LIEBHERR

CARGO DECK CRANE

VOLUME 2

TECHNICAL INFORMATION

TYPE

CBW 45(40)32/20(24,4)27,5 ST

ORDER – NO.

162 211

Subject to alteration!
1st Edition: 03.05.2002 /ab

LIEBHERR–WERK–NENZING GMBH, P.O.Box 10, A–6710 Nenzing / Austria / Europe
Phone (05525) 606–0, Telex 052141 lwn a, Telefax (05525) 606–200

FOREWORD

This **DOCUMENTATION** has been prepared to allow the safe operation of the LIEBHERR crane while utilizing the crane's full range of operating possibilities. In addition, the manual emphasizes the daily routine maintenance and informs the operator of the operating principles of important assemblies and systems.

VOLUME 1 – INSTRUCTION / MAINTENANCE MANUAL

VOLUME 2 – TECHNICAL INFORMATION

VOLUME 3 – SPARE PARTS LIST

The **DOCUMENTATION** is prepared for extended service–, repair– and maintenance work as well as ordering spare parts. This manual shall be used by trained Service–personnel only.

This LIEBHERR crane shall be operated and serviced by from LIEBHERR–WERK NENZING trained or authorized personnel only.

The procedures described in the DOCUMENTATION and general safety precautions shall be observed at all times.

NON–OBSERVANCE OF THESE RULES CAN RESULT IN PERSONAL INJURY AND STRUCTURAL DAMAGE.

Special attention shall be given to the safety devices built–in to the crane. They shall be tested at regular intervals for good condition and proper operation. Crane operation is prohibited if the safety devices are not working properly.

"SAFETY ALWAYS COMES FIRST"

must be the way of thinking and behaviour before, during and after crane operation.

If you receive any further information for the crane, such as technical modifications or changes concerning operation, maintenance, or spare parts – please attach them to provided volumes.

INDEX – VOLUME 2

4. TECHNICAL DESCRIPTION 4.5

4.1. TECHNICAL DATA 4.5
4.2. TECHNICAL DESCRIPTION – ELECTRIC 4.7

5. DESCRIPTION OF HYDRAULIC FUNCTIONS 5.3

5.1. GENERAL 5.3
5.2. DESCRIPTION OF THE MAIN HYDRAULIC COMPONENTS 5.5
5.3. EXPLANATION OF HYDRAULIC CONTROL SYSTEM 5.13

6. EMERGENCY OPERATIONS 6.3

6.1. INSTRUCTIONS FOR EMERGENCY HAND PUMP 6.3
6.2. PROCEDURE TO “LOWER THE LOAD” FOR HOIST GEAR 6.4
6.3. PROCEDURE TO LOWER THE JIB 6.5
6.4. PROCEDURE TO RELEASE THE SLEWING BRAKES 6.7

7. DRAWINGS

INDEX

4. TECHNICAL DESCRIPTION 4.5

4.1. TECHNICAL DATA 4.5

4.1.1. GENERAL DATA 4.5
4.1.2. WORKING SPEEDS 4.5
4.1.3. SLEWING RANGE 4.5

4.2. TECHNICAL DESCRIPTION – ELECTRIC 4.7

4.2.1. POWER SUPPLY 4.7
4.2.2. INSTALLED POWER RATINGS 4.7
4.2.3. SWITCH CABINET X1 ..... 4.8
4.2.4. OPERATION OF MAIN BREAKER 4.8
4.2.5. EMERGENCY STOP FUNCTION 4.8
4.2.6. OPERATION OF MAIN MOTOR (HYDRAULIC DRIVE) 4.8
4.2.7. VENTILATION AND HEATING 4.9
4.2.8. MAINTENANCE 4.9

4. TECHNICAL DESCRIPTION

4.1. TECHNICAL DATA

4.1.1. GENERAL DATA

PERMISSIBLE CAPACITIES:

45 metric tonnes SWL from 4 m to 20 m working radius

40 metric tonnes SWL from 4 m to 24,4 m working radius

32 metric tonnes SWL from 4 m to 27,5 m working radius

WORKING RANGE:

Maximum radius:	27,5 m
Minimum radius:	4 m
Maximal lifting height:	60 m

PERMISSIBLE HEELING:	5˚
PERMISSIBLE TRIM:	2˚

WEIGHT OF CRANE:	approx. 42,9 to

AMBIENT TEMPERATURE:	−25˚C − +45˚C
DESIGN TEMPERATURE:	− 10 ˚C

4.1.2. WORKING SPEEDS

− HOISTING:

Infinitely variable with automatic power regulator:

0 − 17 m/min with 45 metric tonnes

0 − 20 m/min with 40 metric tonnes

0 − 33 m/min with empty hook

− LUFFING:

Infinitely variable speed:

Luffing from min. to max. working radius: 75 sec. with full load

− SLEWING:

Infinitely variable speed: 0 − 0,75 rev/min with full load

4.1.3. SLEWING RANGE

360˚ unlimited and unrestricted.

NOTE:

The mentioned speed values are only theoretical values and may differ in case of different effiency degrees. They are only valid at operation of **one system at the time.**

4.2. TECHNICAL DESCRIPTION – ELECTRIC

4.2.1. POWER SUPPLY

MAIN SUPPLY:	3 x 440 V, 60 Hz, S_{max} appr. 280 kVA
AUXILLIARY SUPPLY:	3 x 220 V, 60 Hz, P_{max} appr. 6 kW

4.2.2. INSTALLED POWER RATINGS

MAIN MOTOR

Voltage	3 x440 V
Nominal power	appr. 220 kW

OIL COOLER

Voltage	3 x440 V
Nominal power	appr. 3,6 kW

SWITCH CABINET HEATING (X1)

Voltage	220 V
Nominal power	appr. 45 W

STANDSTILL HEATING MAIN MOTOR

Voltage	220 V
Nominal power	appr. 100 W

STANDSTILL HEATING SLIPRING COLLECTOR

Voltage	220 V
Nominal power	90 W

HEATING CABIN

Voltage	220 V
Nominal power	2000 W

HEATING OIL TANK

Voltage	220 V
Nominal power	700 W

FLOOD LIGHT JIB

Voltage	220 V
Nominal power	1 x 1000 W

FLOOD LIGHT SLEEWING COLUMN

Voltage	220 V
Nominal power	1 x 1000 W

CRANE LIGHTS

Voltage	220 V
Nominal power	3 x 60 W

CABIN LIGHT

Voltage	220 V
Nominal power	1 x 60 W

4.2.3. SWITCH CABINET X1

Houses all control elements for crane control, lighting and heating system.

