SPERRE

GB

# INSTRUCTION MANUAL

# WATER-COOLED AIR COMPRESSOR HV2/220


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**Sole suppliers of genuine spare parts**

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## INTRODUCTION

**The purpose of this handbook is to describe the design and function of the compressor and to provide basic instructions for inspection and maintenance of the equipment.**

**To ensure proper installation, operation and maintenance from the very beginning, it is essential that the operator should read this handbook with care and attention.**

**The maintenance intervals and certain technical details given in this handbook ate mean values based on experience. These values may vary depending upon the operating conditions of the individual compressor.**

**The manufacturer disclaims liability for damage due to unskilled operation or improper maintenance of the equipment.**

**Keep the compressor in good mechanical order, and remember that proper preventive maintenance of the equipment will reduce the risk of damage and unnecessary shutdowns.**

**The manufacturer reserves the right to amend technical specifications without prior notice.**

**ELLINGSØY, SEPTEMBER 1986**
**SPERRE INDUSTRI A/S**

**CONTENTS** Page

## *1. ORDERING REPLACEMENT PARTS*

A list of replacement parts and drawings of the various components will be found at the end of this handbook.

The following information must be given when ordering spares.

A. COMPRESSOR TYPE
B. COMPRESSOR SERIAL NUMBER
C. PART NUMBER AND DESCRIPTION
D. QUANTITY ORDERED
E. RATED WORKING PRESSURE OF COMPRESSOR

The type designation (A) and serial number (B) are shown on the rating plate which is fixed to the crankcase.

The rating plate is shown in Fig. 1.

Pleace note that the manufactorer does not supply oversize or undersize parts, or unmachined parts for further machining and fitting.

The manufactorer disclames all liability for damage due to the use of non-genuine replacement parts.

ORDER FOR REPLACEMENT PARTS SHOULD BE SENT TO:

SPERRE INDUSTRI A/S
N-6057 ELLINGSØY
NORWAY
PHONE :+47 70 16 11 00
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## *2. DESCRIPTION OF COMPRESSOR*

### *2.1 Design*

The machine coverded by this instruction book is a single cylinder, 2-stage single-acting watercooled air compressor.
The design principle is shown in the cross-sectional drawing Fig. 2.

The first stage of the compressor is the low-pressure stage (LP) and the second is the high-pressure stage (HP).
Air circulation through the compressor is shown in Fig. 3. The letters indicate:

A. Suction filter
B. LP suction valve
C. LP delivery valve
D. LP safety valve
E. LP cooler
F. HP suction valve
G. HP delivery valve
H. HP cooler
I. HP safety valve

All bearings are pressure lubricated by a gear pump fitted to the end of the crankshaft.

Two replaceable tube-type coolers are fitted in the compressor cylinder block. The first serves to cool the air after first-stage compression, the second provides cooling after second-stage compression. The cooling water intake and outlet are located so that the water circulates through the cylinder block and ensures efficient cooling of the air and compressor cylinder walls.

The compressor compresses air from atmospheric pressure to rated pressure, with an upper limit of 35 bars.

The compressor is designed for installation together with an electric motor or other drive unit on a well-stiffended base, with a flexible coupling between compressor and motor.

Every compressor is tested before delivery from the factory, and all compressor sets supplied with motor are aligned before dispatch. See chapters 3.1. and 5.6.

This compressor is designed to supply compressed air for engine starting, and for the operation of air power equipment and instruments. It complies with the requirements specified by the classification institutions.

## *2.2. Safety equipment*

The compressor is fitted with two safety valves, one after the first-stage compression and the other after second-stage compression.

The safety valves, which are set at the factory in accordance with the working pressure specified by the customer, ensure that the pressure does not exceed the limit for which the compressor and the compressed air system are dimensioned.

The cylinder block cooling jacket is fitted with a safety plate which will be blow out if the cooling water is subjected to excessive pressure. Use only manufacturer's genuine safety plates to replace blown plates.

A pressure switch is generally included in the automatic control system. This serves to stop the compressor if the lube oil pressure falls belowe a predetermined minimum.

# *3. INSTALLATION AND OPERATION*

## *3.1. Installation instructions*

Every compressor unit is supplied complete with drawings and specifications showing its dimensions and attachment points. The customer also receives installation instructions giving recommendations for the installation of equipment and piping.

The compressor unit should be installed in a location where the air is not excessively warm. Warm intake air reduces the capacity of the compressor. Normally, the ambient temperature for electrical equipment should not exceed 45$^{o}$C.
The compressor unit bedplate should lie plane to its foundation. After the unit is installed, check the alignment of compressor and motor. The procedure is shown in Fig.4.

Use vernier callipers or inside micrometer callipers to check the distance (W) (Fig.4). This should be the same around the whole circumference of the coupling.

Using a micrometer (A), check the radial misalignment between the coupling halves as shown in Fig.4. The maximum micrometer reading (A) should be as illustrated in Fig. 4.

Even if the unit has been installed on vibration dampers, an alignment check is to be recommended after installation.

Piping should be so installed that there is no risk of water pockets.

Other equipment should not be installed around the compressor unit in such a way that inspection and maintenance operations may be hampered.

## *3.2. Cooling water systems*

It is of the greatest importance to the operation and life of the compressor that a good and reliable supply of cooling water is ensured. The quantities of cooling water required are given in Table T.1. These specifications apply to both seawater and freshwater cooling.

Whether the compressor is connected to a central cooling system or has its own separate cooling water pump, it is important to ensure that the cooling water is circulating properly. In this connection it is not sufficient simply to check that the compressor pressure gauge is registering cooling water pressure.

If the cooling water feed temperature is too low, increased internal condensation may result. If this is the case, the cooling water temperature should be increased. If the temperature cannot be increased by recirculation, condensation can be reduced by reducing the supply of cooling water.

The cylinder block cooling jacket is equipped with a thermometer for the monitoring of cooling water temperature.

Recommended cooling water temperatures are given in Table T.2.

## *3.3. Starting up*

Before initial starting up and after long periods out of use, carry out he following operations:

A. Check the oil level.
B. Check that the quality of the oil has not been impaired by water or other foreign matter.
C. Check compressor valves and lubricate the cylinder with oil.
D. Turn over the compressor by hand, with the suction valve relieved by means of the manual valve opener.
E. Check cooling water circulation.
F. Check that the air line cock between the compressor and the air reservoir is open.
G. Open the manual drain cocks on the water trap.
H. Start the compressor.
I. If everyhing is operating normally, close the drain cocks and set the valve opener in the operating position. Allow the compressor to run for a few minutes before loading it to maximum working pressure.

## *3.4. Operation*

During normal operation, pressures and temperatures should be as shown in Table T.2. Some of the values, which are directly affected by local conditions, may deviate slightly from the figures in the table.

Operation of the compressor is normally monitored by the automatic features of the starting equipment, e.g. pressure switch monitoring of lube oil pressure and thermostat monitoring of cooling water temperature. However, additional regular checking of operation and automatic functions is recommended.

Some water form the compressed air will always condence in the system. The compressor is fitted with manual drain cocks after the HP and LP coolers. If these are not automatically controlled, they must be drained *regularly* by hand. Also, the oil and water traps should be regularly drained by hand, unless this function is performed by an automatic draining system.

Special water traps to collect condensate after the LP cooler can be supplied to order, by the manufacturer.

## *3.5. Stopping*

Stopping the compressor manually for short periods:

A. Operate the manual valve opener to relieve the LP suction valve.

B. Open the water trap drain cocks.

C. Stop the compressor.

If the compressor is to be shut down for a long period, e.g. when a ship is to be laid up, the procedure is as follows:

AA. Lubricate compressor valves, non return valves, cylinder wallsand exposed crankshaft surfaces with corrosin-inhibiting oil, suitable for the envisaged period of shutdown.

BB. If there is any risk of frost, drain the cooling water from the compressor.

CC. Drain off old oil, clean the sump and refill with new oil.

DD. Set the manual valve opener in the horizontal position to relieve he load on the suction valve.

EE. Turn over the compressor manually once a month.

FF. The starter cabinet and other electrical equipment should also be protected from damage by corrosion.

## *4. FAULT TRACING*

The following are some of the faults that may arise in operation.

A. Compressor capacity is low and/or compressor not supplying full pressure.

| *Possible cause* | *Remedy* |
|---|---|
| Dirty, damaged or worn valves | Clean and check all valves. Replace defective parts. |
| Sticking piston rings | Dismantle rings. Clean grooves and rings. Replace defecive parts. When reinstalling, lubricate cylinder walls with oil. |
| Leaking safety valves adjust to correct lifting pressure. | Overhaul safety valves, |
| Defective gasket between crankcase and sylinder block | Replace gasket. |
| Air filter blocked | Clean filter. |

B. LP safety valve blows.

| *Possible cause* | *Remedy* |
|---|---|
| HP valves damaged or dirty | Check and clean valves. Replace defective parts. |

C. HP safety valve blows.

| *Possible cause* | *Remedy* |
|---|---|
| Air line shut-off cock closed. | Open shut-off cock. |
| Non-return valve blocked | Remove and clean non-return valve. Replace defective parts. |

D. Valves require maintenance too frequently.

| *Possible cause* | *Remedy* |
|---|---|
| Overheating | Check cooling water circulation and temp. Inspect coolers and clean if necessary. |
| Dirty intake air | Check suction filter. |
| Inferior lube oil See list of recommended types in | Change the lube oil type. this handbook. Manufactorer can supply further information. |
| Incorrect tightening of compressor valves | Tighten valve to specified torque. clamping screws to specified torque. |

E. Overheating or knocking in crankcase.

| *Possible cause* | *Remedy* |
|---|---|
| Defective bearings | Inspect bearings, check clearances. |
| Insufficent lube oil or lube oil contaminated with water | Drain sump, clean and add new oil. |
| Binding crankshaft bearing | Check bearing clearances. Replace defective parts. |

F. Overheating and scoring of piston.

| *Possible cause* | *Remedy* |
|---|---|
| Piston or gudgeon pin bearing incorrectly fitted clearances and | Replace defective parts, check piston clearances, piston ring gudgeon pin bearing. |
| Deficient cooling | Check cooling water circulation and temperatures. |

G. Excessive lube oil consumption.

| *Possible causes* | *Remedy* |
|---|---|
| Piston rings worn out | Replace piston rings. |
| Defective crankcase breather valve | Replace breather valve. |

## *5. INSPECTION AND MAINTENANCE*

**IMPORTANT: PERSONAL SAFETY**
**Before starting any kind of work on the compressor, the electricity supply must be switched off at the starters and also at the main switchboard. Hang a notice on the switch on the main switchboard to show that repairs are in progress.**

### *5.1. Maintenance schedule*

Change the lube oil after approximately the first 200 hours of running in. Drain off the oil while it is warm, clean the crankcase before refilling with new oil. When cleaning, it is important not to use rags that may leave threads or fluff in the crankcase.

