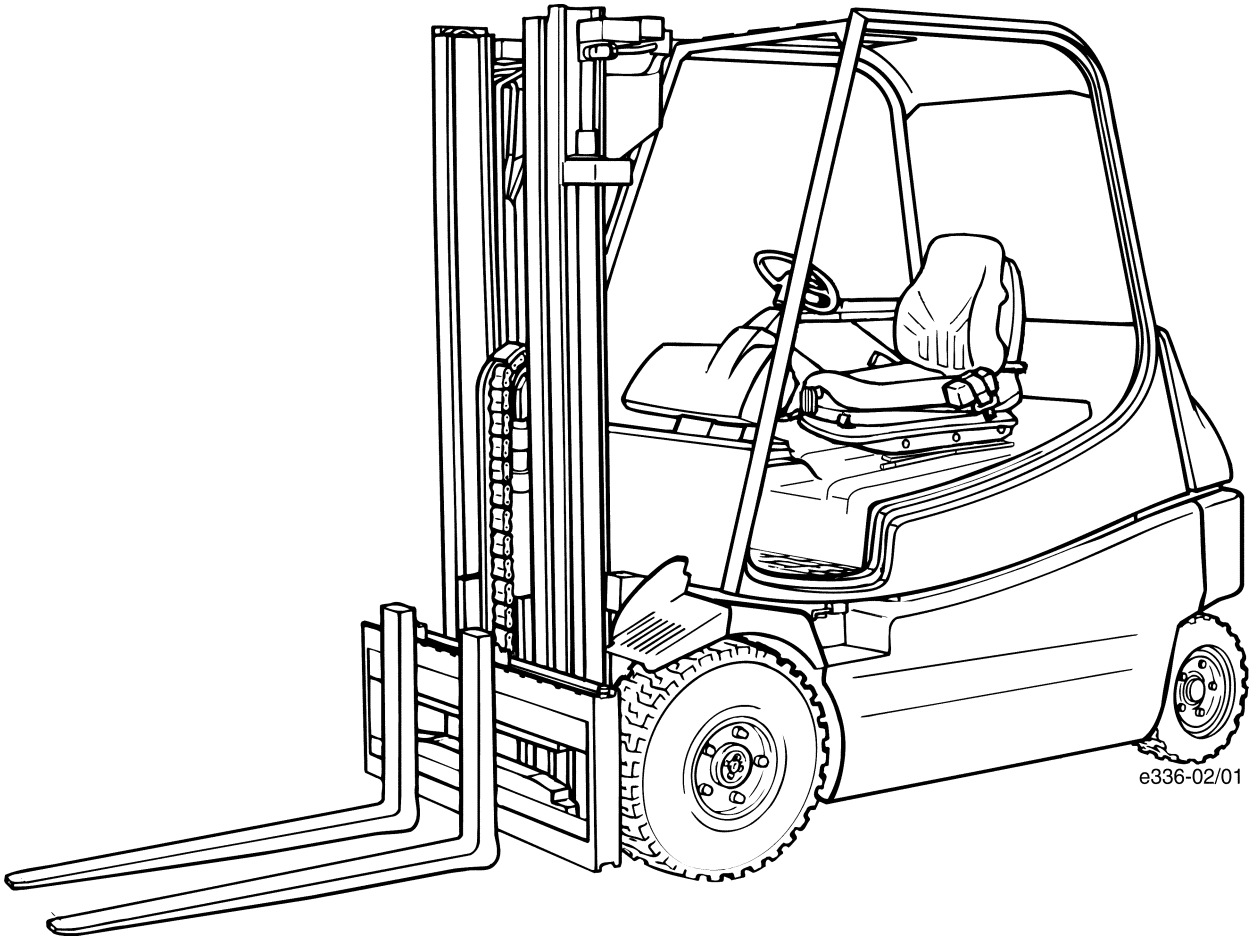
Service Training

Electric Lift Truck E 20/25/30 with shunt drive and LLC Series 336 -02



E01 / Chapter 1
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Service Training