Following components are mounted at the front door of the switch cabine:

−manual operated main switch **X1−Q01**

−main switch for lighting and heating **X1−S02**

−hour counter **X1−P01** (counting the hours run by the hydr. pump, for service purpose)

−emergency stop switch **X1−S01**

4.2.4. OPERATION OF MAIN BREAKER

MAIN BREAKER "ON"

The main breaker must be switched on manually at the front door of the switch cabinet X1. The pilot light "crane on" (at the switch unit X20) illuminates

Preconditions:

−Power supply 3 x 440 V present from ship

−All emergency stop buttons released

MAIN BREAKER "OFF"

For disconnection of the power of the crane (maintenance purpose) turn off main breaker manually by pressing the "crane off" button (at the switch unit X20).

4.2.5. EMERGENCY STOP FUNCTION

If one of the emergency stop buttons is pressed the main contactors **X1−K03, X1−K04** de−energize and the main motor stops. All brakes close immediately, because of the pressure loss in the brake lines. These buttons should be used:

−For shutting down the crane in an emergency case

Emergency push buttons are located:

−At the switch unit X20

−At the switch cabinet door X1

−At the ascent ladder

4.2.6. OPERATION OF MAIN MOTOR (HYDRAULIC DRIVE)

4.2.6.1. MAIN MOTOR START

− Unlock all "EMERGENCY STOP" buttons
− Switch on the main switch **X1−Q01** manually on switch cabinet X1
− Check if pilot light "CRANE ON" is on
− All joy sticks have to be in neutral position
− Press push button "MOTOR ON"
− Check if inserted pilot light "MOTOR ON" comes on after a view seconds (run up time of main motor).

The main drive fails to start, if:

− the main switch is "OFF" (EMERGENCY STOP)
− the overcurrent relay for the main motor has tripped
− the PTC protection (overheat protection) of the main motor has tripped
− the hydraulic oil level is too low

The operating hours counter − on switch cabinet X1 − for the main electric motor records the number of hours run by the hydraulic pump assembly. This data output is used to determine maintenance intervals.

4.2.6.2. MAIN MOTOR OFF

MANUAL SHUT DOWN:

– make sure all motions of the crane are stopped (all joy sticks in neutral position)
– press push button ”MOTOR OFF”
– the main motor stops. The control circuit is interrupted and the multi disc brakes are applied immediately
– if required press push button ”CRANE OFF” to shut down the main breaker **X1–Q01**

AUTOMATIC SHUT DOWN:

In the following cases the main motor is automatically shut down and all brakes apply immediately:

– the overcurrent relays for the main motor has tripped
– the PTC protection (overheat protection) of the main motor has tripped
– the hydraulic oil level is too low

EMERGENCY SHUT DOWN:

– Press one of the ”EMERGENCY STOP BUTTONS”. See section ”EMERGENCY STOP FUNCTION”

4.2.7. VENTILATION AND HEATING

The electr. operated ventilator for oil cooling also circulates the air in the slewing column.

SWITCH CABINET HEATING
Preheats the switch cabinet at low outside temperatures and thus to prevent condensation.

THE HEATING
Inside the slewing column keep the hydraulic oil warm. Temperature control is done by a 20˚room thermostat.

4.2.8. MAINTENANCE

Following maintenance works must be carried out:

–The filters on the switch cabinet fan should be renewed or cleaned approximately every 3000 working hours

–All terminal screws in the switch cabinets, terminal boxes and on the equipment itself, should be checked once a year and tightened if loose.

–In addition, all safety and emergency stop switches should be checked regularly (see ”MAINTENANCE LIST”)

–Check and if necessary clean slip ring collector from carbon particles

–Check condition of brush carbons and grease bearings of slip ring collector if grease nippels are provided.

WARNING
Before opening any electric equipment, it is essential to switch of the power supplies from ship !

INDEX

5. DESCRIPTION OF HYDRAULIC FUNCTIONS 5.3

5.1. GENERAL 5.3

5.2. DESCRIPTION OF THE MAIN HYDRAULIC COMPONENTS 5.5

5.2.1. THE VARIABLE SWASH PLATE PUMP TYPE A11VO LRDS 5.5
5.2.2. CONTROL BLOCK TYPE LUDV 5.7
5.2.3. SLEWING SAFETY BLOCK VALVE 5.9
5.2.4. LOWERING BRAKE VALVE 5.10
5.3.5. HYDRAULIC OPERATED JOYSTICK TYPE TH6 ..... 5.11

5.3. EXPLANATION OF HYDRAULIC CONTROL SYSTEM 5.13

5.3.1. GENERAL 5.13
5.3.2. FUNCTION OF THE LUDV–CONTROL SYSTEM 5.13
5.3.3. FUNCTION OF HYDR. CONTROL SYSTEM (LUDV) WITH ONE USER 5.13
5.3.4. FUNCTION OF HYDR. CONTROL SYSTEM (LUDV) WITH TWO USERS 5.13

5. DESCRIPTION OF HYDRAULIC FUNCTIONS

5.1. GENERAL

NOTE:

ALL HYDRAULIC DRAWINGS NEEDED FOR THE HYDRAULIC SYSTEM ARE FOUND IN SECTION "DRAWINGS".

The numbers quoted in the description of electrical assemblies and hydraulic equipment are identical with those, which appear in the hydraulic circuit diagram, electric diagram, illustrations and oil pressure table.

All items in brackets ( ) are explained under item 5.2 (Description of main hydr. components).