The following maintenance schedule is intended as a guideline for normal maintenance. However, compressor operating conditions vary widely from installation to installation and it is therefor important to adapt the maintenance schedule to the experience of the individual operator.

| *Maintenance intervals* | *Maintenance routine* |
|---|---|
| Daily | A |
| Every 500 hours | B |
| Every 1000 hours | C |
| Every 3000 hours | D |
| Every 9000 hours | E |
| Every 12000 hours | F |

*Routine A*

Check:
- Lube oil pressure
- Lube oil
- Cooling water circulation and temperatures
- Automatic functions
- Drain condensate

*Routine B*

Check:
- LP delivery valve
- HP delivery valve
- Compressor bedplate bolts

*Routine C*

Check:
- LP suction valve
- HP suction valve
- Cylinder through valve apertures
- Pipe connections

Overhaul:
- LP delivery valve
- HP delivery valve

Replace:
- Lube oil after cleaning crankcase
- Lube oil filter

*Routine D*

Check:
- Big-end bearings
- Piston and cylinder wwalls through valve apertures
- Flexible coupling
- Safety valves

Overhaul:
- LP suction valve
- HP suction valve
- Air filter (clean)

*Routine E*

Check:
- Coolers (clean)

*Routine F*

Check:
- - Main bearings
- - Piston, gudgeon pin and rings
- - Gudgeon pin bearing
- Lub oil pump

Before ordering replacement parts, please read the instructions for ordering parts.

## *5.2. Valves*

In the parts list and drawings each valve is shown complete, with its own part number, and also dismantled with the part numbers of the individual components.

After overhaul or replacement of parts, assemble the valves in sequence as shown in the drawing of the dismantled valve.

When assembling valves, lubricate the nut and valve bolt and tighten to the torques (in kpm) given below:

| Dimensjon | Minimum | Maksimum |
|---|---|---|
| M10 | 2,0 | 2,45 |
| M12 | 3,60 | 4,40 |
| M14 | 5,70 | 6,90 |
| M16 | 9,0 | 11,00 |

IMPORTANT:
Before attempting to check compressor valves, loosen the clamping screw on the valve cover before removing the cover.

After inspecting and overhauling valves, it is essential that the clamping screw, which bears against the valve clamping piece and which keeps the valve in place on its seat, should be tightened with an unbrako key to the torque shown in Table T.3.

*Overhaul and mainenance of valves*

Regular and careful maintenance of valves is essential to the capacity and reliability of the compressor. We therefore recommend overhaul in accordance with the following guidelines:

A. When cleaning and dismantling the valve, never clamp the valve directly in a vice to loosen the centre bolt nut. A special clamping jig for this purpose, suitable for all valves, is available from the factory on request. A simple makeshift for clamping the valve is to set it in a vice between two pins which fit into the outermost seat slots of the valve.

B. Clean the valve components and check them carefully.
IMPORTANT: Never use sharp implements on sealing surfaces and plate parts.

C. Replace all parts that are worn or even slightly scored. Check that all guide pins are in order. Maximum wear limit is 10% of the total thickness of components.

D. If a valve spring or spring plate shows signs of weak-ness, all springs must be replaced at the same time, because damage can result if some springs operate longer than others. Replacement of all valve springs is recommended after about 5000 hours running time, even if the springs do not look worn.

E. If there are signs of abrasion or scoring of the valve seat sealing ledges, these must be machined. Most valves are drilled for guide pins, with spare holes for new pins. Guide pins can be driven out by means of a suitable tool. If it proves impossible to remove a broken pin, use one of the spare holes.

F. To remove the valve centre bolt, mark the centre of the pin with a centre punch and then drill out the pin. Remove the centre bolt. After refitting the bolt, drill a hole for the safety pin, drive the pin securely into place and peen the end to prevent it from falling out.

G. After completion of machining and careful replacement of guide pins in their respective holes in the valve seating and/or catch plate, check that the ends of the pins do not but against the bottom of the holes in the matching parts.

Use *only* genuine replacement pins and parts.

Assembly of valves demands precision, care and forethought. Make sure that the various parts are correctly located and that the right numbers are installed. Compare with the lists and drawings of parts to ensure that the right number of parts is present. Total lifting heights of valve plates are given in Table T.4.

## *5.3. Lubricating oil system*

The lube oil pump is a gear pump which is normally capable of operating for long periods without maintenance. The pump is directly driven from the end of the crankshaft, and oil pressure is controlled by means of a by-pass valve in the pump.
To overhaul, dismantle the mounting flange and pipe connections, and pull the pump out.

An easily replaceable lube oil filter is fitted between the delivery side of the pump and the compressor.

IMPORTANT:

Accumulation of condensate in the crankcase may present a serious problem under certain operating conditions, and it is important that the operator should check from the very beginning whether condensate in the lubricating oil is liable to become a problem.

Unless the condensed water emulsifies with the lubricating oil, it will separate out and there is a risk that the compressor will be lubricated with water.

The choise of lube oil is of great importance to the reliable operation of the compressor. The manufactorers have performed extensive tests of lube oils for the oil companies, and the following is a list of lubricants recommended on the basis of these tests.

A list of recommended types of oil is affixed to the compressor on delivery.

| Mineral oil | Syntetic oil |
|---|---|
| BP ENERGOL RC 68 | BP ENERSYN RX 100 |
| CASTROL AIRCOL PD 100 | CASTROL AIRCOL SN 100 |
| CALTEX RPM COMPR. OIL 68 | CHEVRON HD COMPR. OIL 100 |
| ESSO/ EXXON EXXCOLUB 77 | DAPHNE MARINE COMPRESSOR 100 |
| FINA EOLAN AC | ELF PRIMERIA SG 100 |
| GENERAL COMPOL A 100 | ESSO/EXXON ZERICE S 100 |
| MITSUBISHI COMPR. OIL 100 | ESSO/EXXON SYNTESSTIC 68 |
| MOBIL RARUS 427 | MOBIL RARUS 827 |
| NYNÄS COMPR. OIL 68 | NIPPON OIL CO. FAIRCOL SA100 |
| PHILLIPS COMPR. OIL 68 | SHELL CORENA AP 68 |
| SHELL CORENA P 68 | STATOIL COMPWAY S 100 |
| | TEXACO SYN STAR DE 100 |

Further information about lubricants is available on application to the manufacturer.

## *5.4. Bearings*

The compressor has replaceable, two-shell plain big-end and crankshaft bearings. The middle crankshaft bearings serves as an axial guide for the crankshaft.

The gudgeon pin bearings are single shell plain bearings, press-fitted into the little ends. Tolerances and clearances for connecting rod, crankshaft and gudgeon pin bearings are given in Table T.4.

All plain bearings are pressure lubricated.

After inspection or replacement of the big-end bearings it is important to ensure that the bearing does not bind on the crankshaft. It must be possible to turn over the compressor manually.

New two-shell bearings are coated with a running-in compound at the factory.

*Dismantling the gudgeon pin bearing from the connecting rod.*
A. Use a hydraulic press or extractor to remove the old bearing shell.
B. Press in the new bearing shell.
C. Adjust the fit of the bearing to the gudgeon pin in accordance with Table T.4.

## *5.5. Piston and piston rings*

Dismantle the piston as follows:

*LP piston*

A. Remove the cylinder head without dismantling the valves.
B. Remove the big-end bearing bolts and bearings.
C. Withdraw the piston and connecting rod from above.

Assembly sequence is the opposite of the above.

*HP piston*

AA. Remove the big-end bearing bolts and lower bearing shell. Turn over the crankshaft to top dead centre and then back. The upper bearing shell can now be removed.

BB. Turn over the crankshaft to bottom dead centre, then withdraw the piston and connecting rod through the crankcase door.

Assembly sequence is the opposite of the above.

## *5.6. Flexible coupling*

The compressor flywheel serves as one coupling half.

*Dismantle the coupling*

A. Loosen the nuts on each coupling half and give each one a sharp tap with a hammer before removing them completely. This will cause the bolts to loosen from their conical holes in the coupling halves.
B. Remove the bolts and take out the flexible coupling. Avoid spilling oil on the flexible coupling.

The coupling half on the motor is keyed and shrunk on to the axle.

*Alignment*

The prinsiple and values for checking alignment are shown in Fig. 4.

A. Micrometer/dial indicator
B. Magnetic base
C. Flywheel
D. Coupling half, motor
E. Flexible coupling

Check the angle (W) by means of inside micrometer callipers or vernier callipers. The distance (W) in mm should be the same around the whole circumference of the coupling halves.

Check parallel misalignment (A) between coupling halves as shown, around the circumference of the coupling halves (C). Values in mm for maximum parallel misalignment are given in Fig.4.

## *5.7. Coolers*

To ensure reliable operation of the compressor it is important to keep the LP and HP coolers free from deposis of carbon and cooling water salts etc. Insufficient cooling causes excessive air temperature and progressively increases the formation of carbon deposits.

The cooling tubes are roller expanded into tube plates at both ends.

The seals at the cooler ends are O-rings, type OF special quality. Use only manufacturer's spares. To remove the tube bundle, first loosen the cooler covers at both ends. The whole bundle can then be withdrawn by means of two guide rods, pushed through the tubes.

Assemble in opposite sequence.
Instal new seals.

If the cooling tubes show signs of severe corrosions or wear, the complete cooler should be replaced.

## *5.8. Filter*

*The air filter* should be cleaned by means of a good degreasing agent. Blow the filter clean with compressed air and give it a thin coating of compressor oil.