Linde electric lift truck E 20/25/30 with shunt drive and LLC, series **336 -02**
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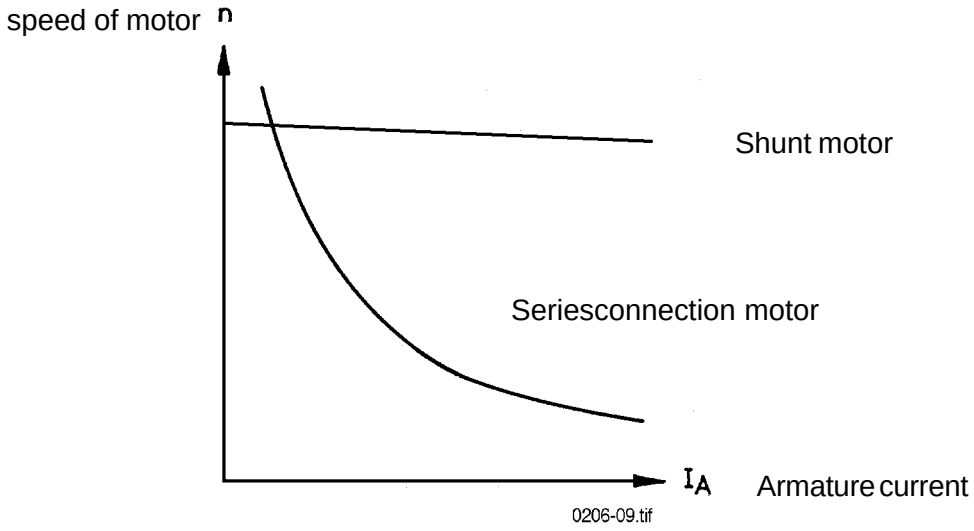
6 ELECTRICAL SYSTEM

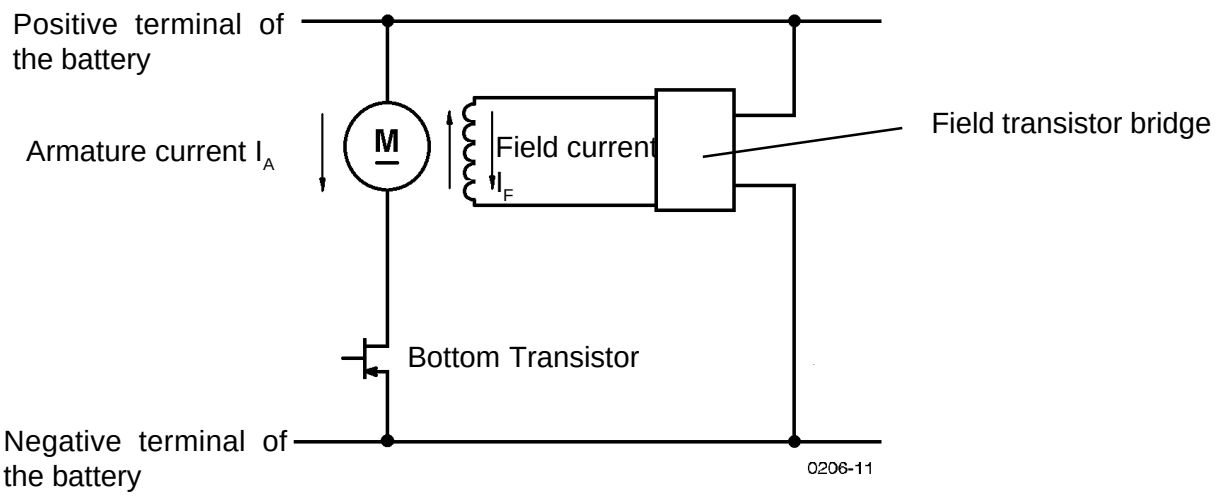
6.1 CONTROL SYSTEM FOR LDC TRACTION DRIVE UNIT

The use of shunt motors as drive motors offers the following advantages:

- Change of direction possible without direction of travel contactors
- Active current operation without contactors
- Simple optional weakening of field without additional components
- Improved cornering ability
- Improved temperature monitoring in the power unit
- Stable speed maintained with different loads



In the shunt motor, the field winding is not connected in series with the armature winding. The field winding is controlled via its own power unit. According to the polarity and the flow of the current in the field winding, the rpm speed and the direction of rotation of the motor can be controlled. The direction of the current in the armature winding always remains the same (with the exception of the braking operation).