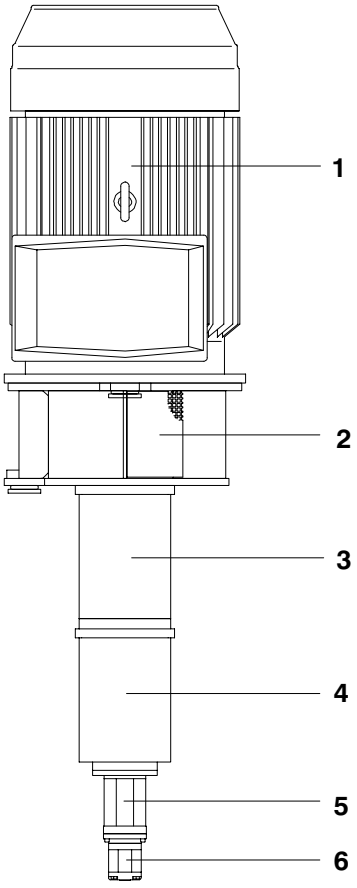
The variable axial piston pumps **HA, EA** and the the two gear pumps **A1, A21** are flanged together and are driven from an electric motor via a coupling.

The variable axial piston pumps **HA, EA** supply the oil for all the crane movements (hoisting, luffing and slewing).

Gear pump **A1** supplies the control oil for all the joysticks.

Gear pump **A21** supplies the oil to the hydraulic oil cooler unit.

ARRANGEMENT OF HYDRAULIC PUMP ASSEMBLY:

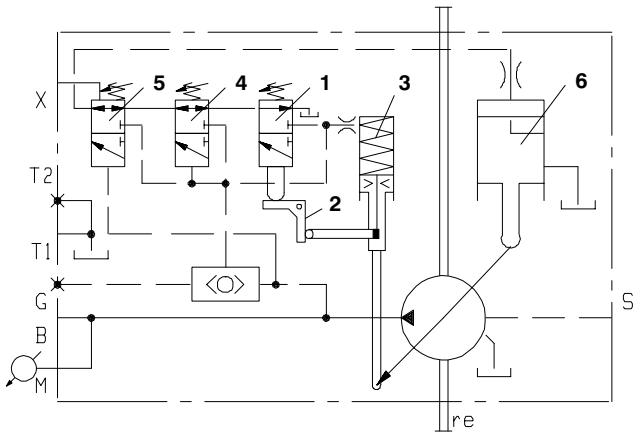


1 Elecrtric main motor **4A—M01**
2 Coupling
3 Variable axial piston pump **HA**
4 Variable axial piston pump **EA**
5 Gear pump **A21**
6 Gear pump **A1**

5.2. DESCRIPTION OF THE MAIN HYDRAULIC COMPONENTS

5.2.1. THE VARIABLE SWASH PLATE PUMP TYPE A11VO LRDS (FOR OPEN HYDR. CIRCUITS)

HYDRAULIC SCHEMATIC



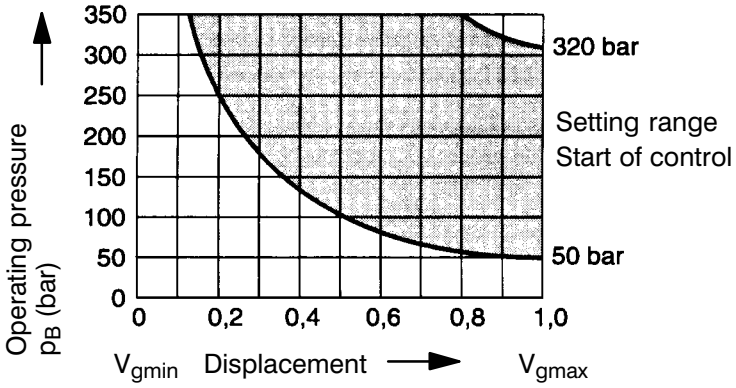
Connections:
B Service line port
S Suction port
T1 Air bleed, tank return line
T2 Air bleed, tank
G Control pressure port
X Port for difference pressure control (sense port)
M Gauge point for pressure port

Layout of components:
1 Pilot control valve
2 Rocker arm
3 Main displacement piston
4 Pressure cut off valve
5 Load sensing valve
6 Counter piston

General description

The A11VO is a variable pump of a axial piston swashplate design for use in open circuit hydrostatic drives. It is suitable for use in either mobile or industrial applications. The pump operates under self−priming condition, with tank pressurisation or with charge pump (impeller). A wide variety of controls are available. Setting of the constant power control is possible via external adjustments, even when the unit is operating. The pump is equipped with a through drive to accept a gear pump or a second axial piston pump up to the same size (100 % through drive). Output flow is proportional to drive speed and pump displacement and is steplessly variable between zero and maximum.

Constant power control (LRDS)



The constant power control controls the output volume of the pump in relation to the operating pressure so that, at a constant drive speed, the preset drive power is not exceeded.

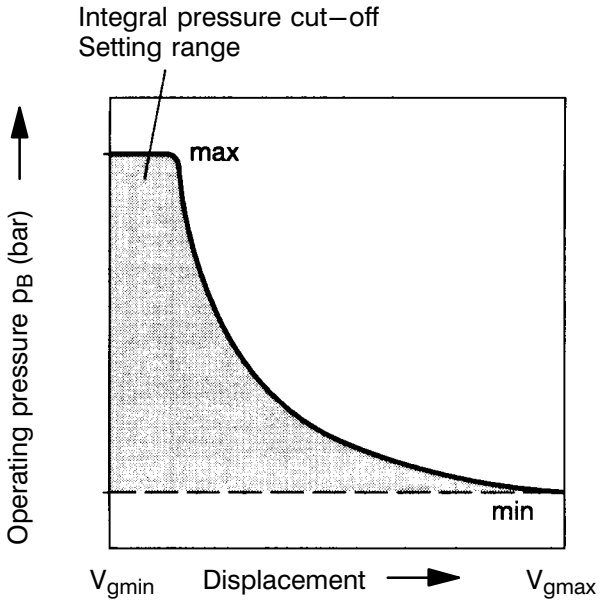
$$p_B \times V_g = \text{constant}$$

p_B = Operating pressure
V_g = Displacement

Optimum power usage is obtained by accurately following the power hyperbola.

Operating pressure applies a force on piston (3) within the control piston on the rocker arm (2). An externally adjustable spring force is applied to the other side of the rocker to determine the power setting.
Should the operating pressure exceed the set spring force, the pilot control valve (1) is operated via the rocker arm (2), allowing the pump to swivel towards zero output. This in turn reduces the effective moment on the arm of the rocker, thus allowing the operating pressure to rise in the same ratio by which the output flow is reduced ($p_B \times V_g$ = constant).