*The oil filter* should be replaced complete. Replacement every 1000 hours running time is recommended.

## *5.9. Cylinder liners*

A special tool is used to remove and install acylinder liners, see sketch F.5.

Before installation, lubricate the outside of the cylinder with a suitable lubricant.

Ensure that the top of the liner is level with the top of the cylinder block.

## *6. TECHNICAL DATA*

**T.1.** *Coolant flows*

| | | |
|---|---|---|
| Shaft speed rpm. | : | 580 - 725 - 875 - 975 |
| Coolant flow l/min. 7-10 bars | : | 25 - 31 - 38 - 41 |
| Pressure drop across compressor (mm.w.c.) | : | 200 - 310 - 520 - 600 |
| Coolant flow l/min. 15-35 bars. | : | 31 - 39 - 47 - 52 |
| Pressure drop across compressor (mm.w.c.) | : | 310 - 540 - 730 - 890 |

**T.2.** *Recommended pressures and temperatures*

| | | |
|---|---|---|
| Recommended minimum inlet temperature Cooling water | : | 30°C |
| Recommended maximum outlet temperature Cooling water | : | 60°C |
| Recommended temperature difference | : | 15-20°C |
| Recommended cooling water pressure | : | 0.5-3.0 bars |
| Recommended lube oil pressure, warm compressor | : | 2.0-0.8 bars |
| Recommended limit switch setting for lube oil pressure/safety stop | : | 0.8 bars |
| Normal working pressure one stage 0-10 bars | : | 1.5-3.5 bars |
| Normal working pressure one stage 10-35 bars | : | 4.0-6.0 bars |
| Maximum working pressure | : | 35 bars |
| Safety valve setting over stage pressure | : | 10% |
| Normal temperature outlet air | : | 30-65°C |

**T.3.** *Torque table*

A - Thread diameter (mm)
B - Key width
C -Torque (kpm), clean and lubricated threads
* - Marker for unbrako screw
** - Marker for BSP threads

| Component | A | B | C |
|---|---|---|---|
| Cylinder head | M20 | 30 | 20 |
| Cooler cover | M16 | 24 | 15 |
| Valve cover HP and LP | M16 | 24 | 15 |
| Valve clamping screw HP and LP | *M20 | 10 | 12 |
| Cap lock nut HP and LP | M20 | 30 | 10 |
| Big end bearing bolts HP and LP | **3/8 | 27 | 10-12 |
| Main bearing studs | M16 | 24 | 12 |
| Bearing housing, crankcase | M12 | 19 | 8 |
| Cylinder block to crankcase | M20 | 30 | 20 |
| Hand hole - Air intake manifold | M12 | 19 | 8 |
| Crankcase covers | M10 | 17 | 4 |

**T.4.** *Clearances*

| | |
|---|---|
| Suction valve LP<br>Lifting height (mm) | 1.2 |
| Pressure valve LP<br>Lifting height (mm) | 1.2 |
| Suction valve HP<br>Lifting height (mm) | 1.0 |
| Pressure valve HP<br>Lifting height (mm) | 1.0 |
| Cylinder/piston<br>clearance LP (mm) | 0.35 |
| Cylinder /piston<br>clearanse HP (mm) | 0.25 |
| Piston/cylinder head<br>clearance LP (mm) | 1.4-1.8 |
| Piston cylinder head<br>clearance HP (mm) | 1.4-1.8 |
| Crankshaft/guide bearing<br>end clearance (mm) | 0.3-0.5 |
| Main bearing/shaft<br>clearance (mm) | 0.10-0.16 |
| Crankshaft bearing<br>play (mm) | 0.10-0.14 |
| Gudgeon pin bearing<br>play (mm) | 0.05-0.06 |

**T.5.** *Piston rings*

| | | Pressure stage LP | HP |
|---|---|---|---|
| Piston illustration (F.6.) | : | B | D |
| Number of compression rings | : | 3 | 5 |
| Number of scraper rings | : | 1 | |
| Number of oil rings | : | 1 | 1 |
| Min. end clearance S (mm) | : | 0.80 | 0.35 |
| Max. end clearance S (mm) | : | 1.05 | 0.55 |
| Wear limit S (mm) | : | 2.05 | 1.55 |

**T.6.** *General data*

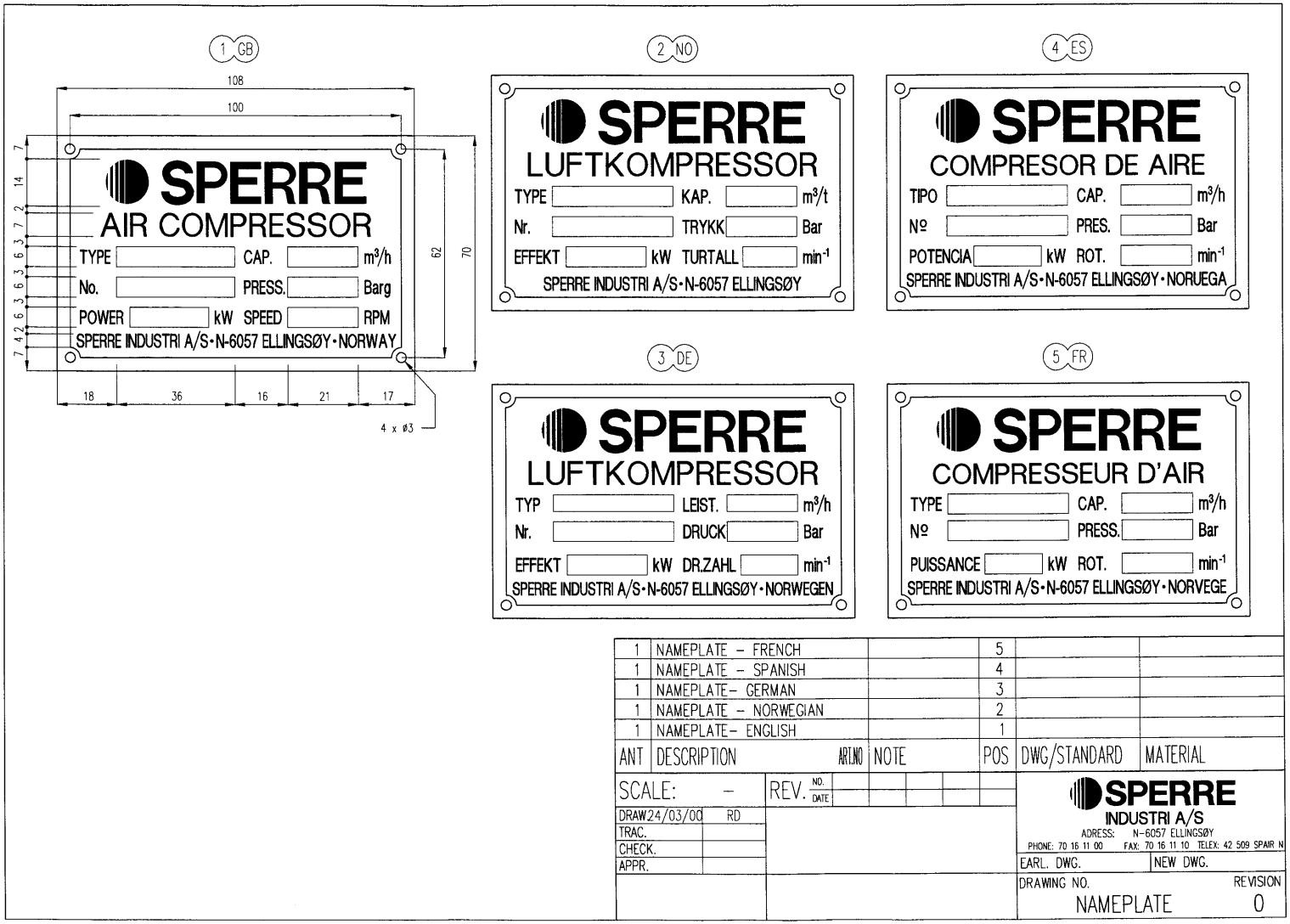
| | | | |
|---|---|---|---|
| Number of cylinders | | : | 2 |
| Cylinder diameter LP | (mm) | : | 220 |
| Cylinder diameter HP | (mm) | : | 97 |
| Stroke | (mm) | : | 140 |
| Crankpin diameter | (mm) | : | 90 |
| Crankshaft diameter at bearing | (mm) | : | 90 |
| Gudgeon pin diameter LP | (mm) | : | 45 |
| Gudgeon pin diameter HP | (mm) | : | 40 |
| Number of valves LP | | : | 2 |
| Number of valves HP | | : | 2 |
| Oil capacity of sump | (litres) | : | 20 |

