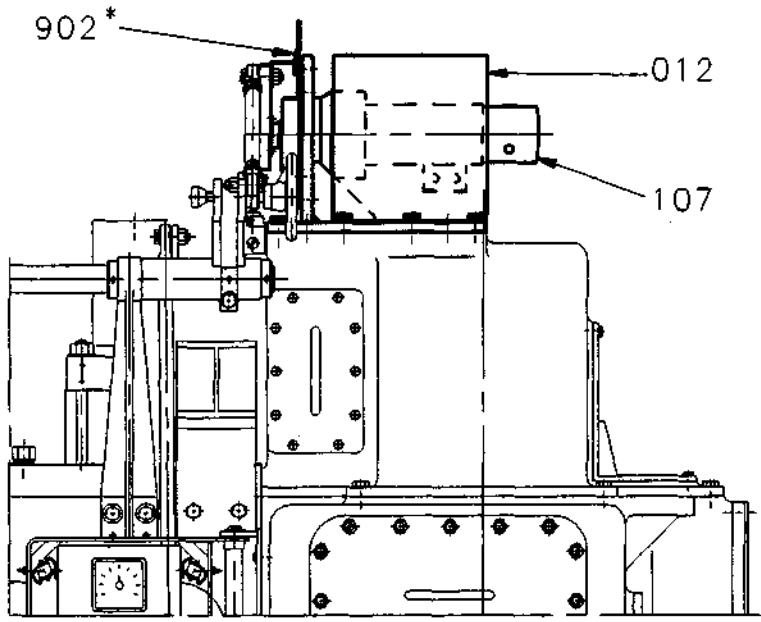
Item No.	Part Description
----------	------------------



**Plate 90613-85 Arrangement of Camshaft**

Item No.	Part Description
023	O-ring
035	Connecting pipe - lub.oil
059	Baseplate
072	Screw
084	Guide pin
096	Bearing cap
118	Bearing shell
131	Screw

Item No.	Part Description
----------	------------------

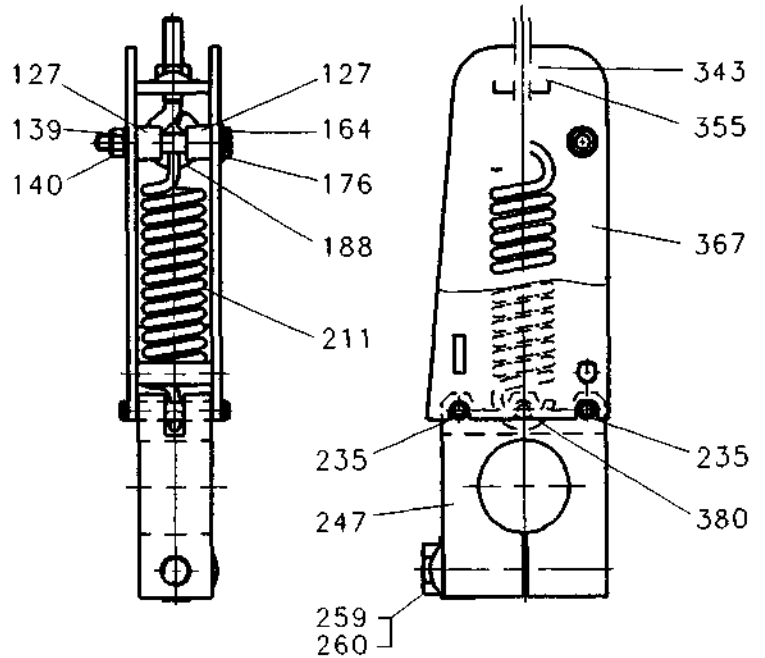
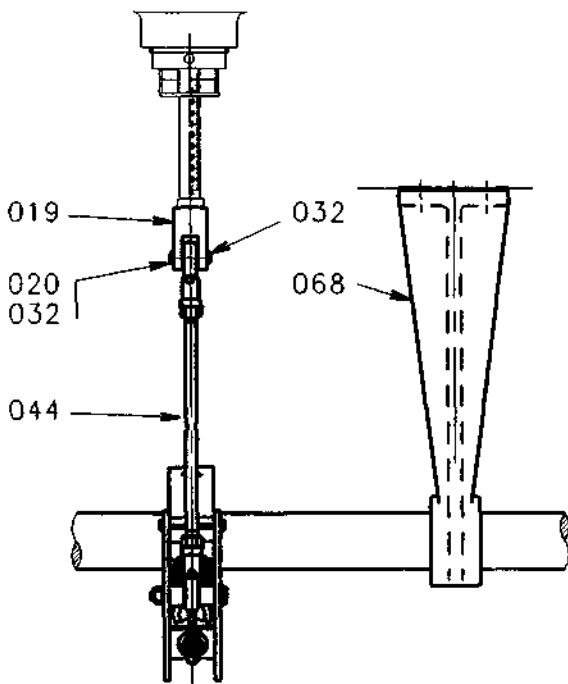
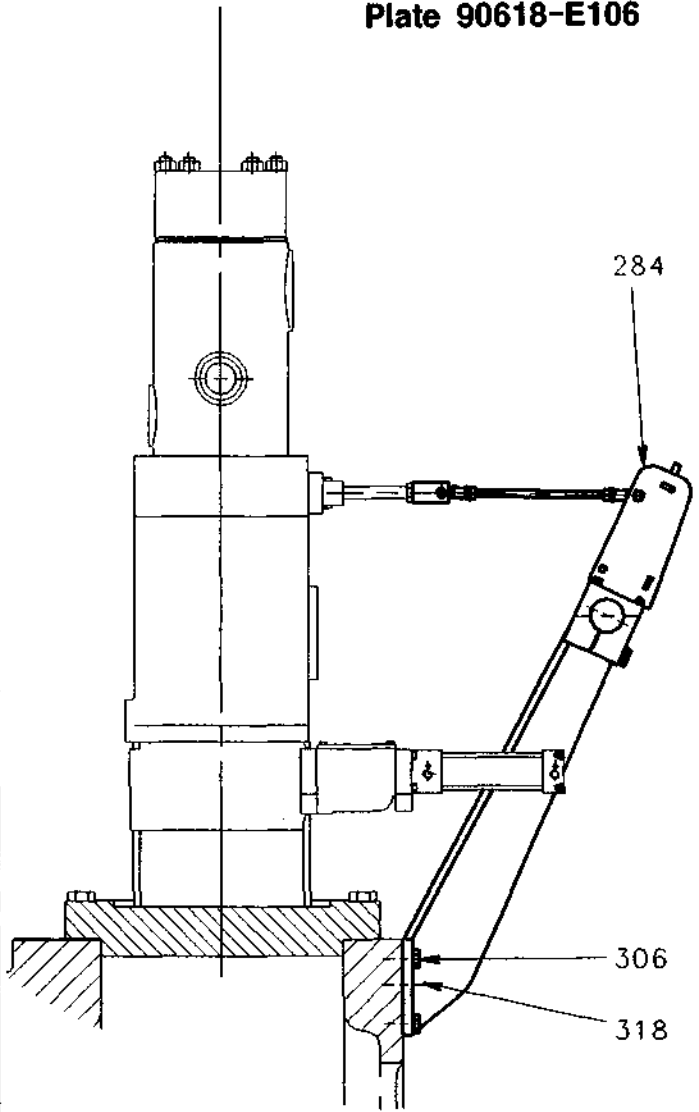
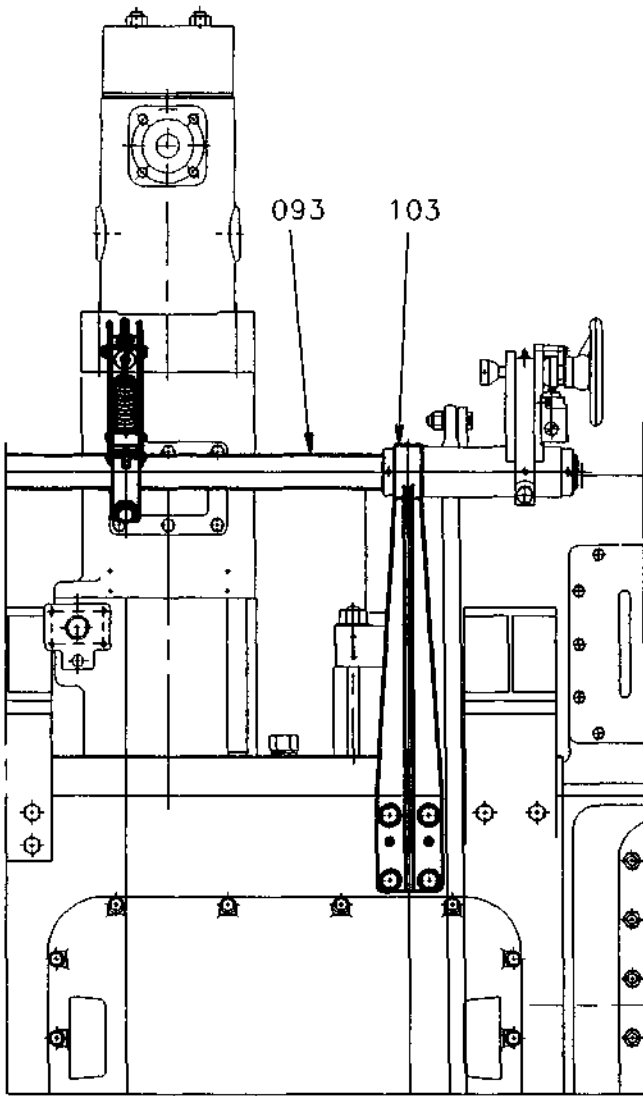


\* TO BE MOUNTED IF NORCONTROL  
DGS8800E GOVERNOR IS USED.



**Plate 90615-E106 Electrical Governor**

Item No.	Part Description	Item No.	Part Description
012 036 061 073 085 107 119 120 132 144	Guard Screw Guide pin Screw Washer Elect. governor actuator Lever Screw Washer Bracket		
901* 902*	Name plate Indicator * To be mounted if norcontrol DGS8800E governor is used.		

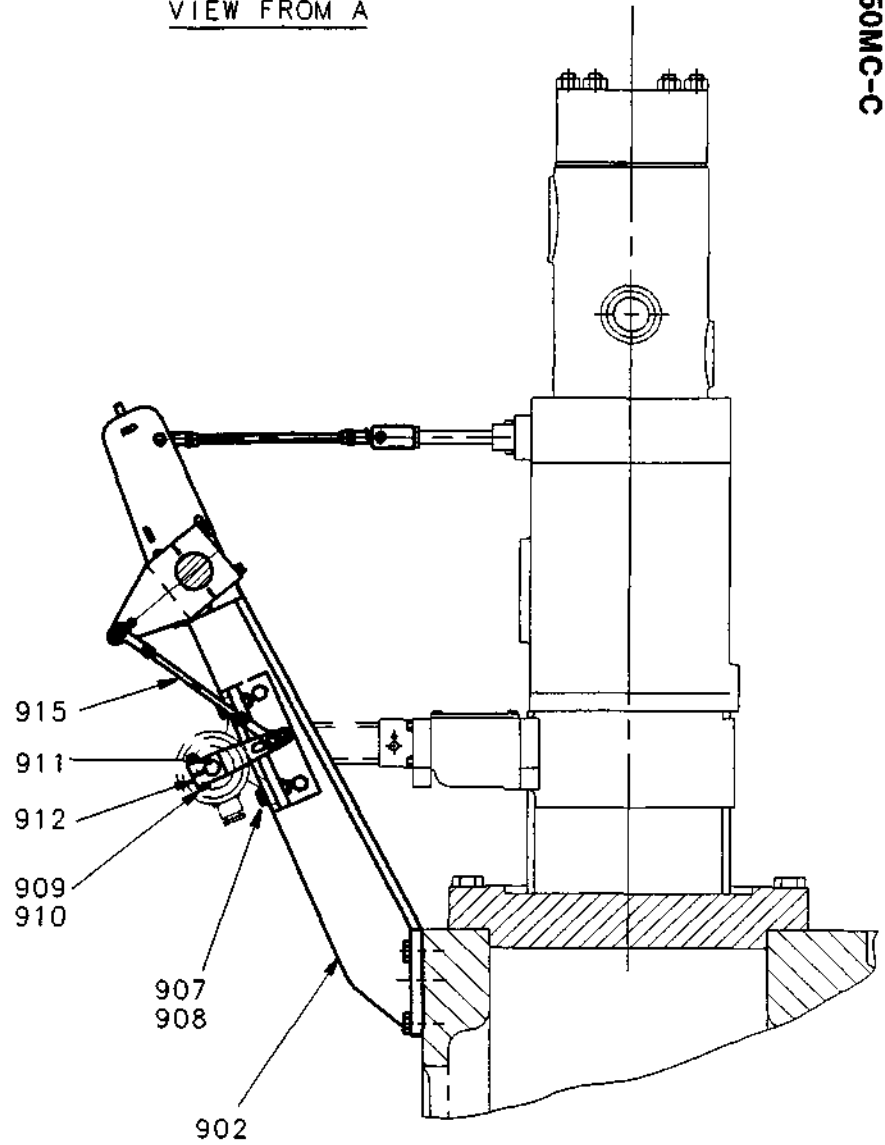
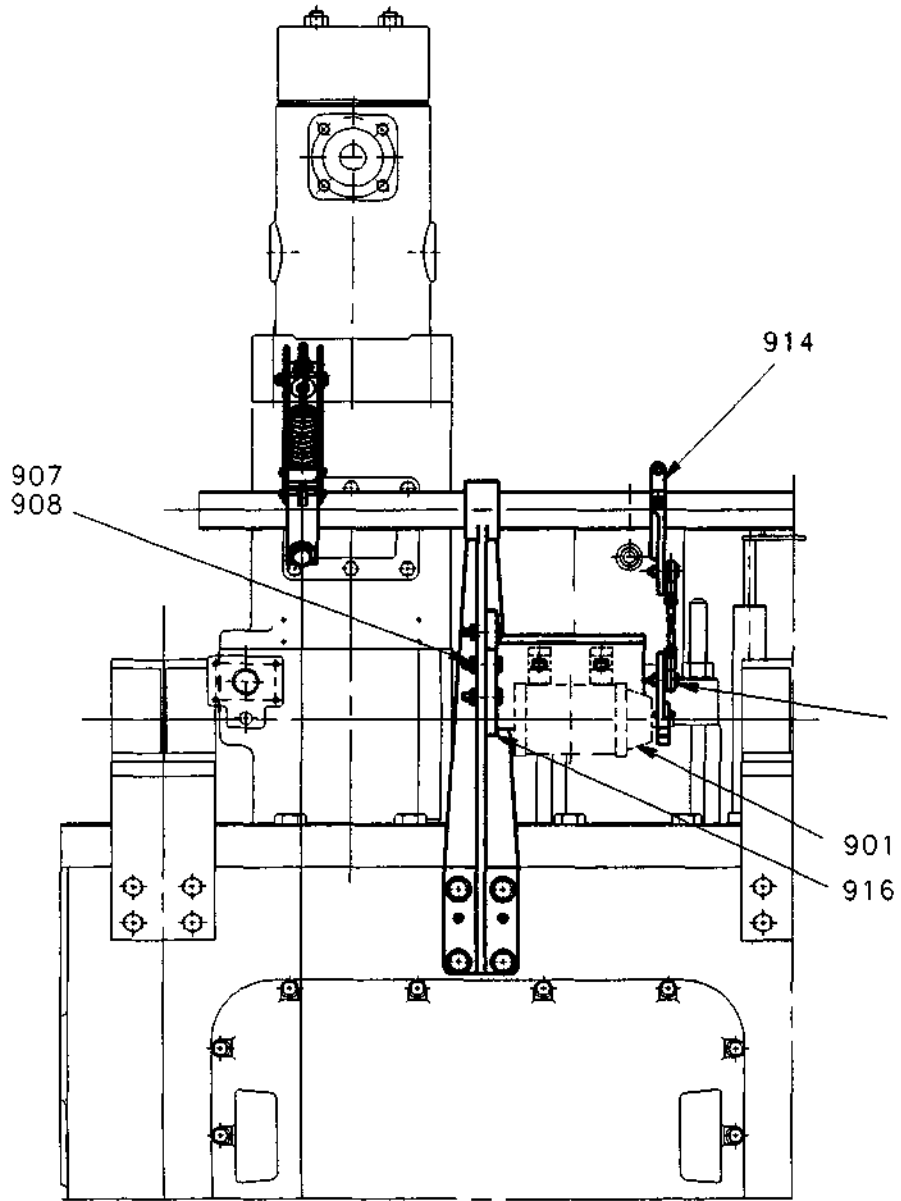


**Plate 90618-E106    Regulating Shaft**

Item No.	Part Description	Item No.	Part Description
019	Forked lever		
020	Pin		
032	Circlip		
044	Pull rod complete		
068	Bearing		
093	Regulating shaft		
103	Bearing		
127	Distance pipe		
139	Washer		
140	Self-locking nut		
164	Washer		
176	Fitted bolt		
188	Eye bolt		
211	Spring		
235	Spring pin		
247	Clamping arm		
259	Screw		
260	Lock washer		
284	Spring loaded lever complete		
306	Screw		
318	Guide pin		
343	Nut		
355	Lock washer		
367	Lever		
380	Spring pin		

FOR 1ST CYLINDER

VIEW FROM A



**HYUNDAI**  
**MAN B&W**  
**S50MC-C**

Fuel Pump Mark Transmitter Arrangement

Plate 90618-E106

**Plate 90618-E106 Fuel Pump Mark Transmitter Arrangement**

Item No.	Part Description
901	Pump mark transmitter
902	Bearing complete
903	Fitted bolt
904	Washer
905	Nut
907	Bolt
908	Nut
909	Bolt
910	Nut
911	Key
912	Arm for transmitter
914	Clamping arm
915	Pull rod complete
916	Bracket

Item No.	Part Description

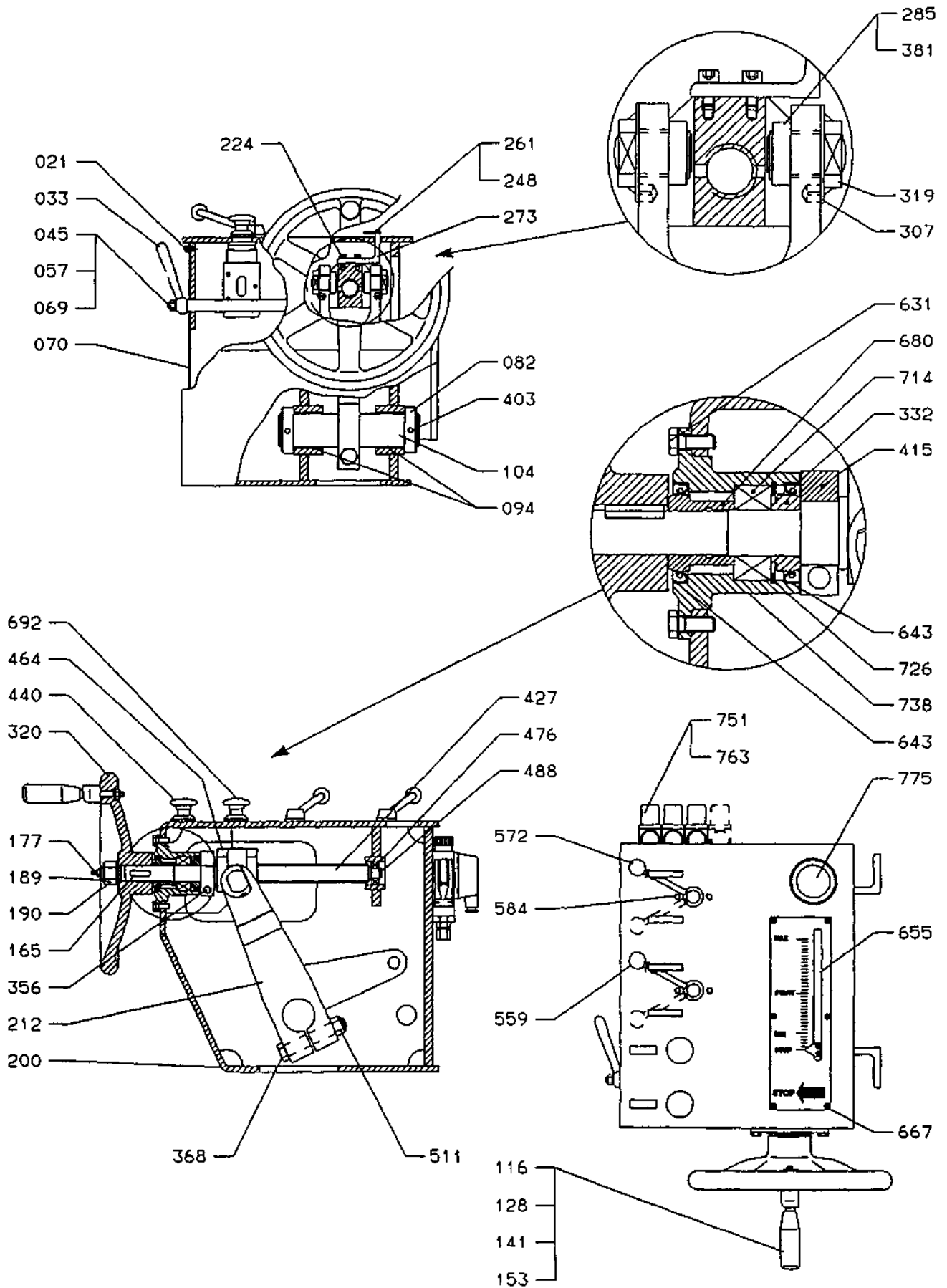
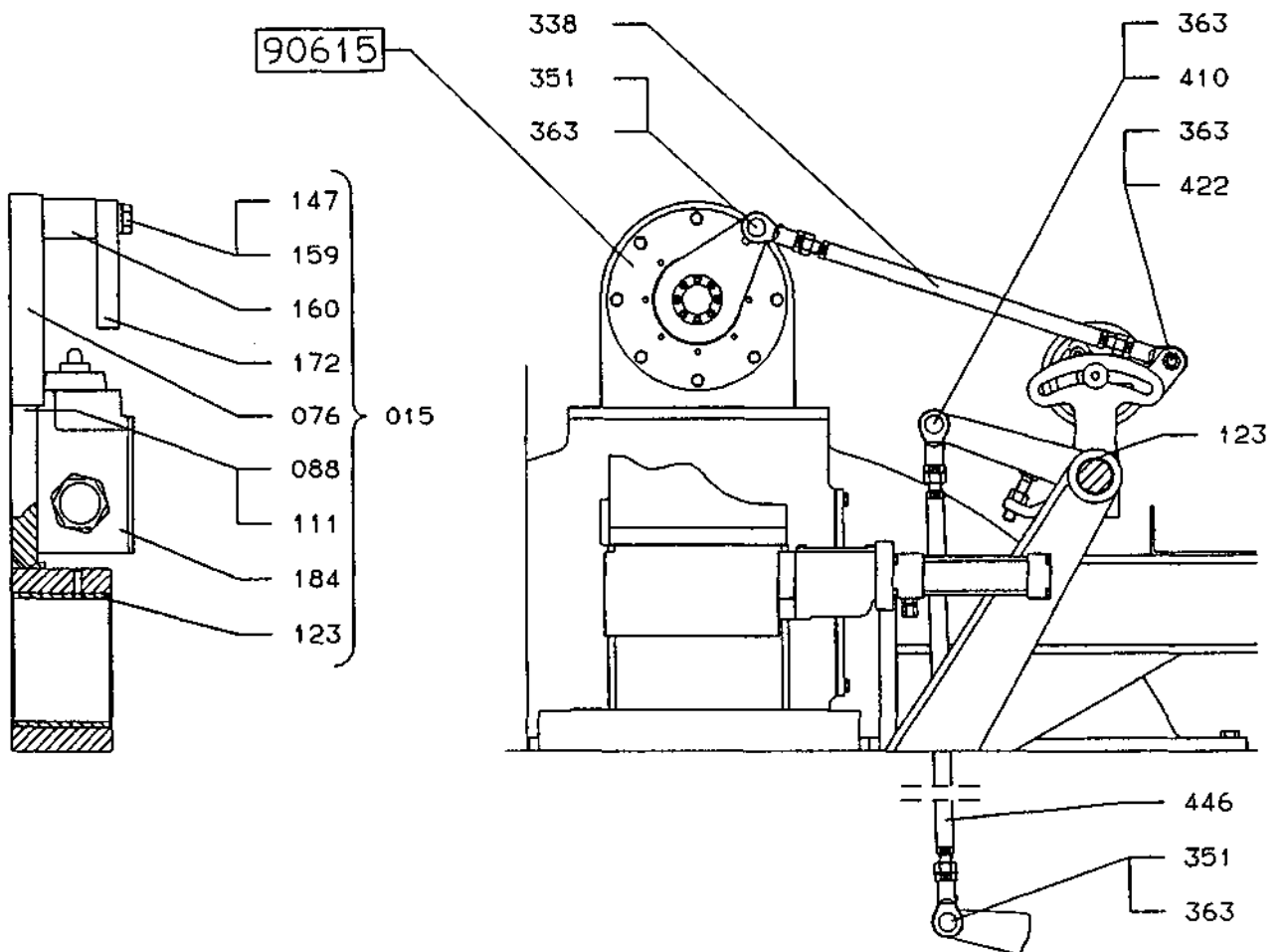
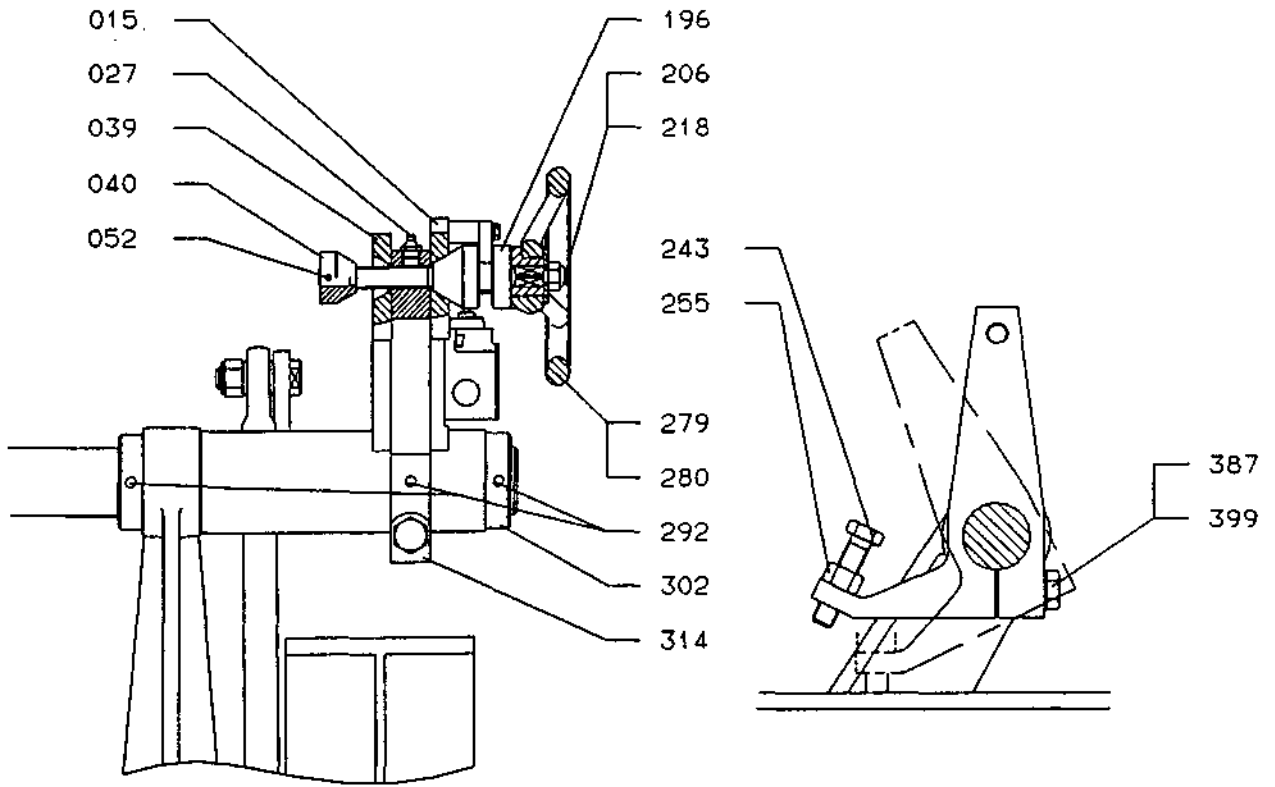


Plate 90620-68 Emergency Console

Item No.	Part Description
021	Screw
033	Handle
045	Shaft
057	Self-locking nut
069	Washer
070	Plate
082	Stop ring
094	Bushing
104	Shaft
116	Spring lock
141	Stud
153	Handle
165	Key
177	Grease nipple
189	Self-locking nut
190	Washer
200	Emergency console
212	Forked lever
224	Screw
248	Pointer
261	Screw
273	Angle lever
285	Slide shoe
307	Lock washer
319	Screw
320	Hand wheel
332	Thrust ring
356	Split pin
368	Screw
381	Retaining ring
403	Tapered pin
415	Clamping block
427	Spindle
440	Stop valve
464	Nut
476	Ball bearing
488	Circlip
511	Self-locking nut
559	Valve "Ahead-Astern"
572	Valve "Remote-Emergency"
584	Screw
631	Screw
643	Sealing ring
655	Name plate
667	Screw
680	Thrust ring
692	Start valve
714	Ball bearing
726	Circlip

Item No.	Part Description
738	Bearing
751	Pressure switch
763	Screw
775	Bellows gland





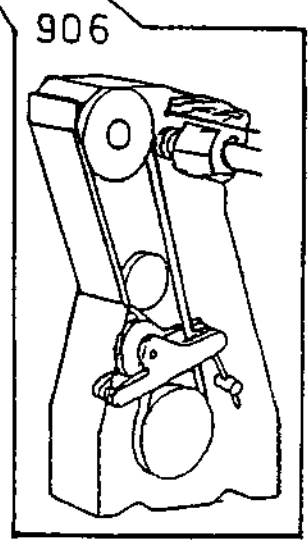
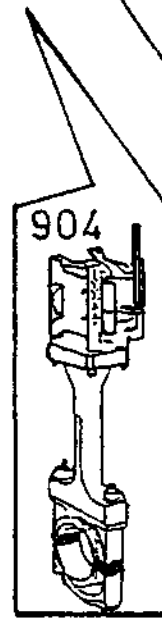
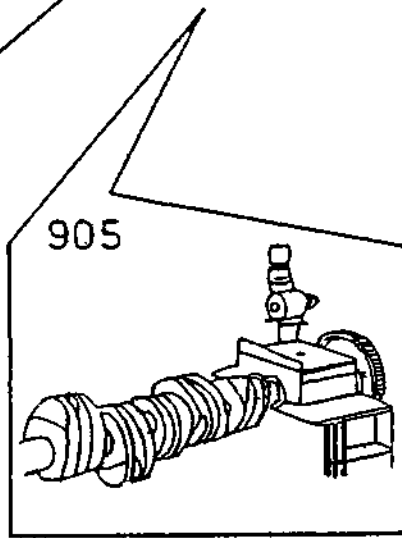
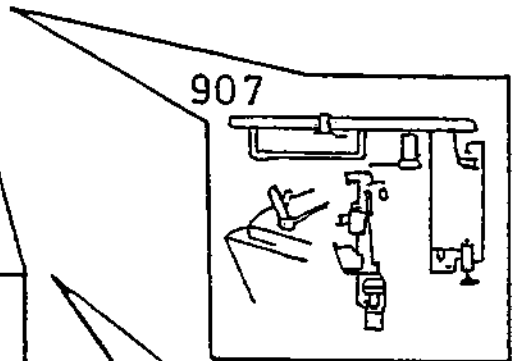
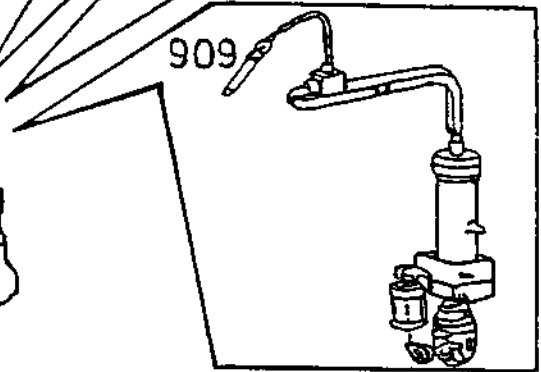
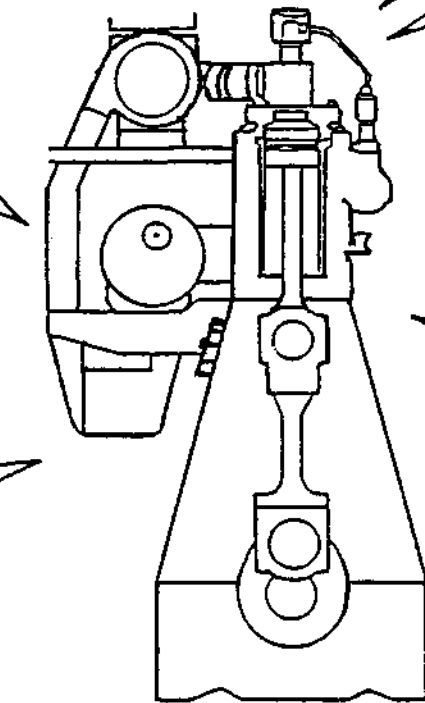
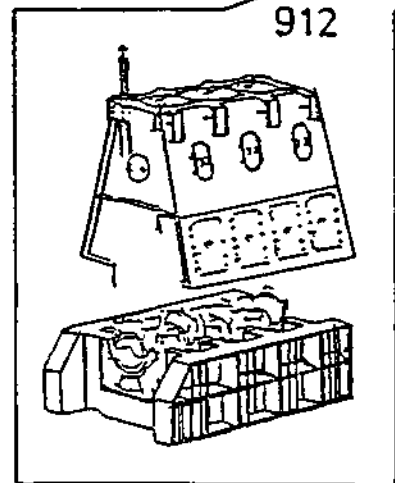
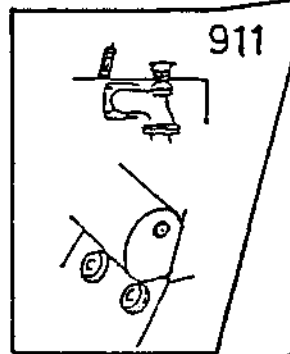
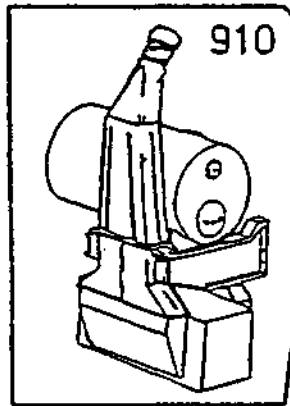
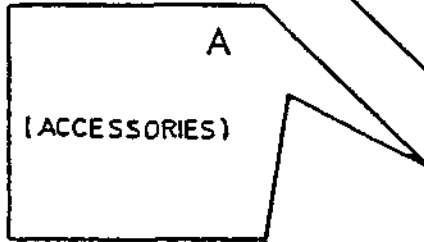
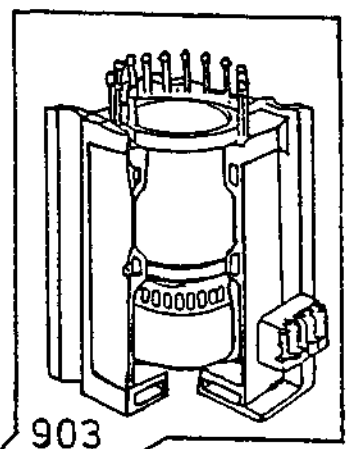
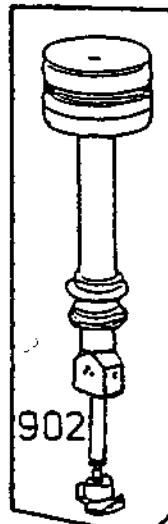
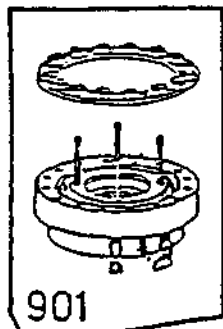
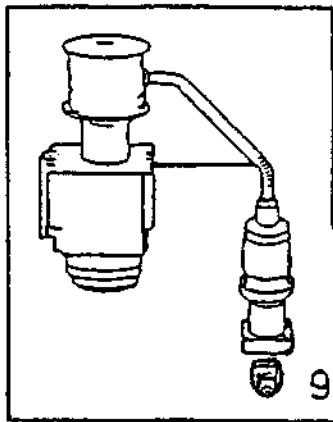
**Plate 90621-62 Arrangement of Layshaft**

Item No.	Part Description
015	Lever, complete
027	Grease nipple
039	Lever
040	Cone
052	Pin
076	Lever
088	Screw
111	Washer
123	Bushing
147	Screw
159	Washer
160	Bushing
172	Lever
184	Switch
196	Cone
206	Self-locking nut
218	Washer
243	Screw
255	Nut
279	Impact socket
280	Impact handwheel
292	Pin
302	Stop ring
314	Clamping arm
338	Pull rod
351	Fitted bolt
363	Self-locking nut
387	Screw
399	Lock washer
410	Fitted bolt
422	Fitted bolt
446	Pull rod, complete

Item No.	Part Description

# STARTING AIR COMPONENTS

907



## Starting Air System

The starting air system consists of the manoeuvring system and the starting air components.