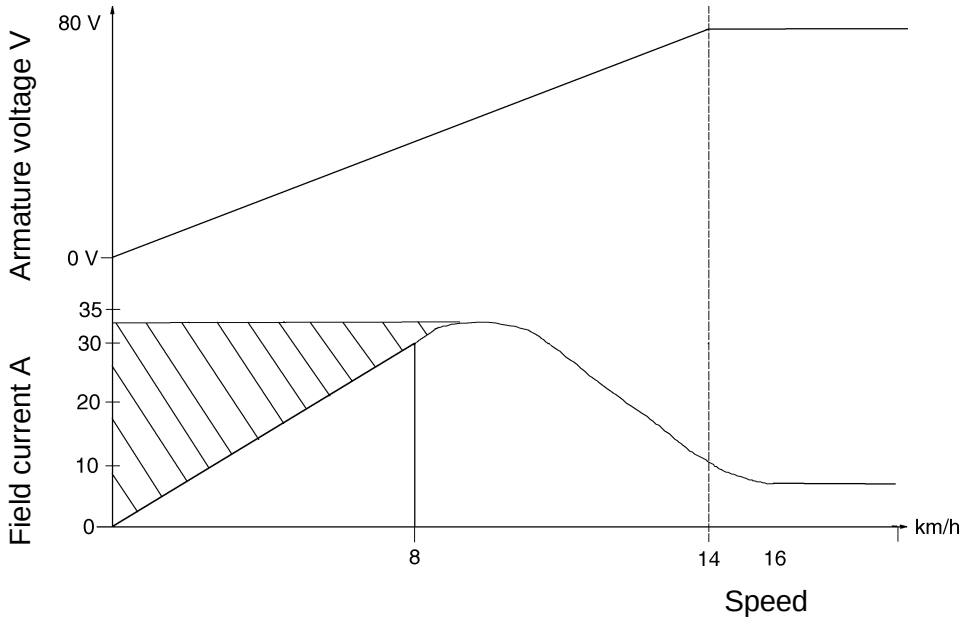
6.1.1 OPERATING PRINCIPLE

The shunt control operates with a clock (or cycle) frequency of 16 kHz. Since the activation of the direction of travel is controlled via the exciter field, no contactors are required for the direction of travel. In the electrical system, there are two power units which drive the three motors. In the power unit A1, the main current unit for the left traction motor and the pump motor is integrated. The power unit 1A1 includes the main current unit for the right traction motor.

The system is activated via the drive electronics 1A2. A closing (switch-on) contactor K1 is added for the complete electrical system; this contactor is activated after the key switch has been switched on.