| *Part No.* | *Description* | *Quantity* |
|---|---|---|
| 1040 | Crankcase cover | 1 |
| 1042 | Crankcase cover, dipstick side | 1 |
| 1064 | Bearing housing, flywheel side | 1 |
| 1068 | Bearing housing, dipstick side | 1 |
| 1078 | Flywheel | 1 |
| 1115 | Cylinder block | 1 |
| 1155 | Main bearing shell cups | 3 |
| 1165 | Bearing shell cups, pair | 4 |
| 1179 | Cooler cover | 1 |
| 1181 | Cooler cover | 1 |
| 1183 | Cooler cover | 1 |
| 1185 | Cooler cover | 1 |
| 1239 | Frame, bursting plate | 1 |
| 1257 | Cylinder head | 1 |
| 1299 | Filter union | 1 |
| 1319 | Valve cover, HP | 2 |
| 1324 | Valve cover, LP suction side | 1 |
| 1325 | Valve cover, LP delivery side | 1 |
| 1332 | Flywheel nut | 1 |
| 1382 | Coupling flange | 1 |
| 1392 | Safety valve seat | 2 |
| 1418 | Connecting rod LP | 1 |
| 1420 | Connecting rod HP | 1 |
| 1440 | Cylinder handhole cover | 1 |
| 1441 | Thermometer union | 2 |
| 1472 | Clamping piece, HP delivery valve | 2 |
| 1478 | Clamping piece, LP suction valve | 1 |
| 1479 | Clamping piece, LP delivery valve | 1 |
| 1522 | Counterweight | 4 |
| 1960 | Cylinder liner | 1 |
| 1970 | Cylinder liner | 1 |
| 2014 | Crankshaft | 1 |
| 3022 | Suction valve, HP complete | 1 |
| 3023 | Delivery valve, HP complete | 1 |
| 3027 | Suction valve, LP complete | 1 |
| 3028 | Delivery valve, LP complete | 1 |
| 3044 | Valve gripper, LP complete | 1 |
| 3071 | Valve seat, HP suction | 1 |
| 3072 | Valve seat, HP delivery | 1 |
| 3075 | Valve seat, LP suction | 1 |
| 3076 | Valve seat, LP delivery | 1 |
| 3087 | Valve spring plate, HP | 2 |
| 3089 | Valve spring plate, LP | 2 |
| 3109 | Valve plate, HP valve | 2 |
| 3111 | Valve plate, LP valve | 2 |
| 3135 | Valve washer | 3 |
| 3145 | Fixing pin | 4 |
| 3146 | Fixing pin | 4 |
| 3167 | Valve catcher, HP suction | 1 |
| 3168 | Valve catcher, HP delivery | 1 |
| 3171 | Valve catcher, LP suction | 1 |
| 3172 | Valve catcher, LP delivery | 1 |
| 3185 | Valve spacer ring | 2 |
| 3186 | Valve spacer ring | 4 |
| 3187 | Valve spacer ring | 1 |
| 3213 | Valve bolt, HP suction | 1 |
| 3214 | Valve bolt, HP/LP delivery | 2 |
| 3218 | Valve bolt, LP suction | 1 |
| 3238 | Valve nut | 4 |

| *Part No.* | *Description* | *Quantity* |
|---|---|---|
| 3245 | Valve unloader, complete | 1 |
| 3265 | Valve spring, HP suction/delivery | 6 |
| 3268 | Valve spring, LP suction/delivery | 6 |
| 3304 | Unloader cover | 1 |
| 3311 | Unloader cylinder | 1 |
| 3319 | Unloader piston | 1 |
| 3331 | Big-end bearing bolt | 4 |
| 3336 | Big-end bearing nut | 4 |
| 3340 | Big-end bearing split pin | 4 |
| 3394 | Piston | 1 |
| 3402 | Piston | 1 |
| 3446 | Connector, pump | 1 |
| 3466 | Gudgeon pin | 1 |
| 3469 | Gudgeon pin | 1 |
| 3484 | Oil scraper ring | 1 |
| 3506 | Compression ring | 5 |
| 3520 | Compression ring | 4 |
| 3534 | Oil ring | 1 |
| 3545 | Oil ring | 1 |
| 3554 | Safety valve seat | 2 |
| 3577 | Ball, oil pump | 1 |
| 3583 | Valve spring/lube oil pump | 1 |
| 3587 | Valve spring/HP safety valve | 1 |
| 3588 | Valve spring/LP safety valve | 1 |
| 3606 | Adjusting screw for oil pump | 1 |
| 3634 | Level gauge glass | 1 |
| 3643 | Pressure gauge board | 1 |
| 3655 | Cooler unit, complete | 2 |
| 3678 | Key | 1 |
| 3696 | Cap nut, clamping screw | 3 |
| 3697 | Cap nut, clamping screw | 1 |
| 3700 | Breaher valve | 1 |
| 3714 | Air filter | 1 |
| 3716 | Air outlet flange collar | 1 |
| 3722 | Oil strainer | 1 |
| 3728 | Oil strainer mesh | 1 |
| 3731 | Oil strainer holder | 1 |
| 3741 | Clamping screw | 2 |
| 3742 | Clamping screw | 1 |
| 3746 | Dipstick | 1 |
| 3770 | Pressure gauge, C.W./lube oil | 2 |
| 3771 | Pressure gauge, LP | 1 |
| 3773 | Pressure gauge, HP | 1 |
| 3775 | Spacer tube | 2 |
| 3781 | Thermometer | 1 |
| 3786 | Spacer ring | 2 |
| 3810 | Seeger ring | 2 |
| 3811 | Seeger ring | 2 |
| 3823 | Gudgeon pin bearing | 1 |
| 3824 | Gudgeon pin bearing | 1 |
| 3832 | Big-end bearing shell, pair | 4 |
| 3841 | Ball valve | 2 |
| 3852 | Sealing ring | 1 |
| 3862 | Sealing ring | 1 |
| 3909 | Valve gasket | 2 |
| 3911 | Valve gasket | 2 |
| 3923 | Main bearing end | 4 |
| 3924 | Main bearing guide | 2 |
| 3925 | Copper washer | 4 |
| 3927 | Copper washer | 9 |

| *Part No.* | *Description* | *Quantity* |
|---|---|---|
| 3928 | Copper washer | 4 |
| 3929 | Copper washer | 19 |
| 3930 | Copper washer | 8 |
| 3932 | Copper washer | 2 |
| 3933 | Copper washer | 2 |
| 3934 | Copper ring | 2 |
| 3937 | Lock washer | 4 |
| 3938 | Lock washer | 2 |
| 3944 | Screw | 2 |
| 3946 | Screw | 4 |
| 3960 | Bursting plate | 1 |
| 3966 | Internal lube oil tubes, set | 1 |
| 3975 | O-ring | 4 |
| 3979 | O-ring | 1 |
| 3997 | Gasket | 1 |
| 4040 | Gasket, crankcase/cylinder | 2 |
| 4043 | Gasket, crankcase cover | 2 |
| 4044 | Gasket, bearing housing | 1 |
| 4045 | Gasket,bearing housing,flywheel side | 1 |
| 4053 | Gasket, air outlet | 1 |
| 4058 | Gasket, LP valve cover | 2 |
| 4059 | Gasket, lube oil pump | 1 |
| 4060 | Gasket, LP valve cover | 2 |
| 4062 | Gasket, cooler cover | 3 |
| 4068 | Gasket, bursting plate | 4 |
| 4090 | Gasket, air filter duct | 1 |
| 4132 | Backnut | 1 |
| 4142 | T-joint | 1 |
| 4189 | Stud | 20 |
| 4192 | Stud | 37 |
| 4193 | Stud | 4 |
| 4206 | Stud | 6 |
| 4207 | Stud | 4 |
| 4208 | Stud | 16 |
| 4210 | Stud | 36 |
| 4215 | Stud | 8 |
| 4220 | Stud | 14 |
| 4237 | Nut | 20 |
| 4238 | Nut | 38 |
| 4240 | Nut | 56 |
| 4242 | Nut | 14 |
| 4254 | Locknut | 6 |
| 4257 | Locknut | 8 |
| 4261 | Set screw | 8 |
| 4269 | Nipple | 1 |
| 4271 | Nipple | 4 |
| 4274 | Nipple | 2 |
| 4275 | Nipple | 1 |
| 4276 | Nipple | 1 |
| 4280 | Nipple | 1 |
| 4282 | Reduction nipple | 1 |
| 4294 | Plug | 3 |
| 4296 | Plug | 9 |
| 4297 | Plug | 1 |
| 4298 | Plug | 1 |
| 4360 | Pressure gauge tube | 2 |
| 4365 | Pressure gauge tube | 1 |
| 4368 | Pressure gauge tube | 1 |
| 4392 | Lube oil ube | 1 |
| 4393 | Lube oil tube | 1 |
| 4403 | Screw | 1 |
| 4406 | Screw | 2 |
| 4414 | Washer | 2 |
| 4419 | Locking tube for bearing shell | 2 |
| 4428 | Safety valve, HP | 1 |
| 4429 | Safety valve, LP | 1 |
| 4441 | Lube oil pump | 1 |
| 4446 | Set screw | 1 |
| 4447 | Set screw | 1 |
| 4450 | Bolt, counterweight | 8 |
| 4452 | Connecting nipple | 2 |
| 4473 | T-joint | 2 |
| 4487 | Coupling bolt | 6 |
| 4524 | Coupling washer | 1 |
| 4674 | Screw | 1 |

**Fig. 1**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62
70
18
36
16
21
17
4 x Ø3
2 NO
SPERRE
LUFTKOMPRESSOR
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Nr. TRYKK Bar
EFFEKT kW TURTALL min⁻¹
SPERRE INDUSTRI A/S·N-6057 ELLINGSØY
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TIPO CAP. m³/h
Nº PRES. Bar
POTENCIA kW ROT. min⁻¹
SPERRE INDUSTRI A/S·N-6057 ELLINGSØY·NORUEGA
3 DE
SPERRE
LUFTKOMPRESSOR
TYP LEIST. m³/h
Nr. DRUCK Bar
EFFEKT kW DR.ZAHL min⁻¹
SPERRE INDUSTRI A/S·N-6057 ELLINGSØY·NORWEGEN
5 FR
SPERRE
COMPRESSEUR D'AIR
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Nº PRESS. Bar
PUISSANCE kW ROT. min⁻¹
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1 NAMEPLATE – SPANISH 4
1 NAMEPLATE– GERMAN 3
1 NAMEPLATE – NORWEGIAN 2
1 NAMEPLATE– ENGLISH 1
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SCALE: – REV. NO. DATE
DRAW 24/03/00 RD
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CHECK.
APPR.
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ADRESS: N-6057 ELLINGSØY
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**Fig. 2**