The following items are described:

- Manoeuvring System
- Main Starting Valve
- Starting Air Distributor
- Starting Valve

## Manoeuvring System

*See also Vol. 1, OPERATION, Chapter 703.*

The manoeuvring system is of electric/pneumatic design. It is designed for:

- Control from engine side control console.  
*See also Chapter 906*
- Remote control from engine control-room and/or bridge.

The system consists of three sub-systems:

- The regulating system
- The reversing system
- The safety system.

### Regulating system:

By means of the regulating system it is possible to start, stop and control the engine.

The START and STOP functions are controlled pneumatically.

### Speed-setting during remote control:

During remote control, the speed-setting is controlled by the control handle on the manoeuvring console, which sends a signal to the governor system.

The engine speed depends on the magnitude of the signal. The governor system will maintain this speed independently of the engine load.

### Speed-setting during manual control:

During control from the engine side control console, the governor is disconnected from the fuel pumps, and the speed control is effected through the regulating handwheel. *See also Vol. 1, OPERATION, Chapter 703 and Plate 90620.*

### Reversing system:

The reversing system contains two pneumatic valves (AHEAD and ASTERN). These valves control the reversing cylinder of the starting air distributor and the air cylinders for reversing the fuel pump rollers.

### Safety system:

The safety system is separately supplied with air and is controlled by the engine monitoring system (with separate power supply). In case of shut-down, the safety system leads an air signal to the puncture valve on each fuel pump, thereby cutting-off the delivery of high-pressure fuel oil, after which the engine stops.

The safety system is connected during all modes of engine control.

### Main Starting Valve

*Plate 90702*

The main starting valve is interposed in the starting air main pipe.

The main starting valve consists of a large ball valve and, optionally, a smaller ball valve which is fitted as a by-pass for the large valve. Both valves are operated by means of pneumatic actuators.

If the smaller ball valve is installed, an adjusting screw will be mounted for setting the slow-turning speed.

Furthermore, a non-return valve is incorporated which prevents blow-back in the event of excessive pressure in the starting air line.

The main starting valve is equipped with a blocking device consisting of a plate which, by means of a handwheel, can be made to block the actuators.

The ball valves and their actuators are, together with the non-return valve and blocking device, built together to form a unit.

On receipt of telegraph order 'Finished with engine', move the blocking device to the **BLOCKED** position.

To avoid alarm, move the telegraph handle into **STOP** position.

#### **Warning !**

During all inspections of the engine, the blocking device of the main starting valve must be in the **BLOCKED** position.

The only exception is when the starting valves are tested for tightness, in which case the blocking device of the main starting valve must be in the **WORKING** position and the shut-off valve for the starting air distributor must be in the **CLOSED** position.

See Vol. I, *OPERATION*, Chapter 703, 'Operations after arrival in port'.

### **Starting Air Distributor**

Plate 90703

The starting air distributor is mounted on the end of the engine and is driven from the end of the camshaft through gear wheels.

The distributor consists of:

- Distributor disc
- Reversing disc
- Housing
- Shaft and bushing

#### Distributor disc:

Short and long recesses are milled into the contact face of the distributor disc. They form two concentric circles.

For an engine which runs clockwise during **AHEAD** (seen from aft), the outer recesses control starting in **AHEAD** direction, and the inner recesses control starting in **ASTERN** direction.

Through the short recesses, starting air is supplied to each starting air valve in turn.

Each of the short recesses is divided into two parts. The part, which during **AHEAD** or **ASTERN** is the first in the running direction, gets its supply air from space **A1** and the next gets its supply from space **A2**.

Through the long recesses, the starting valves that are not supplied with starting air are vented. Through bores, the long recesses communicate with the central space between the shaft and the reversing disc and from there leads through bores in the distributor housing, to the atmosphere.

#### Reversing disc:

The reversing disc is designed with two sets of bores opposite the mentioned two sets of concentric recesses in the distributor disc. By means of an air cylinder connected to the arm of the reversing disc, one of these sets of bores can be cut off while the other set of bores is brought to communicate with the outlet holes which lead to the starting valves.

Furthermore, for engines with remote control, the reversing arm acts as a cam for two 3-way valves, controlling the end positions of the reversing movement.

#### Housing:

Each outlet hole from the distributor housing leads to a starting valve, and the position of the reversing disc determines whether air for **AHEAD** or **ASTERN** running is supplied to the starting air valves.

**Shaft and bushing:**

The shaft rotates in a bushing fitted in a bore placed centrally in the distributor housing. The shaft is driven by the camshaft through gear wheels. The distributor disc is mounted on the other end of the shaft.

During running, the distributor disc is kept free of the reversing disc by means of oil pressure:

Closest to the distributor disc, the bushing has a larger diameter than at the other end. The oil pressure, which is applied at the centre of the bushing, acts on different shaft diameters and gives a small displacement of the distributor disc.

**Function:**

When control air is admitted to the starting air distributor, a control air pressure builds up in spaces **A1** and **A2**, causing distributor disc **B** to be pressed against the reversing disc.

Control air passes through bores in the distributor disc to the short recesses, and further on through bores in the reversing disc and via bores in the distributor housing to the starting valve, thus activating the starting valve.

The long recess in the distributor disc communicates with the remaining starting valves through the bores in the reversing disc and the distributor housing. The pilot air from the starting valves is vented through these bores and through bores in the distributor disc and the distributor housing to the atmosphere.

When the crankshaft starts turning, the distributor disc also turns, thereby moving the short recess from one bore into a position opposite the next bore. Thereby the starting valve which is connected with this bore is supplied with control air, and the starting valve opens. Simultaneously, the long recess in the distributor disc is positioned opposite the bore from the starting valve activated directly before, and the

control air of that starting valve is vented, causing the valve to close.

When the start level RPM of the crankshaft has been reached, and the START signal is vented, space **A1** is vented through a pneumatic valve. At the same time the fuel pump puncture valves are vented, causing fuel oil to be injected into the cylinders. The control air supply through space **A2** continues a short time (adjustable) in order to facilitate the starting.

The venting of space **A1** means that the opening of the starting valves is delayed and that fuel oil therefore can be injected into the cylinder without any risk of blow-back to starting air pipes.

**Starting Valve***Plate 90704*

The starting valve (spring-loaded) is fitted on the cylinder cover. It is controlled by control air from the starting air distributor 90703.

**Function:**

When the main starting valve is open, chamber **P** of the starting valve is pressurised through the starting air pipe.

The starting valve is kept closed by the spring. When chamber **U** above the piston of the starting valve is pressurised with control air from the starting air distributor, the starting valve opens, and starting air now flows from the starting air pipe to the cylinder.

When the starting period is finished, chamber **U** is vented through the vent pipe of the starting air distributor, and the starting valve will close.

Venting of the starting air in chamber **P** and the starting air pipe takes place slowly through small holes in the starting air pipe.

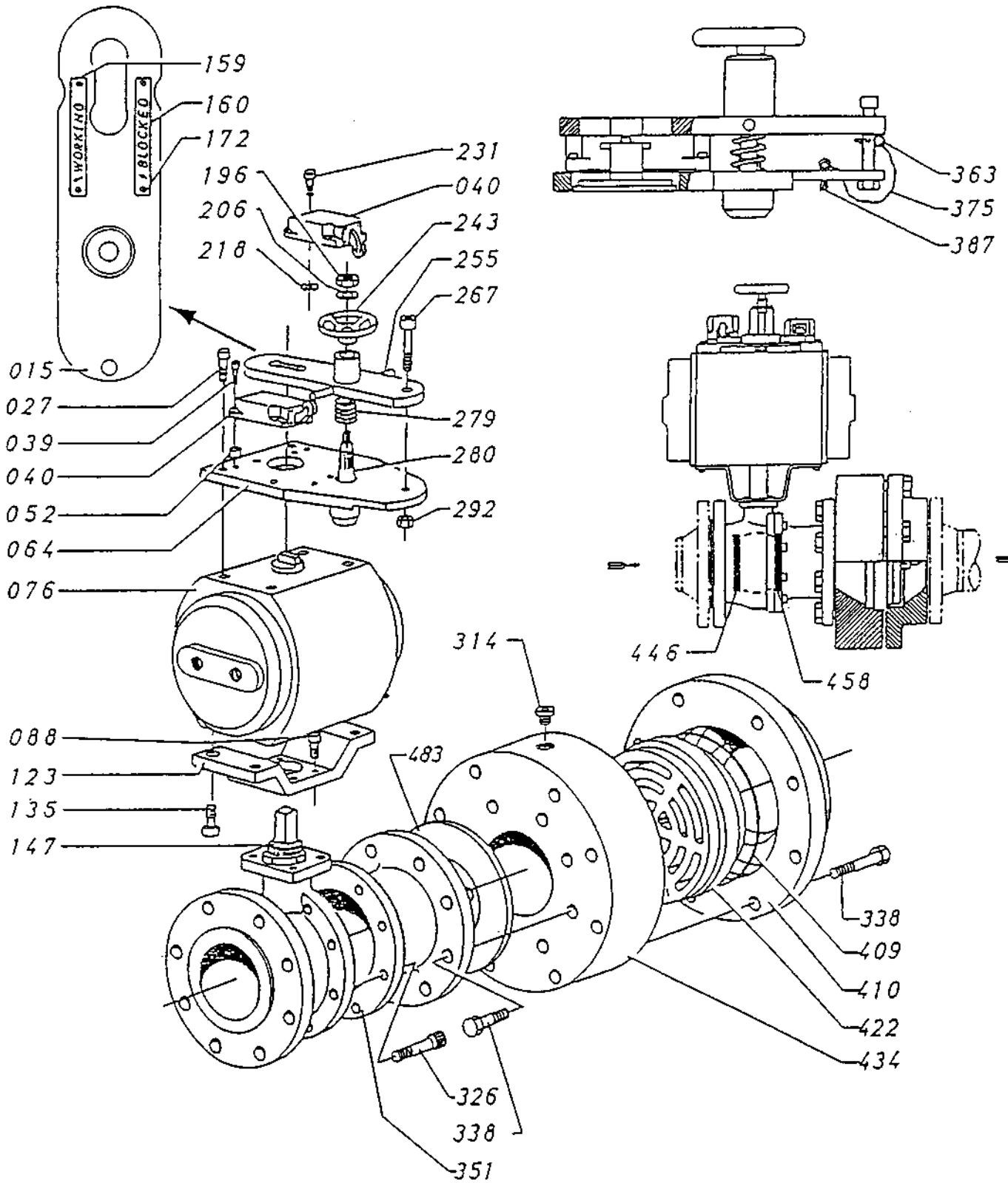
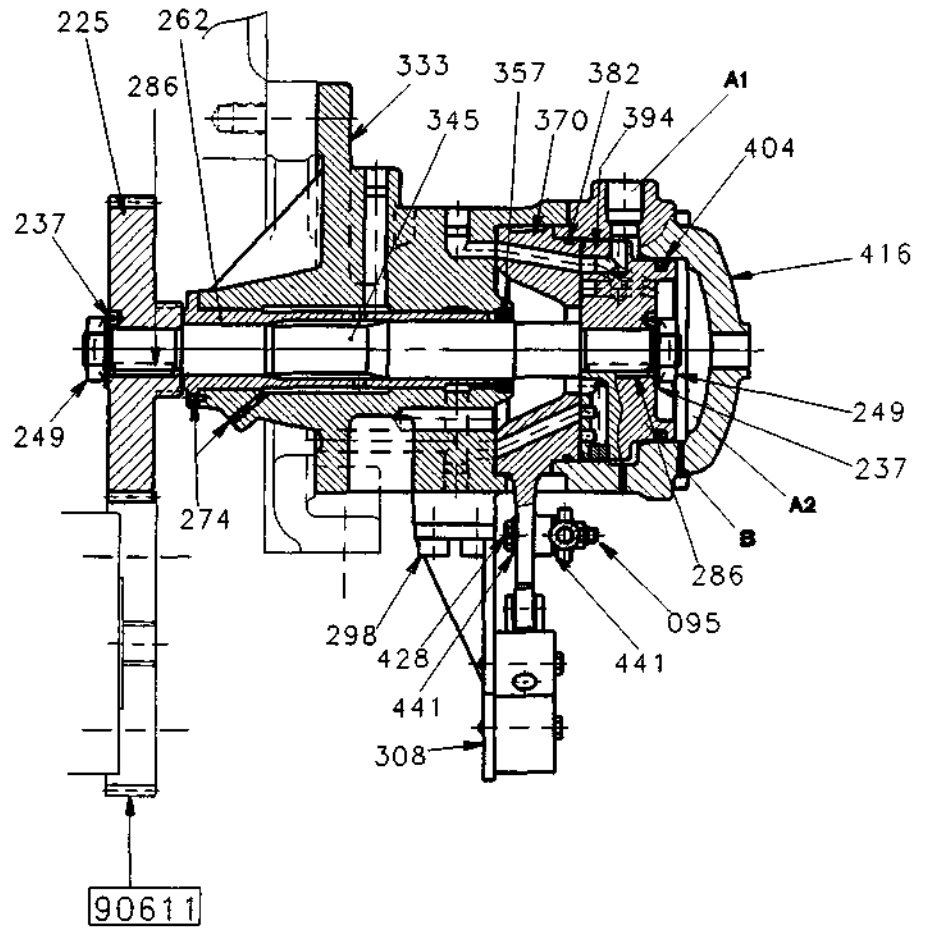
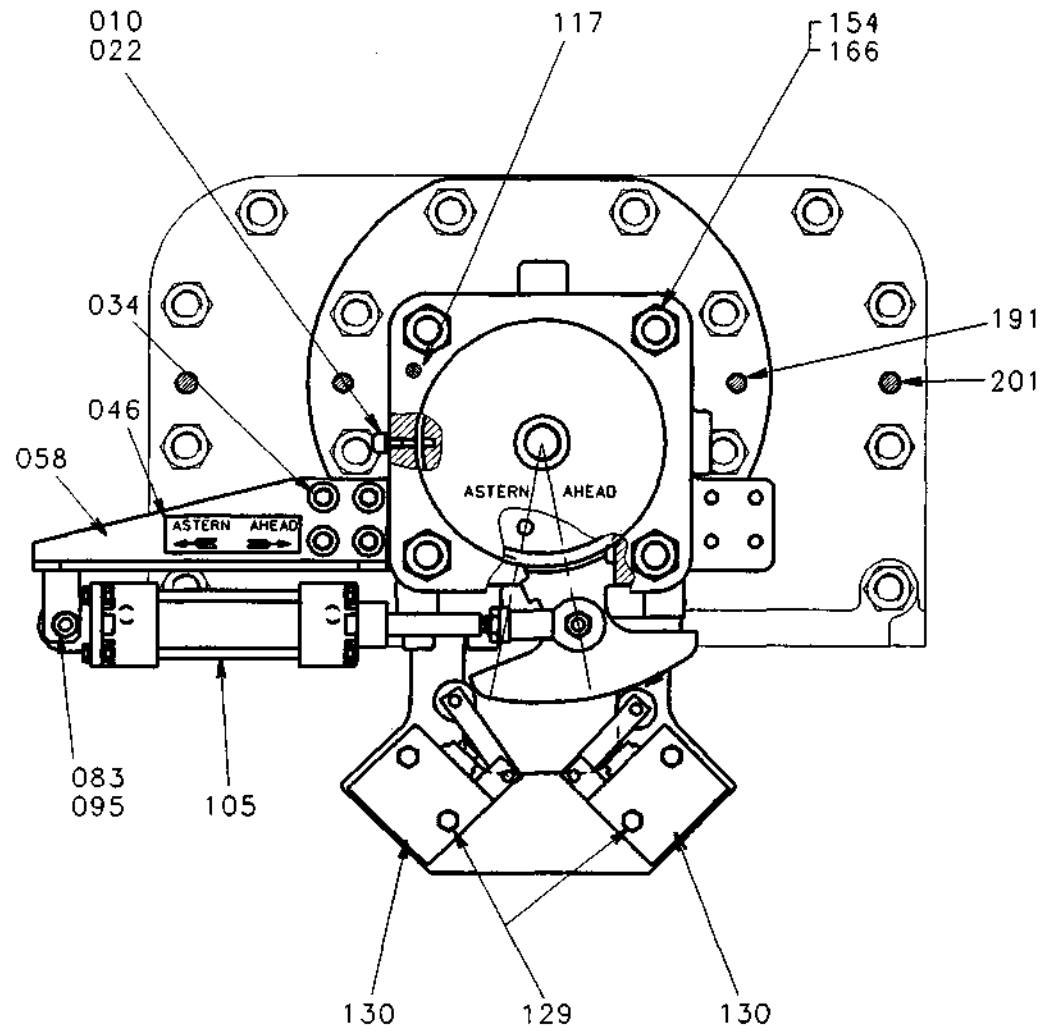


Plate 90702-43 Main Starting Valve

Item No.	Part Description
015	Securing plate
027	Screw
039	Screw
040	Switch
052	Distance pipe
064	Plate
076	Actuator
088	Screw
123	Intermediate piece
135	Screw
147	Ball valve
159	Name plate
160	Name plate
172	Screw
196	Nut
206	Washer
218	Washer
231	Screw
243	Handwheel
255	Pin
267	Screw
279	Spring
280	Spindle
292	Nut
314	Plug screw
326	Screw
338	Screw
351	Intermediate piece
363	Split pin
375	Chain
387	Split pin
409	Packing
410	Housing for non-return valve
422	Non-return valve
434	Housing
446	Upstream seat
458	Downstream seat
483	Packing

Item No.	Part Description





**Plate 90703-E82 Starting Air Distributor**

Item No.	Part Description
010	Screw
022	Gasket
034	Screw
046	Name plate
058	Bracket
083	Fitted bolt
095	Self-locking nut
105	Air cylinder
117	Spring pin
129	Screw
130	3/2-way valve
154	Stud
166	Nut
191	Guide pin
201	Guide pin
225	Gear wheel
237	Lock washer
249	Nut
262	Bushing
274	Spring pin
286	Key
298	Screw
308	Bracket
333	Distributor housing
345	Shaft
357	Sealing ring
370	Reversing disc
382	Sealing ring
394	Distributor disc
404	Piston ring
416	Cover
428	Fitted bolt
441	Washer

Item No.	Part Description
----------	------------------

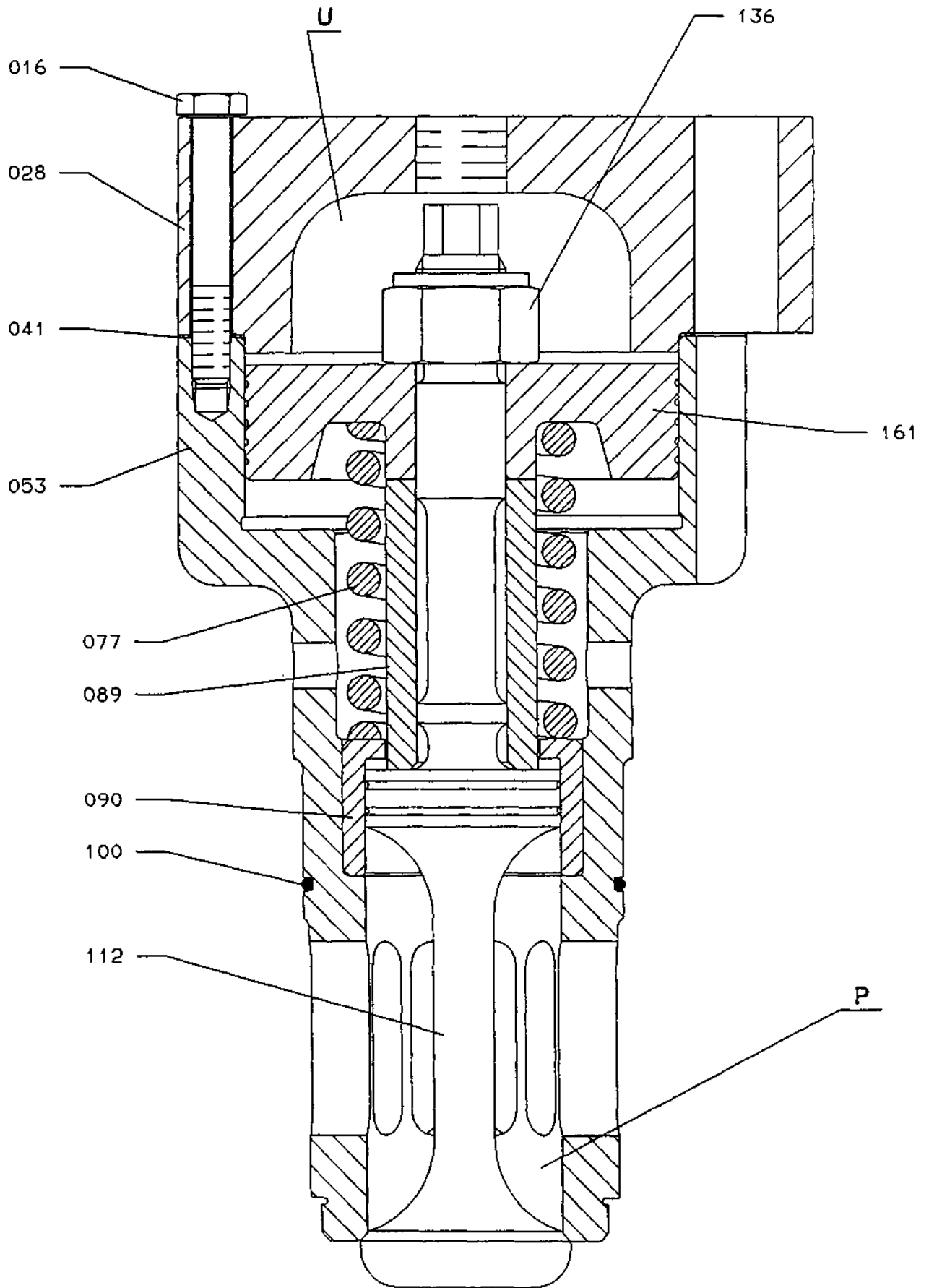


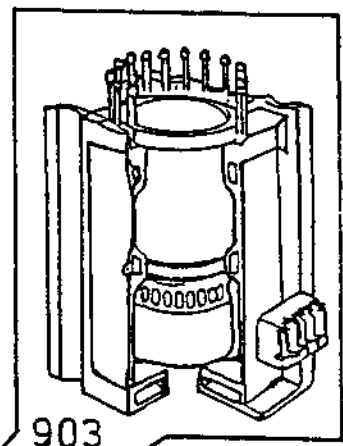
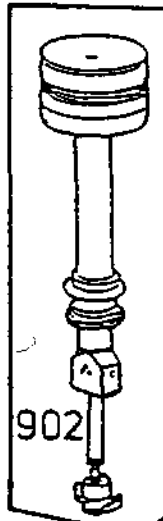
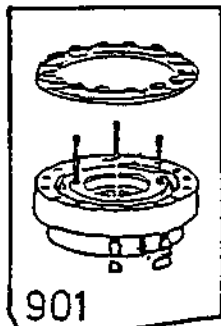
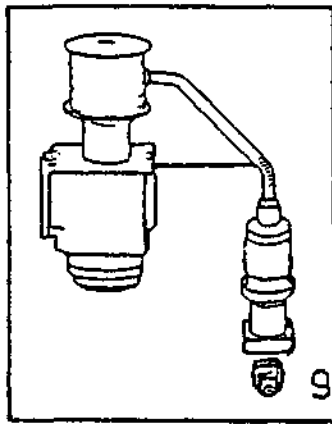
Plate 90704-46 Starting Valve

Item No.	Part Description
016	Screw
028	Cover
041	Packing
053	Valve housing
077	Spring
089	Distance pipe
090	Liner
100	Sealing ring
112	Valve spindle
136	Self-locking nut
161	Piston

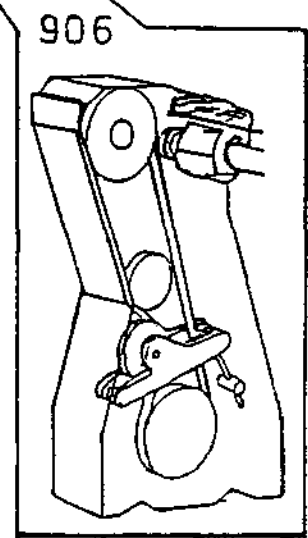
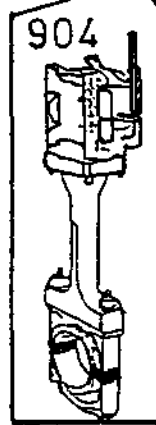
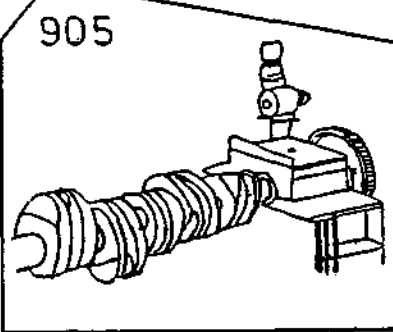
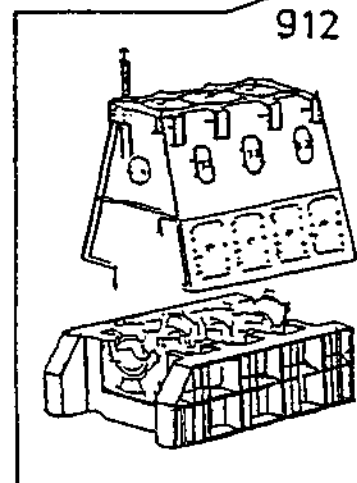
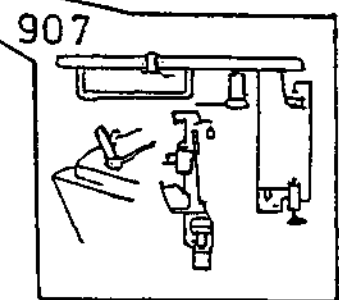
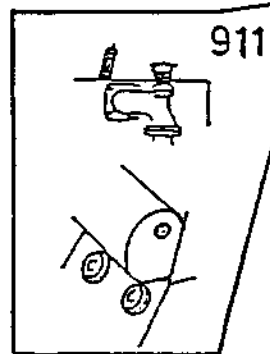
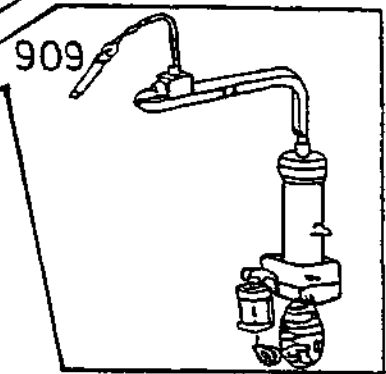
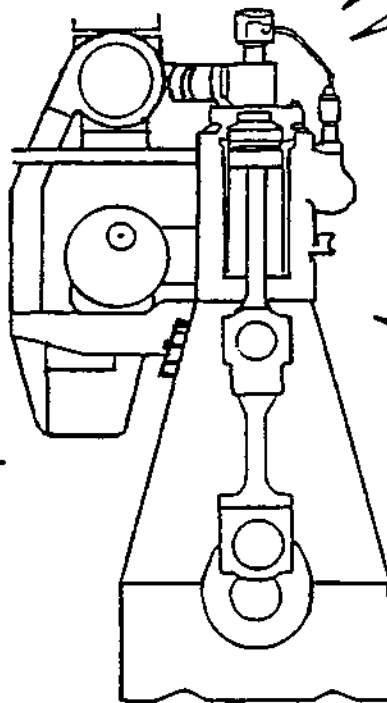
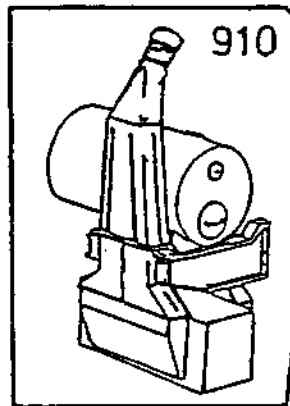
Item No.	Part Description
----------	------------------

# EXHAUST VALVE

908



A  
(ACCESSORIES)



## Exhaust Valve

### General

*Plate 90801*

Each cylinder is equipped with an exhaust valve, which is mounted in a central bore in the cylinder cover. The valve housing is attached by means of four studs and nuts to form a gas-tight seal against a seat in the cylinder cover. The nuts are designed for tightening by means of hydraulic tools.

### Valve housing

The valve housing has an exchangeable bottom piece provided with a hardened, conical seat for the valve spindle.

The bore for the valve spindle is provided with an exchangeable spindle guide.

The valve housing is water cooled. The cooling water is introduced in the lower half of the valve housing. The water is discharged from the top of the valve housing to the cooling water outlet pipe for the cylinder cover. *See plate 90810.*

The cooling water outlet pipe for the cylinder cover incorporates an orifice so as to control the cooling water flow through the exhaust valve housing.

On the front of the valve housing there is a cleaning cover through which the cooling water space can be checked and cleaned.

### Spindle

The valve spindle is either of the Nimonic type, where heat treatment of the seat area provides the required hardness, or of heat resistant steel with hardfacing metal welded onto the seat.

The part of the spindle stem which travels in the sealing arrangement of the air cylinder, is coated with a wear resistant mixture of metal carbide and super alloy, applied by the HVOF-process.

On the lower cylindrical part of the valve spindle a vane wheel is fitted which causes the valve spindle to rotate while the engine is running.

To enable checking the functioning of the exhaust valve while the engine is running, a 'lifting/rotation check rod' is mounted on top of the hydraulic cylinder on the exhaust valve.

Spindle rotation is indicated by regular changes in the top and bottom positions of the check rod during testing.

This is because the air piston is equipped with a short milled groove on the upperside.

At the top of the spindle, two pistons are fitted:

#### 1) Air piston

The piston serves to close the exhaust valve. The piston is locked to the spindle by a two-piece conical ring.

#### 2) Hydraulic piston

The piston serves to open the exhaust valve.

The hydraulic piston has two piston rings and a damper arrangement, designed to dampen the closing of the valve.

### Caution !

After overhauling of the exhaust valve, it is important to check the damper, to avoid knocking. This is done by means of a special bridge gauge.  
*See Vol. II, MAINTENANCE, Procedure 908.*

The hydraulic piston is operated through a piping which communicates with a corresponding hydraulic piston in the actuating gear above the camshaft. This piston is, through the roller guide, actuated by the exhaust cam on the camshaft.

### Air cylinder

The air cylinder is mounted on top of the valve housing. Air to close the exhaust valve is supplied through a non-return valve

and a bore in the sealing air control unit and through a curved pipe to the space below the piston.

Two sealing rings are mounted in the bottom of the air cylinder housing. A drain hole **D** between these rings reveals when the sealing is not sufficient.

A safety valve is mounted in the bottom of the cylinder.

### Hydraulic cylinder

The hydraulic cylinder is mounted on the air cylinder on top of the exhaust valve housing by means of studs and nuts.

The exhaust valve is opened by the valve spindle being pressed down by the hydraulic piston in the hydraulic cylinder.

An orifice designed for deaerating the oil system is fitted below the lifting eye bolt at the top of the cylinder.

Oil which escapes through this orifice is led through a duct to the space around the air cylinder and is drained off through a bore **X**, together with leakage oil from the piston.

### Sealing air

*Plates 90801 - 90802*

A sealing air arrangement is fitted around the spindle shaft under the bottom of the air cylinder.

The sealing air is supplied from the air cylinder and introduced below the sealing rings via a sealing air control unit and an orifice pipe.

The sealing air will prevent the exhaust gas and particles from penetrating upwards and wear-out the running surfaces and polluting the pneumatic system of the valve gear.

The oil mist content in the air from the air cylinder improves the service condition of the sealing rings.

The sealing air control unit contains a valve which automatically cuts off the air flow when the engine is in FINISHED WITH ENGINE status, and a filter housing.

### Hydraulic Valve Actuating Gear

*Plates 90805 - 90806*

The exhaust valve is actuated by a cam on the camshaft through a hydraulic transmission.

A roller guide is kept in contact with the cam by the action of a helical spring which is fixed between the roller guide and the hydraulic cylinder so that the roller of the roller guide will follow the cam on the camshaft.

The hydraulic cylinder is attached to the camshaft housing by four studs, two of which are long enough to permit the spring of the roller guide to be gradually relieved during dismantling of the components.

The roller guide is prevented from turning by means of a key and a keyway.

A piston, which is enclosed in the hydraulic cylinder, rests on a thrust piece in the neck of the roller guide and is locked to the roller guide by a bayonet joint.

The hydraulic cylinder on the camshaft housing is connected to the hydraulic cylinder on the exhaust valve by means of a high-pressure pipe.

Oil is supplied from the lubricating oil system through a non-return valve in the top of the hydraulic cylinder.

Leakage oil from the hydraulic cylinder on the exhaust valve is drained through a pipe connection to the baseplate of the hydraulic cylinder on the camshaft housing. From there the oil is drained off through a bore to the camshaft housing.

A special tool is delivered, which is able to retain the roller guide in its top position and thus put the exhaust valve out of action.