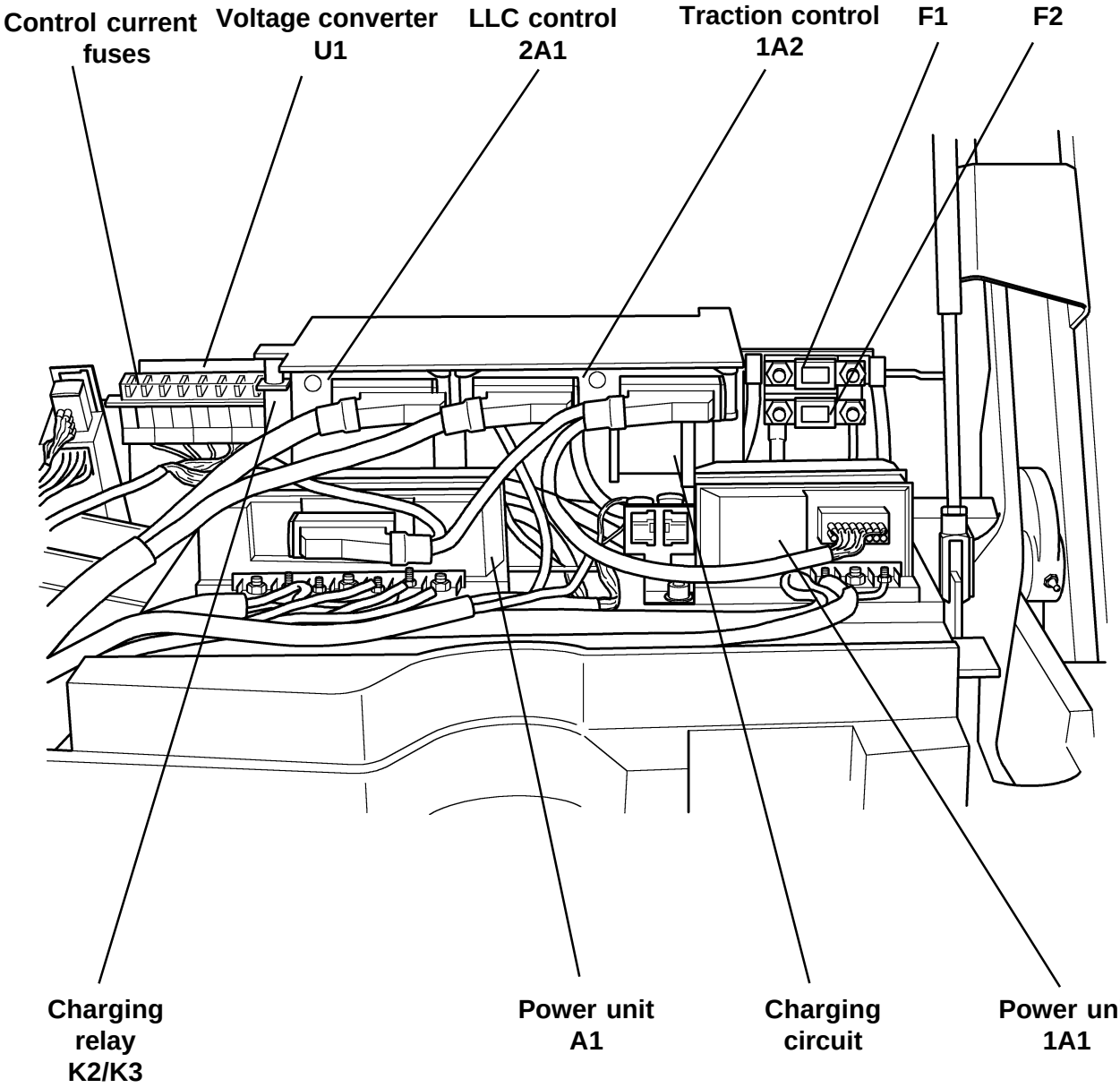
To control the motor speed, the armature voltage is controlled according to the operation of the accelerator, via the bottom transistor and the exciter field. This occurs in proportion to the travel speed and the motor current.

When accelerating, the armature voltage and the exciter voltage are increased. After reaching about 8 km/h, the exciter current is kept constant so that there is a constant current of approx. 33 A in the exciter field. The voltage at the armature winding continues to increase, until at about 14 km/h the full battery voltage is applied at the armature winding. After reaching about 10 km/h, the exciter current is simultaneously reduced until at a speed of approximately 16 km/h, there is an exciter current of 9 A. With a high torque load and low speed, a field current in the shaded area of the graph is possible.



When the truck is stationary, the exciter coil receives an alternating current, in order to prevent a residual magnetism in the exciter winding. If the truck started to move, a residual magnetism would cause a further acceleration of the traction motors. The alternating current is produced by the rapidly alternating switching on of the field transistor bridge.