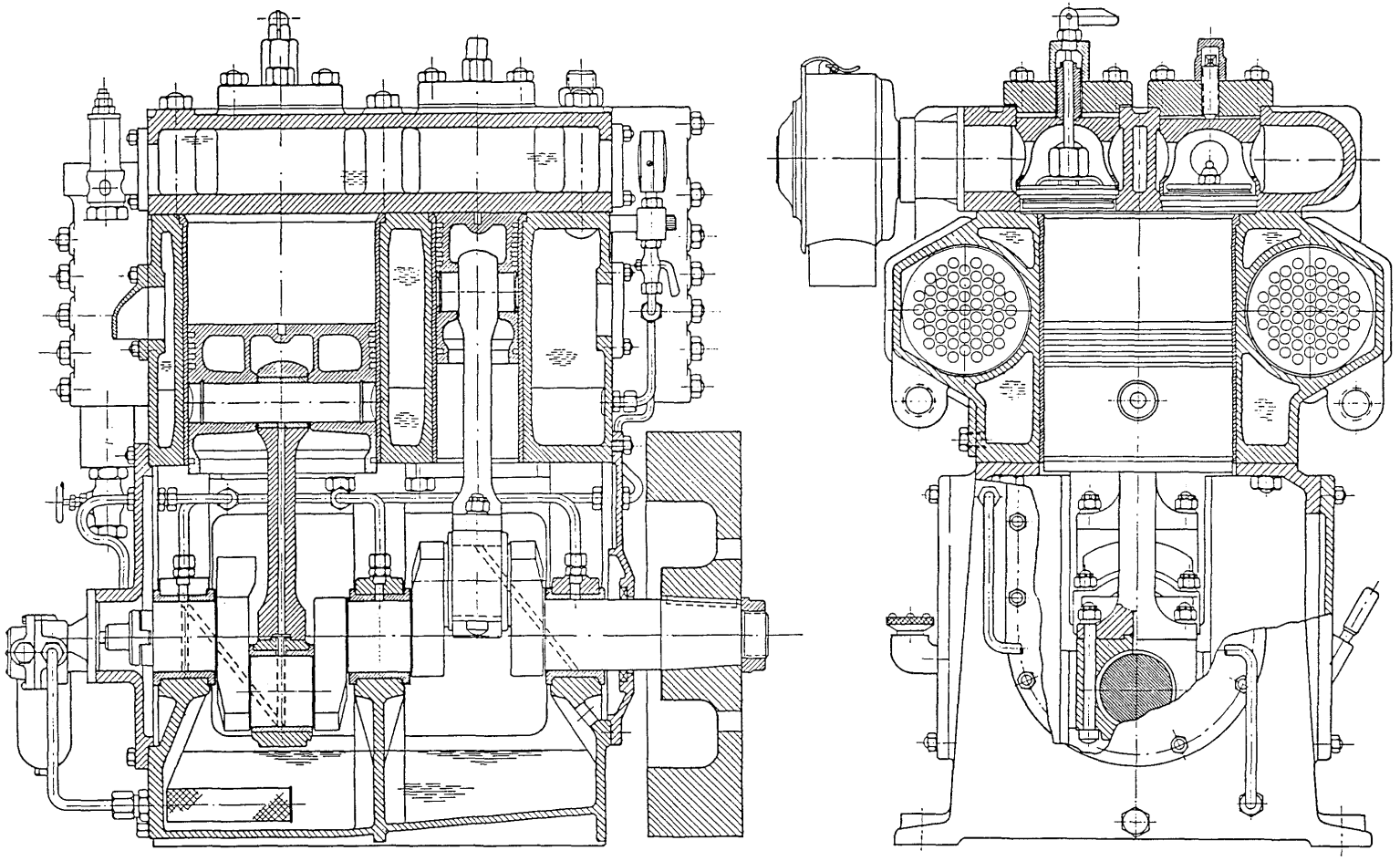


FIG. 3

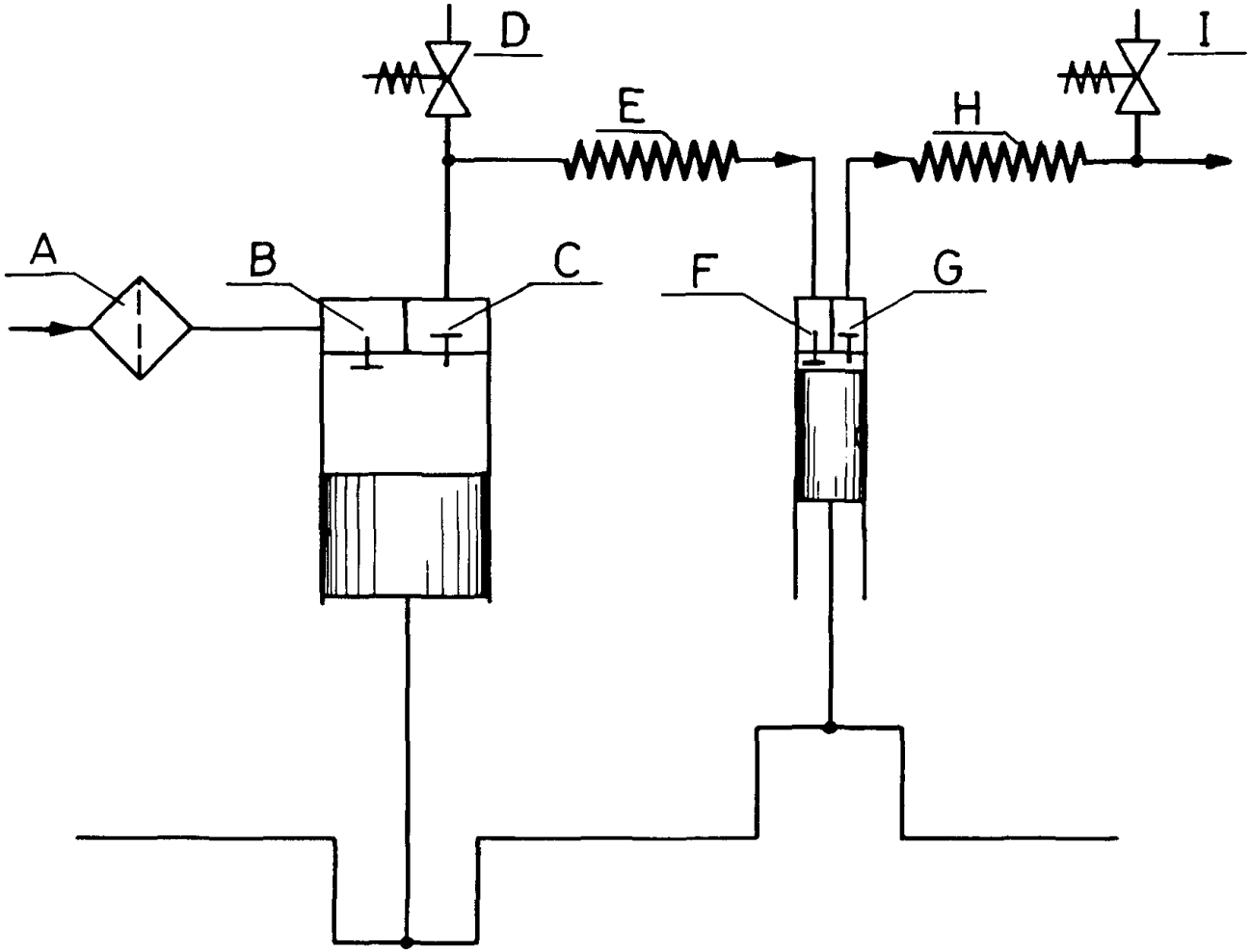


**Fig. 4**

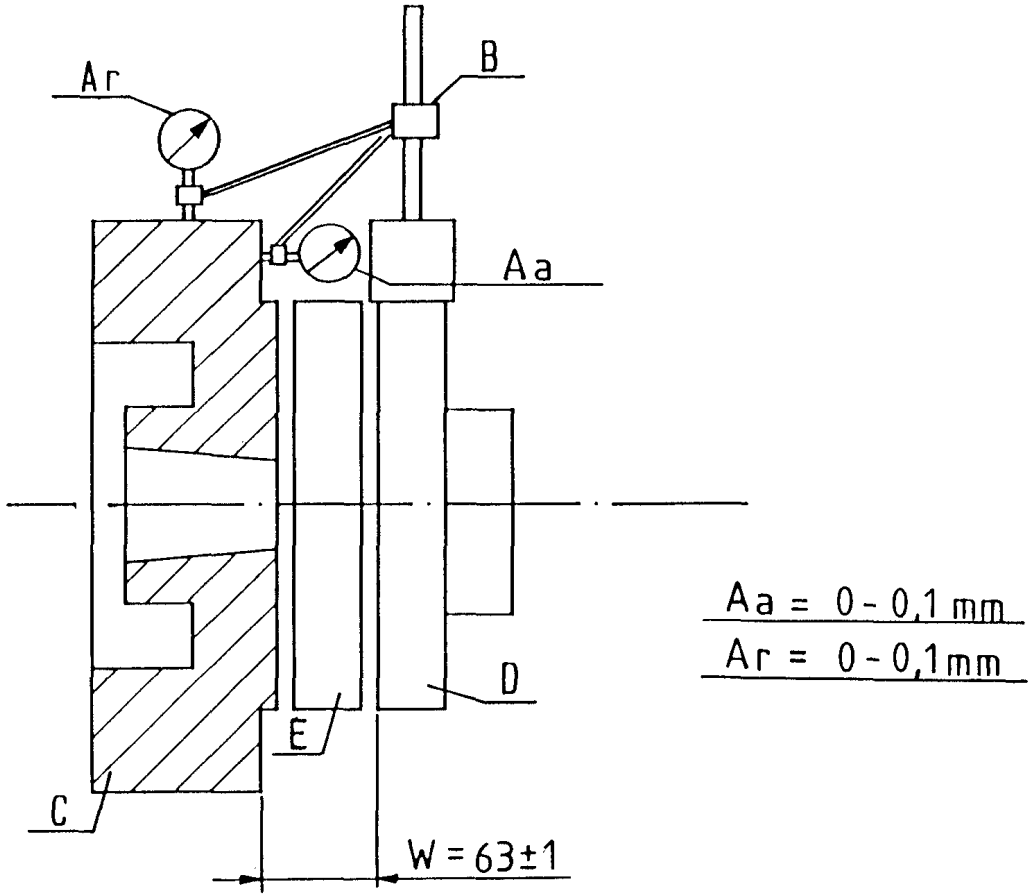