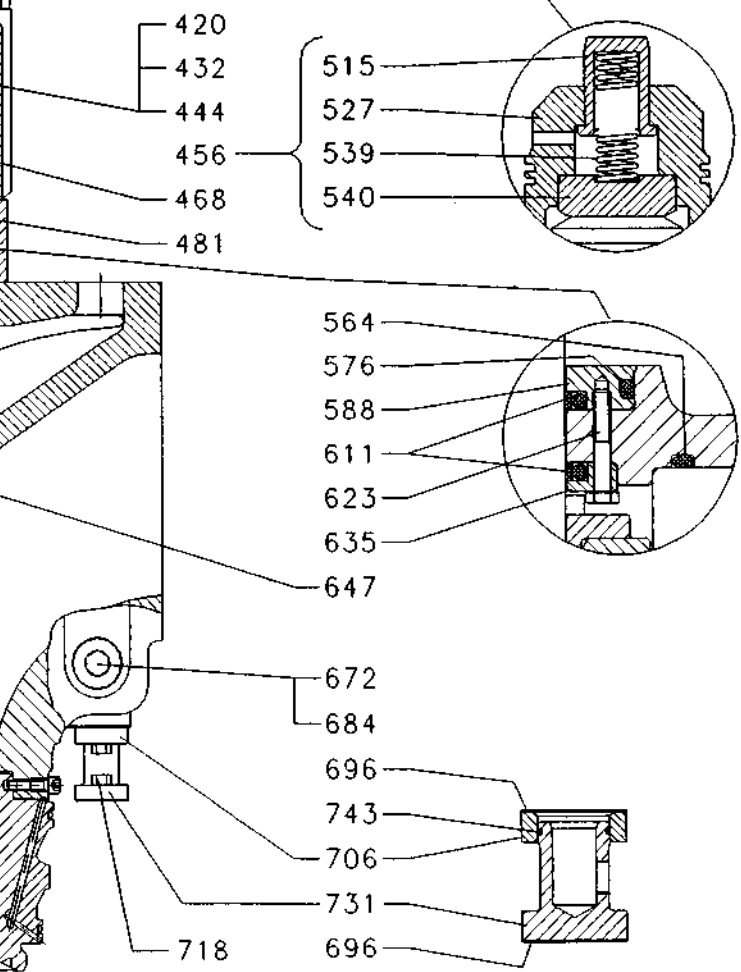
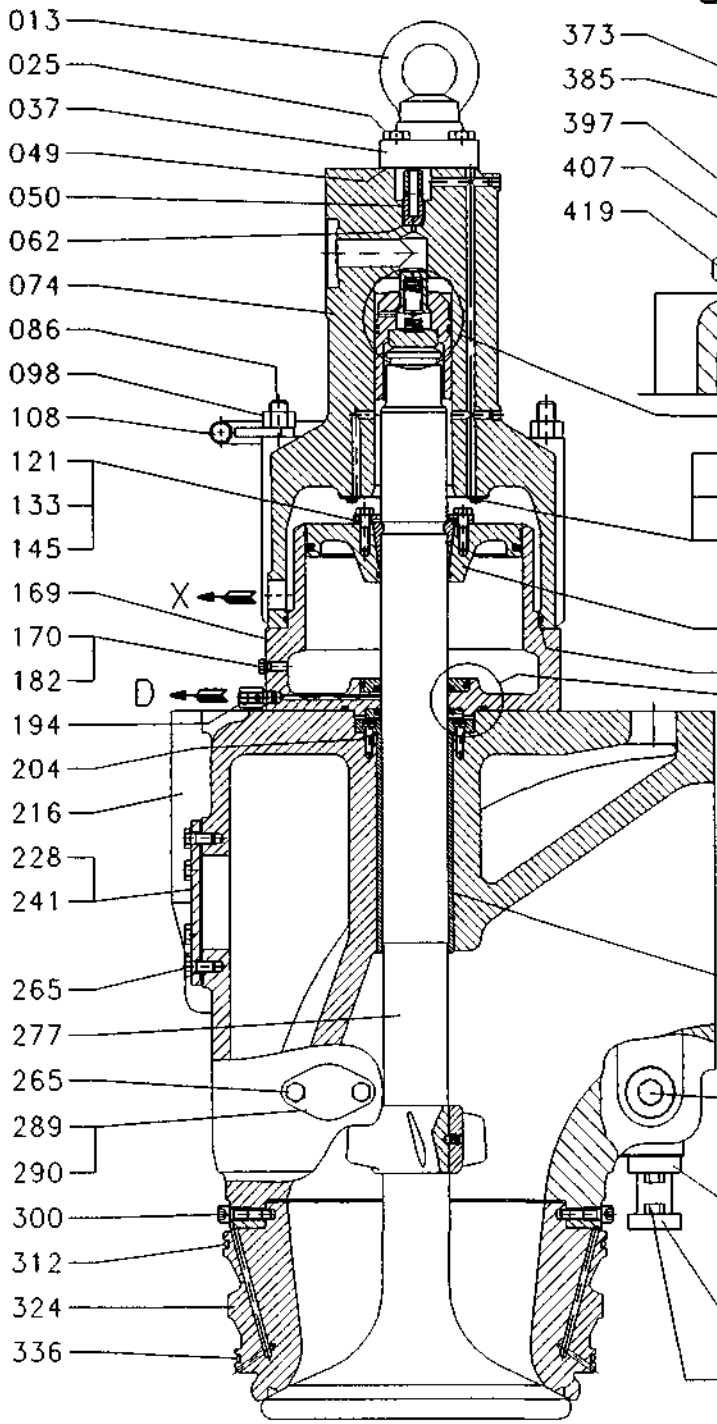
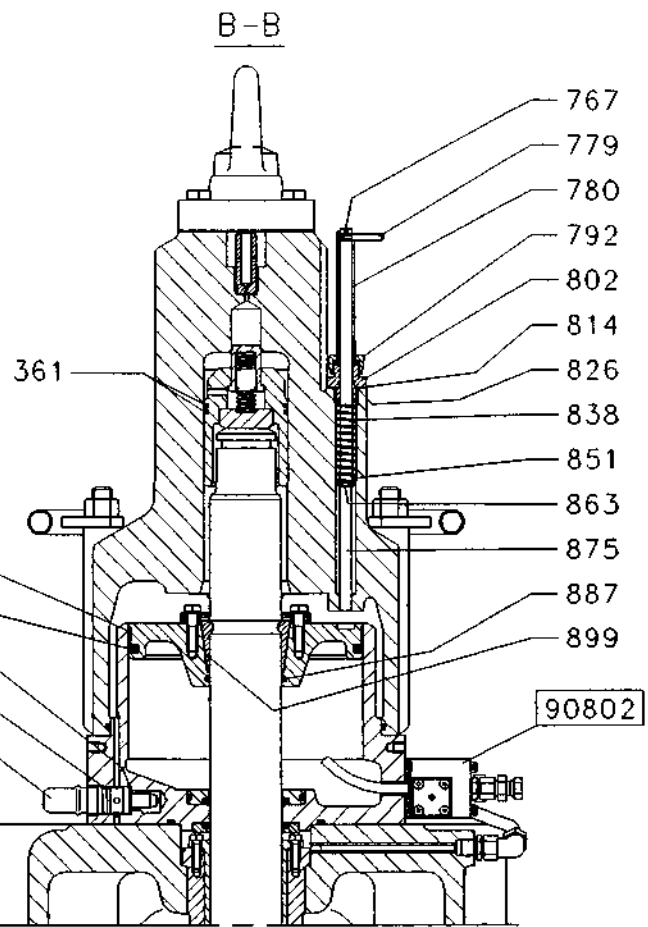
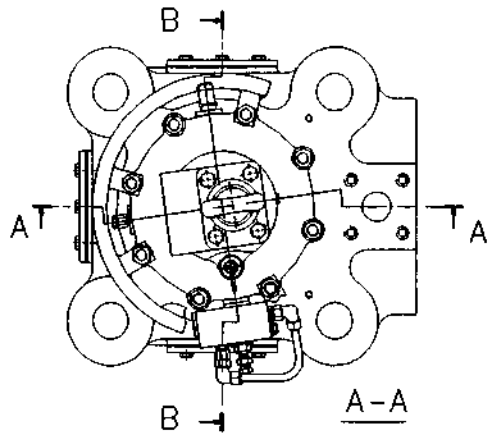
*See Vol. II, MAINTENANCE, Procedure 908.*



Another special tool is delivered, which is able to retain the exhaust valve spindle in the open position.

*See Vol. II, MAINTENANCE, Procedure 908.*

**S50MC-C**



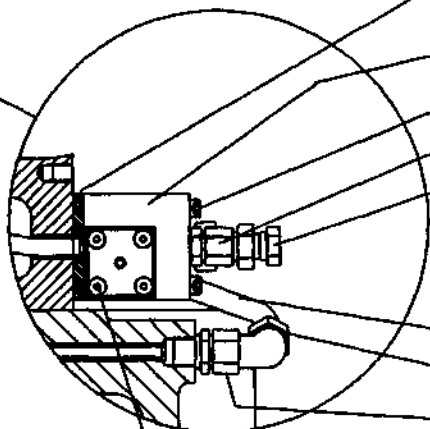
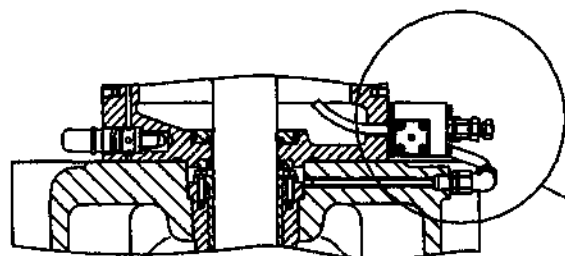
**Plate 90801-147 Exhaust Valve**

Item No.	Part Description
013	Lifting eye bolt
025	Screw
037	Lifting attachment
049	Gasket
050	Orifice
062	Gasket
074	Oil cylinder
086	Stud
098	Nut
108	Safety strap
121	Disc
133	Screw
145	Lock washer
169	Air cylinder
170	Plug screw
182	Gasket
194	Ball cock
204	Screw
216	Valve housing
228	Cover
241	Gasket
265	Screw
277	Valve spindle
289	Flange
290	Gasket
300	Stop screw
312	O-ring
324	Valve seat
336	O-ring
361	Piston ring
373	Guide ring
385	Sealing ring
397	Gasket
407	O-ring
419	Safety valve
420	Disc
432	Screw
444	Lock washer
456	Piston, complete
468	Piston
481	Sealing ring
515	Damper piston
527	Piston
539	Spring
540	Disc, please state height 18 or 15 mm
564	O-ring
576	O-ring
588	Flange
611	Sealing ring

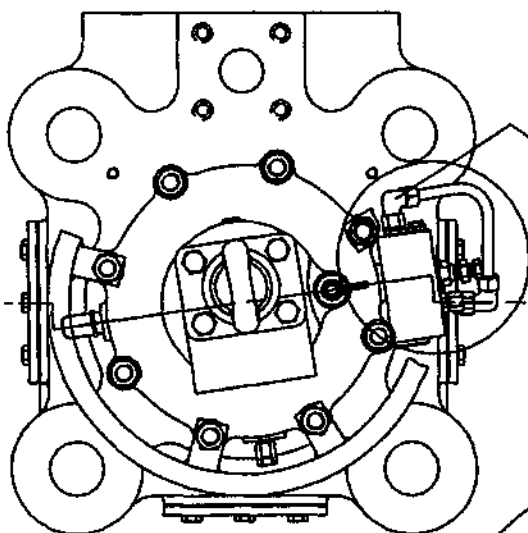
Item No.	Part Description
623	Screw
635	Flange
647	Liner for spindle guide
659	Spindle guide
672	Gasket
684	Plug screw
696	Gasket
706	Flange
718	Screw
731	Cooling water connection
743	O-ring
767	Cup point screw
779	Pin
780	Guide
792	Union nut
802	Screwed connection
814	Gasket
826	O-ring
838	Spring
851	Spring retainer
863	Spring pin
875	Rotation check rod
887	O-ring
899	Conical ring in 2/2

S50MC-C

A-A

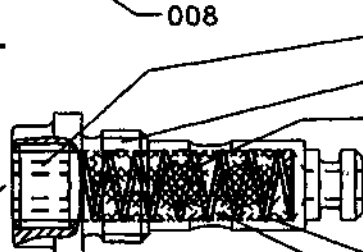


- P01
- P02
- P03
- 003
- 001
- 002
- 005
- 006
- 007
- 008
- 004
- 010



A T A T

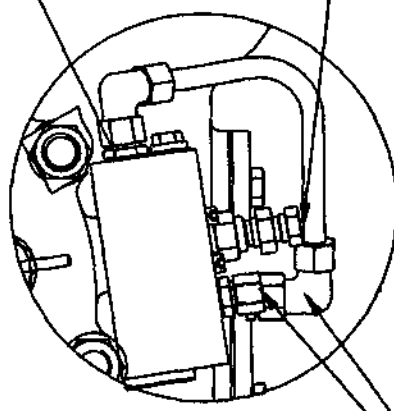
- 113
- 114
- 008



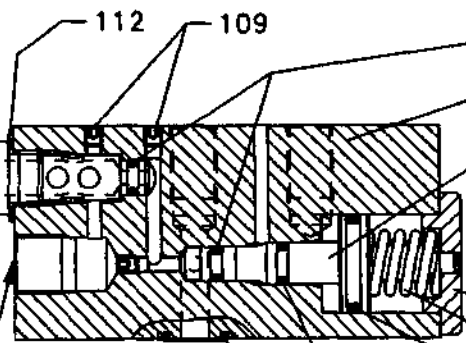
- B01
- B02
- B03
- 111
- B05
- B03

Air inlet 006

- 009
- 010



Control air 011



- 112
- 109
- 107
- 101
- 103
- 111
- 001
- 102
- 104
- 105
- 106
- 108

Sealing air

**Plate 90802-07 Exhaust Valve - Detail**

Item No.	Part Description	MAN B&W Standard No.	Remark (EMD Standard No.)
001	Sealing air control unit		
002	Socket head bolt		230DP106070
003	Pipe with flange		
004	Orifice pipe		
005	Connector		44024051002
006	Non-return valve	EN206A10,105	
007	Pipe		
008	Elbow coupling		440CG201200
009	Connector		440CG421203
010	Gasket		46213017025
011	Gasket		46213013017
101	Valve housing		
102	Cover		
103	Valve spindle		
104	Spring		
105	O-ring		3557L030023
106	O-ring		
107	O-ring		
108	O-ring		
109	Set screw		204DP105006
111	Filter housing		
112	Gasket		46213017025
113	Hex. socket screw	EN59S512	201DP205012
114	Serrated lock washer		273UT305000
B01	Hexagon socket plug	EN47AU12	245CR112000
B02	Filter housing		
B03	Filter plate inside		
B05	Pressure spring		
P01	Plate		
P02	O-ring		
P03	Pipe bend		

**S50MC-C**

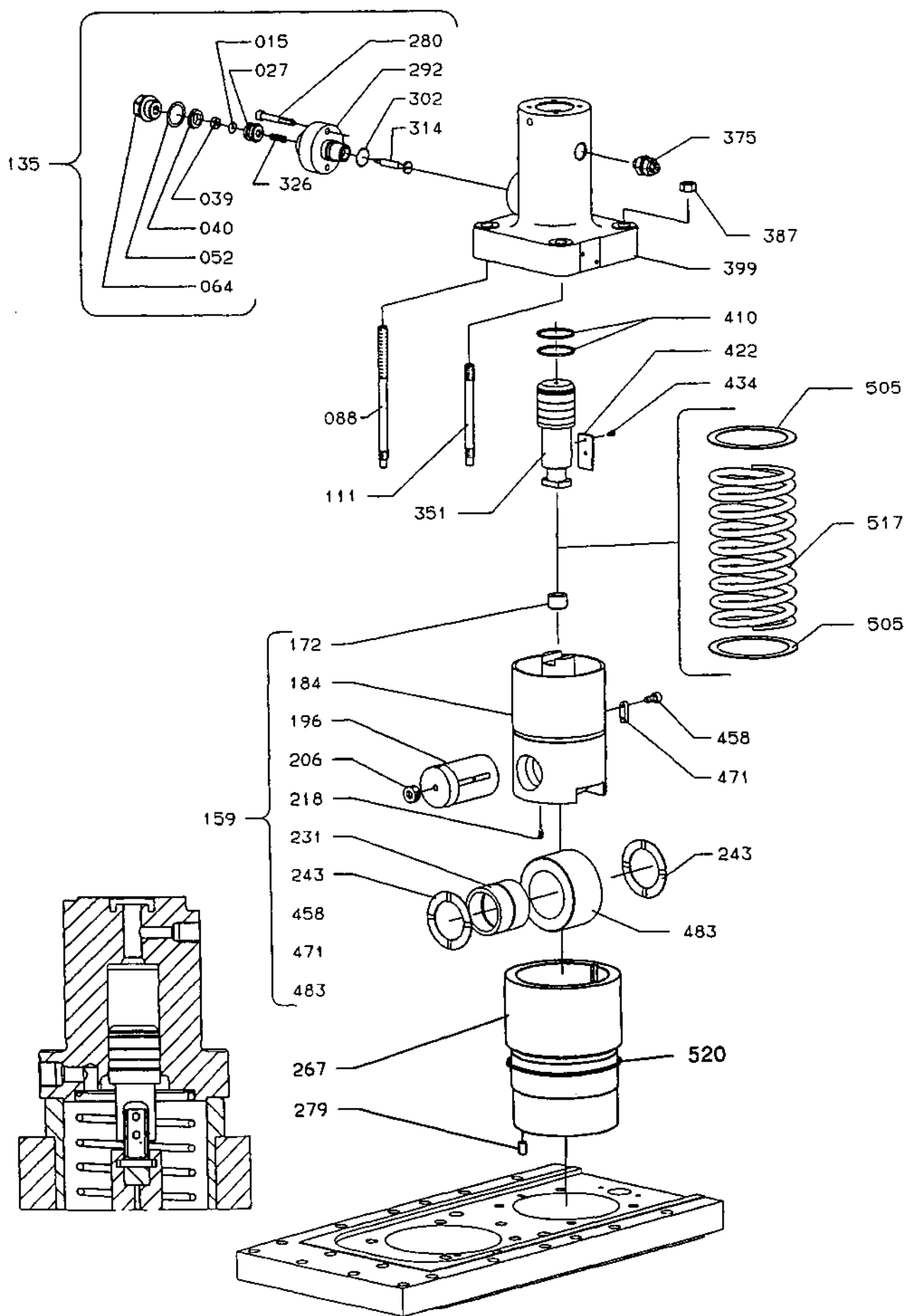
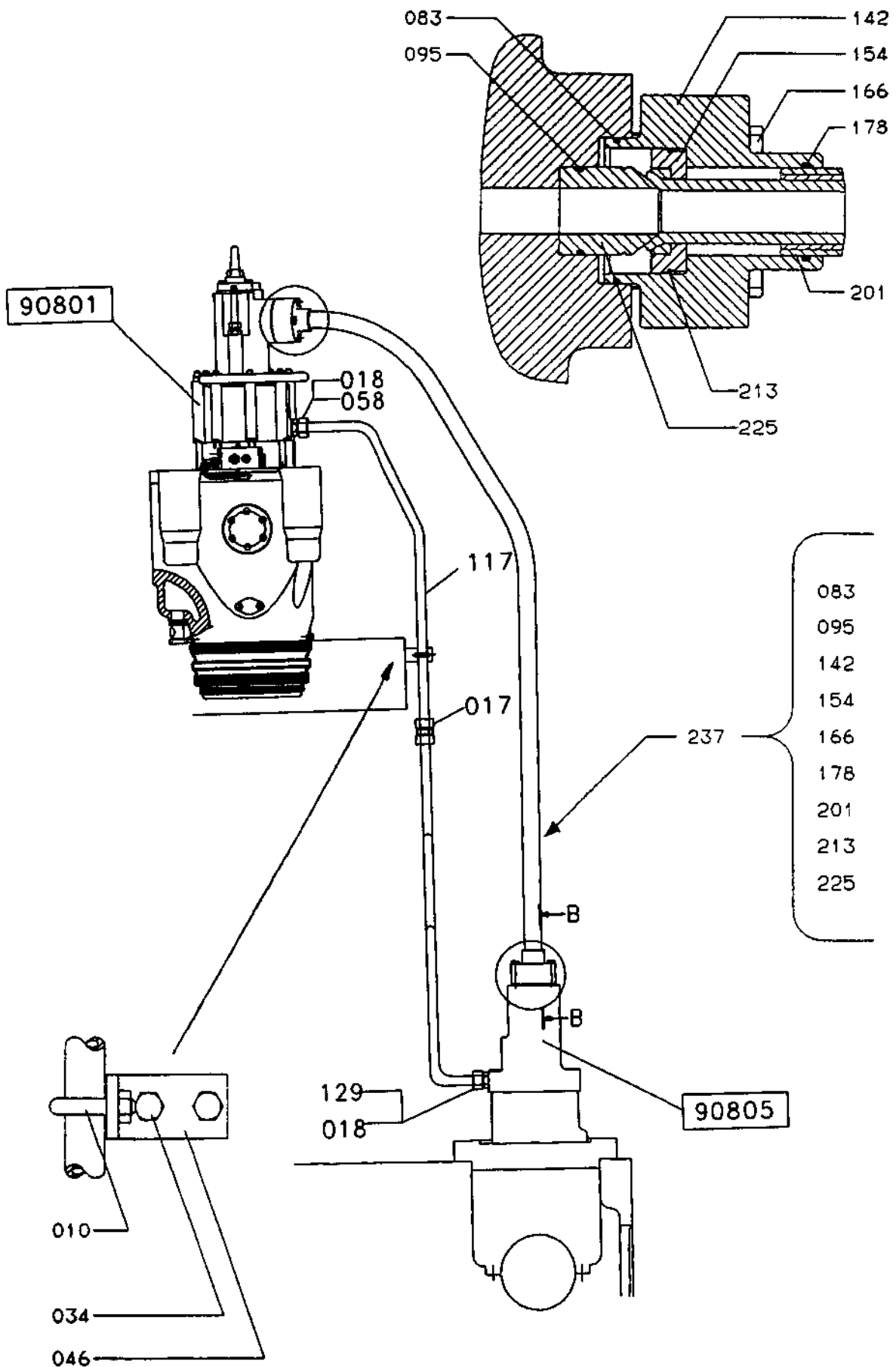


Plate 90805-97 Valve Gear

Item No.	Part Description
015	Lock washer
027	Piston
039	Nut
040	Sealing ring
052	Packing
064	Reducing socket
088	Stud
111	Stud
135	Puncture valve
159	Roller guide, complete
172	Thrust disc
184	Roller guide
196	Shaft-pin for roller
206	Plug
218	Screw
231	Bushing
243	Disc
267	Bushing for roller guide
279	Guide pin
280	Screw
292	Valve housing
302	Sealing ring
314	Spindle
326	Spring
351	Piston
375	Non-return valve
387	Nut
399	Oil cylinder
410	Piston ring
422	Disc
434	Screw
458	Screw
471	Key
483	Roller
505	Disc
517	Spring
520	O-ring

Item No.	Part Description

S50MC-C

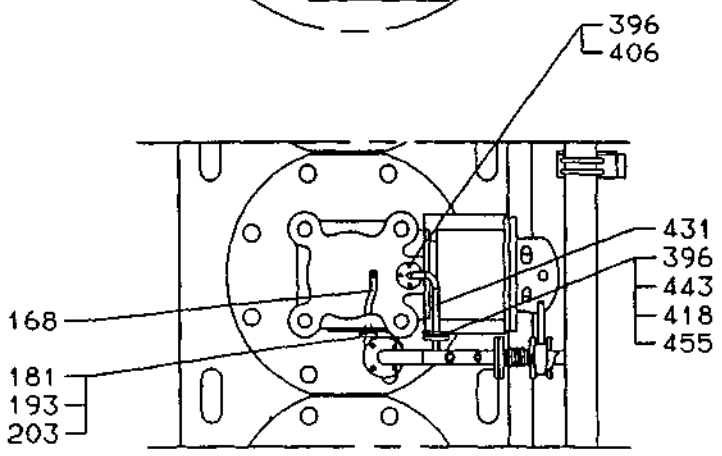
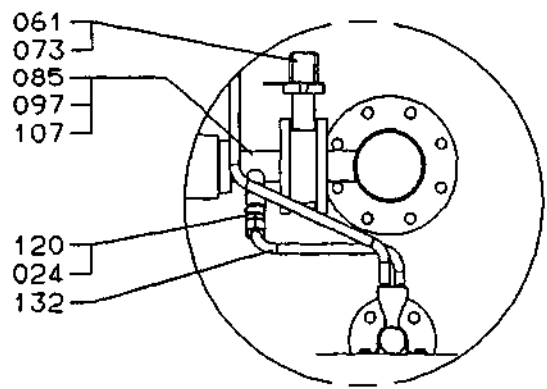
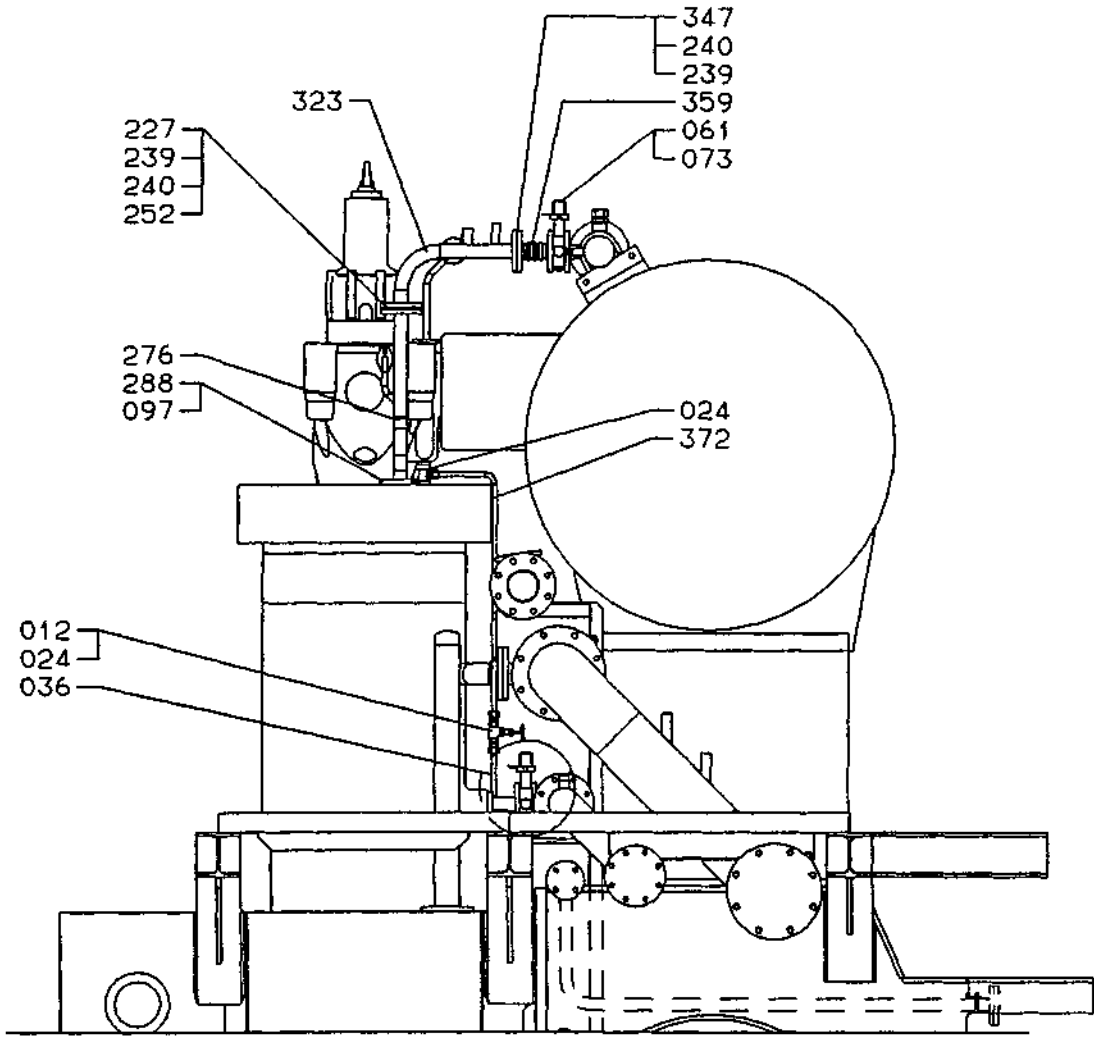




**Plate 90806-58 Valve Gear - Details**

Item No.	Part Description
010	U-bolt
017	Connector
018	Gasket
034	Screw
046	Support
058	Coupling
083	Sealing ring
095	Sealing ring
117	Pipe, L=2160
129	Coupling
142	Thrust flange
154	Sleeve in 2/2
166	Screw
178	O-ring
201	High-pressure pipe
213	Spring ring
225	Intermediate piece
237	High-pressure pipe, complete

Item No.	Part Description



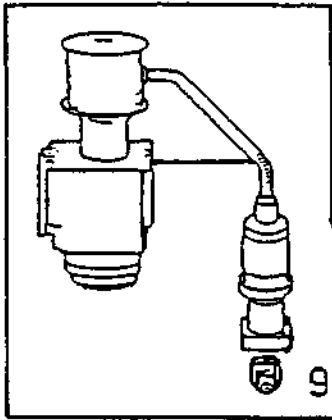
**Plate 90810-43 Arrangement of Cooling Water Pipes**

Item No.	Part Description
012	Valve
024	Coupling
036	Pipe
061	Butterfly valve
073	Screw
085	Pipe
097	Screw
107	Packing
120	Ball valve
132	Drain pipe
168	Pipe (inside valve housing)
181	Packing
193	Screw
203	Screw
227	Screw
239	Nut
240	Packing
252	Orifice plate
276	Cooling pipe
288	Packing
323	Cooling pipe
347	Screw
359	Compensator
372	Pipe
396	Packing
406	Screw
418	Screw
431	Cooling pipe
443	Orifice plate
455	Nut

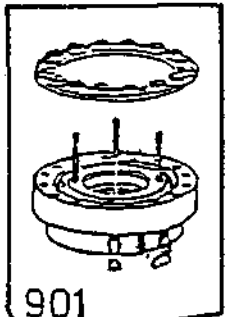
Item No.	Part Description

# FUEL OIL SYSTEM

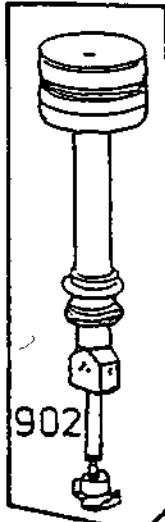
909



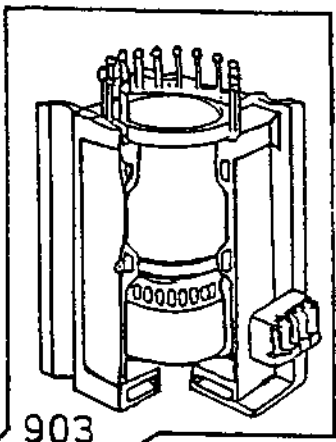
908



901

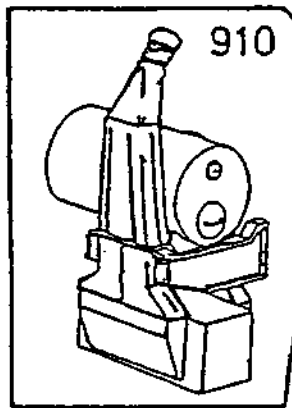


902

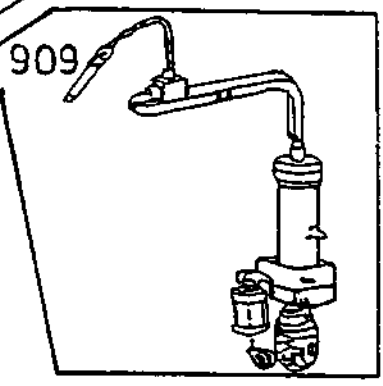


903

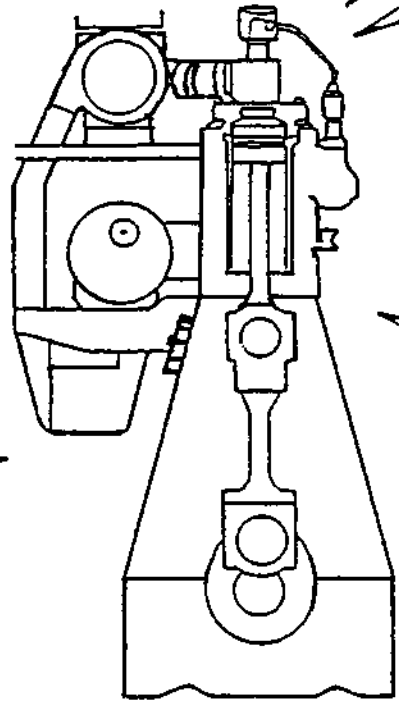
A  
(ACCESSORIES)



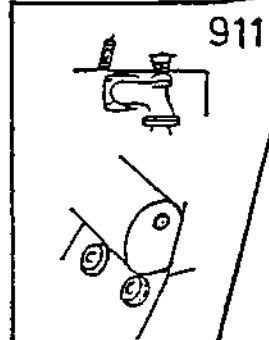
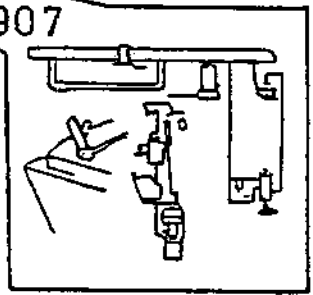
910



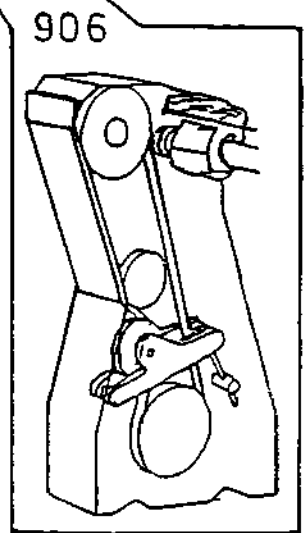
909



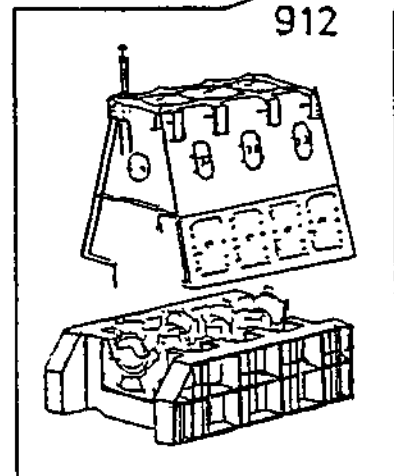
907



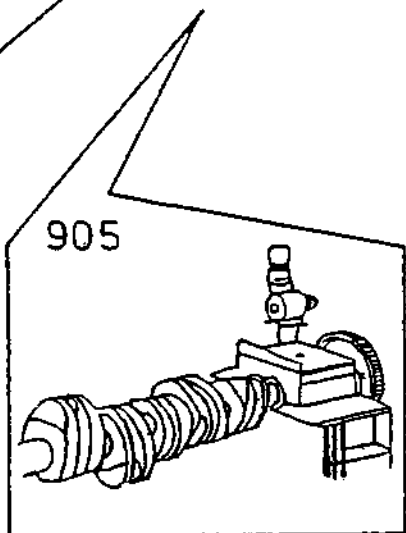
911



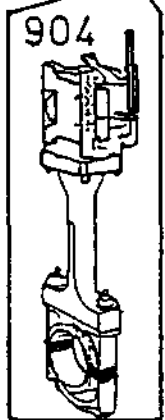
906



912



905



904

## Fuel Oil System

### Fuel Pump

Each engine cylinder is equipped with its own fuel pump, which is mounted on the roller guide housing over the camshaft section corresponding to the cylinder concerned.

The square base of the fuel pump housing is provided with a groove to receive any leaking oil, which is subsequently drained off through a drain pipe.

A bore is provided in the base for a toothed rack which controls the quantity of fuel oil delivered by the pump via the regulating guide.

At the top, the pump housing is closed by a top cover, which incorporates a puncture valve and a suction valve. The cover is attached by means of nuts and studs fitted in the pump housing.

A locating pin fitted at the top of the pump housing ensures the correct positioning of the parts.

Shims are inserted between cover and housing. By changing the number of shims, the maximum combustion pressure can be adjusted.

Oil is supplied through a flanged connection on the front of the pump housing. A shock absorber which neutralizes the shock caused when the plunger uncovers the cut-off holes at the end of each delivery stroke is fitted to a flange on the back of the housings, or in the fuel oil inlet pipe.

The shock absorber consists of a cylinder with a spring-loaded plunger which is pressed back when the surplus oil from the delivery chamber is forced out into the inlet space round the pump barrel.

Two plug screws are fitted in the pump housing opposite the cut-off holes of the barrel. The oil jets which are ejected through the cut-off holes at the end of the delivery stroke, hit the plug screws, which can be replaced when they are eroded.

### Pump Plunger and Regulating Guide

The pump plunger is fitted within the barrel and ground accurately to form an oil-tight seal. Barrel and plunger must always go together and cannot be replaced individually.

During the travel of the plunger, cut-off holes in the barrel are covered and uncovered. This function, in conjunction with the turning of the plunger effected by the regulating gear, serves to regulate the amount of oil injected into the engine cylinder.

The pump plunger is provided with a guide block designed to travel in the milled keyway in the regulating guide. At the bottom it has a foot which rests on a thrust disc in the bayonet joint at the roller guide neck. A clearance of approx. 0.1 mm between the plunger foot and the roller guide permits the plunger to turn in the roller guide.

The regulating guide has a gear rim which engages with the toothed rack at the base of the pump housing. The gear rim and toothed rack are marked with lines enabling the parts to be positioned correctly after disassembly. The toothed rack is linked together with the regulating gear of the engine through a spring-loaded connection. Thus, in the event of a sticking pump plunger, the regulating gear for the remaining fuel pumps will not be blocked.

### Puncture Valve

A puncture valve is fitted in the top cover of the pump. The puncture valve consists of a piston which communicates with the pneumatic/electric system of the engine. In the event of actuation of the shut-down system, or the "Fuel Oil Leakage Alarm System", (option) or when STOP is activated, compressed air is supplied to the top of the piston. This causes the piston with pin to be pressed downwards and open the suction valve and hereby 'puncture' the oil flow to the fuel valve. As long as the puncture valve is activated, the fuel oil is returned through bores to the pump housing, and no injection takes place.

## Fuel Oil System

The fuel oil is supplied through a pipe on the front of the pump housing from the electrically driven circulating pump. The oil pressure is kept constant by means of the overflow valve, *Plate 90915*, which is located between the main fuel oil supply line to the pumps and the return line. The fuel pump and the fuel valves are designed for circulation of warm oil, enabling them to be preheated during standstill and in between the fuel oil injections.

## Fuel Oil Injection

During the suction stroke the spring-loaded suction valve opens and the delivery chamber is filled with oil.