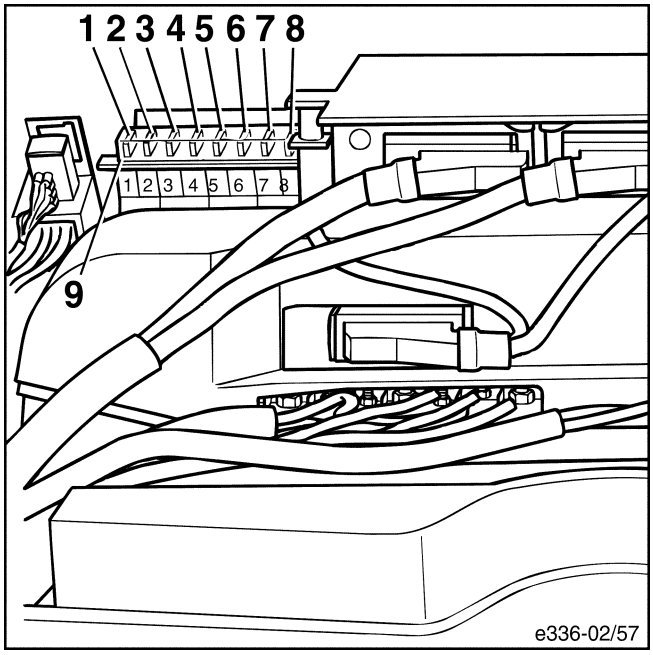
6.1.1.1 COMPONENTS OF THE ELECTRICAL SYSTEM



Main current fuse F1	250A Traction motor 1M1
Main current fuse F2	355A Traction motor1M2, pump motor 2M1

6.1.1.2 CONTROL CURRENT FUSES

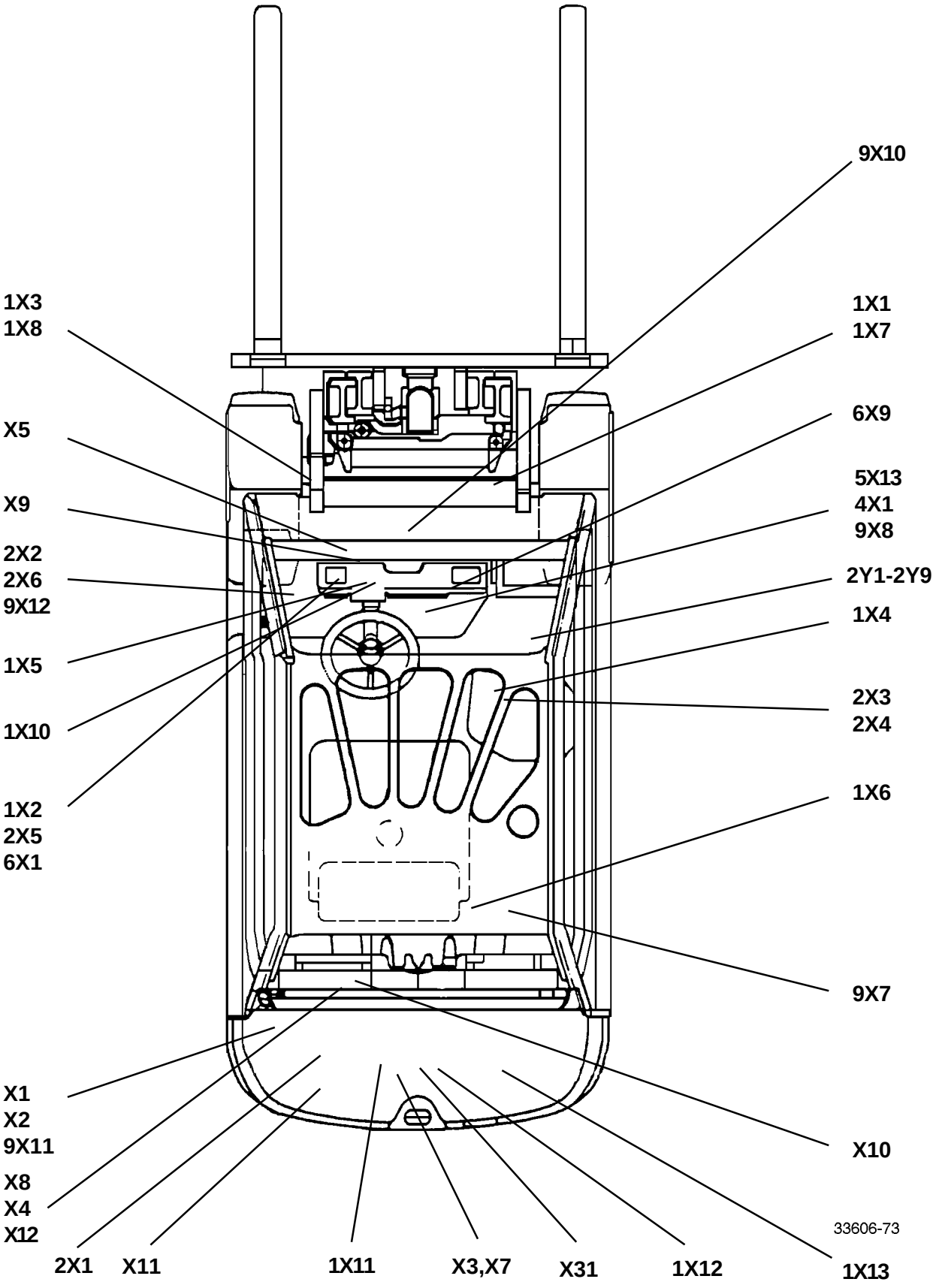
1	6F1	10A	Discharge indicator
2	1F2	10A	Control current fuse in front of the key switch
3	4F3	5A	Horn
4	1F4	5A	Fan
5	1F5	5A	Composite instrument, traction control and pump control unit
6	1F6	5A	Charging circuit
7	F7	5A	Charging circuit
8	F8	5A	Charging circuit