Pressure cut–off (LR**D**S)



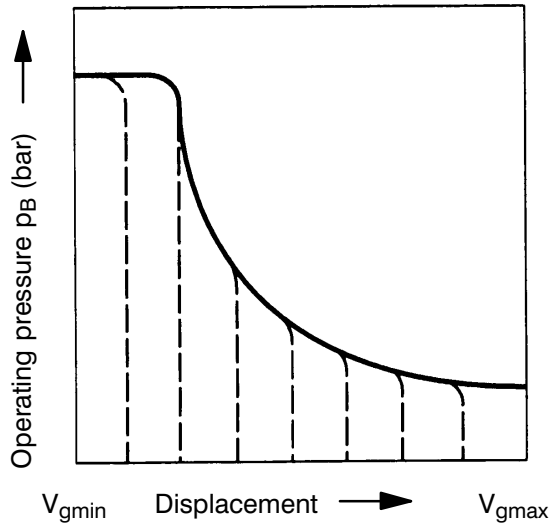
Integral pressure cut–off (LRDS)

The pressure cut–off is in effect a constant pressure cotrol which swivels the pump back to V_{gmin} when the preset operating pressure is reached. This function overrides the constant power control, i. e. the constant power control is effective below the the preset operating pressure. The pressure valve cut–off (4) is integrated into the control housing and is set in the factory to a fixed pressure.

Setting range from 50 to 320 bar (size 35).

Settting range from 50 to 370 bar (size 60 – 250).

Load sensing (LRD**S**)



The load sensing valve (5) is a flow control valve which operates as a function of the load pressure to regulate the pump displacement in order to match the requirement of the consumer unit. The pump flow is influenced by the external orifice (control block, throttle) fitted between pump and serviced unit, but is not affected by load pressure throughout the the range below the power curve.

The valve compares pressure before and after the orifice and maintains the pressure drop (differential pressure) across the orifice – and therefore the pump flow – constant.

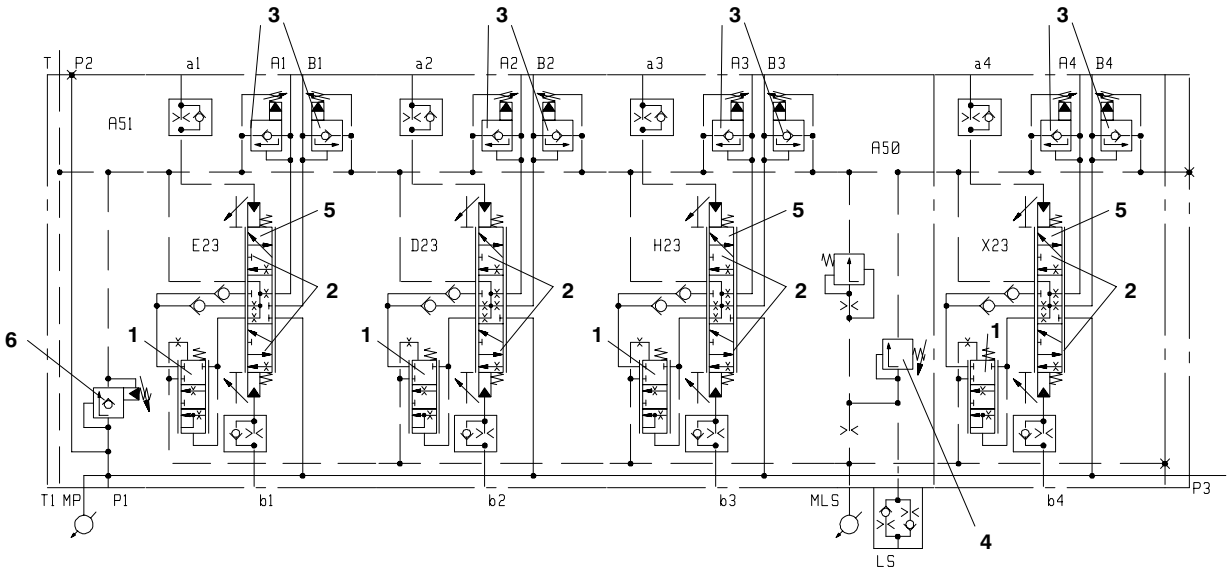
If differential pressure increases, the pump is swivelled back towards V_{gmin}, and differential pressure decreases the pump is swivelled out towards V_{gmax}, until a balance is restored within the valve.

$p_{diff} = p_{pump} - p_{service\ unit}$

Differential pressure may be set within the range 14 bar to 25 bar. The standby pressure for zero stroke operation (orifice closed) is approx. 2 bar above the differential pressure setting. The constant power control and the pressure cut–off are superimposed on the load sensing valve, i. e. the load sensing function operates below the set power hyperbola and set pressure.

5.2.2. CONTROL BLOCK TYPE LUDV (FOR OPEN HYDR. CIRCUITS)

HYDRAULIC SCHEMATIC:



Connections:

P1, P2	Oil supply from pump
T1, T2	Tank return line
A1, B1	Working lines to user 1
A2, B2	Working lines to user 2
A3, B3	Working lines to user 3
A4, B4	Working lines to user 4
a1, b1	Control ports (joy stick) for user 1
a2, b2	Control ports (joy stick) for user 2
a3, b3	Control ports (joy stick) for user 3
a4, b4	Control ports (joy stick) for user 4
LS	Load sensing connection

Layout of components:

1	Pressure scale valve
2	Sense bore
3	Pressure limiting valves (max. working pressure)
4	Pressure limiting valves (max. system pressure)
5	Main piston
6	Pressure release valve

GENERAL DESCRIPTION:

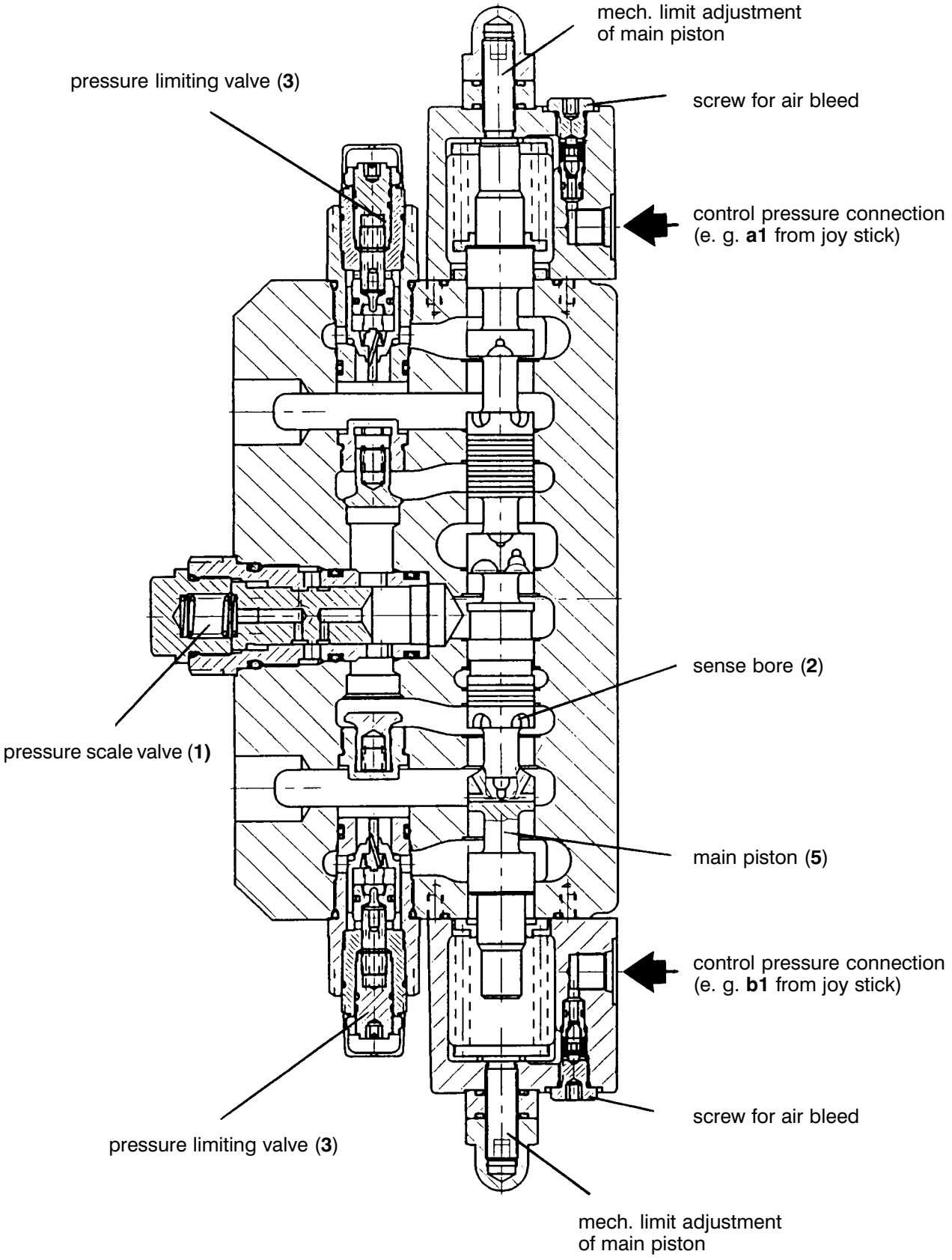
This control block guarantees:

– Load indepedent movement of all users

– Splitting of oil quantity at simultaneous operation of different users in correspondence to the main piston position

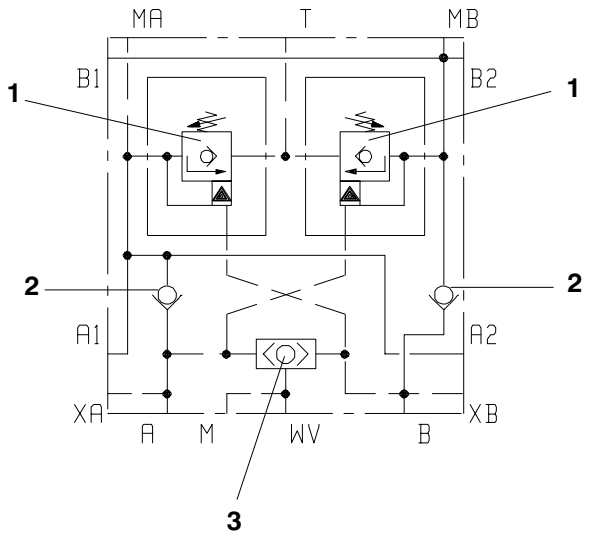
– Control of variable pump, meaning pump only delivers as much oil as used at the time (less heat consumption, higher effiency)

LAYOUT OF LUDV CONTROL BLOCK



5.2.3. SLEWING SAFETY BLOCK VALVE

HYDRAULIC SCHEMATIC



Connections:

A, B	Oil supply
A1, B1, A2, B2	Outlet to the hydr. motors
T	Feed pressure connection
XA, XB	Gauge connections
WV	Brake connection

Layout of components:

1	Interlock valves with non return valves
2	Non return valves
3	Change over valve

GENERAL DESCRIPTION:

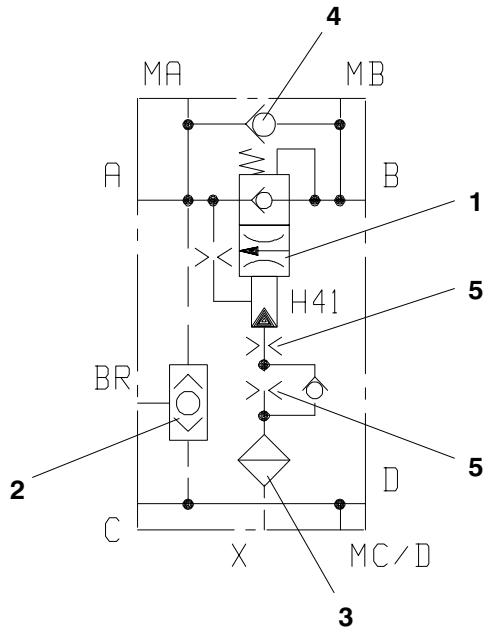
Interlock valves (1) release the flow back from the hydr. motor to the low pressure side only if the pressure has built−up in the opposite pressure line.