As soon as the plunger has covered the cut-off holes in the pump barrel during its upward movement, injection commences through the fuel valves. The vertical position of the cut-off holes thus controls the injection timing. Injection will last until the cut-off holes are uncovered by the oblique cut-off edges, following which the oil is forced through bores in the top of the plunger and out through the cut-off holes of the barrel during the rest of the stroke.

## Fuel Pump Actuating Gear

The roller guide housing containing the fuel pump, the exhaust valve actuating gear and the indicator drive (option), is integrated in the cylinder frame.

On reversible engines, the roller guide for each fuel pump incorporates an angular displaceable reversing link.

The fuel pump is actuated by a cam on the camshaft. The movement is transmitted through the roller guide to the plunger in the barrel of the pump housing which – through the high-pressure pipes – is connected with the fuel valves on the cylinder cover.

The roller guide is forced downwards by the action of two helical springs fixed between the roller guide and the pump base, so that the roller of the roller guide follows the cam on the camshaft. The pump base is attached to the camshaft housing by two studs and nuts.

The thread of these studs is long enough to permit the gradual easing of the roller guide springs when dismantling the components. The plunger rests on a thrust piece in the neck of the roller guide and is locked to the roller guide by a bayonet lock. The roller guide itself is prevented from turning by means of a guide block mounted in the liner of the housing.

The top of the roller guide neck is located inside the pump base and is equipped with a cap which is fitted with a sealing arrangement. This cap, together with a sealing bush that is mounted in the pump base, form a labyrinth to prevent fuel oil from entering the lube oil system.

A special tool, which can lift the roller guide roller free of the fuel cam, is supplied. The tool is to be mounted on the fuel pump top cover, when the puncture valve has been removed.

*For operation of the lifting tool, see the instruction book, Volume II, Procedure 909.*

## Reversing mechanism (only reversible engines)

*Plate 90905*

Reversing is achieved by shifting the roller in the fuel pump drive mechanism at each cylinder. The link connecting the roller guide and roller is provided with a reversing arm, and a pivot is mounted at the top end of the reversing arm. The pivot travels in a reversing guide connected to an air cylinder. The link is self-locking in either the AHEAD or ASTERN position without the aid of external forces. Each cylinder is reversed individually, and the reversing mechanism is activated by compressed air.

## Fuel Oil High-Pressure Pipes

*Plate 90913*

All high-pressure pipes in the system are provided with flexible, steelwire-armoured hoses or a protective outer pipe. The space between the high-pressure pipe and the protective hose/pipe communicates, through drilled passages in the flanges, with a drain bore in the pump top cover.

## Fuel Oil Leakage Alarm (Option)

### Alternative 1:

Each fuel pump is, via drain pipes, connected to a common drain tank, which incorporates a level switch. The drain tank is also equipped with an overflow pipe, which has a small drain bore below, whereby oil from small leakages can be drained to the outlet, without actuating the level switch.

In the event of pipe fractures or major leakages in the system, the aforementioned bore will not be large enough to allow the increased oil quantity to pass, and the oil level in the drain tank will rise until it reaches the level of the overflow pipe. The rising oil level will cause the level switch to actuate an alarm.

### Alternative 2:

The drain pipes of each fuel pump are connected to a diaphragm valve, which sets off an alarm and activates the puncture valve in order to stop the fuel oil flow from the pertaining pump.

## Fuel Valve

*Plate 90910*

The fuel valve consists of a valve head 161, union nut 112, valve body 090, and nozzle 065. Fitted within the valve body are non-return valve 197 with a combined slide/valve, thrust spindle 219 with thrust spring 220, thrust foot 244, and spindle guide 077.

When the fuel valve is fitted in the cylinder

cover, the valve parts are tightened together by the pressure from the nuts being transmitted through valve head, non-return valve, thrust spindle, spindle guide and nozzle to the valve body, which is pressed into the tapered bore in the cylinder cover. The union nut keeps valve head and valve body together during dismantling of the fuel valve.

The spindle guide 077 consists of spindle guide, thrust piece and spindle with cut-off slide. The spindle guide is assembled with a press fit.

The spindle is pressed against the tapered valve seat of spindle guide by the action of the thrust spring 220, the spring pressure being transmitted through the slotted thrust foot 244. The thrust spring determines the opening pressure of the valve.

Optionally, an extra disc can be inserted to raise the opening pressure by 30 bar.

The non-return valve 197 consists of housing, thrust piece, slide and spring. The non-return valve is assembled with a press fit.

The slide is pressed by the spring against the tapered valve seat inside the non-return valve. In this position the head of the slide uncovers a small bore arranged for circulation purposes in thrust piece.

## The functioning of the fuel valve is as follows:

### Position I:

The electrical fuel oil circulating pump circulates preheated oil through the fuel pump and fuel valve. In the fuel valve the oil passes through the central bore of the valve head and continues to the thrust piece of the non-return valve, leaving through the circulation bore of the latter. Thence the oil is passed through the interior of the valve body to an outlet pipe on the side of the valve head.

The space round the tapered valve seat of



the spindle is also filled with oil, but the circulating pump pressure is insufficient to overcome the force of the spring and lift the spindle.

If, for some reason, valve spindle 028/041 should not close during engine standstill, then the closed spindle in the non-return valve will prevent the circulating pump from pressing oil through the nozzle, and thus obviate the risk of the engine cylinder being filled with oil.

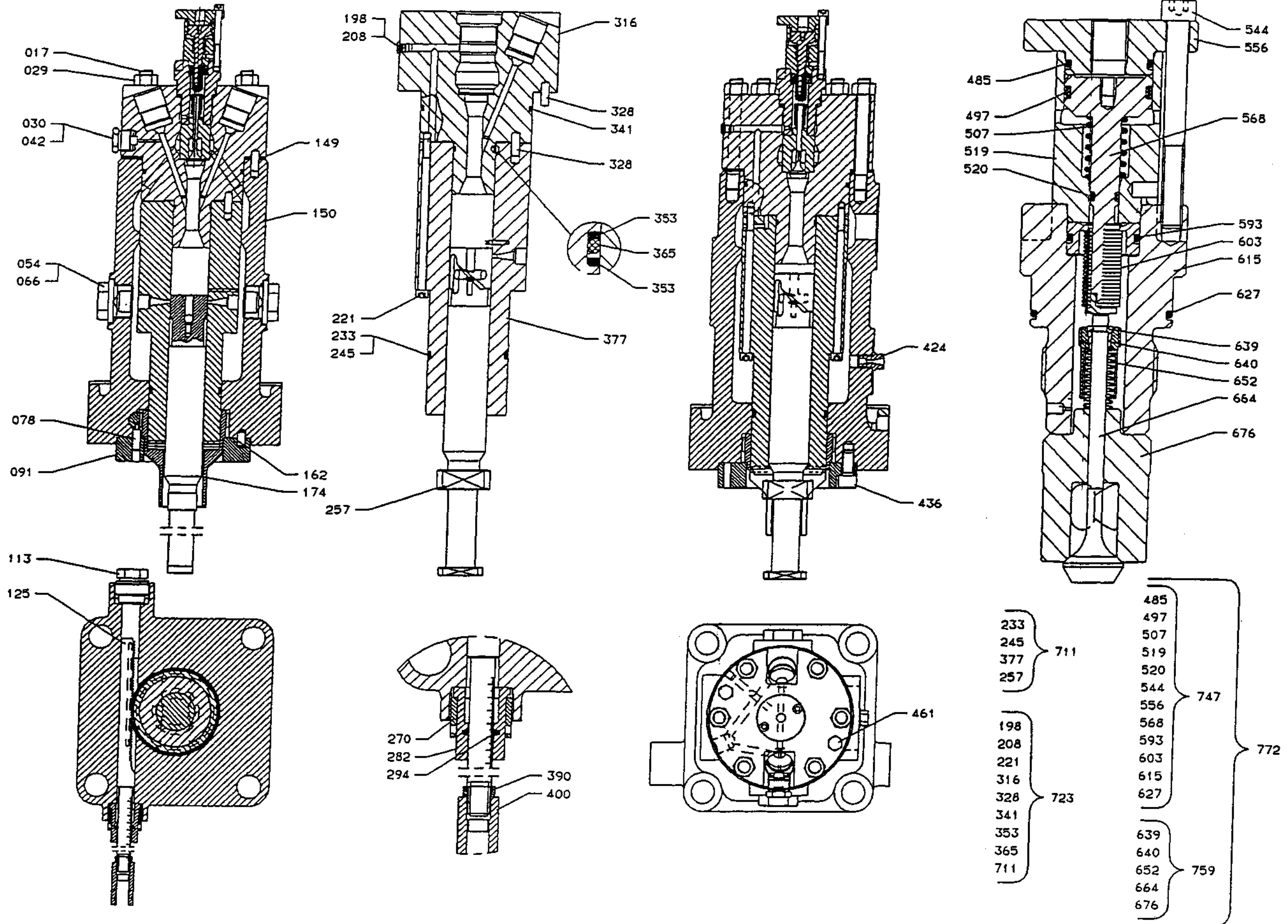
**Position II:**

When, at the beginning of the delivery stroke, the pressure has risen to about 10 bar, the force of the spring in the non-return valve will be overcome and spindle pressed back against the shoulder of thrust piece.

**Position III:**

When the spindle in the non-return valve is pressed upwards, the circulation bore of the thrust piece is closed, and the oil passes the seat of the spindle and enters the space round valve spindle seat in spindle guide. When the pressure has risen to the preset opening value of the fuel valve, the spindle is lifted, and oil is forced through the nozzle into the engine cylinder.

At the termination of the delivery stroke, first the valve spindle and then the spindle in the non-return valve will be pressed against their respective seats, the injection of fuel stops, and oil is again circulated through the valve (position I).



**Plate 90901-153 Fuel Pump**

Item No.	Part Description
017	Stud
029	Nut
030	Disc
042	Plug
054	Packing
066	Plug screw
078	Guide pin
091	Guide bushing
113	Plug screw
125	Toothed bar
149	Shim
150	Fuel pump housing
162	Guide pin
174	Regulating guide
198	Packing
208	Plug screw
221	Screw
233	Sealing ring
245	Back-up ring
257	Plunger
270	Union
282	Pointer
294	Felt ring
316	Top cover
328	Guide pin
341	Sealing ring
353	Back-up ring
365	Sealing ring
377	Pump barrel
390	Nut
400	Forked lever
424	Restriction plug
436	Screw
461	Screw
485	Sealing ring
497	Sealing ring
507	Spring
519	Housing
520	Sealing ring
544	Screw
556	Cover
568	Air piston
593	Sealing ring
603	Flexible connection, complete
615	Housing
627	Sealing ring
639	Conical ring in 2/2
640	Cone
652	Spring

Item No.	Part Description
664	Spindle
676	Housing
711	Pump barrel, complete
723	Pump barrel and top cover, complete
747	Puncture valve, complete
759	Suction valve, complete
772	Comb.puncture valve + suction valve, complete

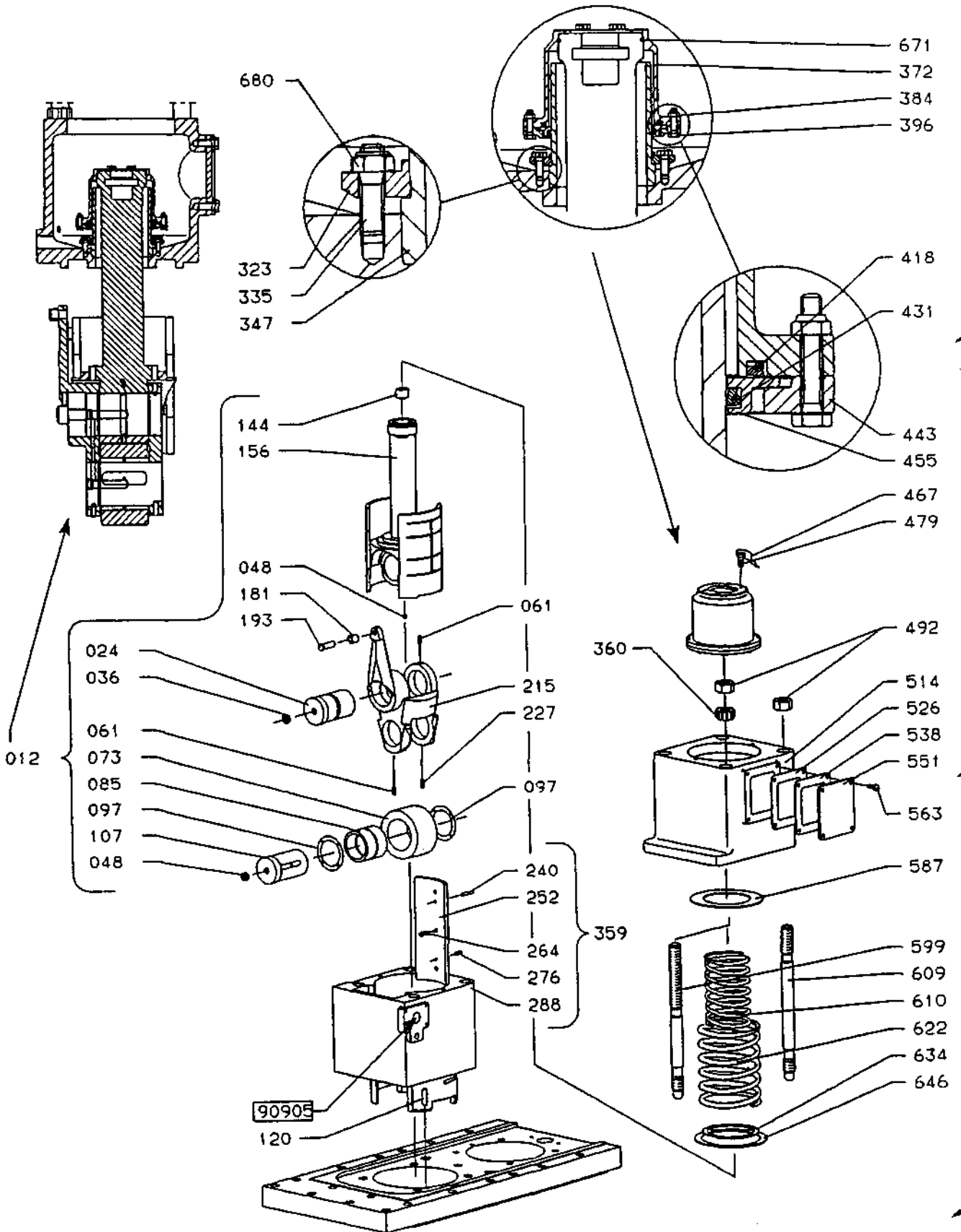
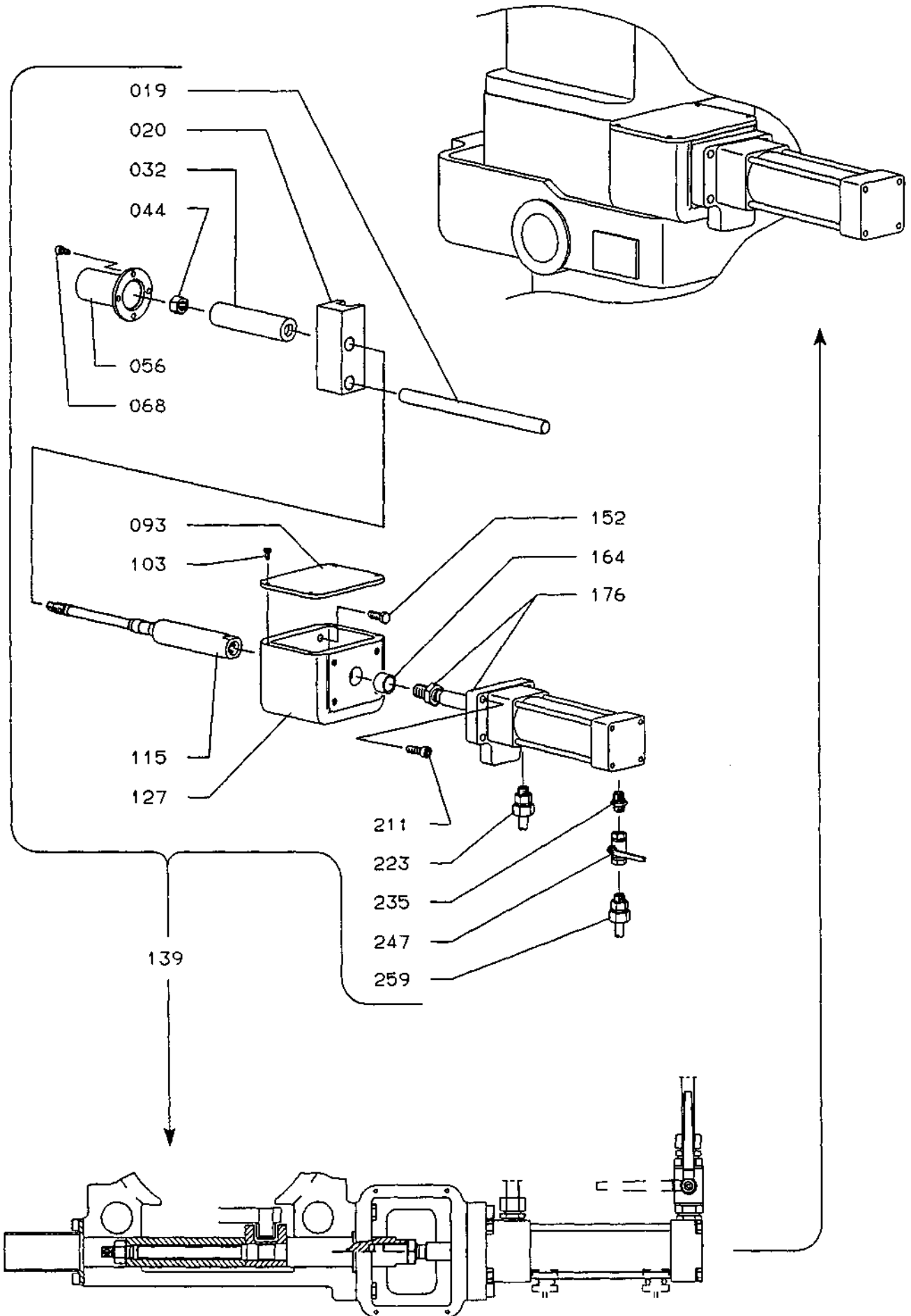


Plate 90902-116 Fuel Pump Gear

Item No.	Part Description
012	Fuel pump roller guide, complete
024	Shaft-pin for link
036	Plug
048	Plug
061	Stop screw
073	Roller
085	Bushing
097	Disc
107	Shaft-pin for roller
120	Guide pin
144	Thrust disc
156	Roller guide
181	Bushing
193	Pin
215	Link for reversing
227	Pin
240	Guide pin
252	Guide block
264	Screw
276	Guide pin
288	Bushing
323	Flange
335	Stud
347	Sealing bush
359	Bushing for roller guide
360	Nut
372	Cap
384	Self-locking nut
396	Screw
418	Scraper ring, axial
431	Scraper ring
443	Flange
455	Holder for scraper ring
467	Locking wire
479	Screw
492	Nut
514	Pump base
526	Packing
538	Packing
551	Cover
563	Screw
587	Disc
599	Stud
609	Stud
610	Spring, internal
622	Spring, external
634	Disc
646	Disc
671	Sealing ring
680	Self-locking nut

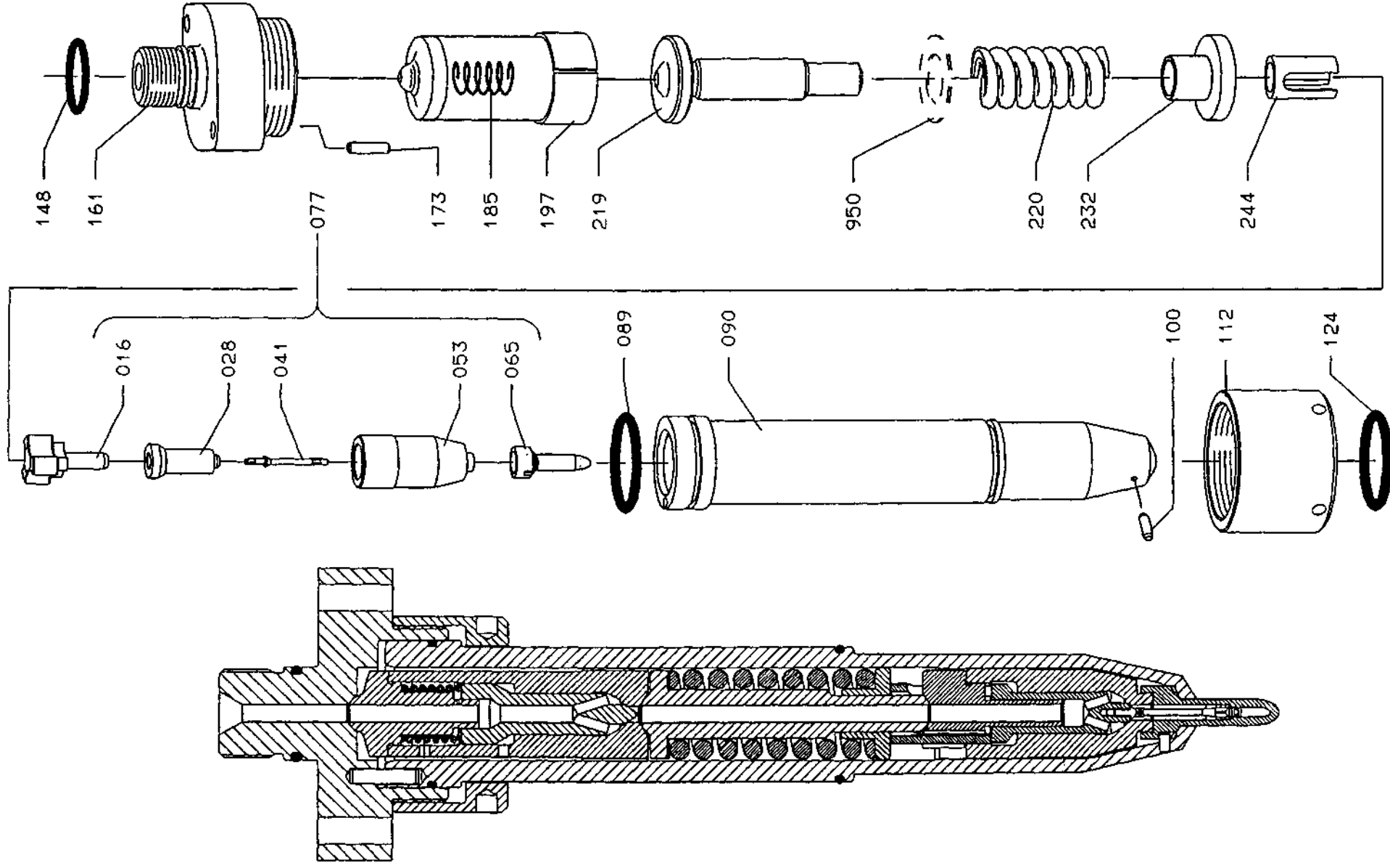
Item No.	Part Description



**Plate 90905-12 Reversing Mechanism**

Item No.	Part Description
019	Shaft
020	Guide for reversing
032	Distance pipe
044	Self-locking nut
056	Guard
068	Screw
093	Cover
103	Screw
115	Bolt
127	Flange for air cylinder
139	Reversing mechanism, complete
152	Screw
164	Bush
176	Air cylinder
211	Screw
223	Union
235	Reducing socket
247	Ball valve
259	Union

Item No.	Part Description
----------	------------------

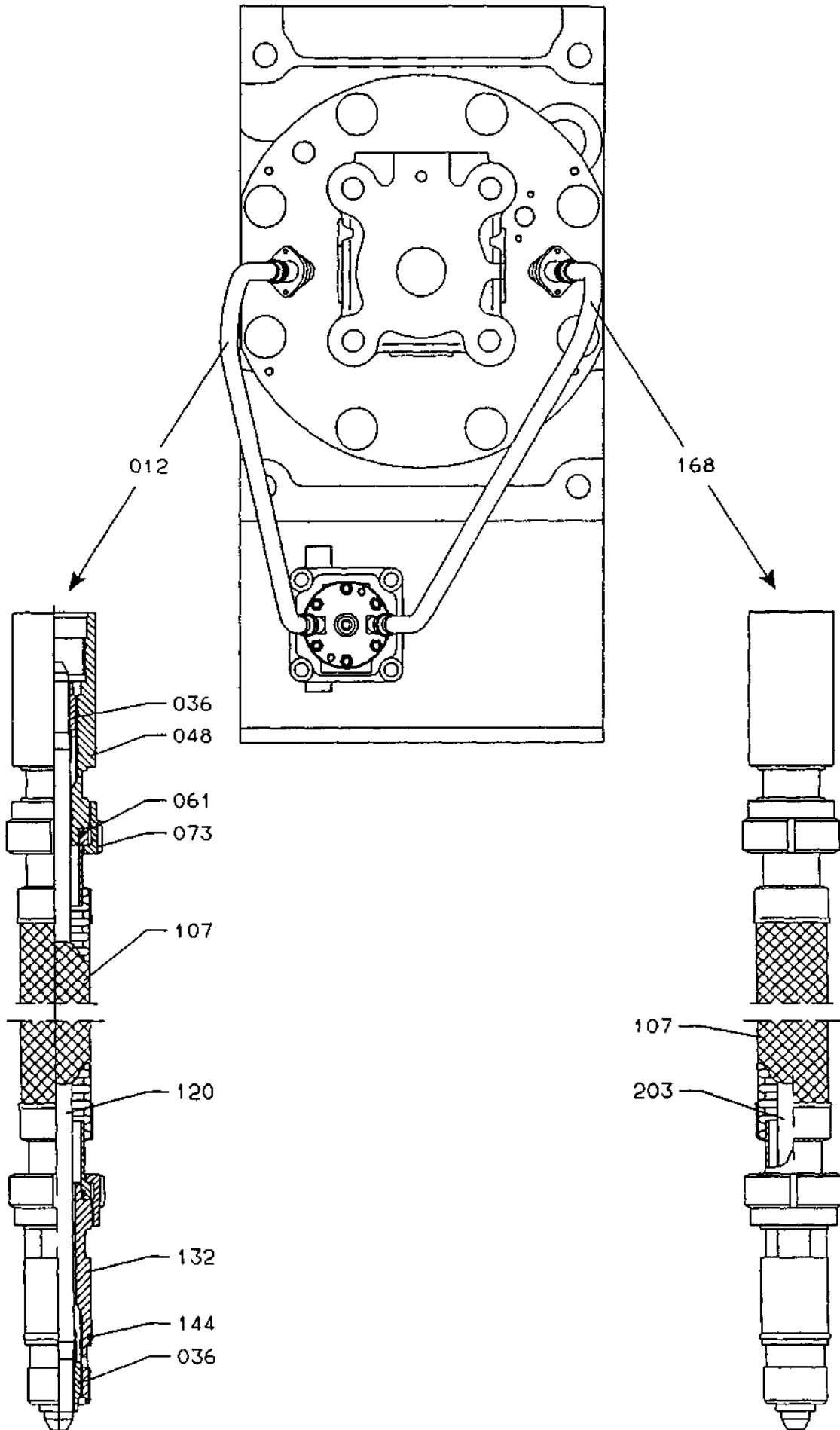




**Plate 90910-93 Fuel Valve**

Item No.	Part Description
016	Thrust piece
028	Spindle
041	Cut-off slide
053	Spindle guide
065	Nozzle
077	Spindle guide, complete
089	O-ring
090	Holder
100	Guide pin
112	Union nut
124	O-ring
148	O-ring
161	Valve head
173	Guide pin
185	Spring
197	Non-return valve, complete
219	Thrust spindle
220	Spring
232	Spring guide
244	Thrust foot
950	* Additional disc, + 30 bar
	*) Optional extras

Item No.	Part Description



**Plate 90913-97 High-Pressure Pipes**

Item No.	Part Description
012	High-pressure pipe, complete
036	Thrust bushing
048	Union nipple
061	O-ring
073	Union nut
107	Flexible hose, complete
120	High-pressure pipe
132	Union nipple
144	O-ring
168	High-pressure pipe, complete
203	High-pressure pipe

Item No.	Part Description
----------	------------------

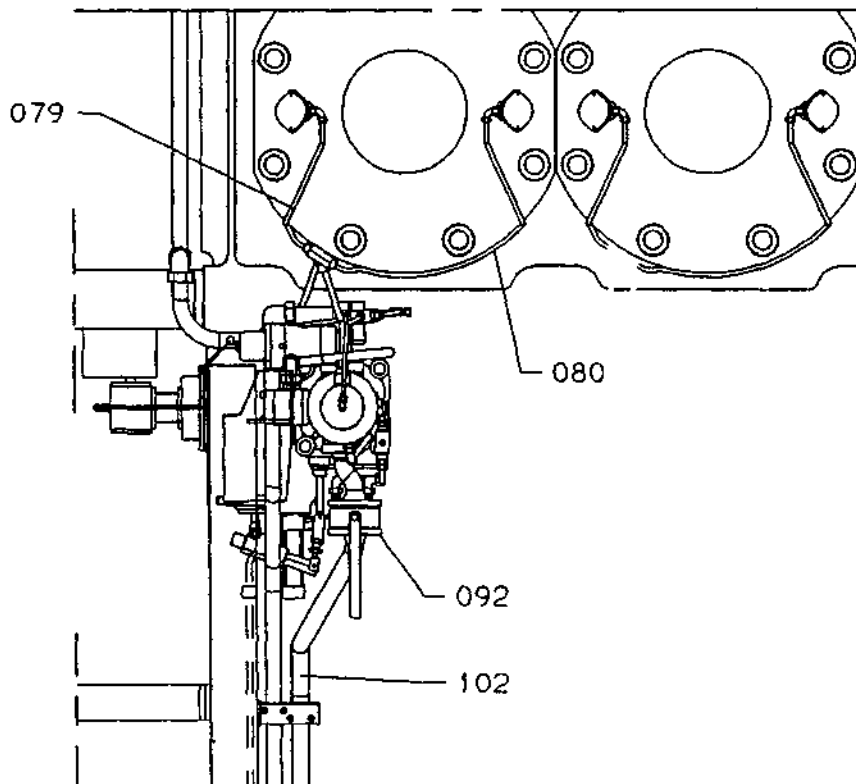
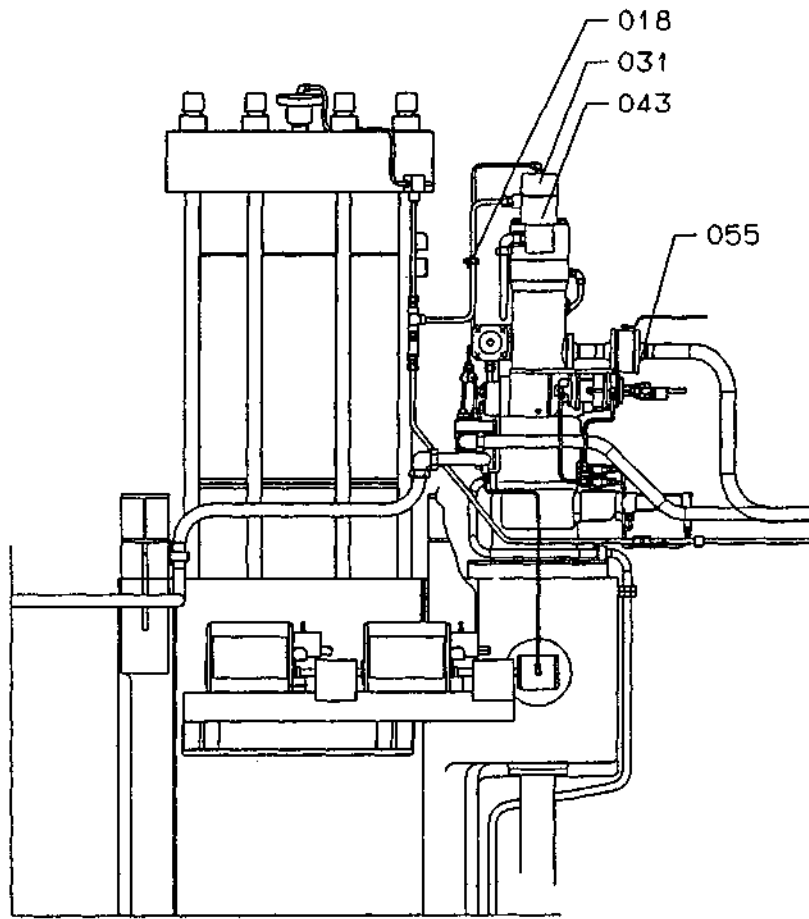


Plate 90914-43 Fuel Oil System

Item No.	Part Description
018	Return oil pipe, L=350
031	Control air pipe, L=900
043	Pipe, L=650
055	Fuel oil inlet pipe
079	Return oil pipe, L=600
080	Return oil pipe, L=1050
092	Ball valve
102	Fuel oil inlet pipe

Item No.	Part Description
----------	------------------

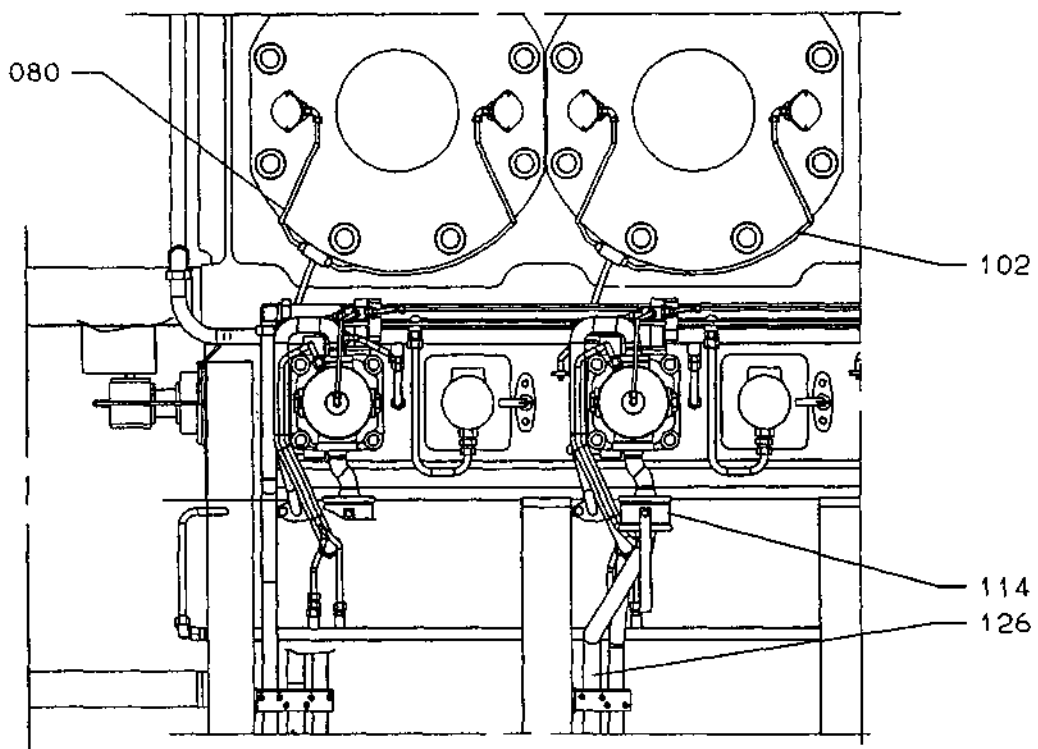
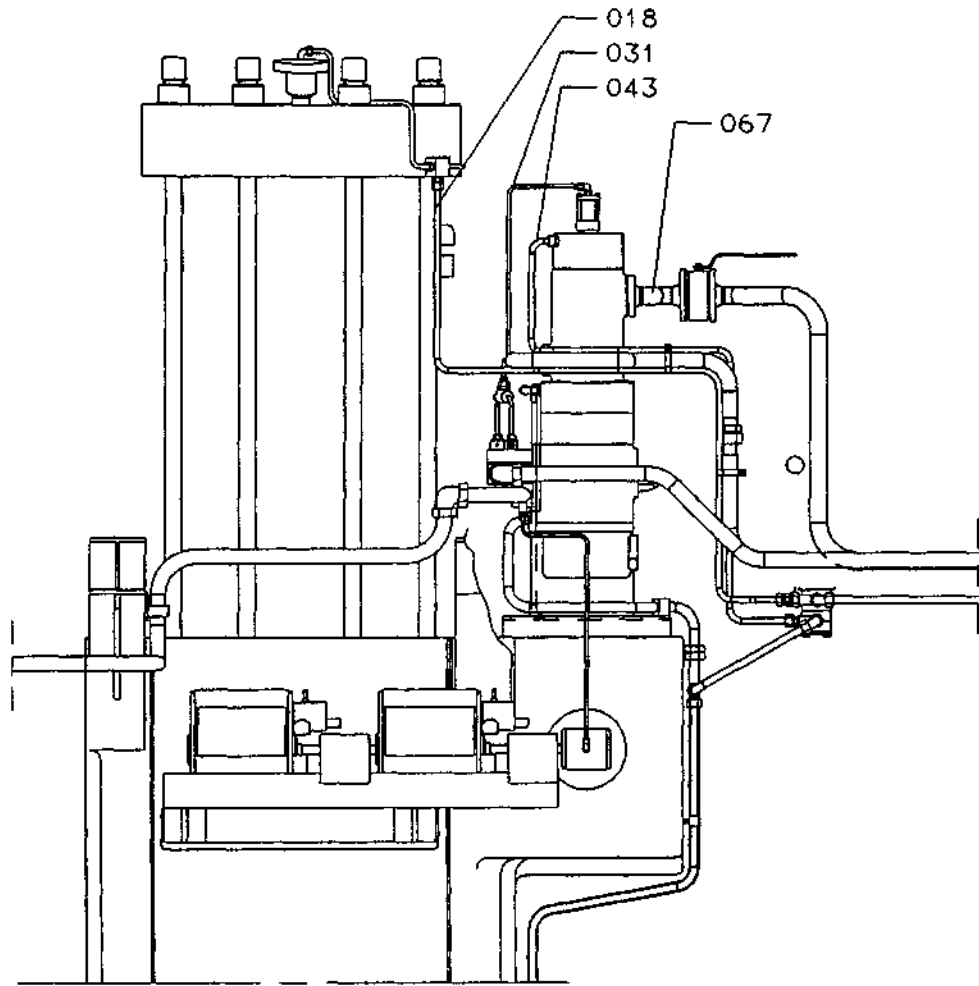