FIG. 5

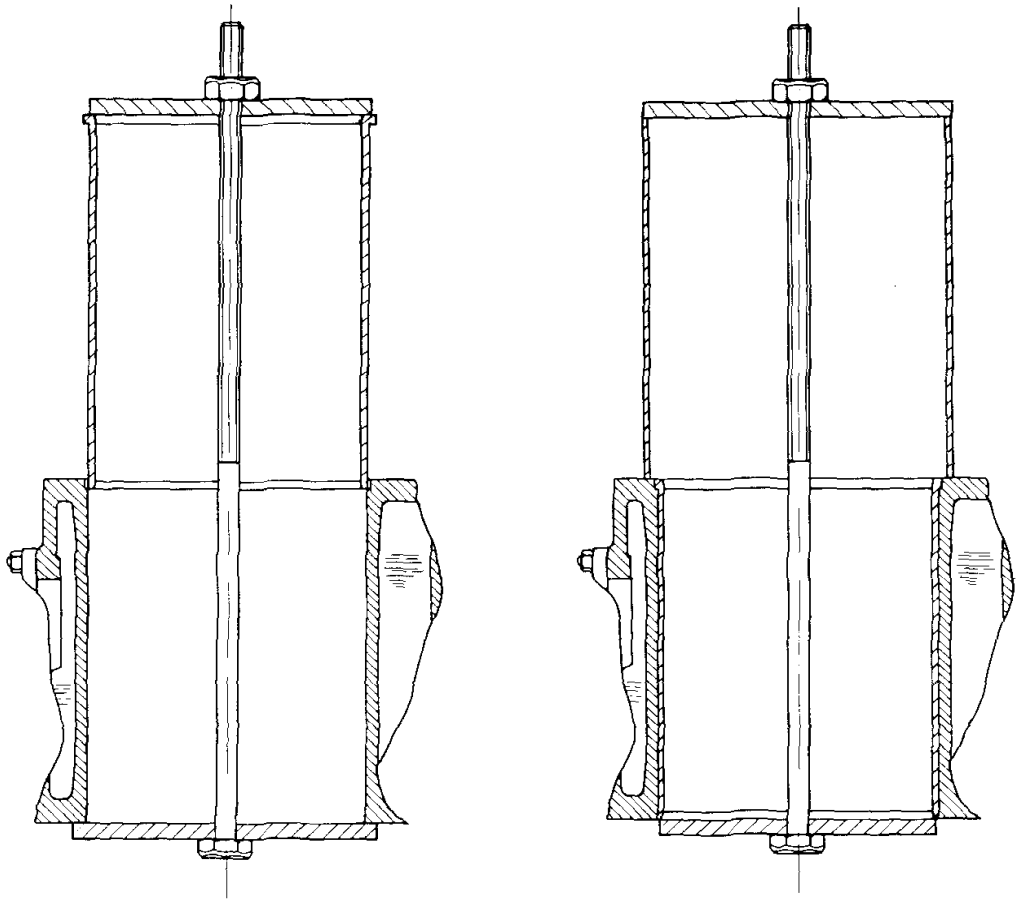
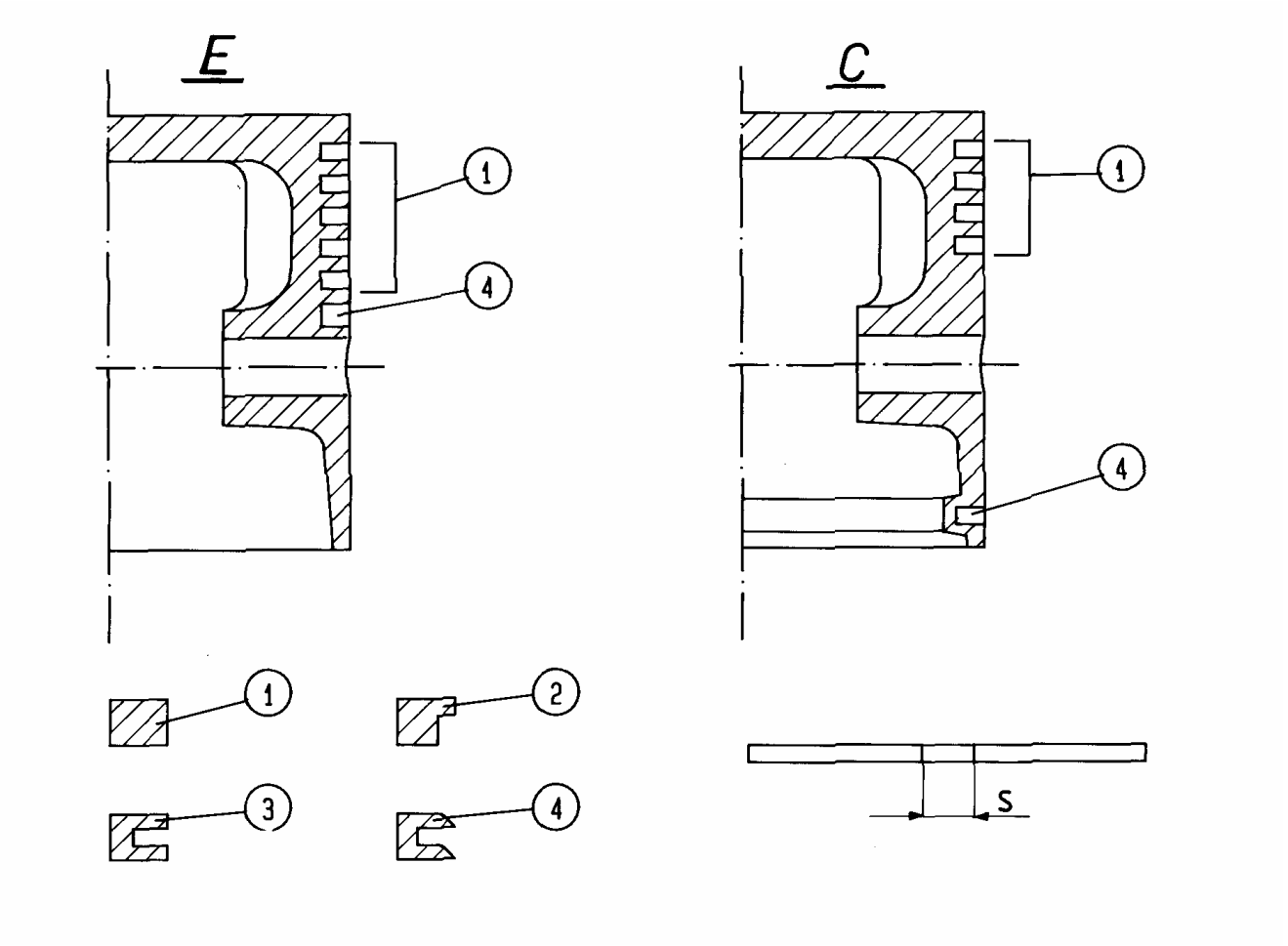
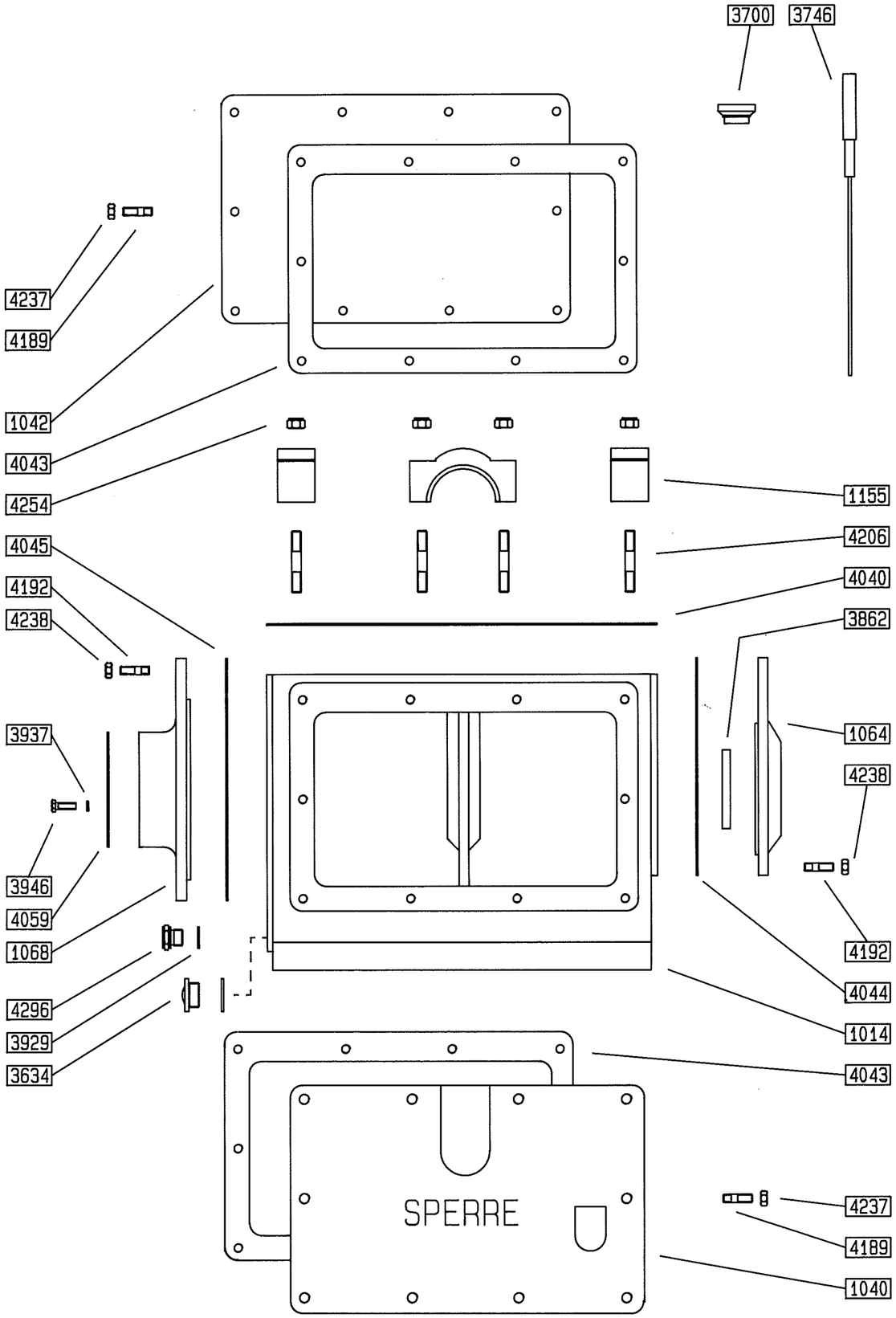