Non return valves (2) allow the oil to flow into **one** direction only. The return oil from the hydr. motor must pass through interlock valve as the non return valves block the oil.

Change over valve (3) connects the corresponding pressure A or B with the lamella brakes.

5.2.4. LOWERING BRAKE VALVE

HYDRAULIC SCHEMATIC:



Connections:

A, C	Oil supply lines
B, D	Outlet to hydr. motor
X	Port for control of lowering brake valve
MC/D	Control port
BR	Connection for disc brake
MA, MB	Gauge connections

Layout of components:

1	Lowering brake valve
2	Changeover valve
3	Sinter filter
4	Non return valve
5	nozzles

GENERAL DESCRIPTION

Lowering brake valve (1) releases the oil flow from the hydr. motor back to the tank via the LUDV block. It is controlled by the pressure from port **X.**

Via changeover valve (2) the multiple disc brake is released from oil supply line **A** or **C.**

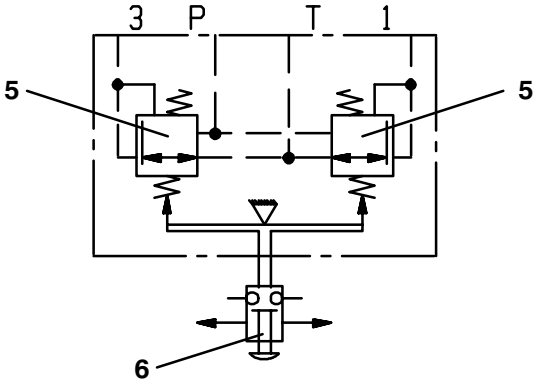
The actual working pressure in the hoist line can be measured at gauge connection **MA.**

5.2.5. HYDRAULIC OPERATED JOYSTICK TYPE TH6

HYDRAULIC SCHEMATIC

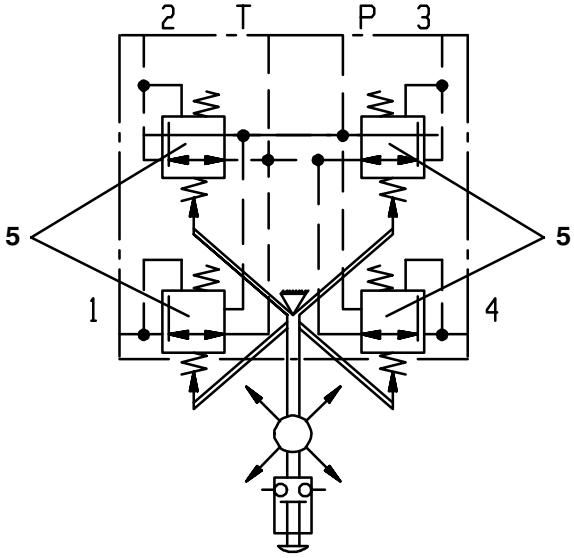
Single control:

(with integrated electric contact)



Double control:

(with integrated electric contact)



Connections:

P Control pressure circuit

T Tank return line

1, 3 Control lines for user 1 to control block (e.g. hoist system)

2, 4 Control lines for user 2 to control block (e.g. slew system)

Layout of components:

5 Proportional control valves

6 Integrated el. contact

GENERAL DESCRIPTIONS

–Sensitive control by means of extremely low operating forces and thus an increase in ease of operation

–Positive reference points in the lever position, before start of movement and at the end of fine control

–All connections on buttom face of unit

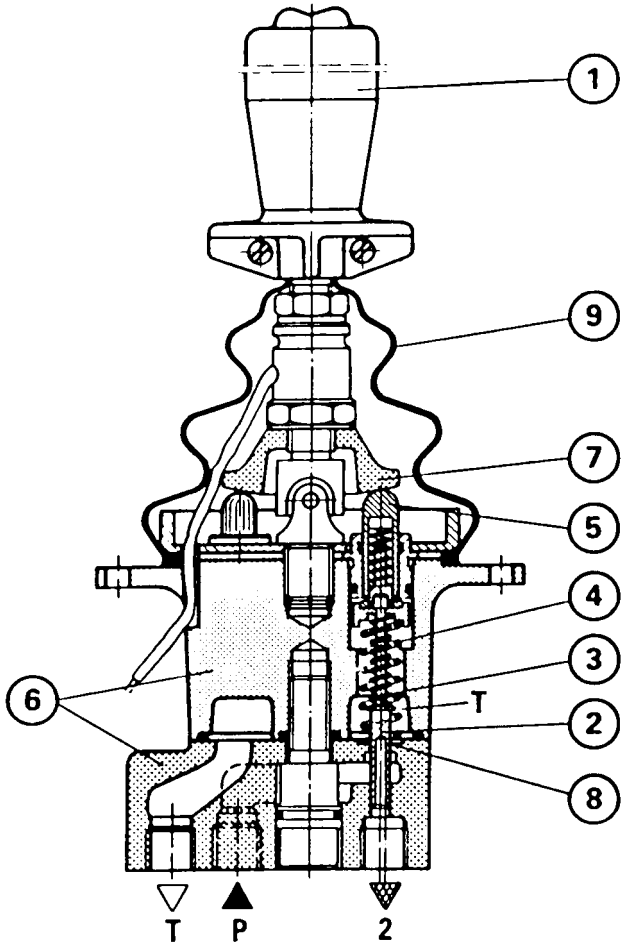
–Safe return and reduction of response time by direct return of the plunger to neutral position

–Stainless steel and brass plunger components offer anti–corrosion and non–stick feature

MAINTENANCE:

–Maintenance free

Layout of joystick:



DESCRIPTION OF FUNCTION:

Hydraulic pilot units type TH6 operate on the basis of direct operating pressure reducing valves.

They comprise mainly the operating element (1), the valve cartridge comprising regulating spool (2), regulating spring (3), return spring (4), plunger (5) and the housing (6).
Pilot units TH6 offer pressure–related fine adjustment of valves, pump and motor control.