Plate 90914-44 Fuel Oil System

Item No.	Part Description
018	Return oil pipe
031	Control air pipe, L=800
043	Pipe
067	Fuel oil inlet pipe
080	Return oil pipe
102	Return oil pipe
114	Ball valve
126	Fuel oil inlet pipe

Item No.	Part Description
----------	------------------

S50MC-C

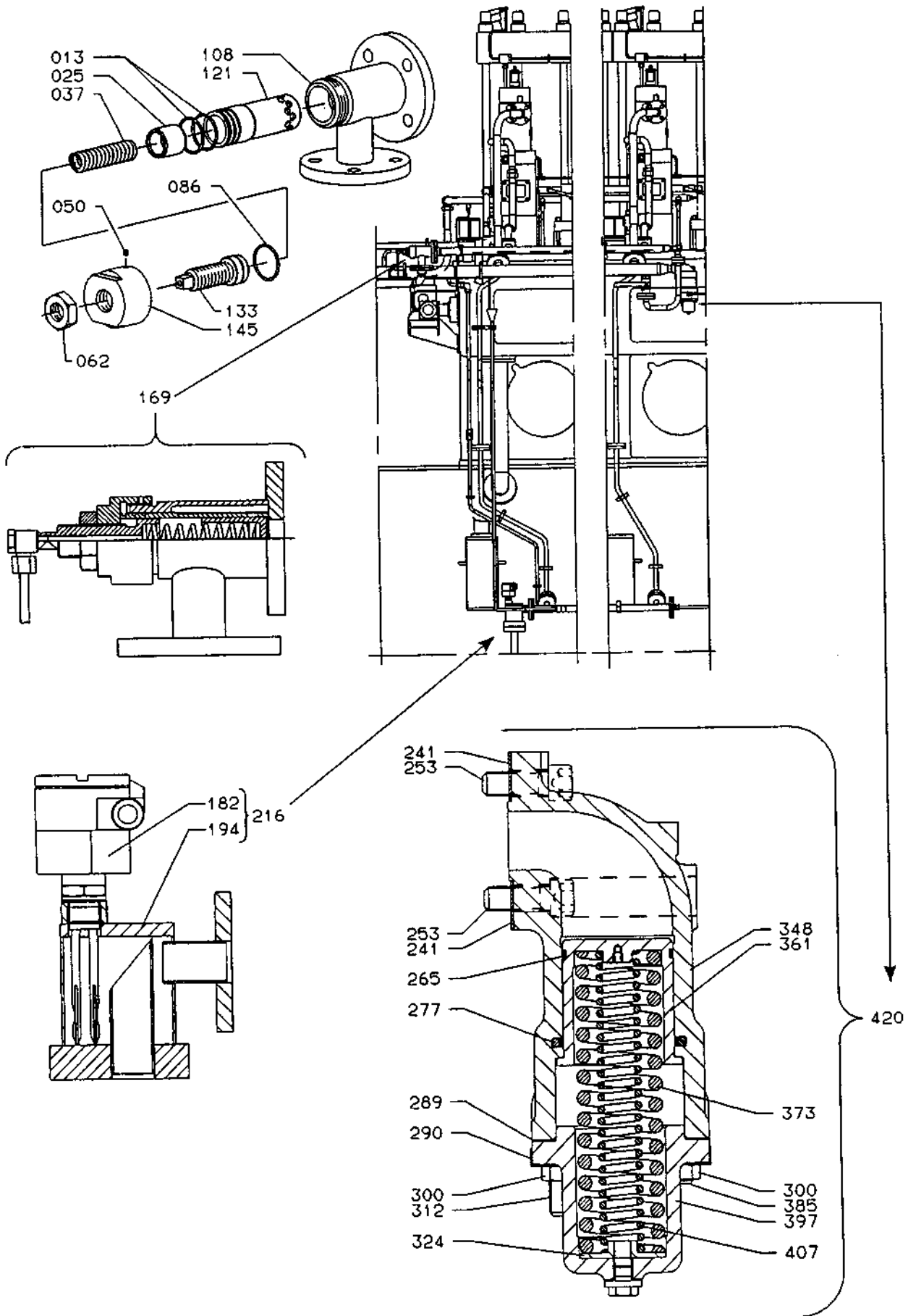




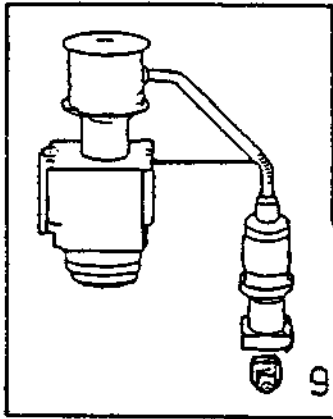
Plate 90915-24 Fuel Oil System - Details

Item No.	Part Description
013	O-ring
025	Piston
037	Spring
050	Cup point screw
062	Nut
086	O-ring
108	Housing
121	Valve housing
133	Spring guide
145	Valve cover
169	Over-flow valve, complete
182	Level switch
194	Drain box
216	Drain box, complete
241	Packing
253	Screw
265	Wearing ring
277	Sealing ring
289	Packing
290	Lock washer
300	Nut
312	Stud
324	Spring guide
348	Housing
361	Piston
373	Spring
385	Stud
397	Flange
407	Spring
420	Shock absorber, complete

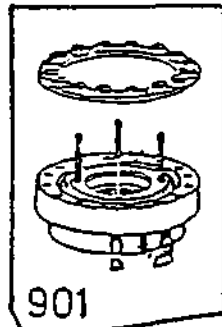
Item No.	Part Description

# TURBOCHARGER SYSTEM

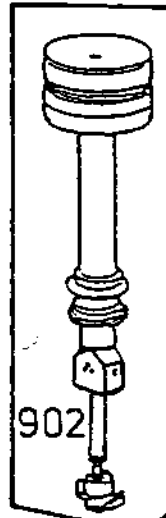
910



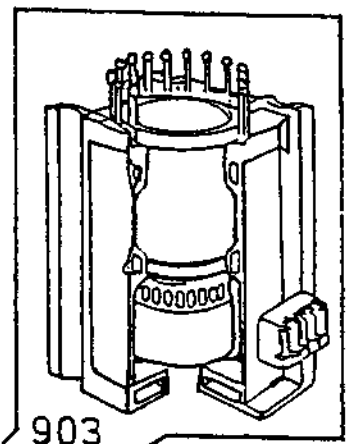
908



901

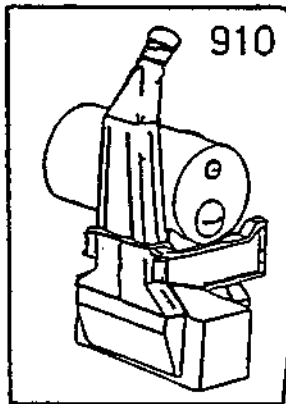


902

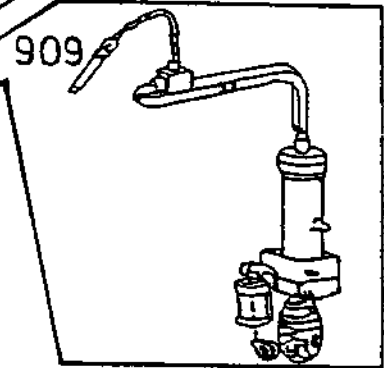


903

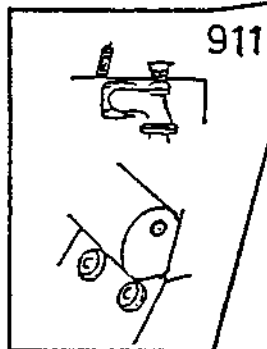
A  
(ACCESSORIES)



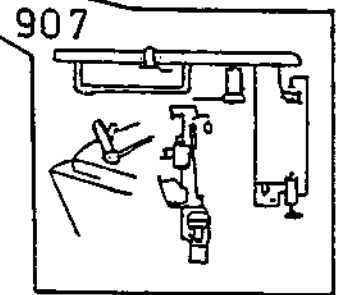
910



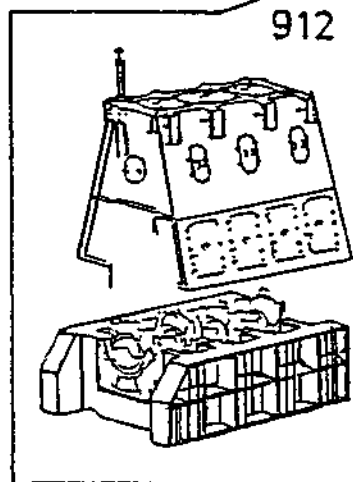
909



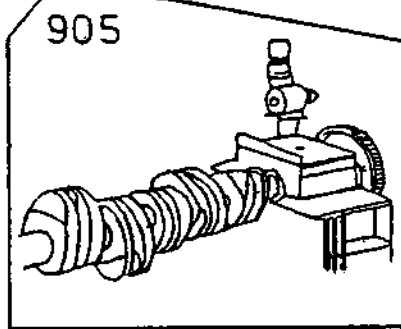
911



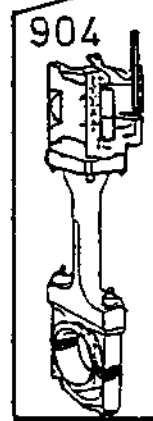
907



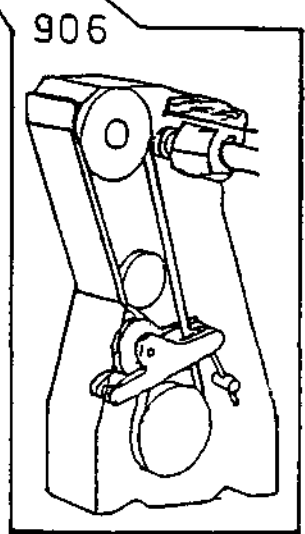
912



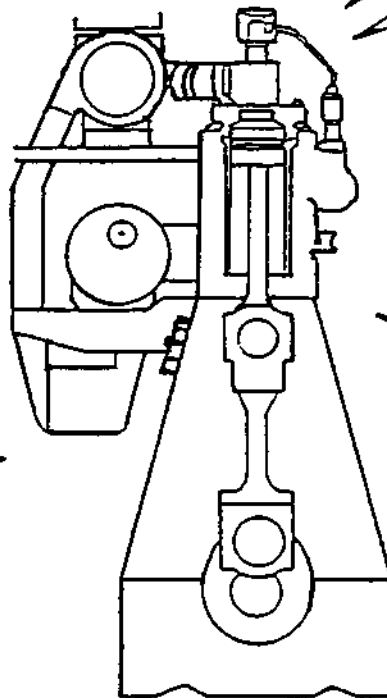
905



904



906



## Air System of Engine

*(Regarding the turbocharger, see the producer's special instructions)*

The engine is supplied with scavenge air from one turbocharger mounted at the aft end of the engine.

Alternatively, one or two turbochargers may be located on the exhaust side.

The engine exhaust gas drives the turbine wheel of the turbocharger and, through a common shaft, the turbine wheel drives the compressor wheel.

The compressor draws air from the engine room, through the air filters. From the compressor outlet, the air passes through the charging air pipe to the charging air cooler (Plate 91005) where the air is cooled down.

*The charging air pipe, with compensator, is insulated and can be clad internally with a sound-absorbing material.*

*The air cooler is designed to separate condensate from the air. See also 'Charging Air Cooler' in this Chapter.*

The air is pressed into the scavenge air receiver through non-return valves mounted in the air cooler housing after the water mist catcher. The non-return valves (flap valves) open by pressure from the turbocharger.

From the scavenge air receiver, the air flows to the cylinder through the scavenge air ports when the piston is in the bottom position. When the exhaust valves open, the exhaust gas is pressed into a common exhaust gas receiver (Plate 91003), from where the gas drives the turbine of the turbocharger with an even and steady pressure.

### Scavenge Air Receiver

*Plate 91001*

The scavenge air receiver is a container having a large volume. The receiver is bolted on to the cylinder frame.

Scavenge air is collected in the receiver after the air has passed through the cooler, the water mist catcher and the non-return valves.

The receiver and the cylinder frame communicate through circular openings.

The two auxiliary blowers are placed at the aft end of the air cooler housing. The suction side of the auxiliary blowers is connected to the space before the non-return valves in the air cooler housing. The discharge side is connected to the scavenge air receiver via a non-return valve, in order to prevent reversed air flow. *See also item, "Non-return valves", further on.*

The scavenge air receiver is provided with man-hole covers and also a safety valve (Plate 91103).

### Running with Auxiliary Blowers

During starting of the engine, and when the engine is running at low load the turbocharger is not able to supply enough air for the engine process. In these cases a pressure switch will automatically start the auxiliary blowers.

When the auxiliary blowers are operating, they draw air from the engine room through the turbocharger's air filter and compressor side.

*This enables the turbocharger to maintain a reasonable number of revolutions during starting and at low load.*

The air passes through the charging air pipe, the charging air cooler, and the water mist catcher, to the suction side of the blowers. From the blowers, the air is discharged to the scavenge air receiver via non-return valves.

The non-return valves fitted in the air cooler housing are now closed due to partial vacuum and gravitation acting on the valve flaps.

A lack of air supply will occur if the non-return valves do not close.

### **Non-Return Valves**

It is of the utmost importance that the non-return valves of the auxiliary blowers always function correctly and move easily. This can be checked by moving the valves manually, e.g. in connection with the regular scavenge port inspections.

The non-return valves protect the blowers and engine during:

- Starting the auxiliary blowers
- Running with auxiliary blowers.

#### Starting the auxiliary blowers:

- 1) Owing to the relatively high starting current, the blowers start in sequence, with 6-10 seconds in between.

The non-return valve of the blower that has not yet started must be in the closed position to prevent the blower from rotating backwards. Otherwise, there is a risk of burning out the electric motor when it starts.

- 2) If an auxiliary blower fails to start, the non-return valve must be in the closed position. Otherwise, the operating blower will not be able to draw fresh air in through the turbocharger and air cooler. This is due to differences in the air flow resistance.

#### Running with auxiliary blowers:

In the event of failure of an auxiliary blower during running, the non-return valve must close to ensure the continued supply of fresh air to the engine.

See 'Starting the auxiliary blowers', Item 2, above.

### **Exhaust Gas Receiver**

#### *Plate 91003*

From the exhaust valves, the exhaust gas is led to the exhaust gas receiver where the pulsatory pressure from the individual exhaust valves is equalized and led to the turbocharger at a constant pressure.

The exhaust gas receiver is fastened to the seating by flexible supports. Compensators are inserted between the receiver and the exhaust valves, and between the receiver and the turbocharger.

Inside the exhaust gas receiver, a protective grating is mounted before the turbocharger.

For quick mounting and dismantling of the joints between the receiver and the exhaust valves, clamping rings are used to hold the parts together. The exhaust gas receiver and the exhaust pipe are insulated.

The exhaust receiver may be provided with by-pass flanges for:

- Emergency running without turbochargers
- Improvement of fuel consumption at part load
- Turbo Compound system (TCS).

### **Charging Air Cooler**

#### *Plate 91005*

The charging air cooler insert is of the block type. It is mounted in a housing which is welded up of steel plates.

The cooler housing is provided with inspection covers.

The air cooler housing has been prepared for cleaning of the cooler insert without removing it. This is achieved by means of a built-in spray-arrangement.

See also Vol. II, MAINTENANCE, Chapter 910.

The cooler is designed with an air reversing chamber which has a water mist catcher incorporated. The water mist catcher is built up of a number of lamellas which separate the condensation water from the scavenge air during the passage of the air flow.

The separated water is collected in the bottom of the cooler housing from where it is removed by a drain system.

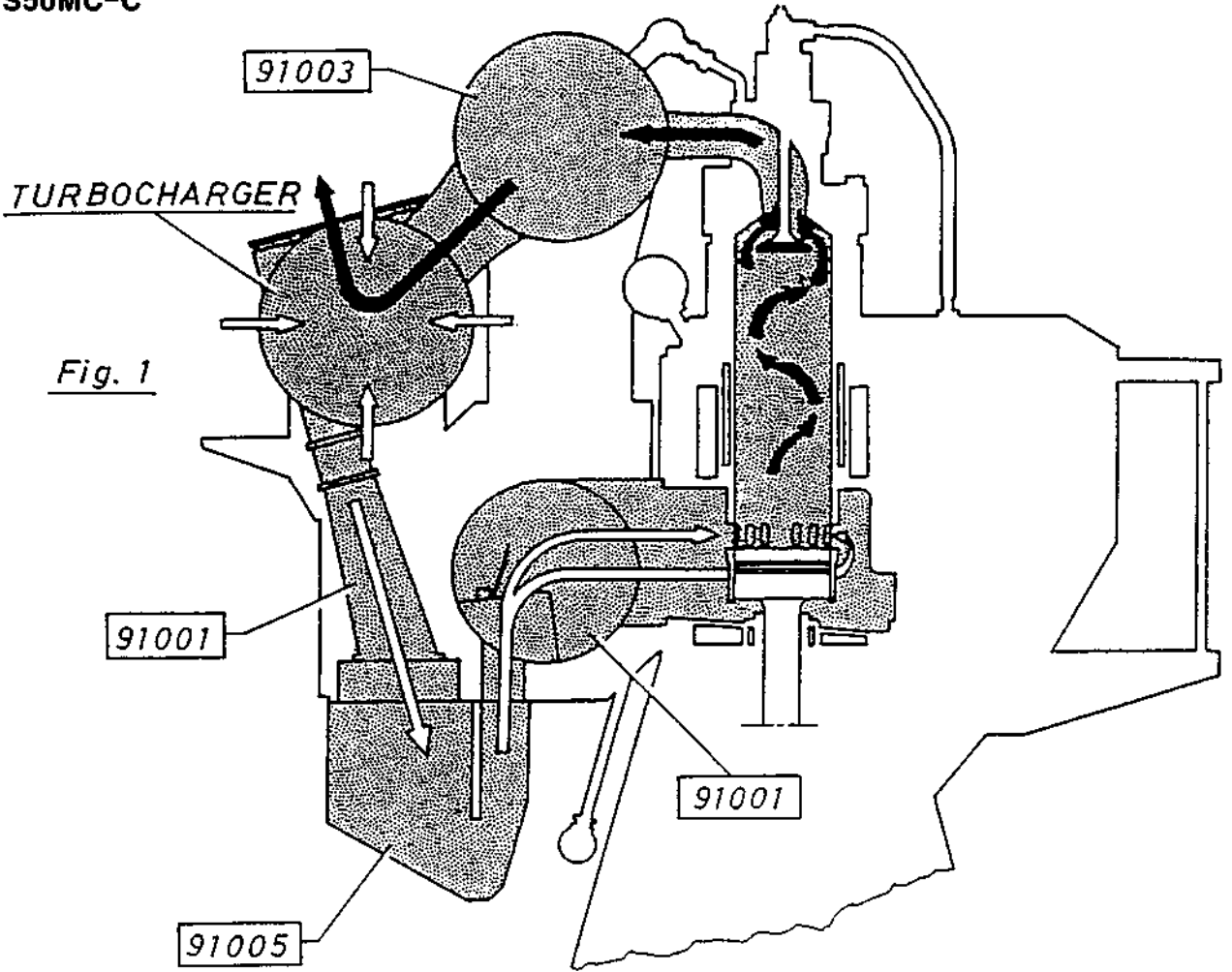
**Caution !**

It is important to check that the drain functions correctly, as otherwise water droplets may enter the cylinders.  
*See Vol. I, OPERATION, Chapter 706, 'Cleaning of Turbochargers and Air Coolers'.*

An alarm device for high water level in the drain system is installed.

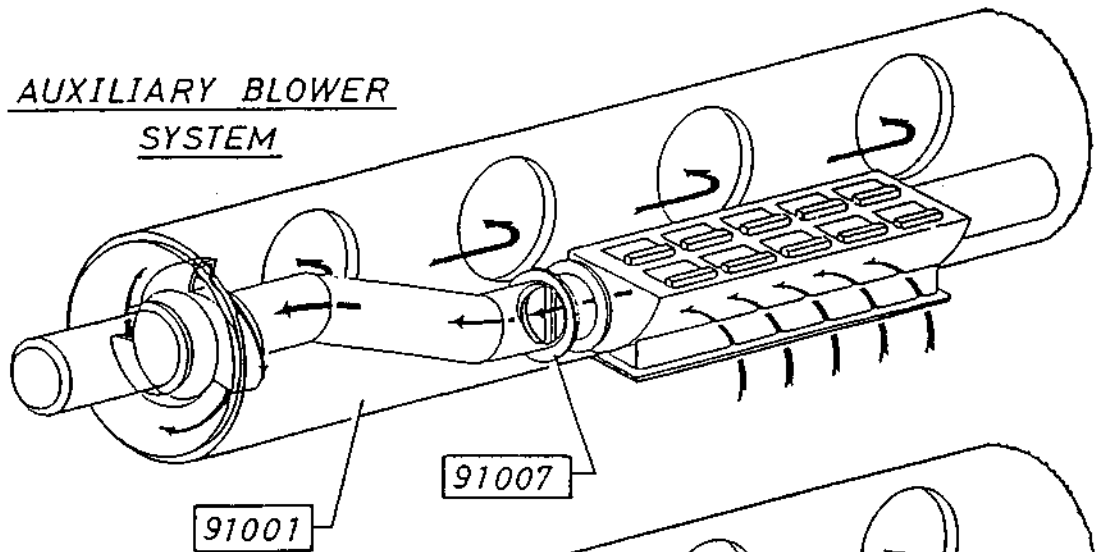
### **EI. Panels for Auxiliary Blower**

*See special instructions supplied by the engine builder.*

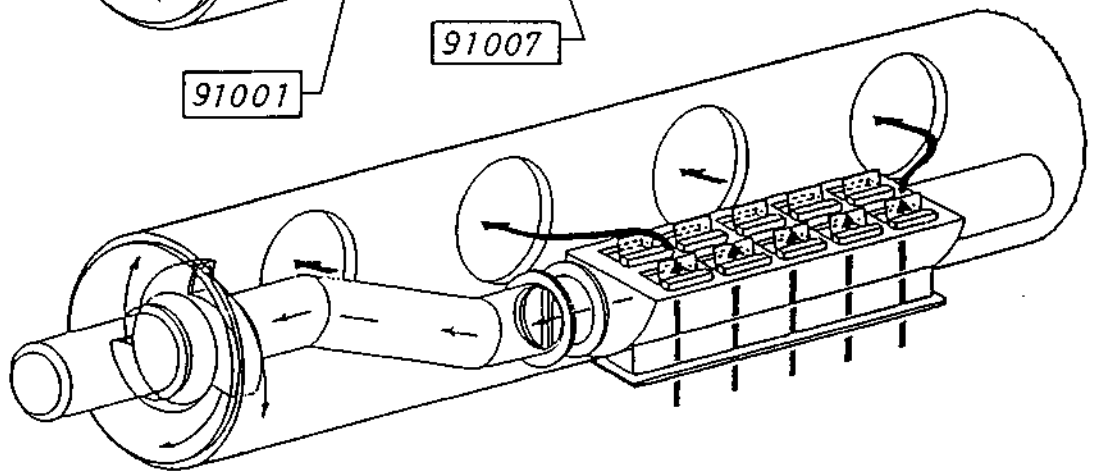


**AUXILIARY BLOWER SYSTEM**

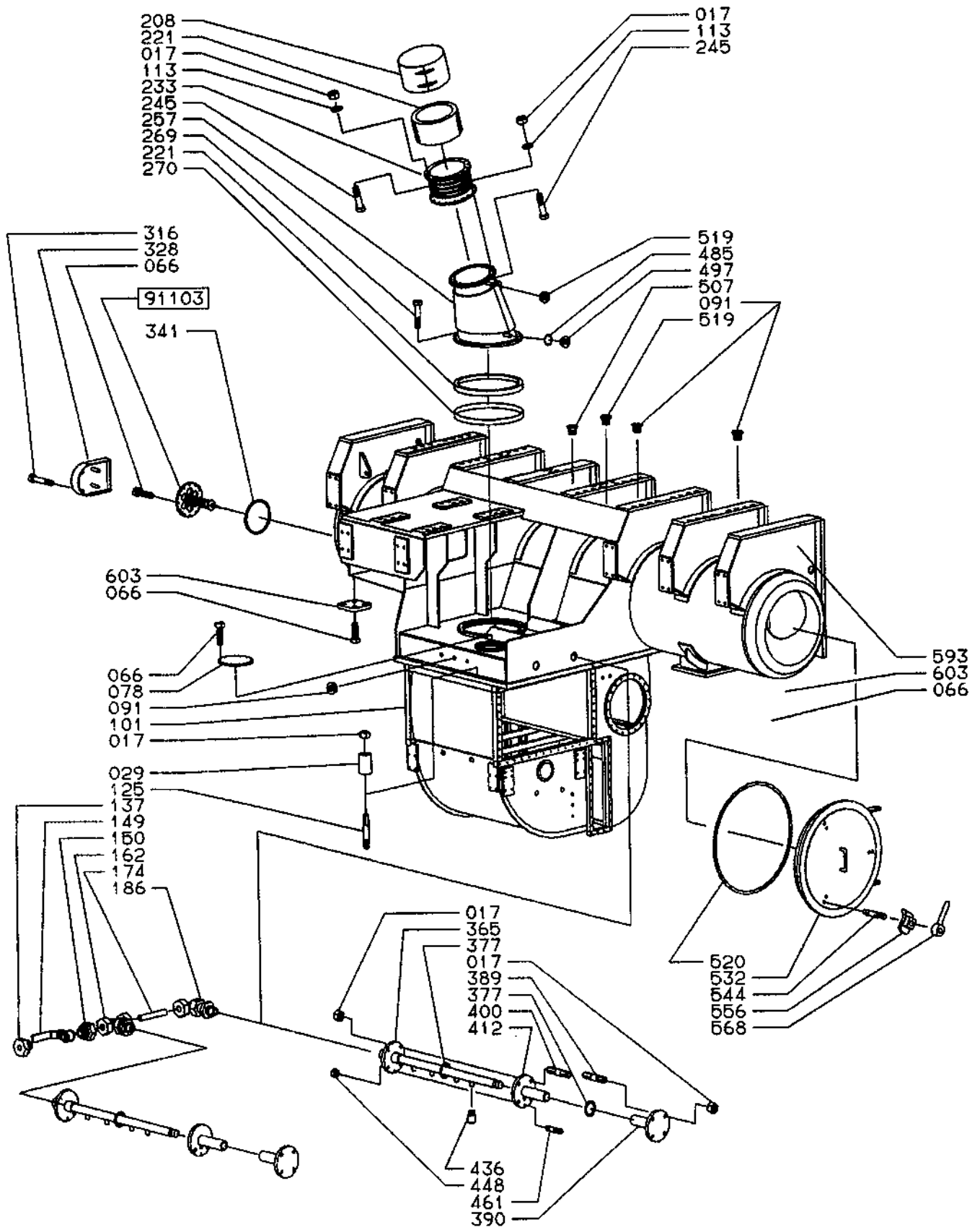
**Fig. 2**



**Fig. 3**



S50MC-C

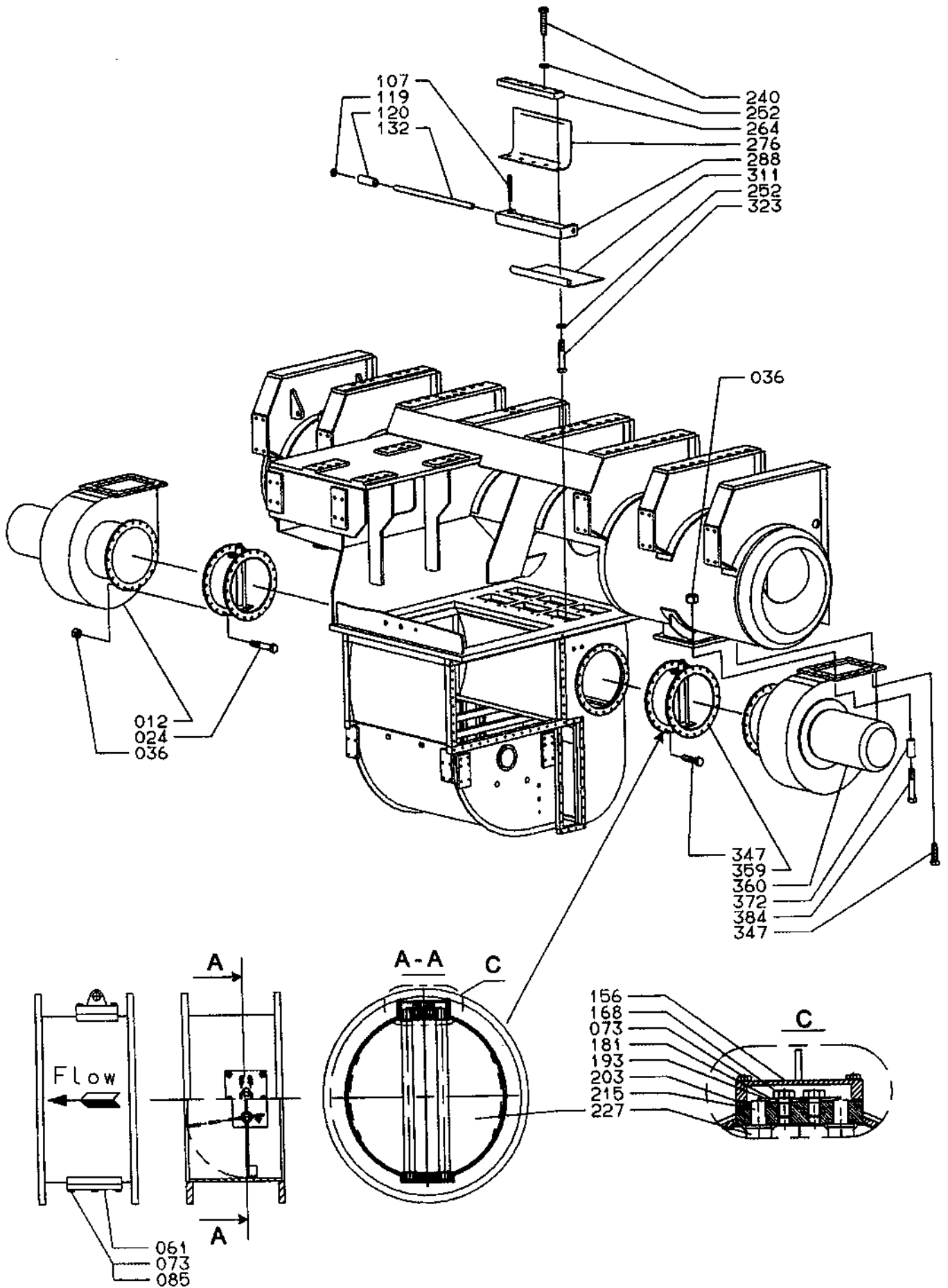




**Plate 91001-89 Scavenge Air Receiver**

Item No.	Part Description
017	Nut
029	Distance pipe, L=30
066	Screw
078	Cover
091	Plug screw
101	Air cooler
113	Washer
125	Stud
137	Coupling
149	Ball valve
150	Coupling
162	Coupling
174	Steel pipe
186	Coupling
208	Insulation cover
221	Insulation material
233	Compensator
245	Screw
257	Charging air pipe
269	Screw
270	Insulation cover
316	Screw
328	Guard
341	Packing
365	Cleaning pipe
377	Packing
389	Stud
390	Guide - cleaning pipe
400	Stud
412	Guide - cleaning pipe
436	Spray nozzle
448	Nut
461	Stud
485	Sealing ring
497	Plug screw
507	Plug screw
519	Plug screw
520	O-ring
532	Manhole cover
544	Stud
556	Clamp
568	Wing nut
593	Scavenge air receiver
603	Flange

Item No.	Part Description

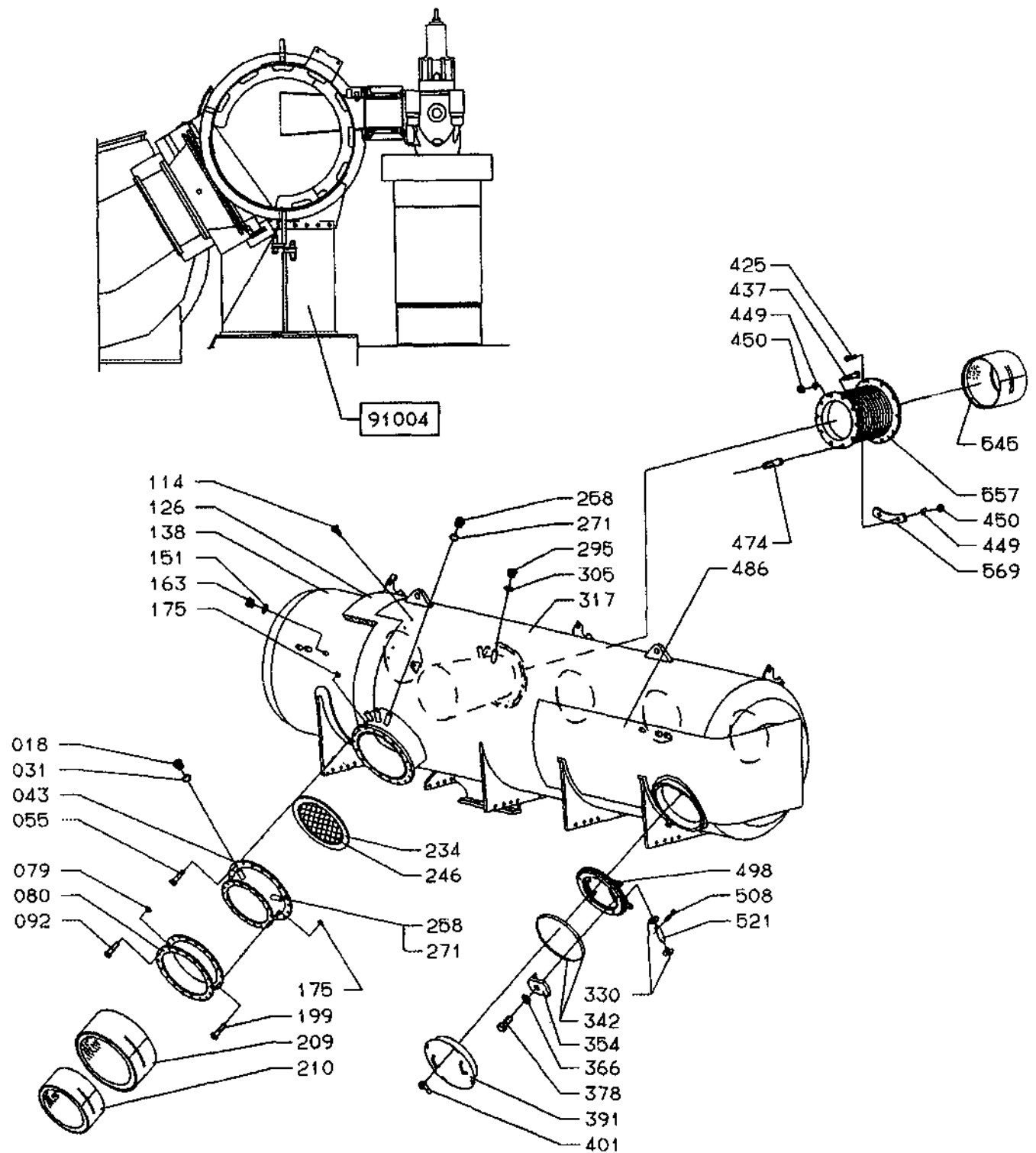


**Plate 91002-79 Scavenge Air receiver**

Item No.	Part Description
012	Auxiliary blower
024	Screw
036	Nut
061	Cover
073	Screw
085	Packing
107	Spring pin
119	Sealing ring
120	Sliding bearing
132	Shaft
156	Cover
168	Screw
181	Locking plate
193	Locking device
203	Packing
215	Shaft
227	Butterfly valve flap
240	Screw
252	Spring washer
264	Clamp
276	Stop plate
288	Support
311	Valve flap
323	Screw
347	Screw
359	Butterfly valve, complete
360	Auxiliary blower
372	Distance pipe, L=20
384	Screw