**Fig. 6**

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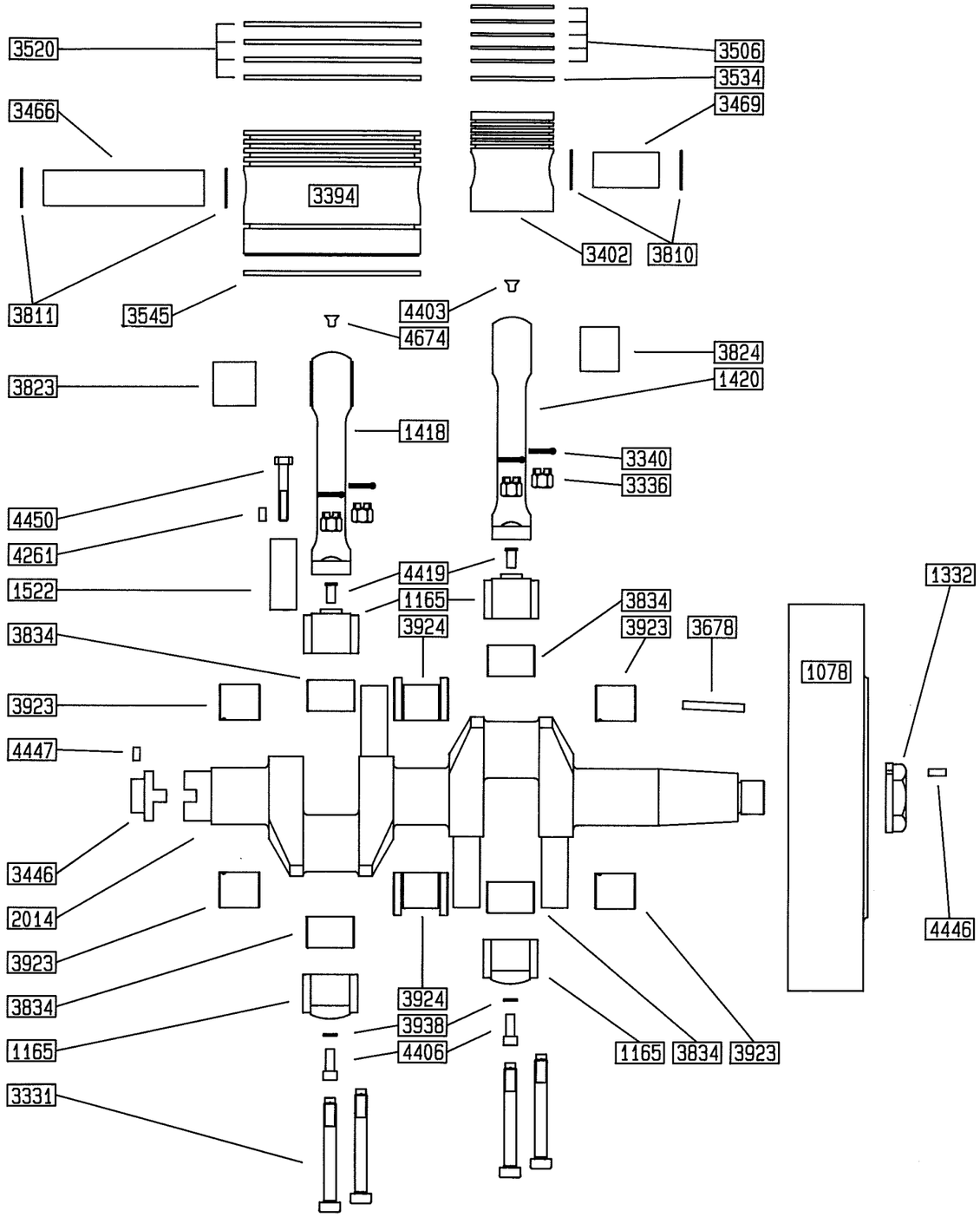
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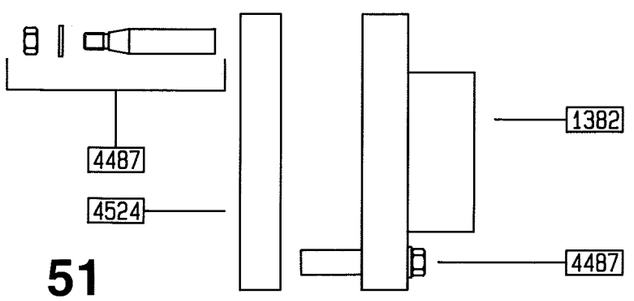
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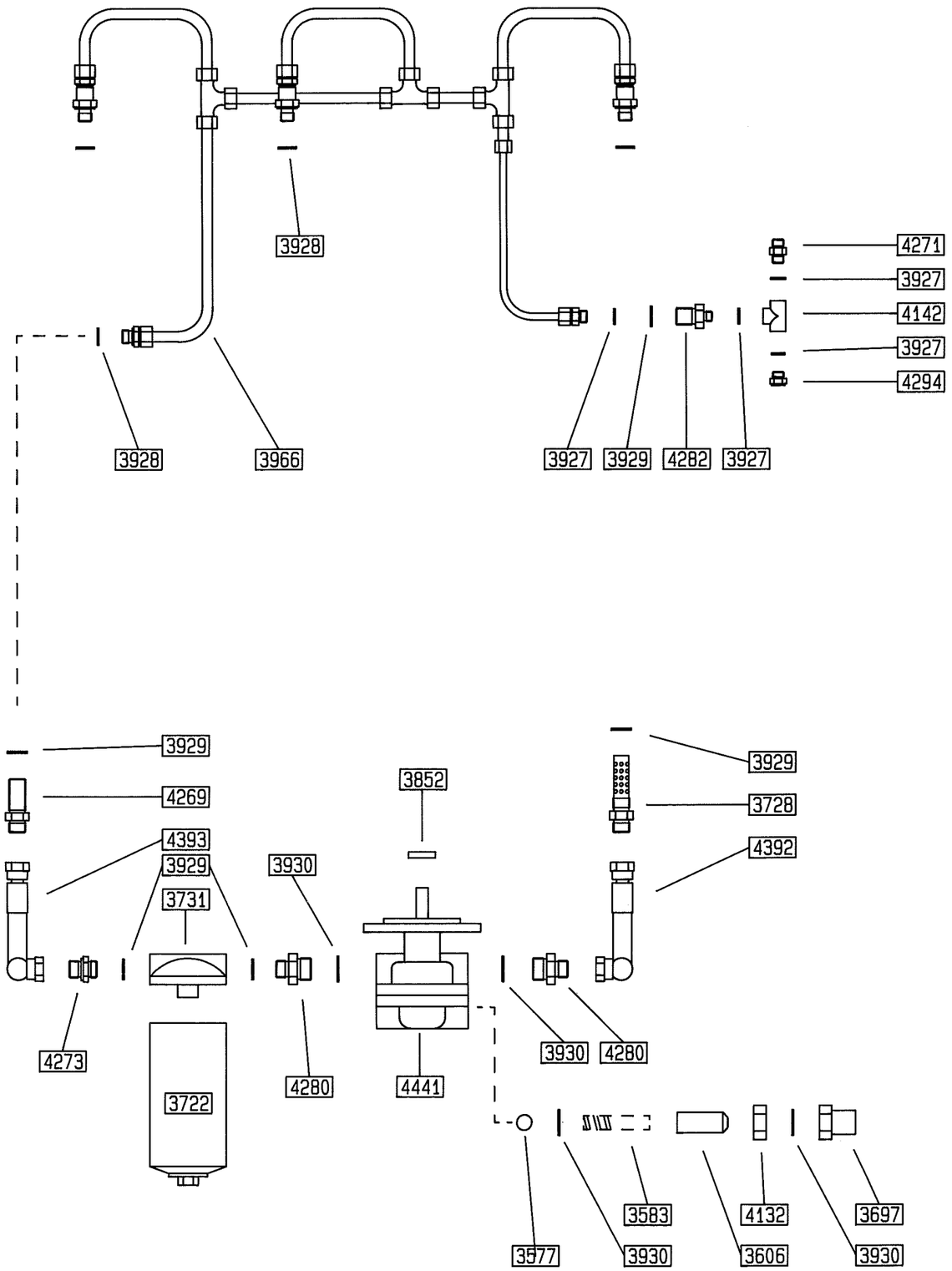
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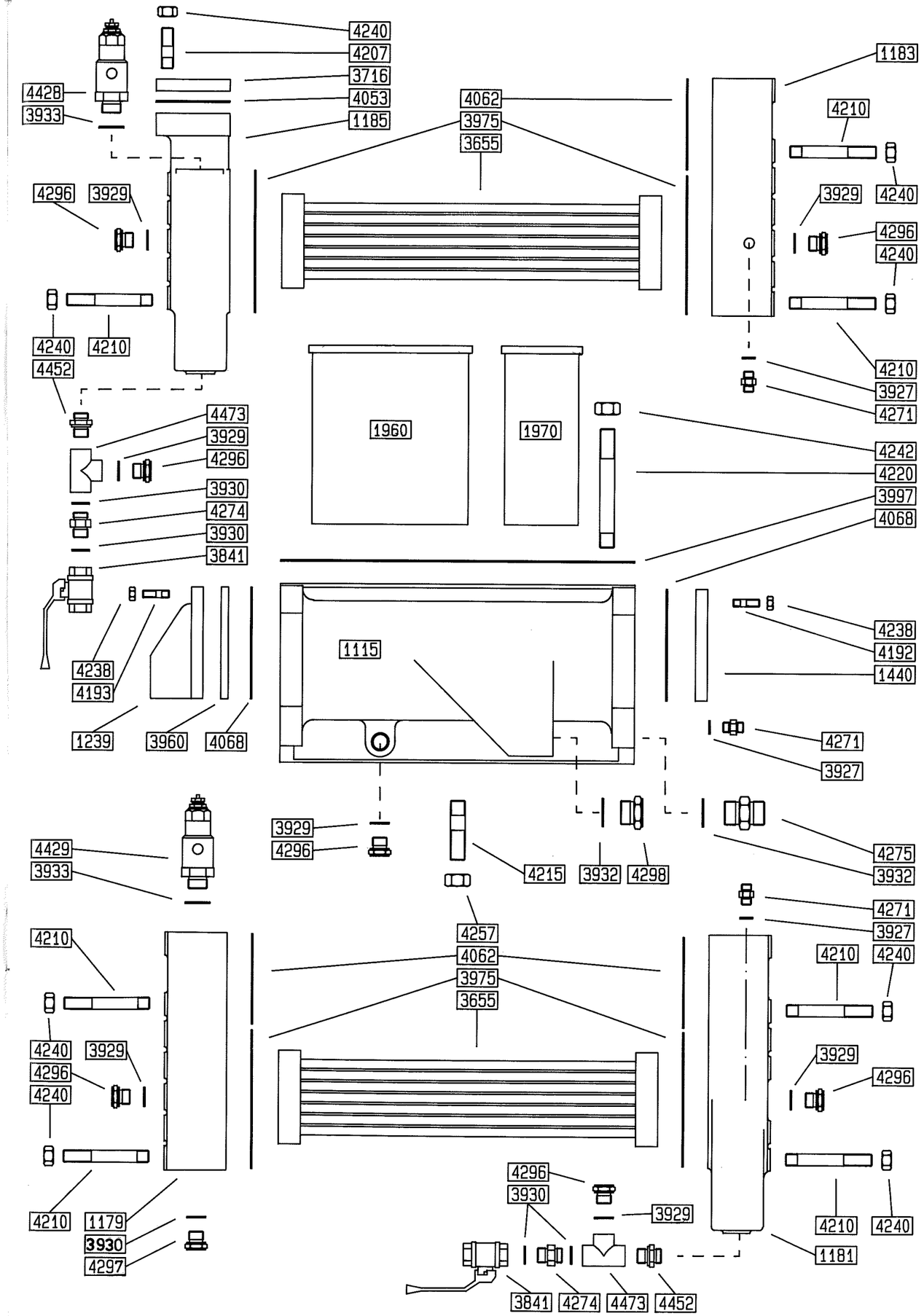