In neutral position, the operating element is held in zero position by return spring (4). When lever (1) is operated, the plunger (5) is pushed against the return spring (4) by means of the switch plate (7). At the same time, the regulating spool (2) is pushed through the regulating spring (3). When the regulating stroke begins, there is a connection from port P via bore (8) and ports 1, 2, 3 or 4 to the unit to be controlled (valve, pump or motor). These controlles are related to the lever position and the regulating spring characteristic.

A special feature of the TH6 pilot unit is the increase in the fine control range when using Rexroth high pressure mobile control blocks and sandwich mobile control blocks. This range is indicated by definite reference points.

In connection with the pilot oil supply system, the pressure remote can function without a separate pilot pump. Hand emergency is guaranteed when the prime mover is not running, due to the oil supply in the accumulator of this system.

Rubber gaiter (9) protects the mechanical components from contamination, so that the pilot units are suitable for the most difficult applications conditions.

5.3. EXPLANATION OF HYDRAULIC CONTROL SYSTEM

All items in brackets ( ) are shown under item 5.2 (Description of main hydraulic components).

5.3.1. GENERAL

The control block LUDV **A50** guarantees:

– Load independent movement of all users

– Splitting of oil quantity at simultaneous operation of different users in correspondence to the main piston position.

– Control of variable pump, meaning pump only delivers as much oil as used at the time (less heat consumption, higher effiency).

5.3.2. FUNCTION OF THE LUDV–CONTROL SYSTEM

5.3.2.1. FUNCTION OF SENSE BORE

The function of sense bore (2) can be compared with the function of an adjustable nozzle. The sense bore (2) causes a difference pressure between the variable pump and the use (e. g. variable motor, hydraulic cylinder).

5.3.2.2. FUNCTION OF PRESSURE SCALE VALVE

The function of pressure scale valve (1) can be compared with a hydraulic controlled pressure limiting valve which is controlled by the pressure from the use creating the highest pressure.

5.3.3. FUNCTION OF HYDR. CONTROL SYSTEM (LUDV) WITH ONE USER (E. G. MAIN HOIST "LIFTING")

At control of hydr. joystick "main hoist lifting" the control oil passes from joystick block **H21** via port **1** and a nozzle to port **a2** at the LUDV– block **A50**. Through an internal bore the control oil passes to the control port of main piston (5). The main piston moves, sense bore (2) opens and at the same time the main piston (5) gives direction into "lifting". The pressure from sense bore (2) acts on pressure scale valve (1) and sets the internal piston in correspondence to the working pressure. The oil from variable pumps **EA, HA** can pass via the opened main piston (5) and connections **A2** and **A2** to the hydraulic motor **HU**.

Via the pressure scale valve (1) the working pressure is sensed through port (LS) of the control block **A50** at the load sensing valves (5) of the variable pumps **EA, HA** through part X.

The output of variable pumps **EA, HA** increases. The pressure scale valve (1) has only got two positions: opened or closed.

If the oil flow to the user changes due to the different control from the joy stick, the pressure difference between pump and user (e. g. hydr. motor) changes at sense bore (2) of the control block more or less. That means for a short time the oil flow to the sense bore (2) is the same but the opening of the main piston (5) is smaller or bigger.

That causes a pressure change at the sense bore (2) which is sensed at the load sensing valve (5) of the variable pumps **EA, HA.** The load sensing valve (5) corrects this pressure change by changing the pump control oil and due to that the pitch of the variable pumps until a basic pressure difference of approx. 20 bar has set up again (adjusted at load sensing valve (5) of the variable pumps **EA, HA**).

5.3.4. FUNCTION OF HYDR. CONTROL SYSTEM (LUDV) WITH TWO USERS (E. G. MAIN HOIST AND SLEWING)

5.3.4.1. BOTH USERS ARE OPERATED WITH DIFFERENT WORKING PRESSURES AND FULL SPEED (SATURATION MODE)

At operation of both users the highest pressure is setting up at pressure scale valves (1) via main pistons (5). The pressure at the corresponding sense bores (2) will be always controlled to the highest working pressure. That means, the pressure **before and behind** all sense bores (2) are the same. The pressure between the variable pumps and the users will be kept at a costant value by the load sensing valve (5) inside the variable pumps **EA, HA.**