Item No.	Part Description

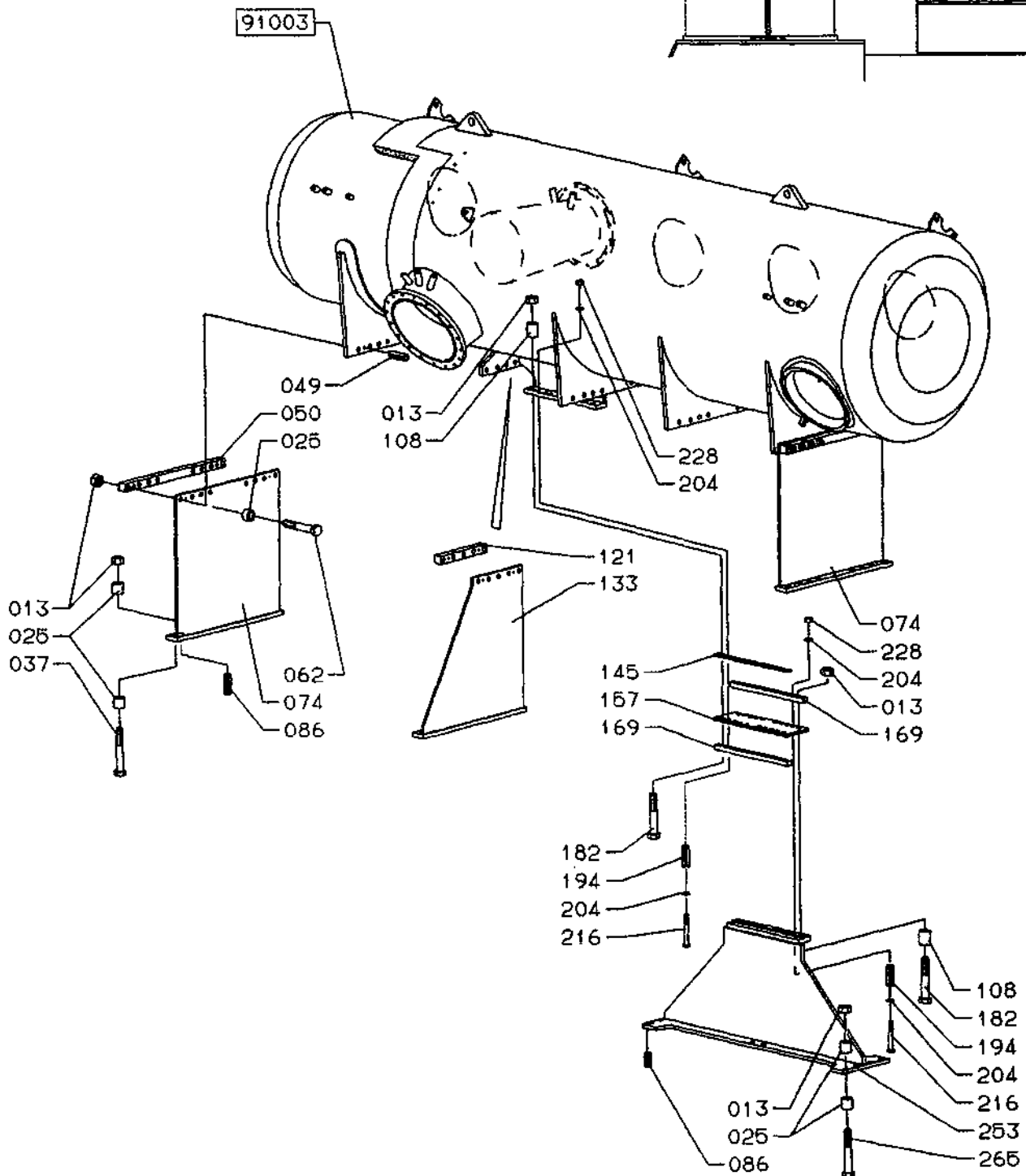
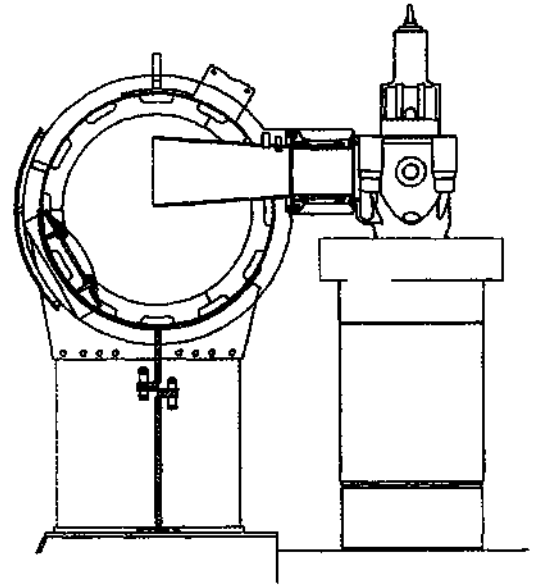
S50MC-C



**Plate 91003-139 Exhaust Pipes and Receiver**

Item No.	Part Description
018	Plug screw
031	Packing
043	Gas inlet
055	* Screw
079	Nut
080	Compensator
092	* Screw
114	Blind rivet
126	Insulation - roll
138	Exhaust receiver
151	Packing
163	Plug screw
175	Nut
199	* Screw
209	Insulation cover in 2/2
210	Insulation cover in 2/2
234	Grid, complete
246	Wire gauze
258	Plug screw
271	Packing
295	Plug screw
305	Packing
317	Insulation plate cover
330	Washer
342	Packing
354	Locking plate
366	Washer
378	* Screw
391	Cover
401	Wing nut
425	* Screw
437	* Screw
449	Locking plate
450	Nut
474	Stud
486	Arrangement of heating shield
498	Manhole cover
508	Split pin
521	Hinge rod
545	Insulation cover in 2/2
557	Compensator
569	Plate
	* These Screws are Special screws for hot joint, they are marked with a "T", and MUST NOT be used elsewhere

Item No.	Part Description

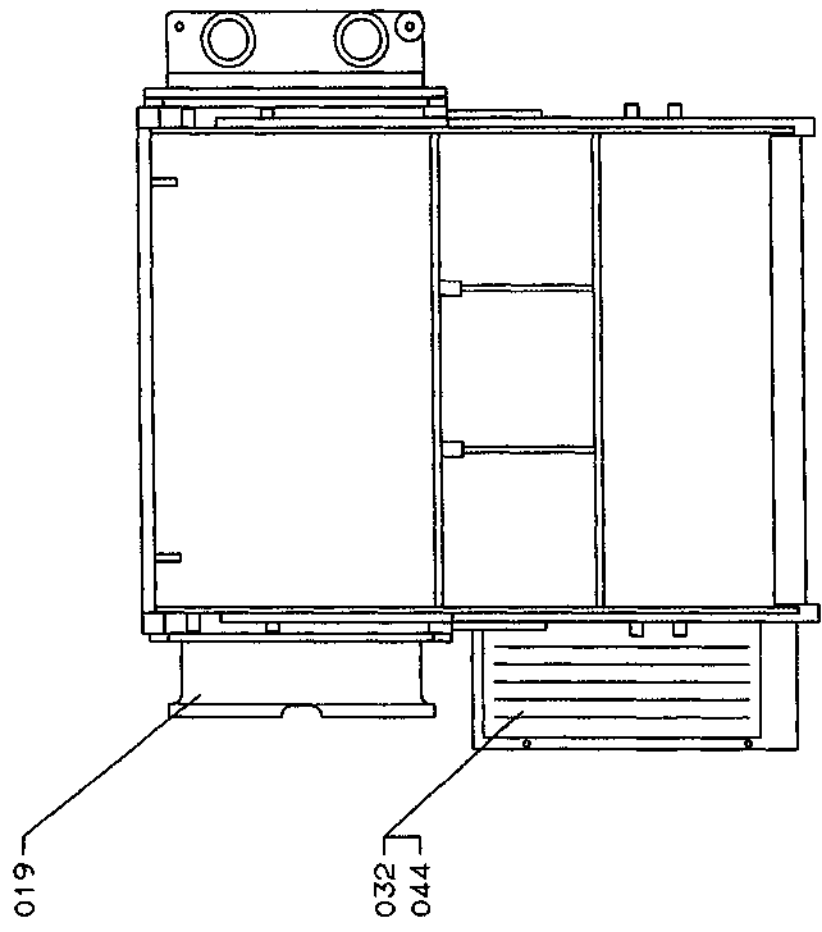
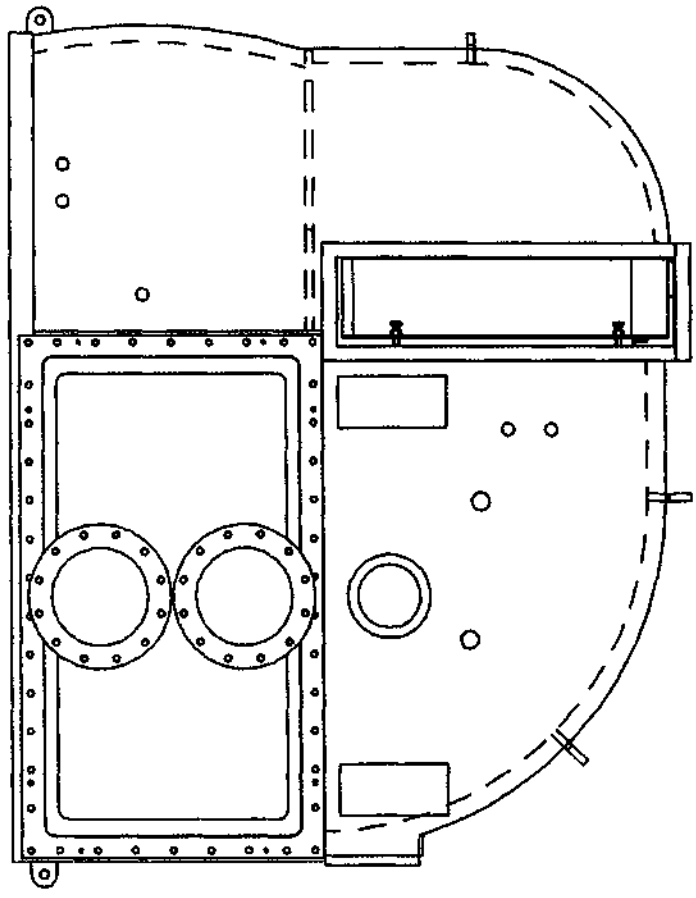


**Plate 91004-24 Exhaust Receiver**

Item No.	Part Description
013	Nut
025	Distance pipe, L=25
037	Screw
049	Spring pin
050	Clamp
062	* Screw
074	Support
086	Spring pin
108	Distance pipe, L=45
121	Clamp
133	Support
145	Shim
157	Spring plate
169	Clamp
182	Screw
194	Spring pin
204	Washer
216	* Screw
228	Nut
253	Support
265	Screw
<p>* These screws are special screws for hot joints, they are marked with a "T", and MUST NOT be used elsewhere</p>	

Item No.	Part Description

**S50MC-C**





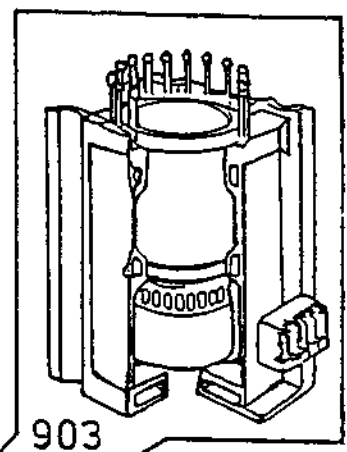
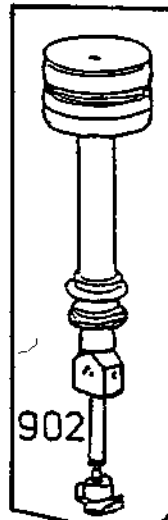
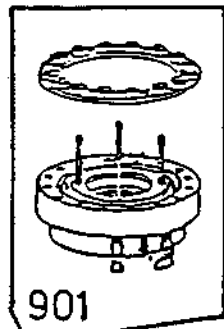
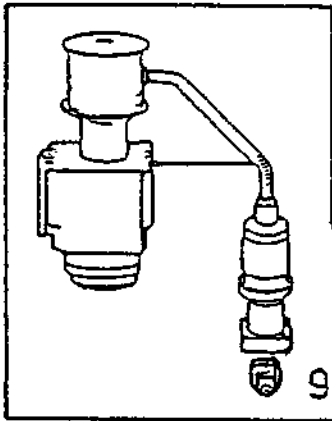
**Plate 91005-93 Air Cooler**

Item No.	Part Description
019 032 044	Cooler insert Water mist catcher Packing material

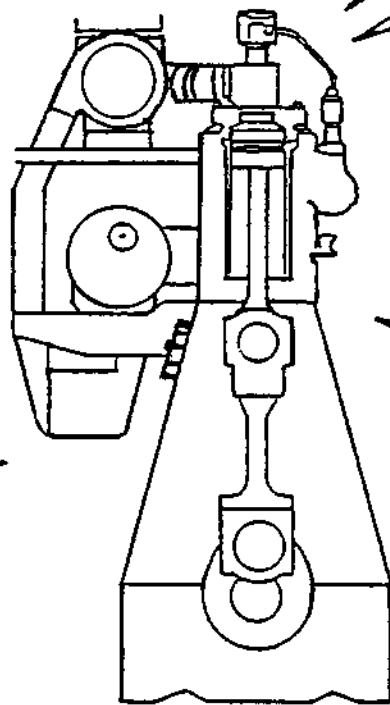
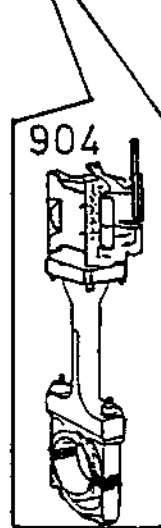
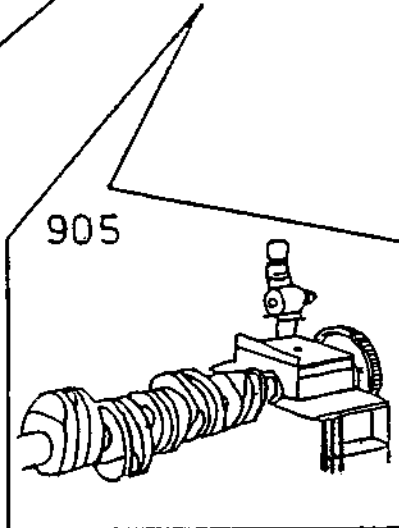
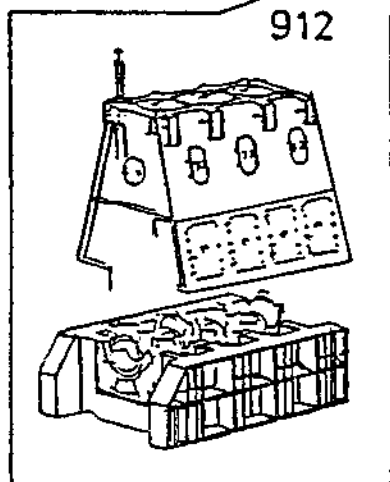
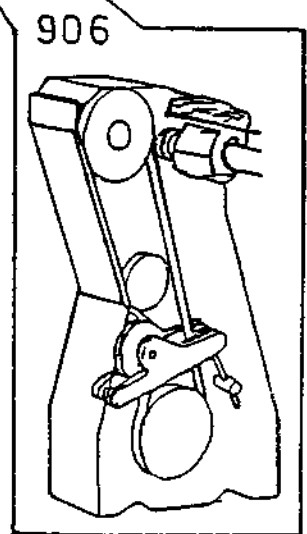
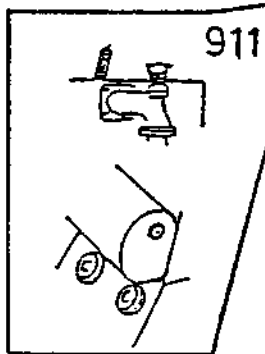
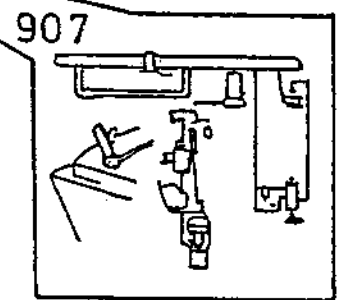
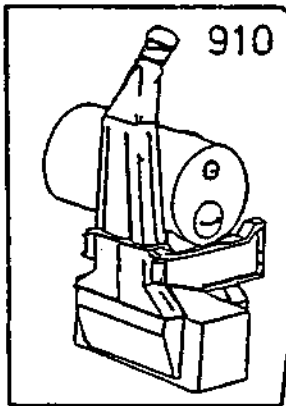
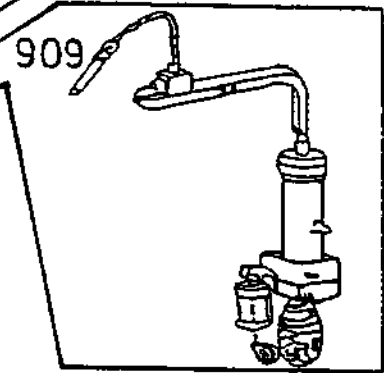
Item No.	Part Description
----------	------------------

# SAFETY EQUIPMENT

911



A  
(ACCESSORIES)



## Safety Equipment

### Safety Valves – Relief Valves

Each cylinder cover is provided with a spring-loaded safety valve which is set to open at a pressure somewhat higher than the maximum firing pressure in the cylinder.

On the exhaust side of the engine a number of spring-loaded relief valves are fitted, which will open in the event of an excessive pressure arising in the crankcase, for instance as a result of the ignition of oil vapour.

*Regarding how to:*

- avoid evaporation of the lubricating oil,
- detect the oil mist using an 'Oil Mist Detector'.

*see Vol. I, OPERATION, Chapter 704.*

#### Warning !

**Do not stand near crankcase doors or relief valves – nor in corridors near doors to the engine room casing in the event of an alarm for:**

- a) oil mist
- b) high lube oil temperature
- c) no piston cooling oil flow, or
- d) scavenge box fire

Alarms b, c and d should be considered as pre-warnings of a possible increasing oil mist level.

*See also our Service Letter SL97-348/ERO.*

The scavenge air receiver is fitted with a safety valve which is set to open should the pressure in the scavenge air receiver exceed a value somewhat higher than the normal scavenge air pressure of the engine.

In some cases it may be necessary to open the valve manually, *see Vol. I, Chapter 704, "Turbocharger Surging"*.

Each starting valve inlet pipe is provided with a safety cap. The safety cap consists of a bursting disc enclosed by a perforated cylinder and a perforated cover in order to protect any bystanders, in the event of a burst.

The cover is provided with a check plate, which shows if the bursting disc has been damaged.

### Safety Cap in Starting Air Line

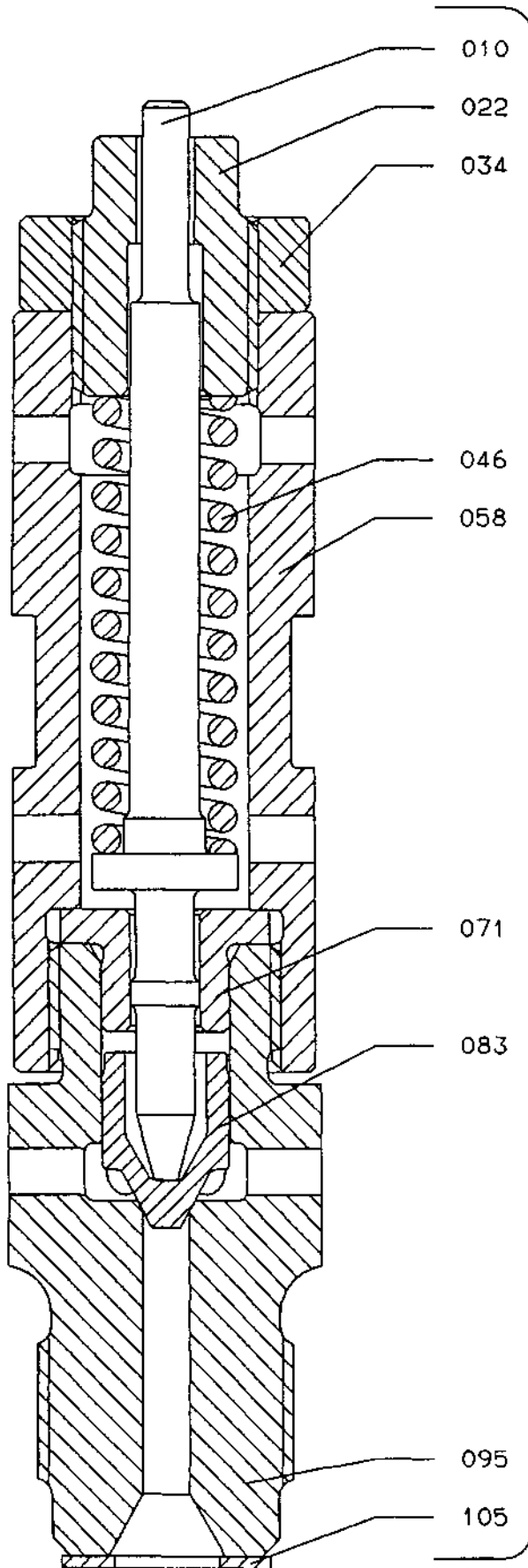
If the bursting disc of the safety cap is damaged due to excessive pressure in the starting air line, overhaul or replace the starting valve which caused the burst, and mount a new disc.

If a new disc is not available immediately, turn the cover in relation to the cylinder, in order to reduce the leakage of starting air.

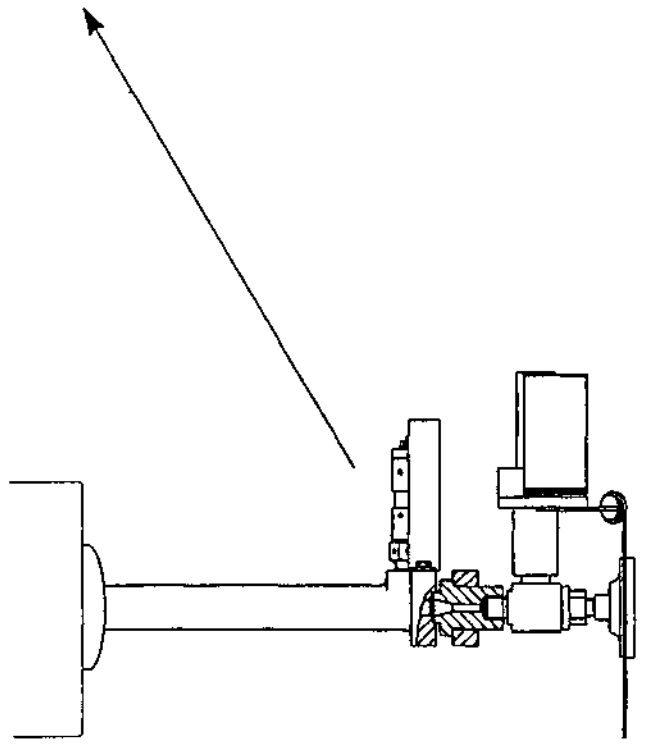
#### Note !

**Mount a new bursting disc and return the cover to the open position at the first opportunity.**

S50MC-C



117

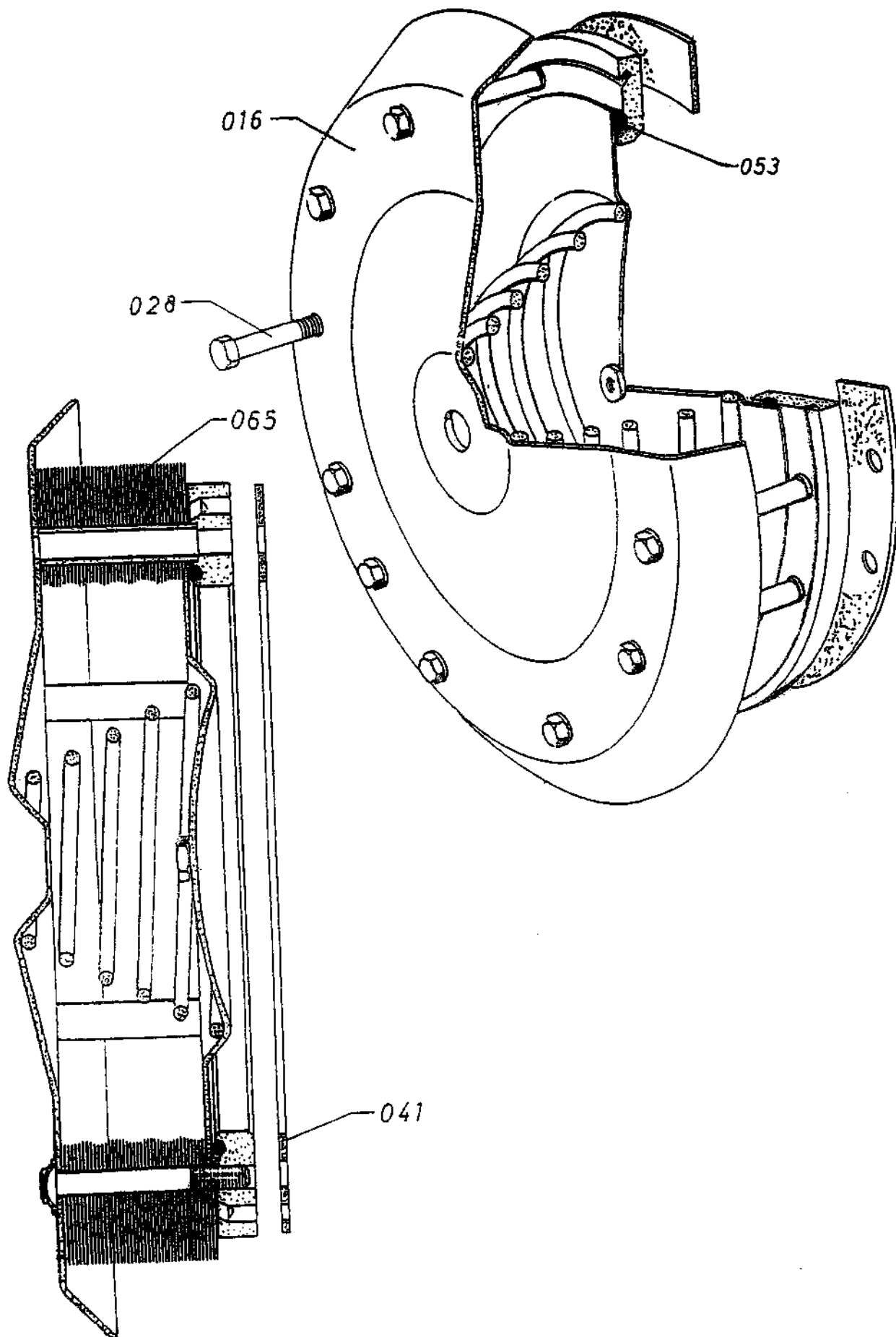


**Plate 91101-33 Safety Valve**

Item No.	Part Description
010	Spindle
022	Spring retainer
034	Lock nut
046	Spring
058	Valve housing
071	Stop ring
083	Valve flap
095	Valve guide
105	Gasket
117	Safety valve, complete

Item No.	Part Description
----------	------------------

S50MC-C



**Plate 91102-07 Relief Valve**

Item No.	Part Description	MAN B&W Standard No.	
016	Relief valve		
028	Screw		
041	Gasket		
053	O-ring		
065	Flame arrester		
	Please state type of relief valve, when ordering spare parts.		



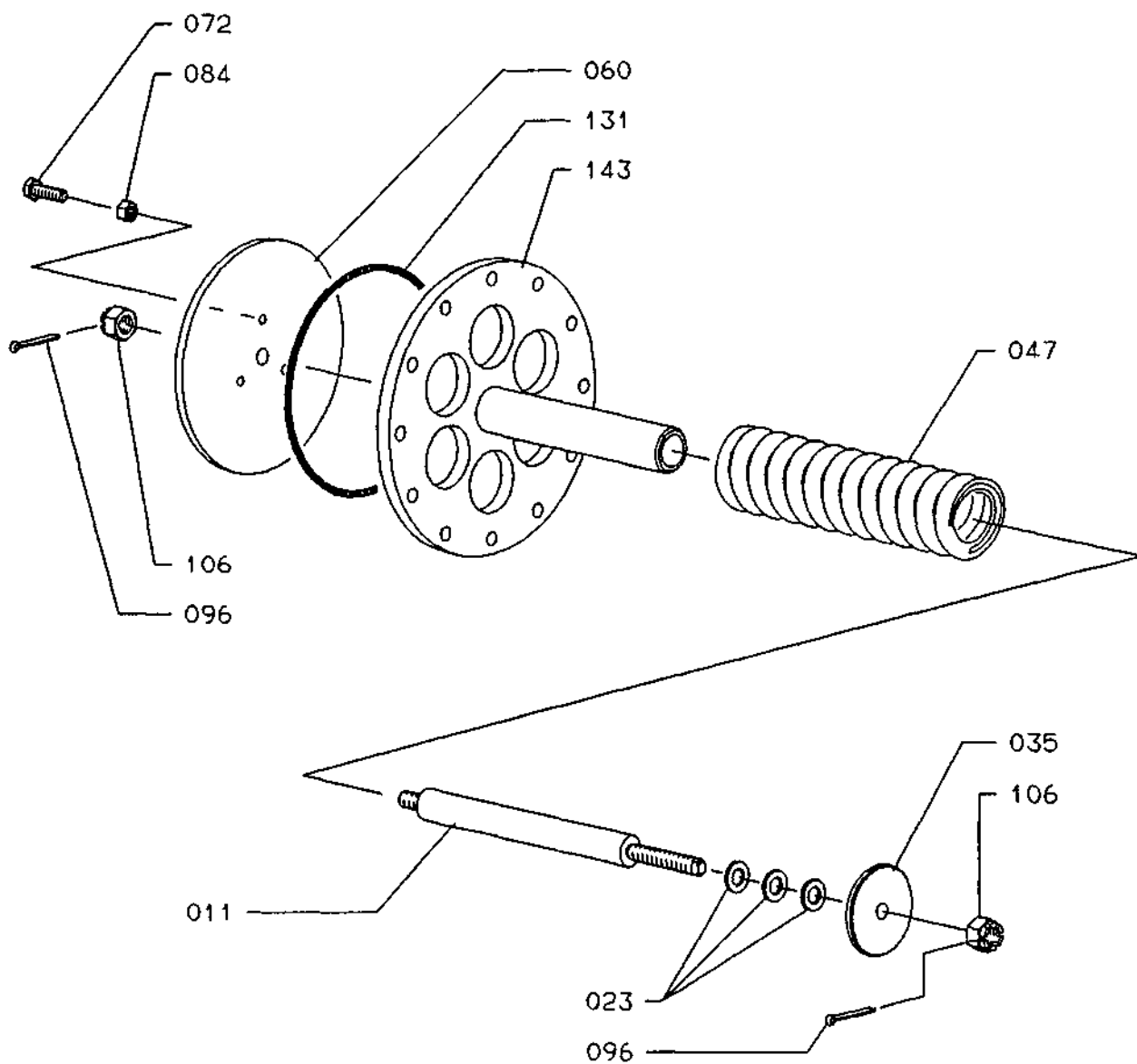
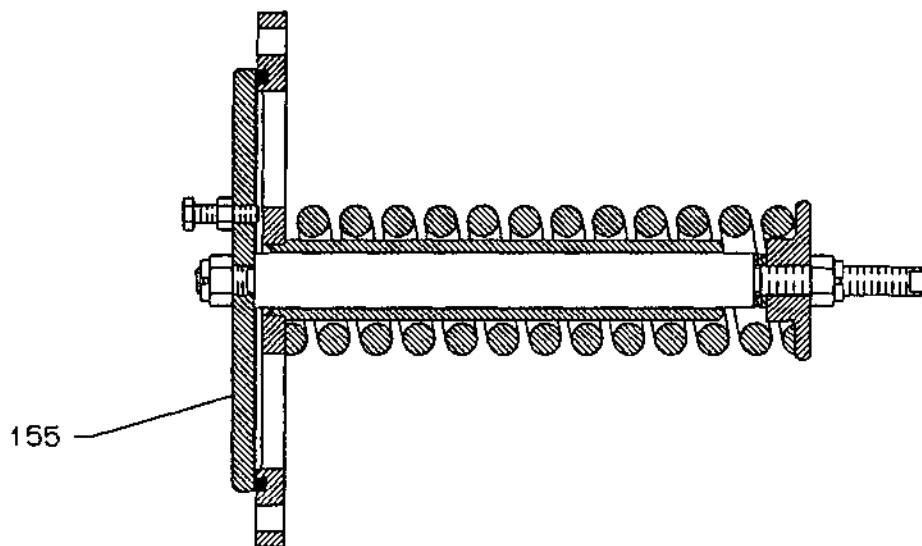
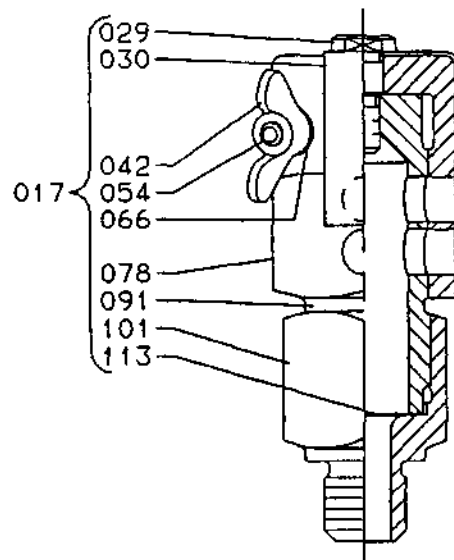
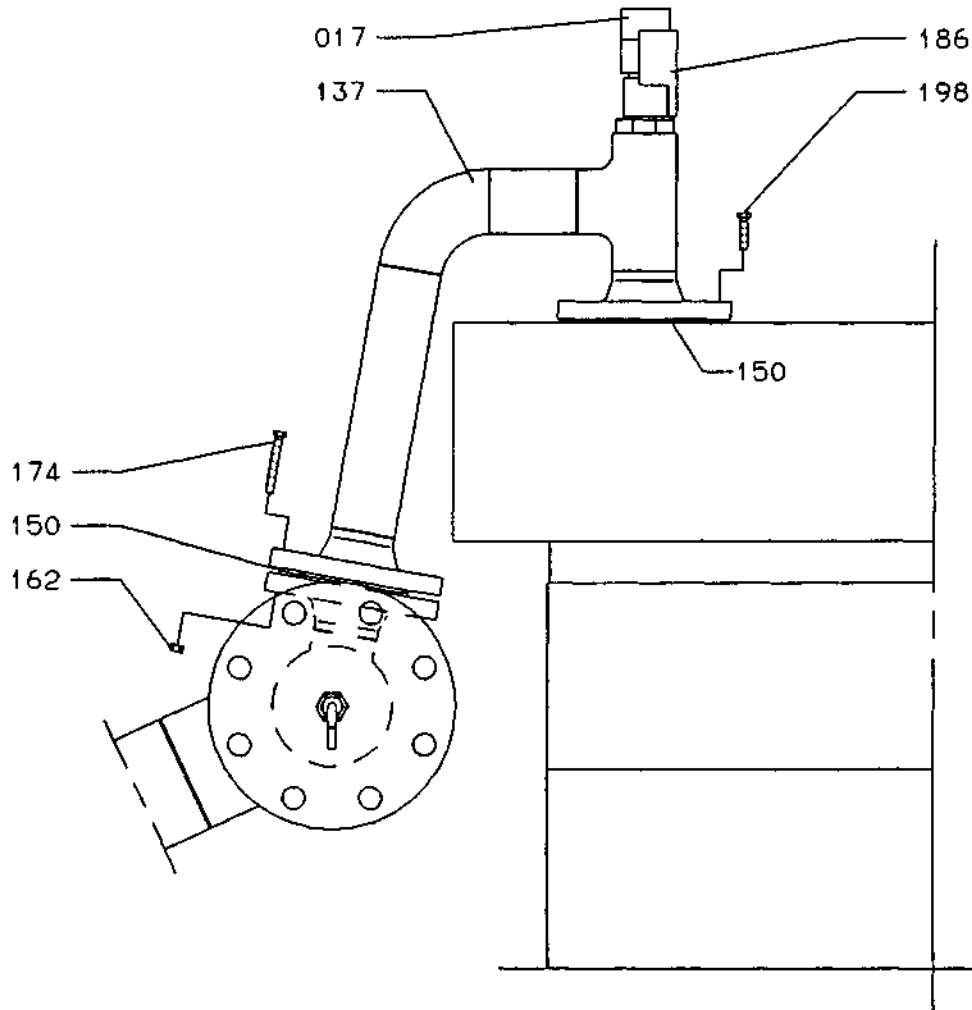