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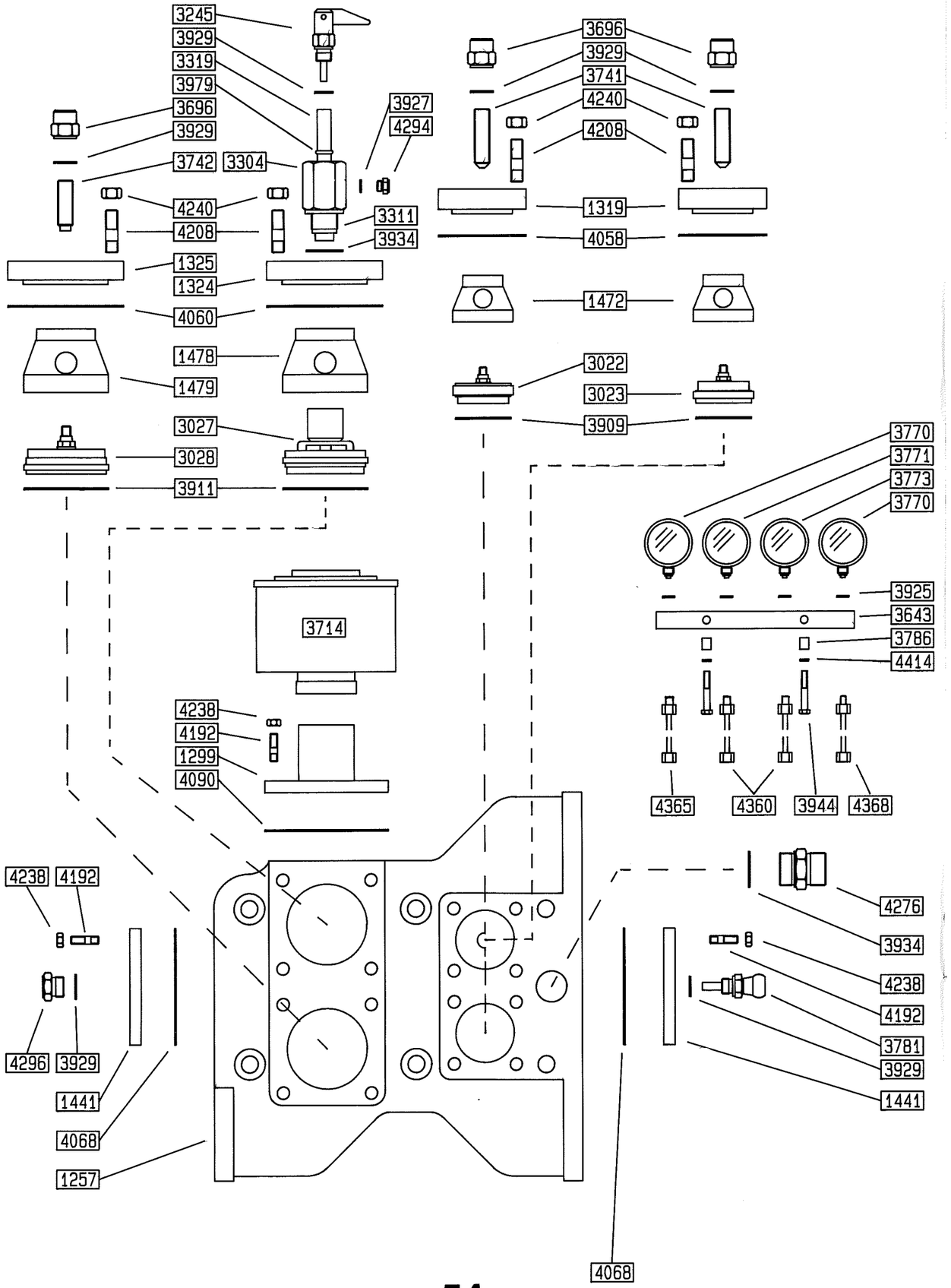
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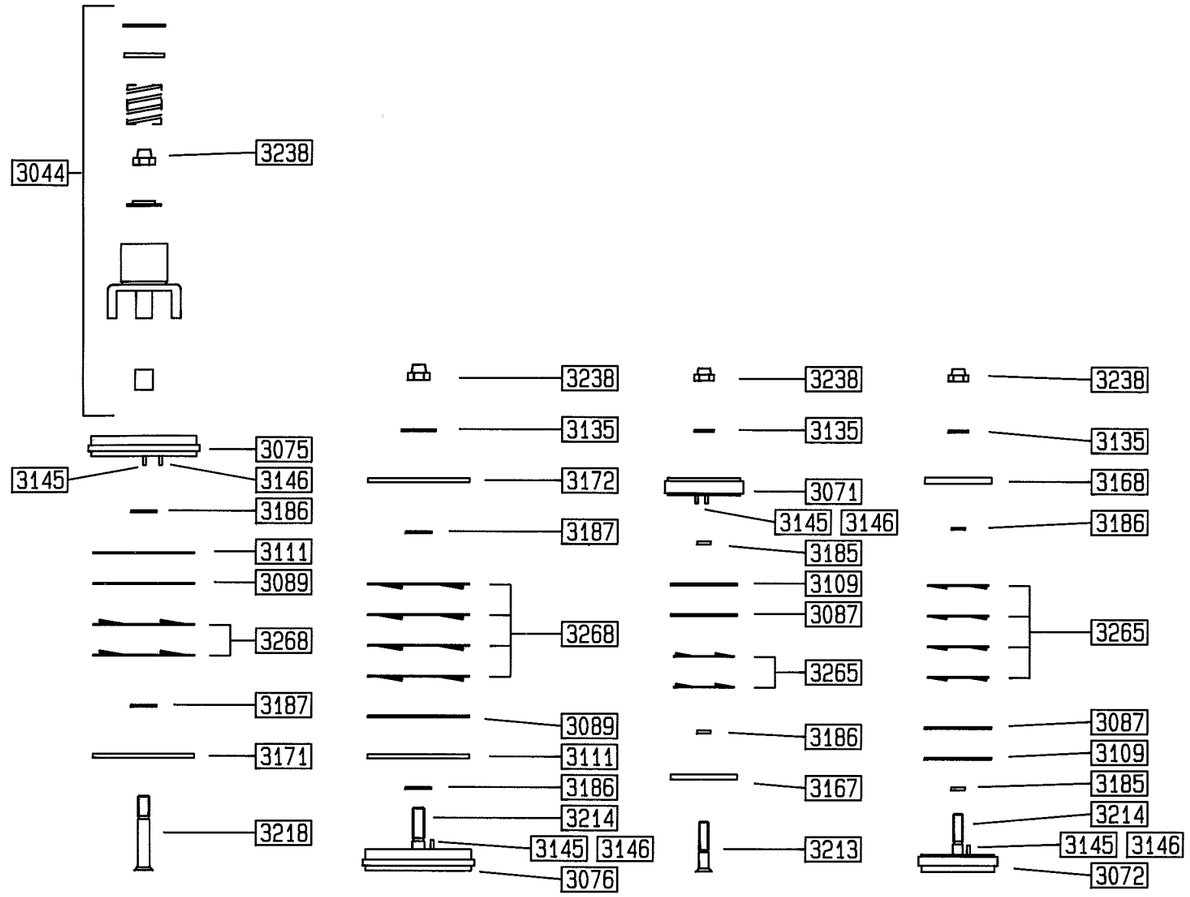
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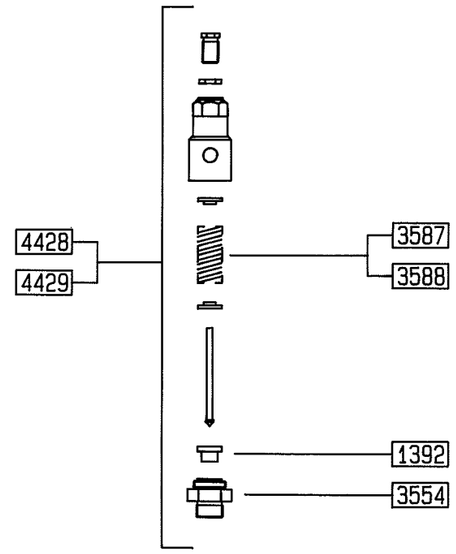
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