NOTE: Only use original Linde replacement fuses with high voltage design.

6.1.1.3 POSITIONS OF THE CONNECTORS IN THE E25/30 TRUCK

X1	Connector connector, 42 pin	connecting connector, main/end cable loom	in the counterweight, electric installation on left
X2	Connector connector, 10 pin	connecting connector, main/end cable loom	in the counterweight, electric installation on left
X3	Connector connector, 2 pin	microswitch, S2, emergency off	in the counterweight, electric installation underneath the LLC
X4	Connector connector, 2 pin	connector connector, contactor coil K1	in the counterweight, electric installation on left
X5	Connector connector, 2 pin	connector connector, reed contact switch 3S1, steering	on the steering control valve
X7	Connector connector, 4 pin	connector connector, steering potentiometer 3B1	in the counterweight, electric installation underneath the LLC
X8	Connector connector, 6 pin	connector connector, voltage transformer U1	in the counterweight, electric installation on the left
X9	Connector connector, 3 pin	connector connector, overhead guard switch S4	driver's overhead guard, behind steering column covering
X10	Battery connector		in the counterweight, electric installation on the right
X11	Connector connector, 29 pin	connector connector, drive electronics, power unit A1	in the counterweight, electric installation on the left
X12	Connector connector, 6 pin	connector connector, charge/discharge circuit	in the counterweight, electric installation on left
X31	Battery negative point	central battery negative point, conductor rail	conductor rail between power units A1 and 1A1
1X1	Connector connector, 4 pin	connector connector, rpm speed sensor 1B1	fastening plate on right traction motor
1X2	Connector connector, 4 pin	diagnostic connector, drive electronics	behind switch covering to the left of the steering column
1X3	Connector connector, 4 pin	connector connector, rpm speed sensor 1B2	fastening plate on the left traction motor
1X4	Connector connector, 3 pin	connector connector, hand brake switch 1S4	above control valve, working hydraulics
1X5	Connector connector, 3 pin	connector connector, brake pedal switch 1S5	underneath bottom plate, driver's overhead guard
1X6	Connector connector, 2 pin	connector connector, seat switch S3	at the back, on the right, on the driver's seat
1X7	Connector connector, 4 pin	connector connector, right traction motor 1M1	fastening plate on the right traction motor
1X8	Connector connector, 4 pin	connector connector, left traction motor 1M2	fastening plate on the left traction motor
1X10	Connector connector, 4 pin	connector connector, accelerator 1A4	underneath bottom plate, driver's overhead guard
1X11	Connector connector, 42 pin	connector connector, drive electronics 1A2	in the counterweight, electric installation in the middle
1X12	Connector connector, 42 pin	connector connector, drive electronics 1A2	in the counterweight, electric installation in the middle
1X13	Connector connector, 16 pin	connector connector, power section 1A1	in the counterweight, electric installation on the right
2X1	Connector connector, 42 pin	connector connector LLC 2A1	in the counterweight, electric installation on the left
2X2	Connector connector, 4 pin	connector connector, rpm speed sensor 2B8	on the fastening plate, pump motor
2X3	Connector connector, 6 pin	connector connector, joystick 2B1	underneath the joystick arm rest
2X4	Connector connector, 6 pin	connector connector, joystick 2B2	underneath the joystick arm rest
2X5	Connector connector, 4 pin	diagnostic connector LLC	behind switch covering to the left of the steering column
2X6	Connector connector, 4 pin	connector connector, pump motor 2M1	on the fastening plate, pump motor
4X1	Connector connector, 2 pin	connector connector, horn switch 4S1	behind switch cover on the right of the steering column
5X13	Connector connector, 3 pin	connector connector, flashing pilot indicator	behind switch cover on the right of the steering column
6X1	Connector connector, 4 pin	diagnostic connector, composite instrument	behind switch cover on the left of the steering column
6X9	Connector connector, 36 pin	connector connector, composite instrument 6P2	to the right of the steering column on the composite instrument
9X7	Connector connector, 4 pin	connector connector, power supply SA	at the back on the right, underneath driver's overhead guard
9X8	Connector connector, 6 pin	connector connector, single pedal direction switch 1S13	behind switch cover to the right of the steering column
9X10	Connector connector, 2 pin	connector connector, ventilator 9M1	at fan for traction and pump motor
9X11	Connector connector, 2 pin	connector connector, ventilator 9M2	in counterweight, electrical system on the left
9X12	Connector connector, 2 pin	connector connector, ventilator 9M3	in wheel box on left


9X10
1X3
1X8
1X1
1X7
X5
6X9
X9
5X13
4X1
9X8
2X2
2X6
9X12
2Y1-2Y9
1X4
1X5
2X3
2X4
1X10
1X6
1X2
2X5
6X1
9X7
X1
X2
9X11
X10
X8
X4
X12
33606-73
2X1
X11
1X11
X3,X7
X31
1X12
1X13

6.1.2 POWER UNITS

The truck has two separate power units. The power unit 1A1 contains the power transistors for the armature winding and field winding of the right traction motor 1M1. The power unit A1contains the power transistors for the armature winding and field winding of the left traction motor 1M2, and the power transistor for the pump motor 2M1. The power units have a connecting connector linking them to the control unit. The main current connections of the power transistors are connected to the outside via stud bolts. The motor leads are connected to the stud bolts.

The power units contain the actual current indicators which monitor the armature current of the relevant motor. Heat sensors are fitted near the power transistors, and these sensors monitor the temperature of the transistors. If the transistor temperature rises above 70°C, this will produce a continuous reduction of the armature current of the traction motors. At a temperature of 80 °C, the armature current is reduced to 50% and the truck only travels at creep speed. The temperature and the related reduction in power or cut-out is monitored by the drive electronics.

The intermediate circuit capacitors are located under the covering. The capacitors are required to act as buffers for the battery. In principle, the intermediate circuit capacitors shift the battery directly the motors, and thereby compensate for the inductivity of the electric leads.