Plate 91103-14 Safety Valve

Item No.	Part Description
011	Spindle
023	Washer
035	Spring retainer
047	Spring
060	Valve flap
072	Screw
084	Nut
096	Split pin
106	Castle nut
131	Seal
143	Valve seat
155	Safety valve, complete

Item No.	Part Description



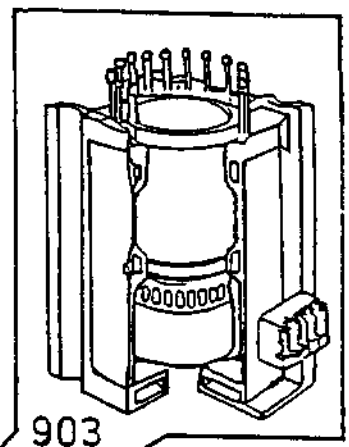
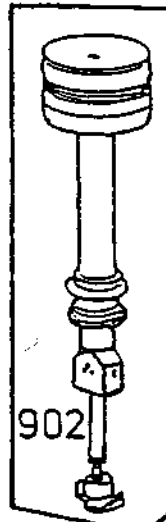
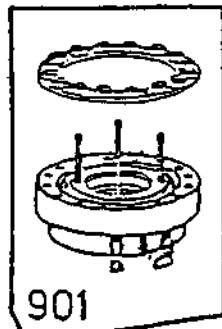
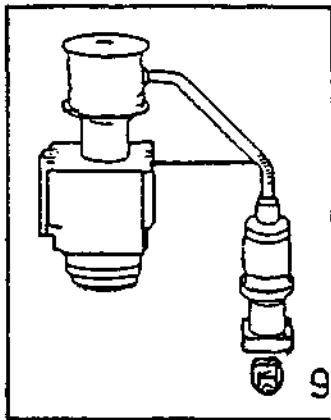
**Plate 91104-63 Arrangement of Safety Cap**

Item No.	Part Description
017	Bursting cap, complete
029	Screw
030	Check plate
042	Wing nut
054	Screw
066	Washer
078	Bursting cap cover
091	Perforated cylinder
101	Housing
113	Bursting disc
137	Starting air pipe, complete
150	Gasket
162	Nut
174	Screw
186	Safety cap
198	Screw

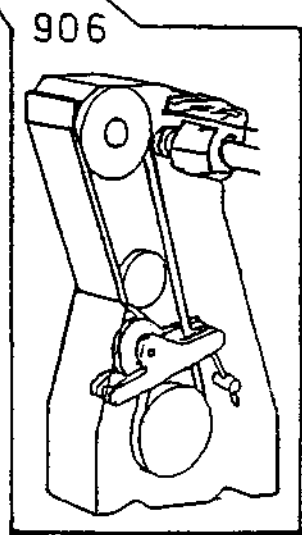
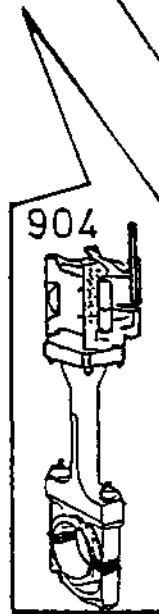
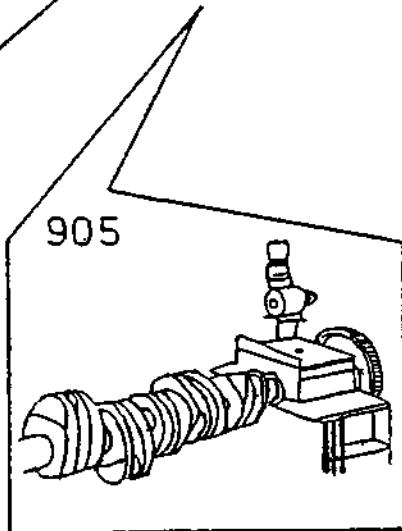
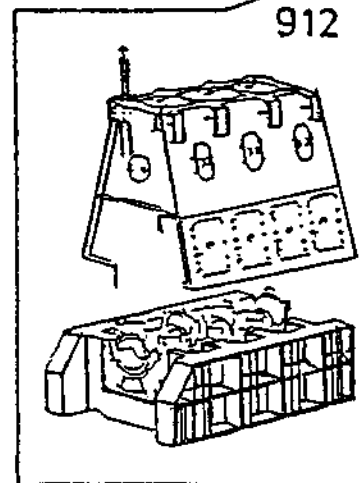
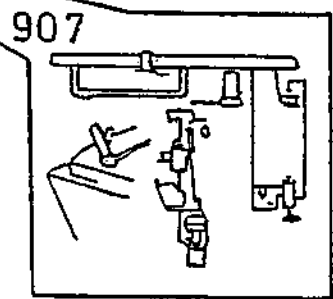
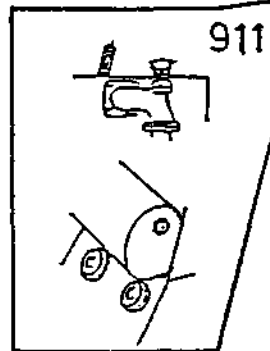
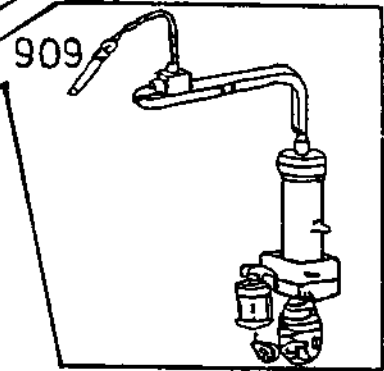
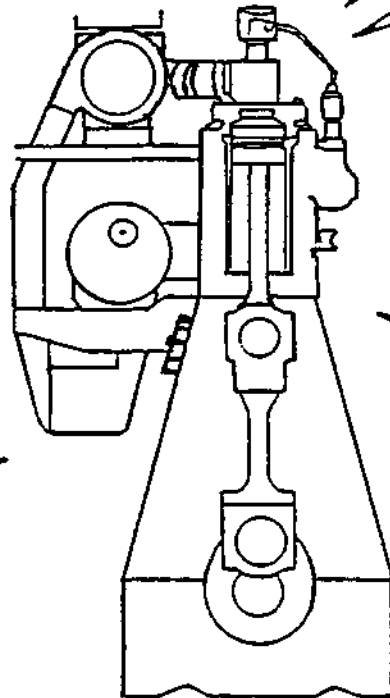
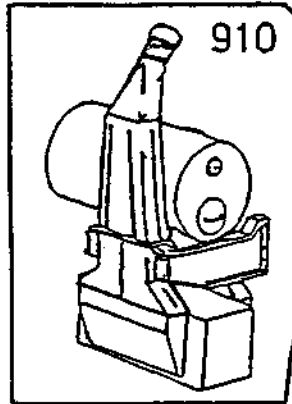
Item No.	Part Description

# ASSEMBLY OF LARGE PARTS

912



A  
(ACCESSORIES)



## Assembly of Large Parts

### Bedplate, Framebox, etc.

The bedplate is made in one section, consisting of two welded, longitudinal girders and a number of cross girders which support the main bearings. The main bearings, which are of the thin-shell type, consist of steel shells, lined with tin-aluminum and coated with a tin-flash layer.

*See also Vol. I, OPERATION, Chapter 708.*

Each main bearing has one main bearing cap which is secured by four studs and nuts, designed for tightening by means of hydraulic tools.

The aft end of the bedplate incorporates the thrust bearing as well as the chain drive.

*See also Chapter 905.*

At the foremost end of the bedplate, an axial vibration damper is fitted. (*Plate 91211*). Regarding the design and functioning of the axial vibration damper, *See Chapter 905.*

A framebox is bolted on to the top of the bedplate. Like the bedplate, the framebox consists of one section with the chain drive located at the aft end. Together, the bedplate and the framebox constitute the crankcase of the engine.

The framebox is fitted with steel-plate doors for access to the crossheads and to the main and crankpin bearings.

The bedplate, the framebox, and the cylinder frame, which rests on top of the framebox, are tightened together to form one unit by means of stay bolts, the bottom of which is screwed into the bedplate.

For each cylinder, the framebox is equipped with a slotted pipe in which the piston cooling oil outlet pipe fitted to the crosshead is able to travel. From the slotted pipe the cooling oil is, through an outlet pipe, led to the oil tray of the bedplate.

Equipment for local checking of the cooling oil temperature and flow, and for temperature and flow alarms, is installed in

conjunction with the outlet pipe.

*See also Vol. I, OPERATION, Chapter 701.*

The bedplate of the engine is positioned on either epoxy or cast iron supporting chocks and bolted to the engine seating in the ship by means of long holding-down bolts, which are equipped with distance tubes of cast iron.

*Plate 91215* shows the holding-down bolts, which have spherical washers and nuts with spherical contact face on the lower end of the bolts. The contact faces of the topplate for the spherical washers must be plane.

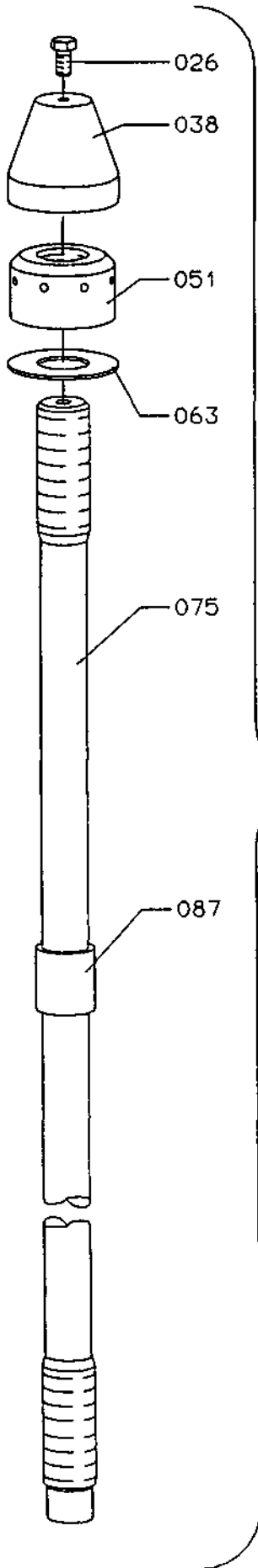
The engine is secured in the athwartship direction by a number of side chocks fitted in both sides in way of a bedplate cross-girder. The side-chock liners are tapered 1:100 and are fitted from the aft end at both sides of the engine.

The side-chock liners are secured in their correct position by means of inside-hexagon screws.

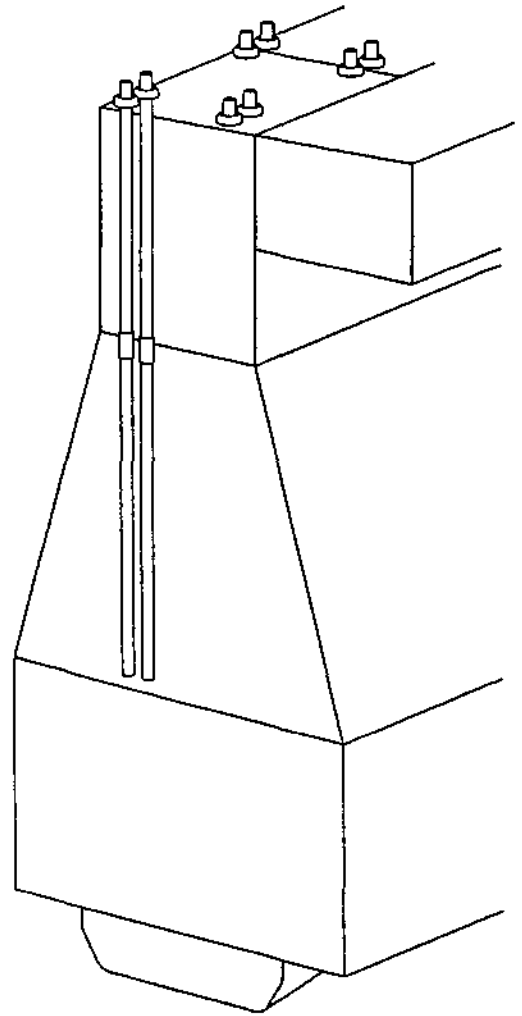
The engine is secured in the fore-and-aft direction by one end chock with one end-chock bolt with spherical washer at the aft end of each of the two longitudinal girders of the bedplate. The end-chock liners have a 1:100 taper and are fitted from above.

*Regarding the engine seating for the specific engine, see the supplier's special instructions.*

S50MC-C



014





**Plate 91201-74 Arrangement of Stay Bolts**

Item No.	Part Description
014	Stay bolt, complete
026	Screw
038	Protective cap
051	Nut
063	Washer
075	Stay bolt
087	Guide bushing

Item No.	Part Description
----------	------------------

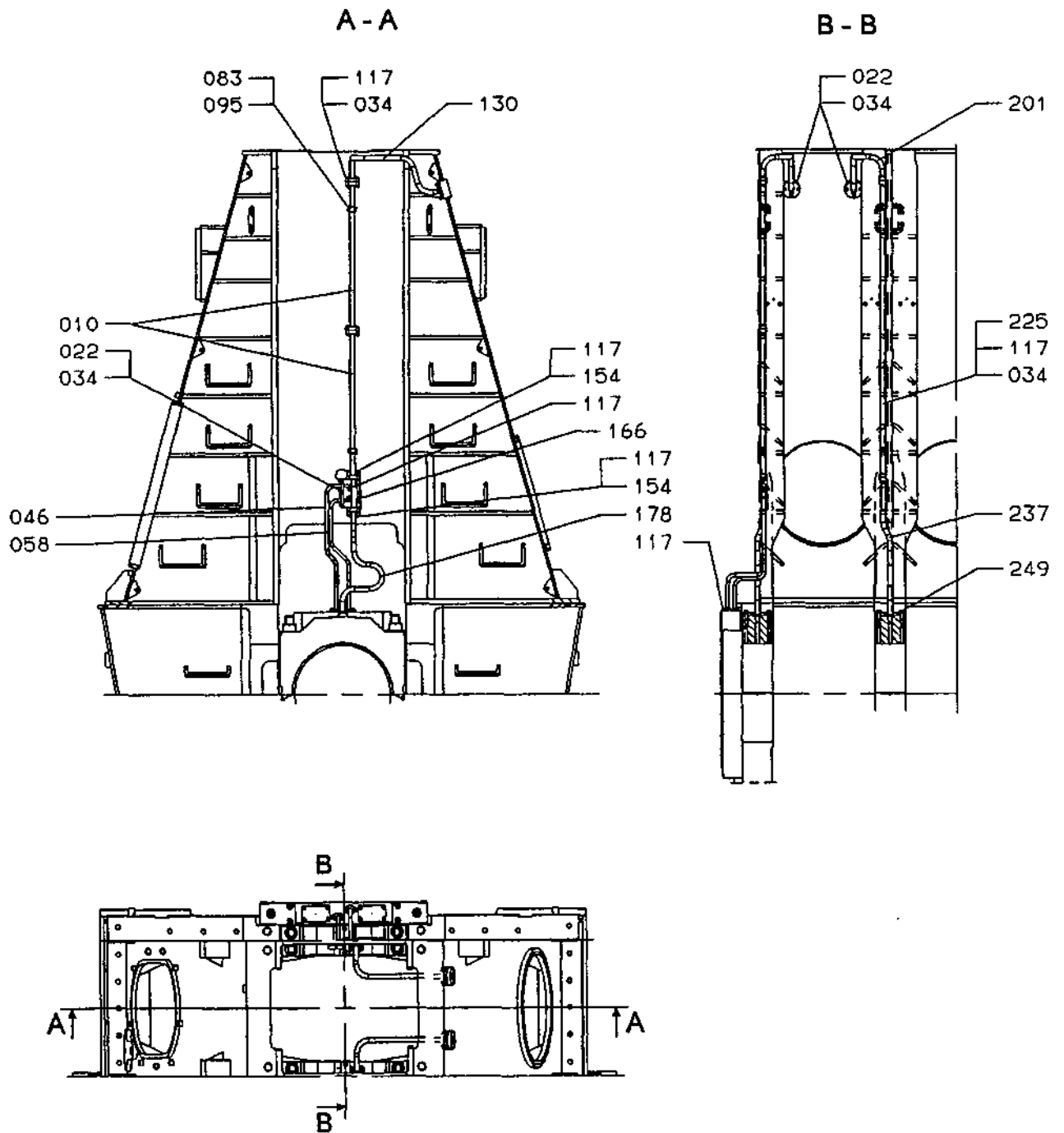


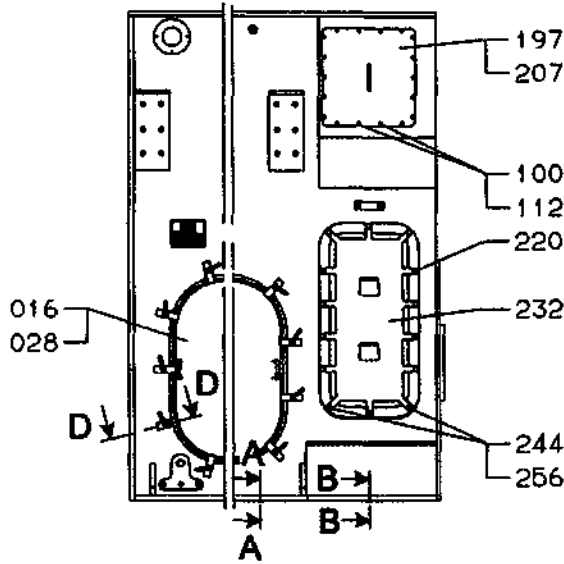
Plate 91204-02 Frame - Details

Item No.	Part Description
010	Lub.oil pipe
022	Stud
034	Self-locking nut
046	Damper-oil pipe
058	Damper-oil pipe
083	Pipe clamp
095	Screw
117	Screw
130	Lub.oil pipe
154	Distance pipe, L=25
166	Flange
178	Lub.oil pipe
201	Lub.oil pipe
225	Lub.oil pipe
237	Lub.oil pipe
249	Screw

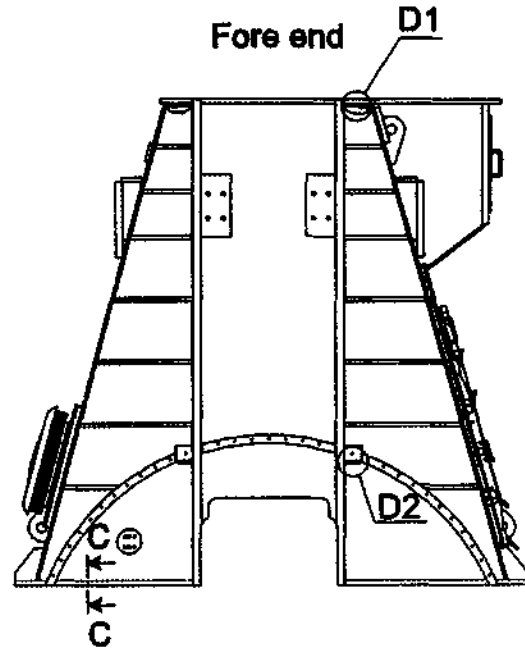
Item No.	Part Description
----------	------------------

S50MC-C

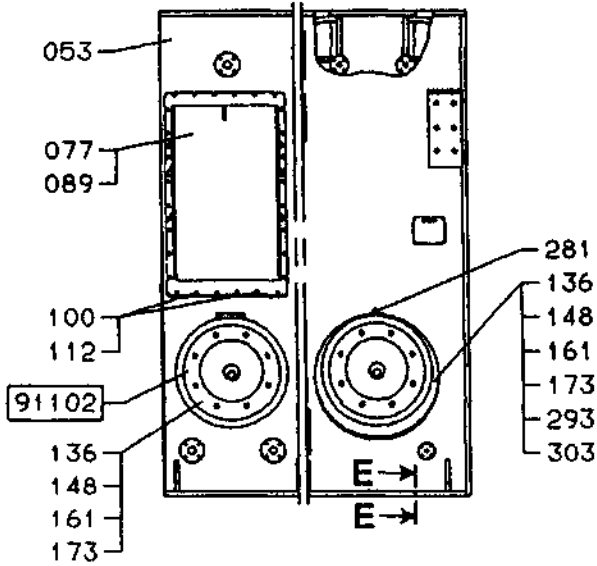
**Front side**



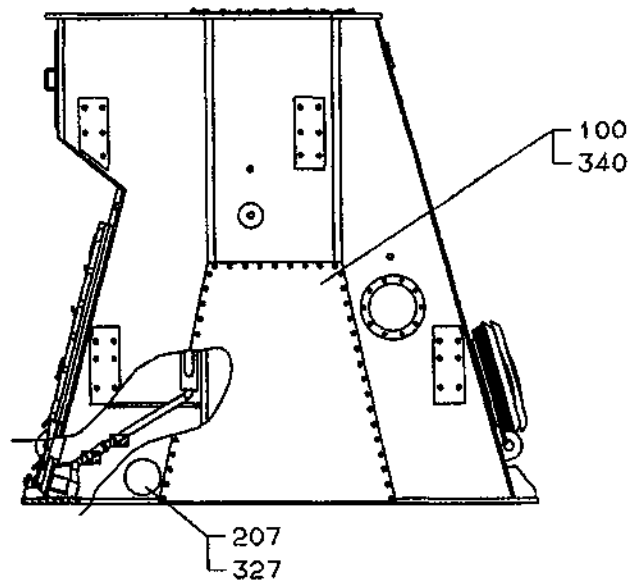
**Fore end**



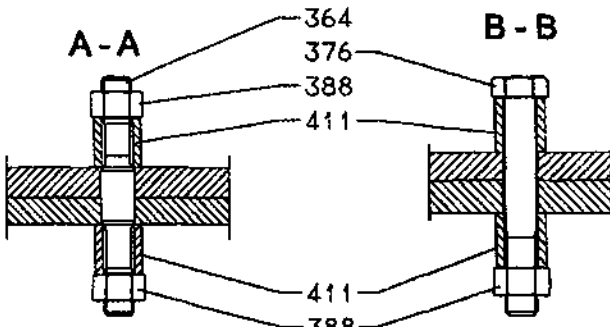
**Rear side**



**Aft. Side**



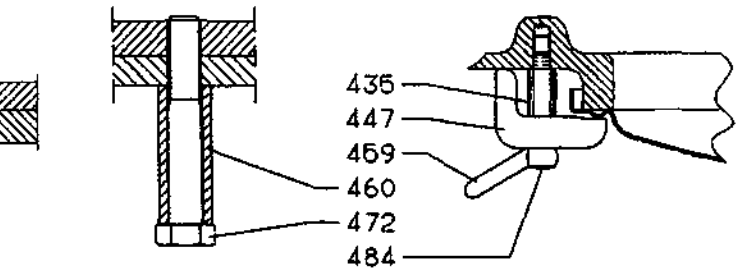
**A-A**



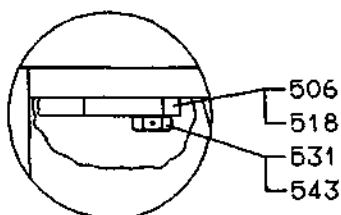
**B-B**

**C-C**

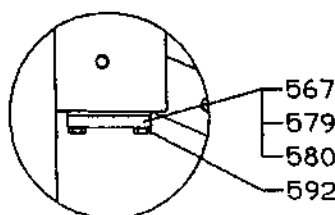
**D-D**



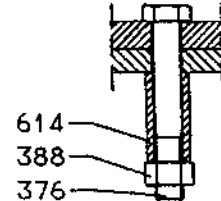
**D1**



**D2**



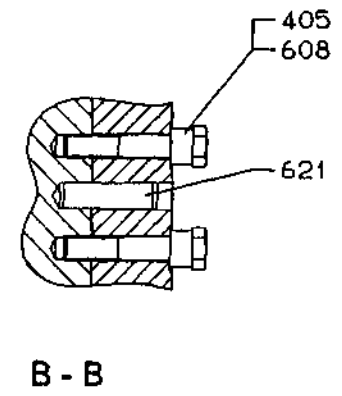
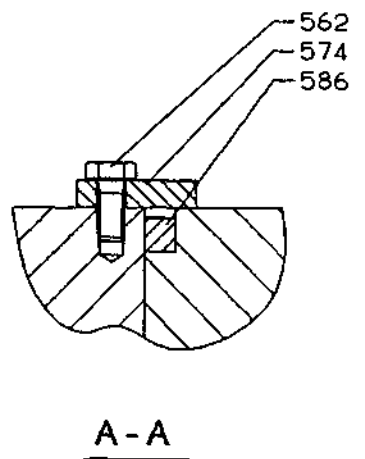
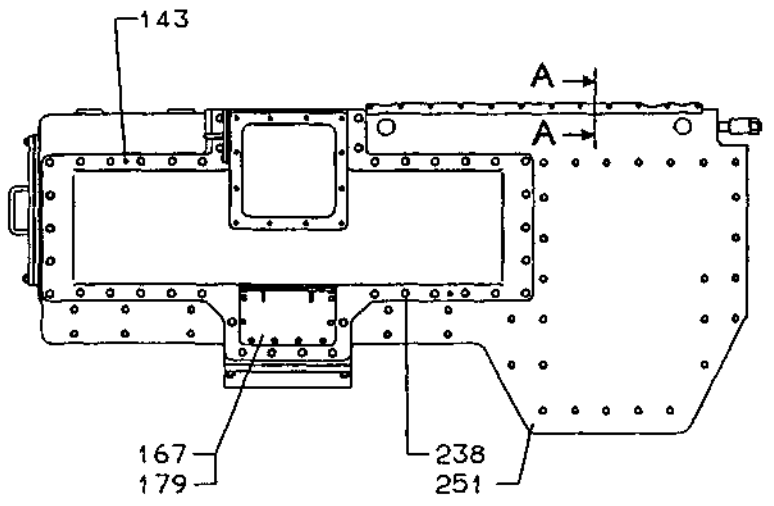
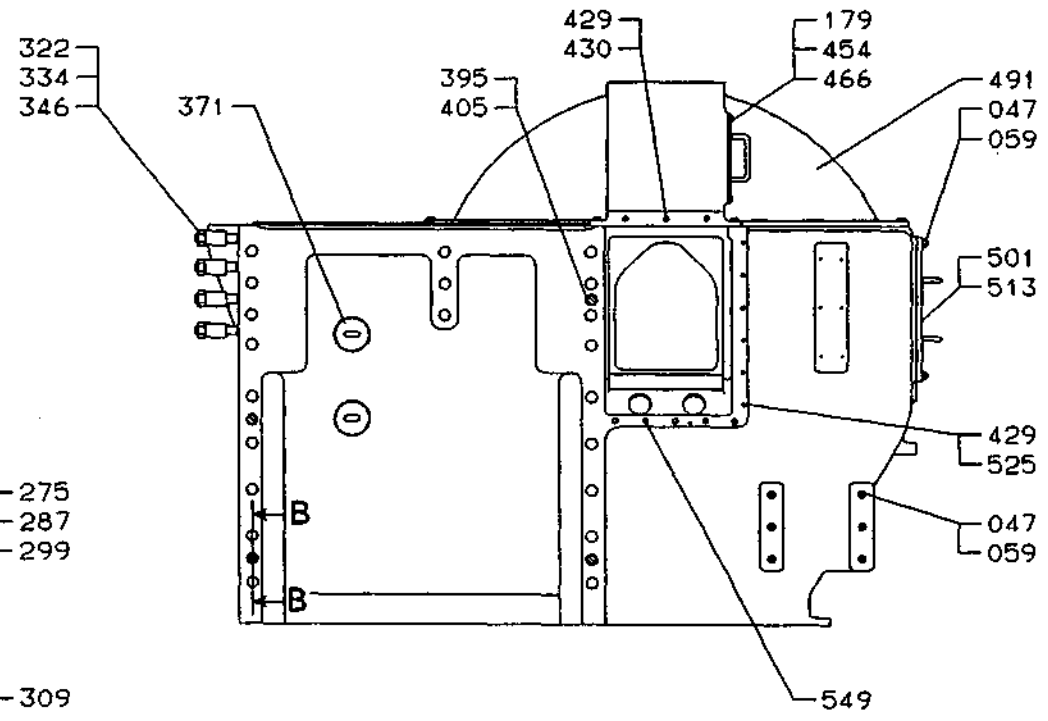
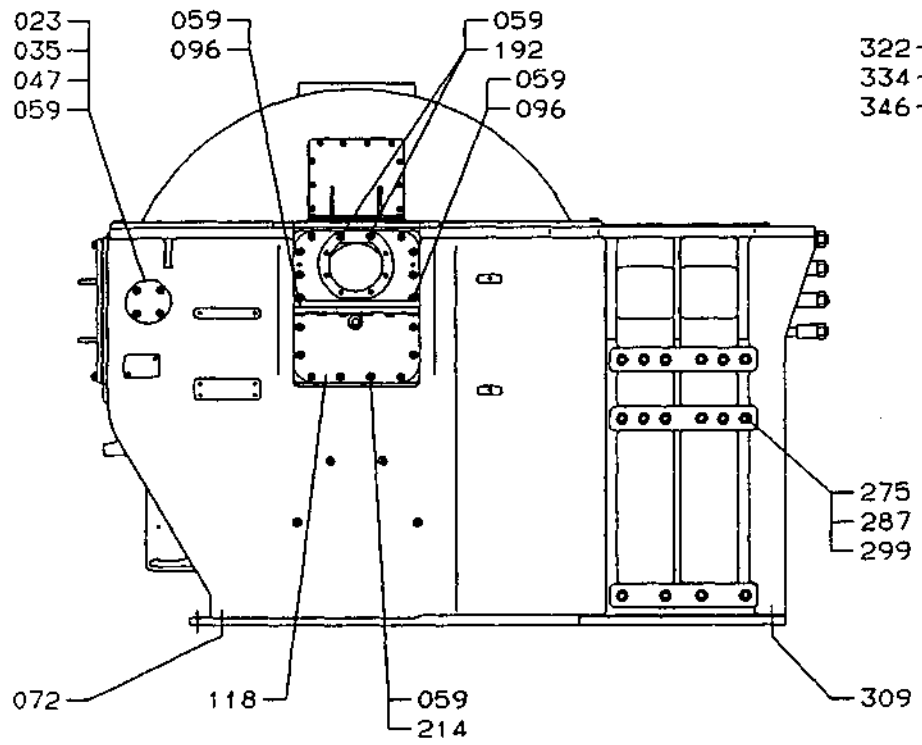
**E-E**



**Plate 91205-133 Frame**

Item No.	Part Description
016	Frame box door
028	O-ring
053	Frame box
077	Frame door, rear
089	Screw
100	Stud
112	Nut
136	Relief valve
148	Packing
161	Screw
173	Drain pipe
197	Cover
207	Screw
220	Screw
232	Frame door, rear
244	Stud
256	Nut
281	Eye bolt
293	Cover
303	Screw
327	Cover
340	Cover
364	Fitted bolt
376	Screw
388	Nut
411	Distance pipe, L=50
435	Spring
447	Door fastner
459	Wing nut
460	Distance pipe, L=120
472	Screw
484	Stud
506	Face
518	Sealing ring
531	Screw
543	Locking wire
567	Face
579	Sealing ring
580	Face
592	Screw
614	Distance pipe, L=100

Item No.	Part Description

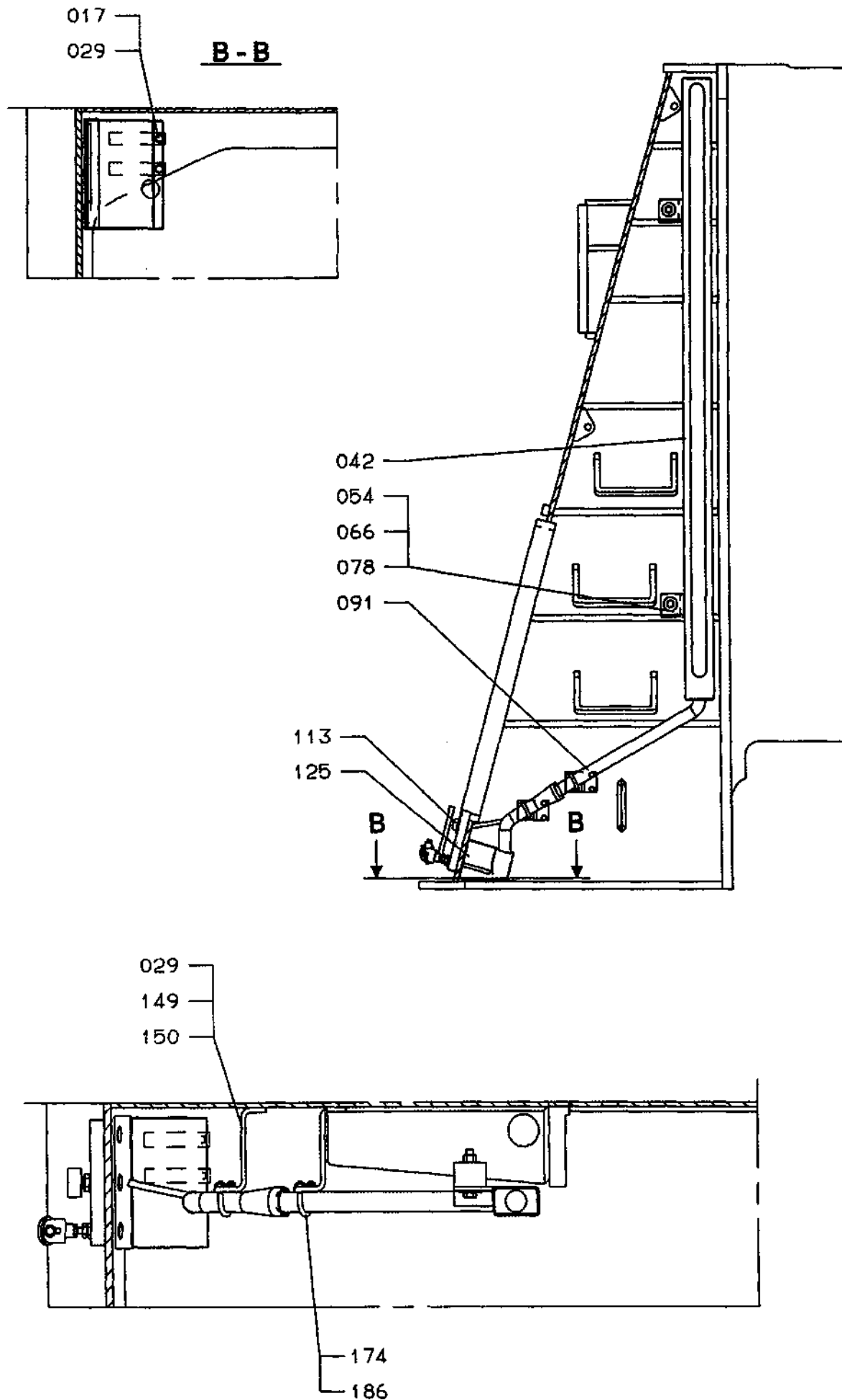


**Plate 91206-74 Chain Wheel Frame with Covers**

Item No.	Part Description
023	Packing
035	Flange
047	Stud
059	Nut
072	Screw
096	Stud
118	Cover
143	Guide pin
167	Cover
179	Screw
192	Stud
214	Stud
238	Screw
251	Chain wheel frame, upper
275	Stud
287	Distance pipe, L=25
299	Nut
309	Screw
322	Stud
334	Distance pipe, L=70
346	Nut
371	Plug
395	Distance pipe, L=90
405	Screw
429	Locking wire
430	Screw
454	Gasket
466	Cover
491	Top guard
501	Gasket
513	Cover
525	Screw
549	Screw
562	Screw
574	Rail for sealing
586	Packing, rubber
608	Distance pipe, L=35
621	Guide pin