5.3.4.2. MORE USERS IN OPERATION

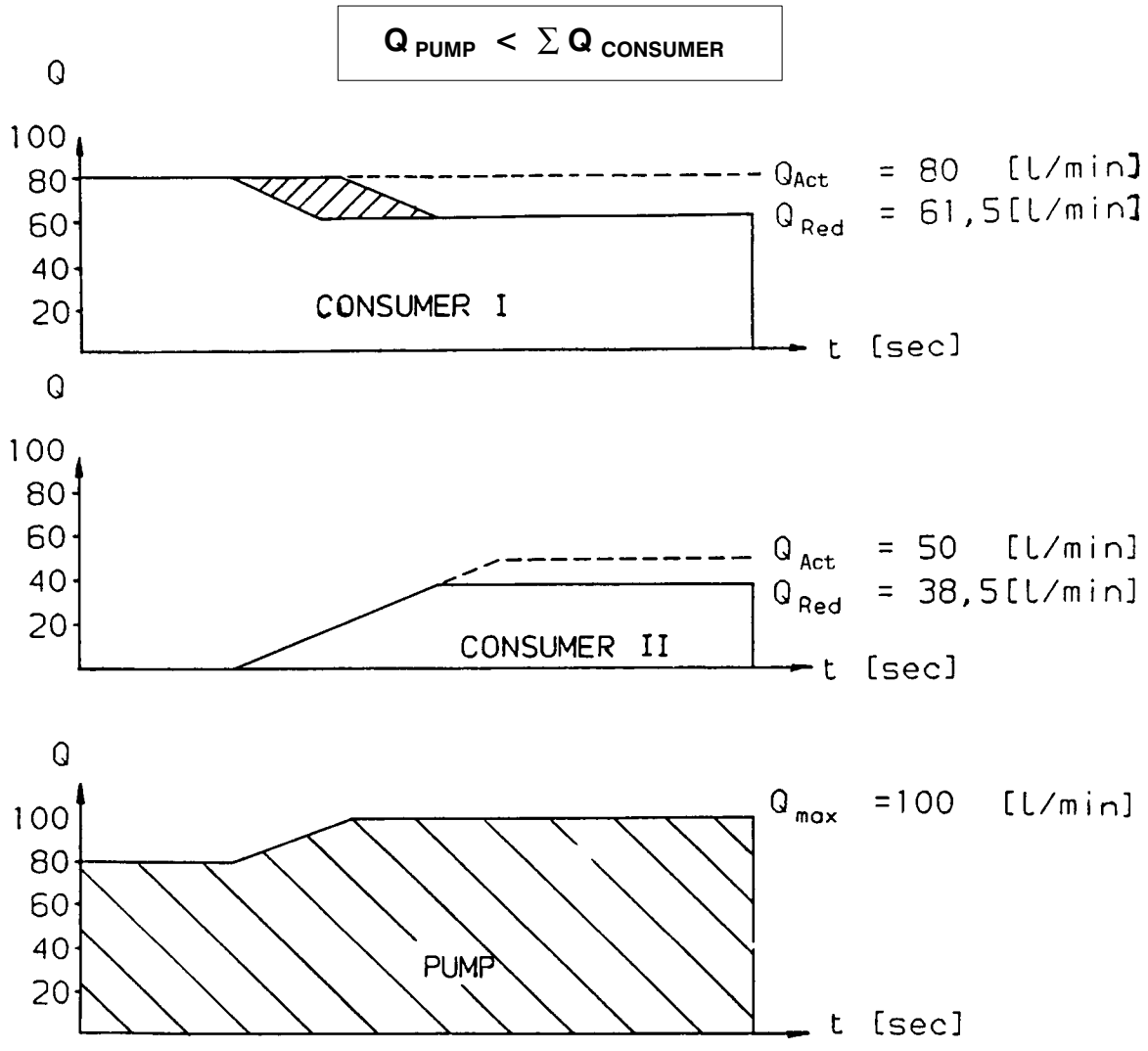
If the oil consumption of all users used at the time is higher than as the max. pump output, the pressure difference between the highest working pressure and the pump pressure gets smaller and therefore all pressure differences at the sense bores (2). The working pressure remains at a constant value.

That means, the distribution of the oil flow to all users will be reduced at the same relation as well as the actual speeds of all users.

Characteristics of oil flow:
At max. pump delivery (e. g. 100l/min) one user is operated needing 80 % of that delivery.
At operation of a second user needing another 50 % of the pump delivery the oil flow to both users will be reduced at a ratia of 8:5 (61,5 l : 38,5 l).

Characteristics of pressure:
At max. pump delivery (e. g. 100 l/min) and operation of one user with 100 % the pressure difference between the variable pump and the user will be approx. 20 bar (adjusted at load sensing valve (5) of variable pumps).
At operation of a second user with another 100 % the pressure difference wil drop from 20 bar to approx. 10 bar.
The oil flow to both users will be limited to approx. 50 l/min each.

CHARACTERISTICS OF OIL FLOW BETWEEN VARIABLE PUMP AND USERS



INDEX

6. EMERGENCY OPERATIONS 6.3

6.1. INSTRUCTIONS FOR EMERGENCY HAND PUMP (only at main motor standstill) 6.3

6.1.1. GENERAL 6.3
6.1.2. LAYOUT OF EMERGENCY HAND PUMP 6.3

6.2. PROCEDURE TO LOWER THE LOAD 6.5

6.2.1. PROCEDURE 6.5
6.2.2. LAYOUT DRAWING 6.5

6.3. PROCEDURE TO LOWER THE JIB 6.7

6.3.1. PROCEDURE 6.7
6.3.2. LAYOUT DRAWING 6.7

6.4. PROCEDURE TO RELEASE THE SLEWING BRAKE 6.9

6.4.1. PROCEDURE 6.9
6.4.2. LAYOUT DRAWING 6.9

6. EMERGENCY OPERATIONS

6.1. INSTRUCTIONS FOR EMERGENCY HAND PUMP (only possible at main motor standstill)

6.1.1. GENERAL

The hand pump shall be used only in case of a total standstill of the crane.

It is possible to carry out following emergency movements or operations:

– lower the load to ground (open brakes of hoisting winch and/or lower jib)

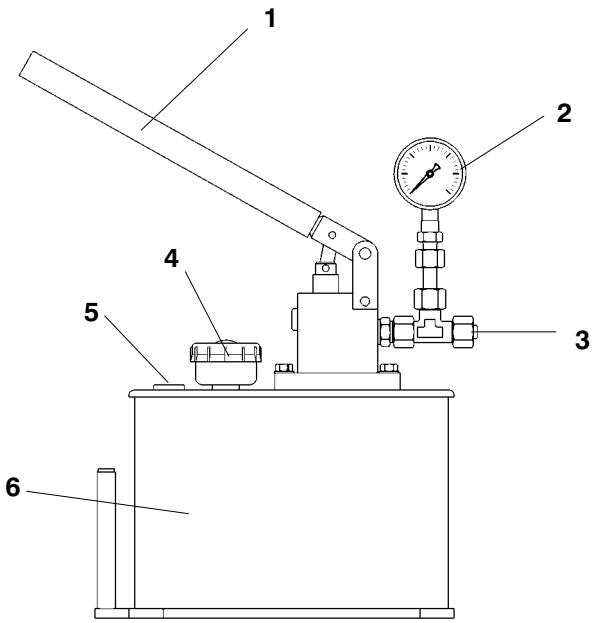
– turn the crane (open the slewing brakes)

⚠ WARNING !

The operation of the emergency hand pump must be done at a place from where the emergency movement can be seen!

In case of emergency operation there is no stopping of crane movements by limit switches or other safety devices. Therefore the movements have to be supervised by additional personnel !

6.1.2. LAYOUT OF EMERGENCY HAND PUMP



1 Pump lever

2 Pressure gauge (minimum 15 bar to release the brakes)

3 Connection to **hydraulic system** (pressure line of pump)

4 Oil filling and dipstick

5 Breather filter

6 Tank

NOTE ! At longer usage of hand pump during emergency operation (for example at large lifting heights) check oil level of hand pump with dipstick and if necessary refill tank with hydraulic oil.