Item No.	Part Description

S50MC-C





**Plate 91207-81 Arrangement of Piston Cooling**

Item No.	Part Description
017	Screw
029	Locking wire
042	Slotted pipe
054	Screw
066	Self-locking nut
078	Washer
091	Drain pipe
113	Sight glass
125	Drain box
149	Bracket
150	Screw
174	Clamp
186	Self-locking nut

Item No.	Part Description
----------	------------------

S50MC-C

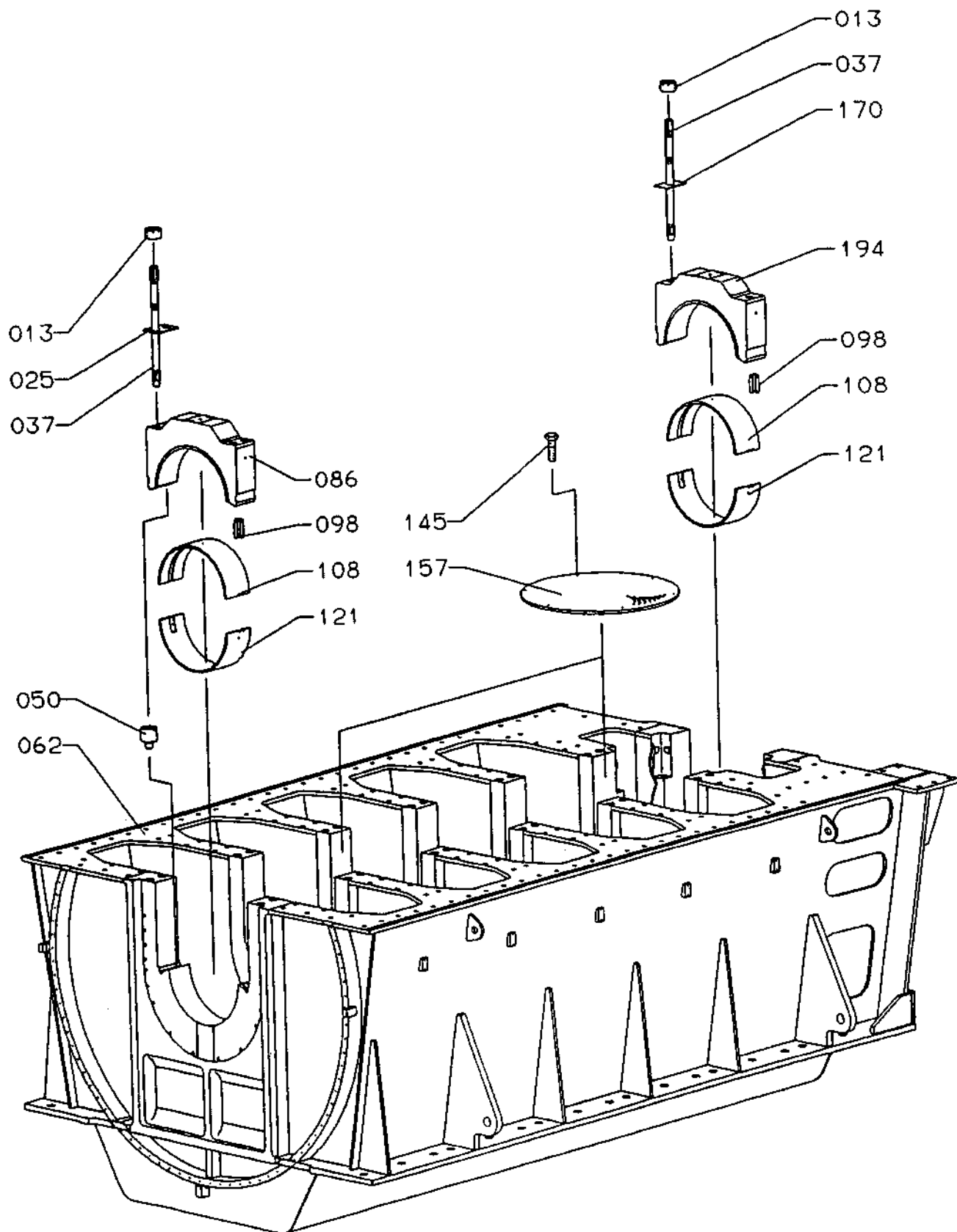
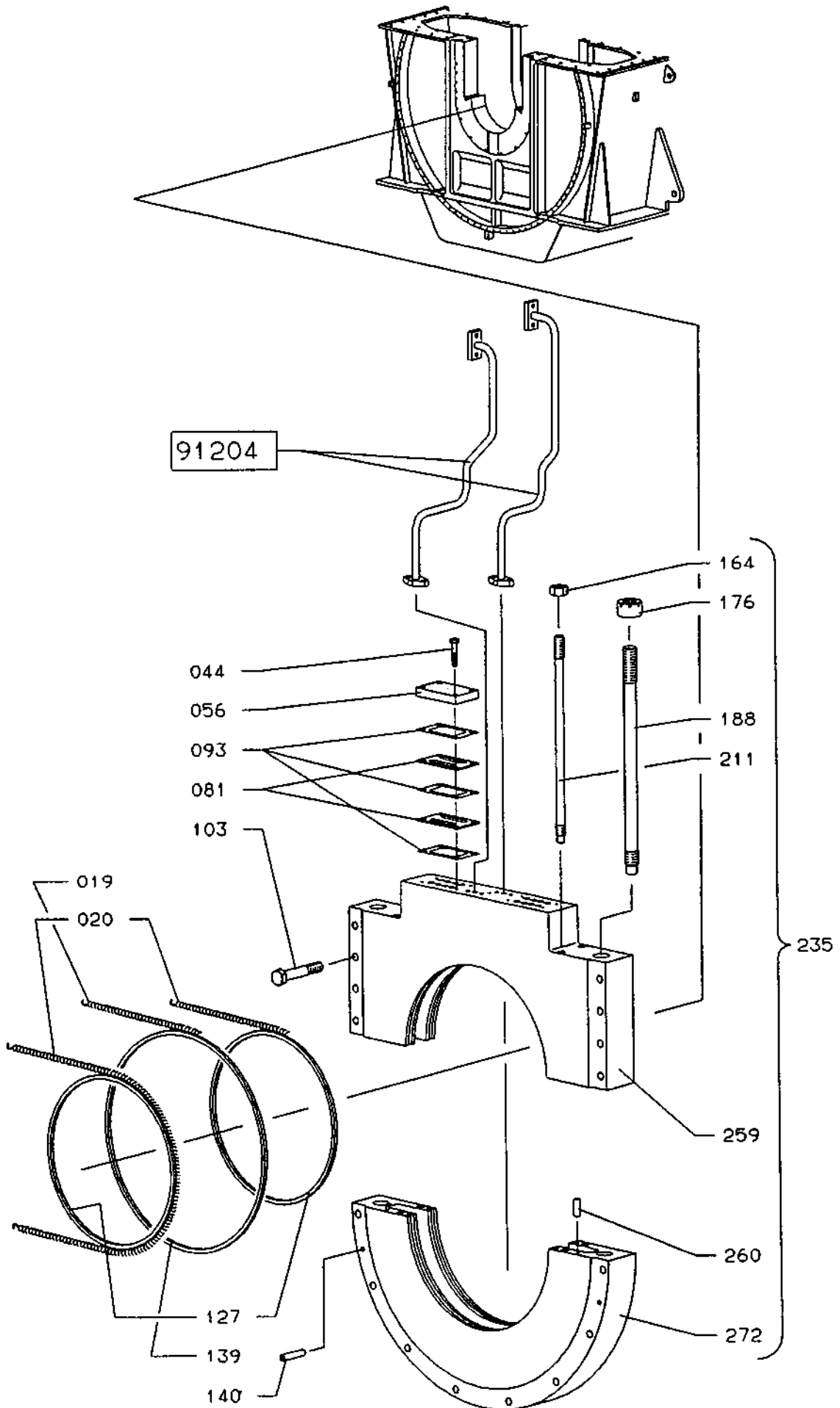


Plate 91210-108 Bedplate

Item No.	Part Description
013	Nut
025	Baseplate
037	Stud
050	Screw
062	Bedplate
086	Main bearing cap
098	Spring pin
108	Main bearing, upper shell
121	Main bearing, lower shell
145	Screw
157	Grate
170	baseplate
194	Main bearing cap

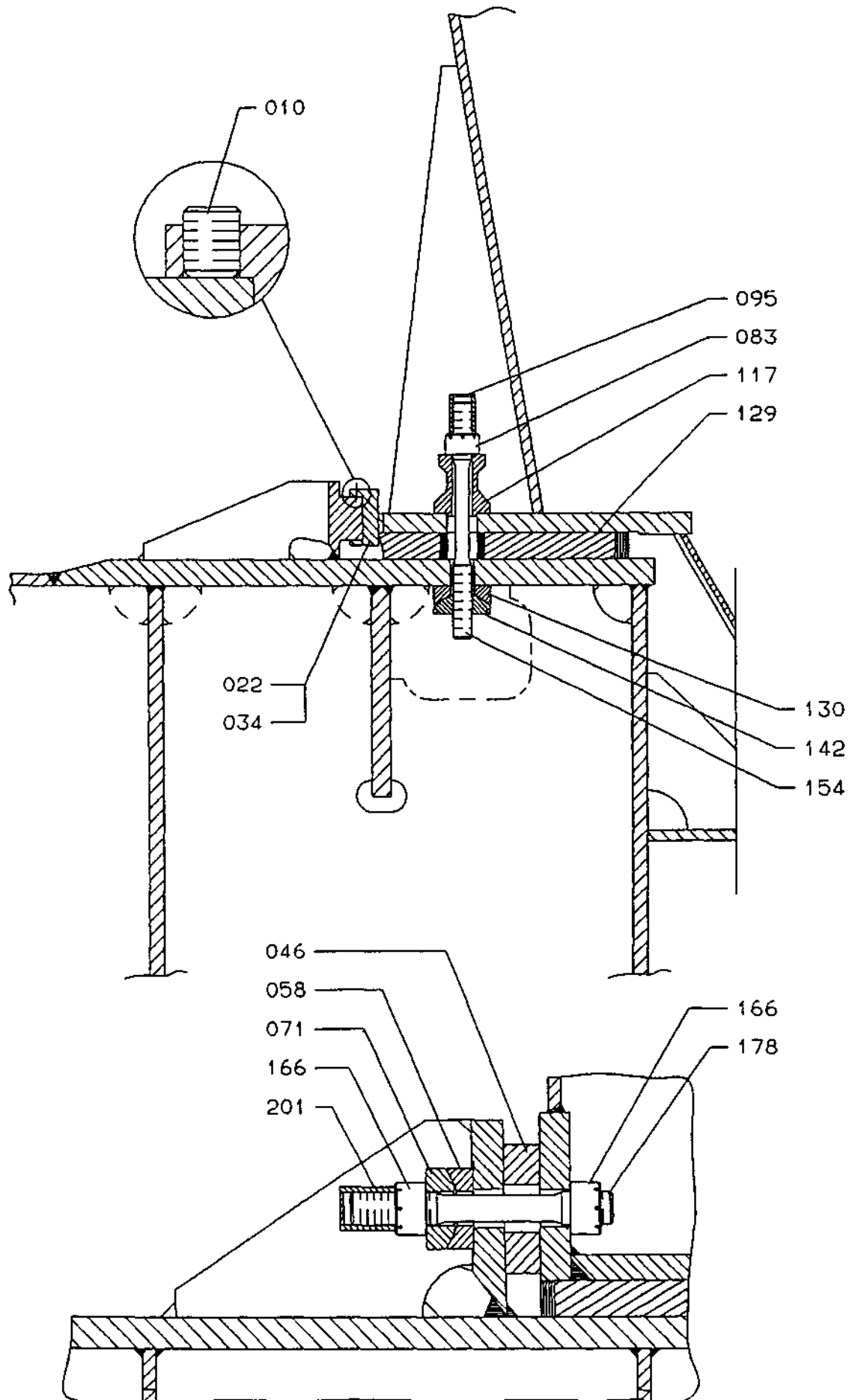
Item No.	Part Description
----------	------------------



**Plate 91211-55 Axial Vibration Damper**

Item No.	Part Description
019	Spring
020	Spring
044	Screw
056	Restriction for damper
081	Restriction for damper
093	Restriction for damper
103	Screw
127	Oil seal in 2/2
139	Oil seal in 2/2
140	Guide pin
164	Nut
176	Nut
188	Stud
211	Stud
235	Axial vibration damper housing, complete
259	Damper housing, upper part
260	Guide pin
272	Damper housing, lower part

Item No.	Part Description



**Plate 91215-50 Holding-Down Bolts and End-Chock Bolts**

Item No.	Part Description
010	Grub screw
022	Liner, port side
034	Liner, starboard side
046	Liner
058	Spherical washer
071	Spherical washer
083	Nut
095	Protecting cap
117	Distance pipe
129	Epoxy chocks
130	Spherical washer
142	Spherical nut
154	Holding down bolt, M36x4
166	Nut
178	Stud for end chock bolt, M52x5
201	Protecting cap

Item No.	Part Description

## Top Bracing of Main Engine

*(Shipyard work to be carried out against special order only)*

By means of top bracing the main engine, it will in most cases be possible to obtain such a high natural frequency of the system "engine – ship's side – ship's bottom" that annoying vibrations of the engine top or ship's hull will be eliminated.

Top bracing is usually mounted on the uppermost platform brackets on the starboard side (rear side) of the engine, and is executed as shipyard work in accordance with our principle drawing.

The top bracing, including the friction shims, should be checked at the same intervals as apply to the holding-down bolts in order to ensure that the tightening force is correct.

Bolts for top bracing are to be tightened by means of a torque wrench. As regards tightening force, see drawing No. 785310-4.

When during the trial trip the engine has reached its working temperature, the two bolts for the frictional assembly of the top bracing are loosened. After approximately one minute the bolts are tightened again. This procedure is carried out for each individual top bracing.

If one or more links are omitted, the tightening torque of the remaining links are to be increased accordingly. If, for example, 4 links are specified and 1 is omitted, the 3 remaining links are to be tightened by 33.3% extra. The tightening should be checked as follows:

Check if relative movements occur between top bracing and fastening plate (casing side or girder). This can be carried out by placing a dial gauge (or similar) as shown on drawing No. 782561-5. Carry out checking of the top bracing at the forward end, the centre, and the aft end of the engine.

Any movement can also be measured by means of, for instance, an ASKANIA vibrograph with a high gear ratio, fastened to the top bracing with the contact point touching the casing.

If ascertaining relative movements larger than  $\pm 0.02$  mm, increase the tightening by 40% (at all top bracings). At the same time, observe at which tightening torque the nuts at all top bracings are loose. If the relative movement (after having increased the tightening torque) has still not disappeared, increase the tightening torque with an additional of 40%, and again observe the loosening torque at each bolt.

After some time in service the top bracing might become ineffective (due to setting or wear of the friction material). The tightening should therefore be checked (as described above) if:

- 1) Unexpected change of level of hull – vibrations are observed, or
- 2) The turbocharger(s) start to vibrate intensely.

If the above-mentioned is not observed, the checking should be carried out once or twice a year.

To check the setting of the ship (alteration of full form) in relation to the top bracing, mount a device which enables a possible setting to be measured by means of a dial gauge, as shown on drawing No. 782561-5. Two pieces of square bar iron can, for instance, be welded to the top bracing and the fastening-on point on the casing so that, after marking with e.g. a centre punch, they together form a well-defined measuring distance. A suitable distance between the measuring points would be 200 mm.

Checking for possible settings of the ship's hull should be made 3-4 times a year. In the case of tankers, further measurements should be taken after loading and unloading, and also when the ship has had a rough trip.

The draught of the ship should be noted at each measuring. If exceptional deviations are ascertained, special precautions are to be taken.



This drawing, together with its supplements, is the property of HMI-EWD and subject to copyright protection. The material is placed at the disposal of the recipient solely for his own use, and only for the manufacture, repair or use as original HMI-EWD products, according to contract or other written agreement hereon with HMI-EWD. The material must not, either wholly or partly, be copied, reproduced, made public or in any other way made available to any third party without the written consent to his effect from HMI-EWD. The material must not be transferred or handed over to any third party, neither direct nor by succession to the rights of the recipient.

이 도면과 보완도면의 재산이므로 본사와 승인없이 이도면을 제3자에게 양도, 복사, 판매 허가나, 이도면에의해 부품을 제작하여 제3자에게 제공하는 것은 불합당합니다.

Bolts for top bracing are to be tightened by means of a torque wrench.

The bolts at the engine side are to be tightened to 470 Nm. The bolts at the hull side are to be tightened to 120 Nm.

When during the trial trip the engine has reached its working temperature, the two bolts for the frictional assembly of the top bracing at the hull side are to be loosened. After approximately one minute the bolts are tightened again. This procedure is to be carried out for each individual top bracing.

Make sure that the beams are supported in the vertical direction during this operation.

The tightening should be checked as follows:  
Check if relative movements occur between top bracing and fastening plate (casing side or girder). This can be carried out by placing a dial gauge (or similar) as shown on drwg. No. 0788449-9. Carry out checking of the top bracing at the forward end, the centre, and the aft end of the engine.

If relative movements larger than  $\pm 0.02$  mm are ascertained, increase the tightening torque at the bolts at the hull side to 215 Nm (at all top bracings). At the same time, observe at which tightening torque the nuts are loosened at all top bracings. If the relative movement (after having increased the tightening torque) has still not disappeared, increase the tightening torque to 310 Nm, and again observe the loosening torque at each bolt.

After some time in service top bracing might become ineffective (due to setting or wear of the friction material). The tightening should therefore be checked (as described above) if:

- 1) Unexpected change of hull level - vibrations are observed, or
- 2) The turbocharger(s) start to vibrate intensely.

If the above-mentioned is not observed, the checking should be carried out once or twice a year.

Standard for surface roughness (ISO 1302-1978) Class No. N1 N2 N3 N4 N5 N6 N7 N8 N9 N10 N11 N12 R <sub>max</sub> (µm) 0,025 0,05 0,1 0,2 0,4 0,8 1,6 3,2 6,3 12,5 25 50 Tolerances for dimensions without tolerance indication (ISO 2768-1988) Parallel series H max. size (mm) 0,5 0,6 0,8 1,0 1,2 1,6 2,0 2,5 3,2 4,0 5,0 6,3 8,0 10 12,5 16 20 25 32 40 50 63 80 100 up to 0,5 up to 0,6 up to 0,8 up to 1,0 up to 1,2 up to 1,6 up to 2,0 up to 2,5 up to 3,2 up to 4,0 up to 5,0 up to 6,3 up to 8,0 up to 10 up to 12,5 up to 16 up to 20 up to 25 up to 32 up to 40 up to 50 up to 63 up to 80 up to 100	Supplement Dwg no.:		Projection:		Mass (kg):		Material / Blank:		
	0788449-9								
			Licensor's Ident. no.:		Dist.:		Licensor's Material / Blank:		
			0792358-4.0						
	Date	Des.	Chk.	Appd.	A.C.	E	Change / Replacement		C.No
					*	*	Replaced by Ident. No.:		9
					*	*			8
					*	*			7
					*	*			6
					*	*			5
				*	*			4	
				*	*			3	
				*	*			2	
				*	*			1	
				*	*			0	
980813KJWSDCLSJ				*	*				
Similar Drawing No.:				Replacement of Ident. No.:					
Scale:	Size:	Type:	Page No.:						
	A4	L-S50MC/S50MC-C	01 (01)						
Info. No.:	Description:			Ident. No.:					
384618	TOP BRACING INSTRUCTIONS			A14-166630-4					

This drawing, together with its supplements, is the property of HMI-EMO and subject to copyright protection. The material is placed at the disposal of the recipient solely for his own use, and only for the manufacture, repair or use on original HMI-EMO products, according to contract or other written agreement between HMI-EMO. The material must not, either wholly or partly, be copied, reproduced, made public or in any other way made available to any third party without the written consent to his effect from HMI-EMO. The material must not be transferred or handed over to any third party, neither direct nor by succession to the rights of the recipient.



이 도면은 현대중공업의 지적재산권으로서 승인없이 비도면을 제3자에게 양도, 복사, 판매하거나, 이도면에의식 부품을 제작하여 제3자에게 판매하는 것은 불법입니다.

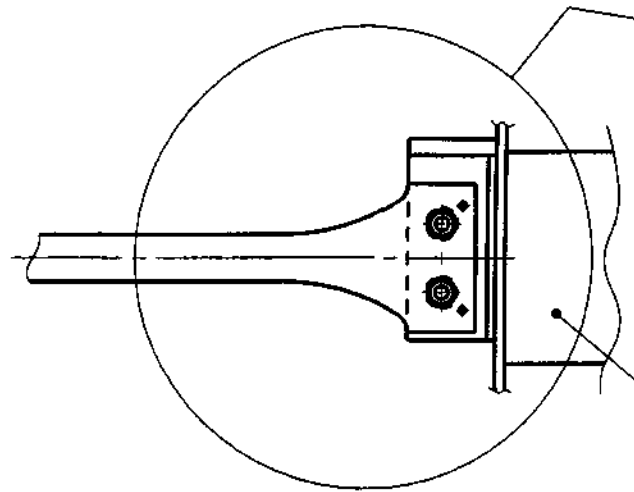
### Transverse top bracing

Engine bore	a)	b)
	±kN	MN/m
98	248	230
90	209	210
80	165	190
70	126	170
60	93	140
50	64	120
46	55	110
42	45	100
35	32	85

Forces from engine and minimum required rigidity of hull side.

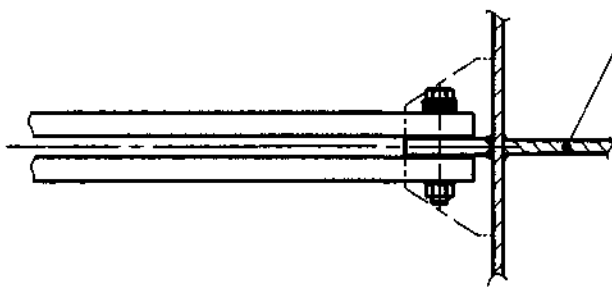
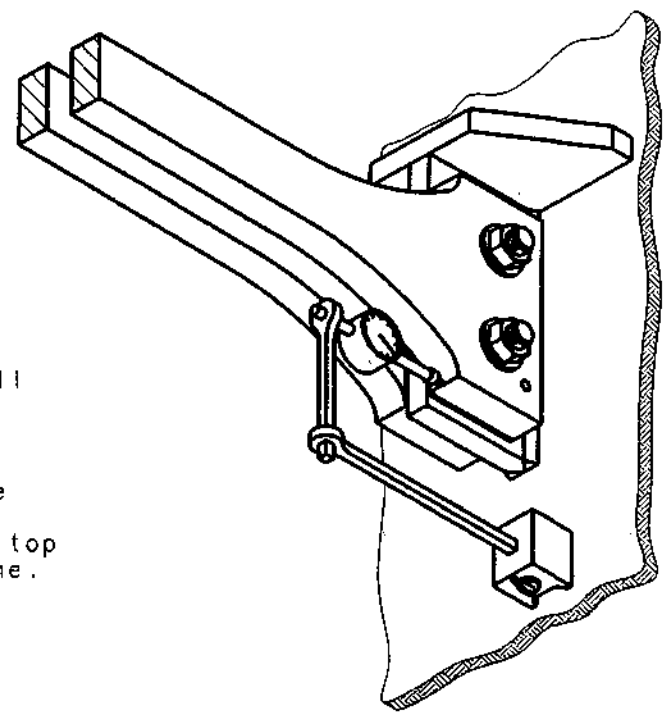
- a): Force per bracing at specified number.
- b): Minimum horizontal rigidity. Horizontal installation of the Top bracing is required.

<small>Standard for surface roughness(ISO 1302-1978)</small> <small>Classes No. N1 N2 N3 N4 N5 N6 N7 N8 N9 N10 N11 N12</small> <small>Ra μm 0.025 0.05 0.1 0.2 0.4 0.8 1.6 3.2 6.3 12.5 25 50</small> <small>Tolerances for dimensions without tolerance indication(ISO 2768-1989)</small> <small>permissible deviation</small> <small>up to 6 over 6 over 30 over 120 over 315 over 1000</small> <small>Medium series</small> <small>±0.1 ±0.2 ±0.3 ±0.5 ±0.8 ±1.2</small>	Supplement Dwg no.:	Projection: 	Mass (kg):	Material / Blank:			
	Licensor's Ident. no.:		Dist.:	Licensor's Material / Blank:			
	0792027-7.0						
	Date	Des.	Chk.	Appd.	A.C.	E	Change / Replacement
				*	*	Replaced by Ident. No.:	9
				*	*		8
				*	*		7
				*	*		6
				*	*		5
				*	*		4
				*	*		3
				*	*		2
				*	*		1
				*	*		0
980808KJWSDCLSJ				*	*		
Similar Drawing No.:				Replacement of Ident. No.:			
Scale:	Size:	Type:	Page No.:				
	A4	K-L-S/MC/MC-C	01 (01)				
Info. No.:	Description:			Ident. No.:			
384616	Top bracing-forces			A14-166600-8			

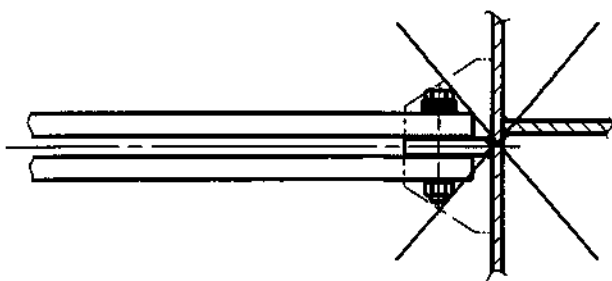


Reinforcement of the hull side to which the top bracing is attached.

It is important that the reinforcement is placed so that it supports the top bracing in the centreline.



Correct



Incorrect

This drawing, together with its supplements, is the property of HMI-EMD and subject to copyright protection. The material is placed at the disposal of the recipient solely for his use and only for the manufacture, repair or use of original HMI-EMD products, according to contract or other written agreement between HMI-EMD. The material must not, either wholly or partly, be copied, reproduced, made public or in any other way made available to any third party without the written consent in writing from HMI-EMD. The material must not be transferred or handed over to any third party, neither direct nor by accession to the rights of the recipient.

Standard for surface roughness

The haptic symbols and class numbers are in accordance with ISO 1302-1978.

Class No.	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12
R <sub>a</sub> max. value in μm	0,025	0,05	0,1	0,2	0,4	0,8	1,6	3,2	6,3	12,5	25	50

Tolerances for dimensions without tolerance indication (ISO 2768-1988)

This standard states the permissible deviations for dimensions without direct tolerance indication on metallic components manufactured by casting.

Dim. measurement	0,3	over 0,3	over 30	over 120	over 315	over 1000
For possible deviations	±0,1	±0,2	±0,3	±0,5	±0,8	±1,3

Supplement Drawing no.:						Projection:		Mass (kg):		Material / Blank:	
						Licensor's Ident. no.:		Dist.:		Licensor's Material / Blank:	
						0788449-9.0					
Date	Des.	Chk.	Appd.	A.C.	E	Change / Replacement					C.No
				*	*	Replaced by Ident. No.:					9
				*	*						8
				*	*						7
				*	*						6
				*	*						5
				*	*						4
				*	*						3
				*	*						2
				*	*						1
				*	*						0

Similar Drawing No.:			Replacement of Ident. No.:		
Scale:	Size:	Type:	Page No.:	HYUNDAI	
~	A3		01 (01)	Heavy Industries Co., Ltd.	
Info. No.:		Description:		Ident. No.:	
384608		Data for top bracing		A13-166601-0	



## **B. OVERSEAS NETWORK**

# OVERSEAS NETWORK

## ABU-DHABI

1st. Fl., Saeed Ahmed Gobash Bldg., Merdian Area  
Plot C31 Sector E 16 16 Abu-Dhabi, U.A.E.  
P.O. Box 6101 Abu-Dhabi U.A.E.  
Tlx : 23381 HYUNDAI EM Tel. : 829942

## AL-KHOBAR

P.O. Box 419 Dahrn Airport  
Jorboa Bldg., Prince Fawwaz Ave. Block No. 354  
Site No. 5, Al-Khobar Saudi Arabia  
Tlx : P/P THRU 8753 HYDBAH GJ,  
670196 HYDALK SJ  
Tel. : 8643299, 8647888, 8646044, 8646723

## AMSTERDAM

Rivierstate Bldg., 3rd Fl., Amsteldijk 166 1079 LH  
Amsterdam, The Netherlands  
Tlx. : 18591 HDAMS NL Tel. : 020-462090

## BAGHDAD

House No. 21, Street No. 38  
Quater No. 906, Uehdah Area, Baghdad, Iraq  
Tlx. : 2595 HDBAG IK Tel. : 671011, 671015

## BANGKOK

Rm. 602, Narai Hotel, 222 Silom Road, Bangkok,  
Thailand  
Cable : NARAI HOTEL, BANGKOK  
C.P.O. Box 1896  
Tlx. : NARITEL TH81175  
Tel. : 235-6784, 233-3350 Ext. 602

## BOMBAY

69 Mittal Chamber Nariman Point, Bombay 400021  
Tlx. : 5246 Tel. : 235213, 241528

## BAHRAIN

P.O. Box 22266 Muharraq, Bahrain  
Tlx. : 8551 HYDBAH GJ Tel. : 671011,  
8618 HYDBAH GJ 671015

## DACCA

C/O Korea Trade Center  
28 Gulshan Avenue (South) Gulshan Model Town,  
Dacca-12, C.P.O. Box 2832  
Tlx. : KTC DAC Tel. : 303012

## DAMMAM

Abdulla. M. Al-Utaishan Est  
(Building Materails-Import & Contract)  
P.O. Box 2178 Dammam, Saudi Arabia  
Tlx. : 601207 OTASHN SJ Tel. : 32746

## DUSSELDORF

4th Fl., Emanuel-Leutze-Str 1  
D-4000, Dusseldorf 11, West Germany

Tlx. : 8582803 HD U S D Tel. : (0211) 593090,  
593099

## FRANKFURT

Sprendlinger Landstr 178 6050 Offenbach Am Main  
Tlx.: 4185488 HDFR-D Tel. : 0611-842077

## HONG KONG

Rm 1001, Wing on Centre Bldg. Connaught Road  
Central, Hong Kong  
Tlx. : 83464 HKHDS HX Tel. : 5-445895/442743

## HOUSTON

1 Houston Center, Suite 1824 Houston Texas 77002  
U.S.A.  
Tlx. : 774-126 HYUNDAI HOU Tel. : 713-759-9811/2

## JAKARTA

Korea Center Bldg. 2nd Fl., Ji Gatot Subroto 57-  
58 Jakarta, Indonesia  
Tlx. : 45736 HDC JKT Tel. : 513458, 510487

## JEDDAH

P.O. Box 5678, Jeddah, Saudi Arabia  
Tlx. : 400040, HYDJED SJ Tel. : 57042, 601839

## KUWAIT

Al-Bahar Bldg., Intersection of Arabian Gulf Street  
& Hamad Almubarak Street Salmieh, Kuwait  
Tlx. : 2794 HYDKWT Tel. : 611881/611482/  
637812

## KUALA LUMPUR

No. 6.11 & 6.12 5th Fl. Wisma Stephens 88 Jalan  
Raja Chulan Kuala Lumpur Malaysia  
Tlx. : 483366, 483579, 483472 Tel. : HDKL MA  
30807

## LAGOS

Hyundai Corp. Plot 839 Festival Rd Victoria  
Lagos, Nigeria  
Tlx. : Tel. : 24054

## LEIDSCHENDAM

Midaenweg 7 Leidschendam Netherlands  
(Hyundai-Holland Motor)  
Tlx. : 34123 HDMOH NL Tel. : 070-209209

## LONDON

10th & 11th Fl., St., Martin's House, 1 Hammersmith  
Grove London, W6-ONB, England  
Tlx. : 938270/937796/934696 HOLDNG  
Tel. : (01) 741-1531 (Office) (01) 748-6719 (Office)  
(01) 741-3103 (Office)

## LOS ANGELES

Hyundai Corp. L/A Office  
19401 S. Main St. Gardena, Ca 90248 U.S.A.  
Tlx. : 910-346-7780/HDAMERICA  
Tel. : 213-538-9120/1 213-770-2972, 213-770-2975

## MANILA

401 Sarmiento Bldg., Ayala Avenue, Makati Metro  
Manila, Philippines Cable : HDCORPMNLA  
Tlx. : 45841 HDMNL PM Tel. : 871480

## MIAMI

Suite No. 355,2801 Ponce De Leon Boulevard Coral  
Gables, Florida 33134 U.S.A. Miami  
Tlx. : 515779 HYUNDAI CGBL  
Tel : 305-446-0144/305-446-0145

## MILANO

Via Sporting Milasole No.2, El 20090, Noverasco  
Di Opera Milano Itay

## NAIROBI

P.O. Box 68149 NAIROBI

## NEW JERSEY

Polygon Plaza 3rd Floor, 2050 Center Ave.  
Fort Lee, N.J. 07024, U.S.A.  
Tlx.: 252109 HDNJ UR Tel. : 201-592-7766

## NEW YORK

One Penn Plaza, Suite 360  
250 West 34th Street, New York, N.Y. 10001  
U.S.A.  
Tlx.: 235531 HSHI UR  
125425 HYUNDAI NYK  
Tel. : 212-695-7810,  
212-793-0605,  
212-446-7914

## PARIS

Tour Maine Montparnasse  
33 Avenue Du Maine, 75755 Paris Cedex 15, France  
Tlx. : 203639 F HD PARIS Tel. : 538-6776, 538-6841

## QATAR (DOHA)

P.O. Box 3441 Doha State of Qatar Hyundai Corp.  
Tlx. : 4039 HYDOAT DH Tel. : 326192

## RIYADH

P. O. Box 2761, Riyadh Saudi Arabia.  
Tlx. : 200197 HYDRYD SJ Tel. : 64739, 69694

## SAN FRANCISCO

300 Montgomery Street, Suite 480 San Francisco,  
Calif, 94104 U.S.A.  
Tlx. : 278778 HDSFO UR Tel. : 415-956-4908/9

## SANTIAGO

Huertanos 1022, of, 1009, FONO 88160 Santiago  
Chilo,  
P.O. Box Casilla 3304  
Tlx. : SGO 451 HYUNDAI Tel. : 88160

## SEATTLE

Hyundai Corporation Fourth N, Blanchard Bldg.,  
Suite 270 Seattle, Washington 98121 U.S.A.  
Tlx. : 329476 HYUNDAI SEA  
Tel. : 206-682-1698/9

## SINGAPORE

Suite 2403, 24th Fl., Ocean Bldg., Collyer Quay,  
Singapore 1  
Tlx. : RS 21923 HYUNDAI Tel. : 982460,  
221937

## TAIWAN

Chia Hsin Bldg., Rm. 507, 96 Chung Shan N Road  
Section 2 Taipei Taiwan 104  
Tlx. : 27704 HDCTWN

## TOKYO

8th Fl., Yurakucho Denki Bldg., 1-7-1, Yurakucho,  
Chiyoda-Ku, Tokyo, Japan 100  
Cable : ROKATLAS TOKYO  
Tlx. : J28548 HDT, 2226343 HD SHTK, 2523639  
HD SHTK  
Tel. : 03-211-0851/5

## TORONTO

Suite 3030 Hudson s Bay, Center 2 Bloor Street East,  
Toronto Ontario M4 M1 48 Canada  
Cable : MOOGONG TORONTO  
Tlx. : 06-22949 HDCORP TOR  
Tel : (416) 923-7752, (416) 923-7803

## HYUNDAI HEAVY INDUSTRIES CO., LTD. ENGINE & MACHINERY DIVISION

### Head Office

1, Cheonha-Dong, Ulsan, Korea  
Tel.: Ulsan (32) 4141, (33) 4141  
Telex: HHI EMD K53815. 52191