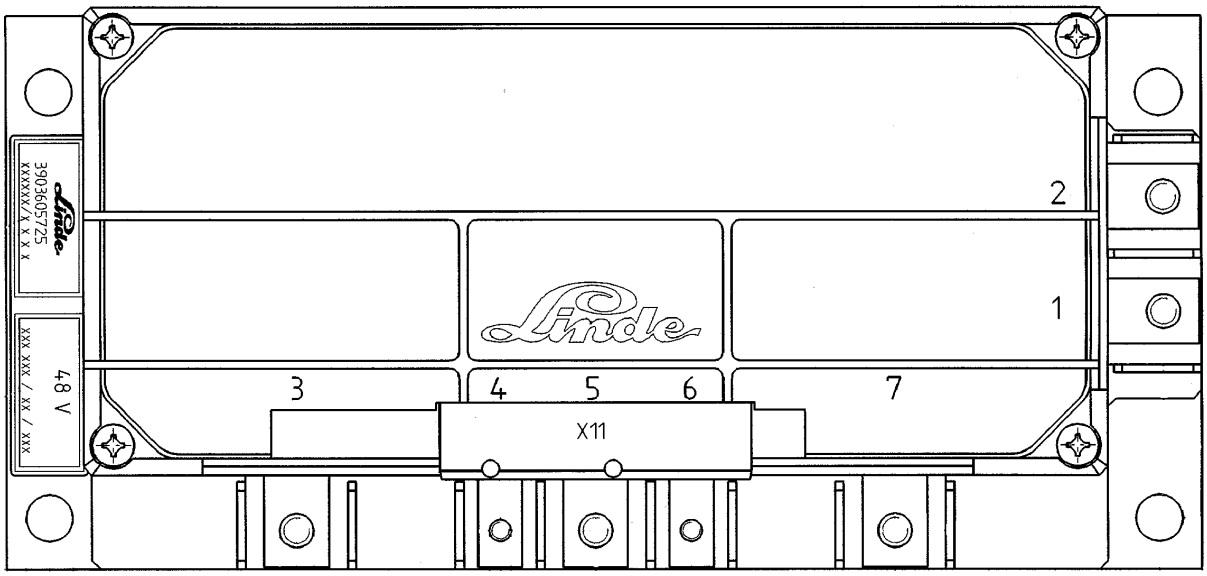
The complete activation logic for the transistors and monitoring system is integrated with the power unit. This means that the power unit monitors itself, and in the event of a fault, it sends a signal (separately for the traction motor and the pump motor) to the traction control or pump control unit. The signal (approval from the power unit) can be monitored in window (6).

Assembly of the power units:

- Remove any dust and foreign bodies from the power module's fastening surface in the area of the dissipator.
- With a spatula, apply a **very thin** layer of thermal conducting paste WP12 to the power module's fastening surface to reduce the thermal contact resistance (heat transmission resistance) between the power module and counterweight.
- Correctly position the power module.
- Tighten the hexagon socket screws M10 x 35. Tightening torque 49 Nm.
- Fit the connectors.

NOTE: The hexagon socket screws, M10 x 35, are to be tightened with the correct tightening torque to ensure the correct positioning of the power module.
After 30 min, retighten the opposite hexagon socket screws as the heat dissipating compound can still change during this time.

6.1.2.1 POWER UNIT A1



Main circuit connections

1 Negative connection for the power unit (source for the power transistors)
2 Positive connection for the power unit
3 Drain connection for the power transistor for pump motor D2
4 Field winding connection E1 for the left traction motor
5 Armature connection A2 for the left traction motor
6 Field winding connection E2 for the left traction motor
7 Armature connection A1 for the left traction motor

Connector allocation X11

1 PWM transistor signal for pump motor 2M1
2 0 V for PWM signal from transistor for pump motor 2M1
3 Not allocated
4 Not allocated
5 Not allocated
6 Actual current indicator signal for traction motor 1M2
7 0V for actual current transmitter 1M2
8 Not allocated
9 Not allocated
10 Not allocated
11 Internal battery voltage
12 PWM transistor signal for armature at top of traction motor 1M2

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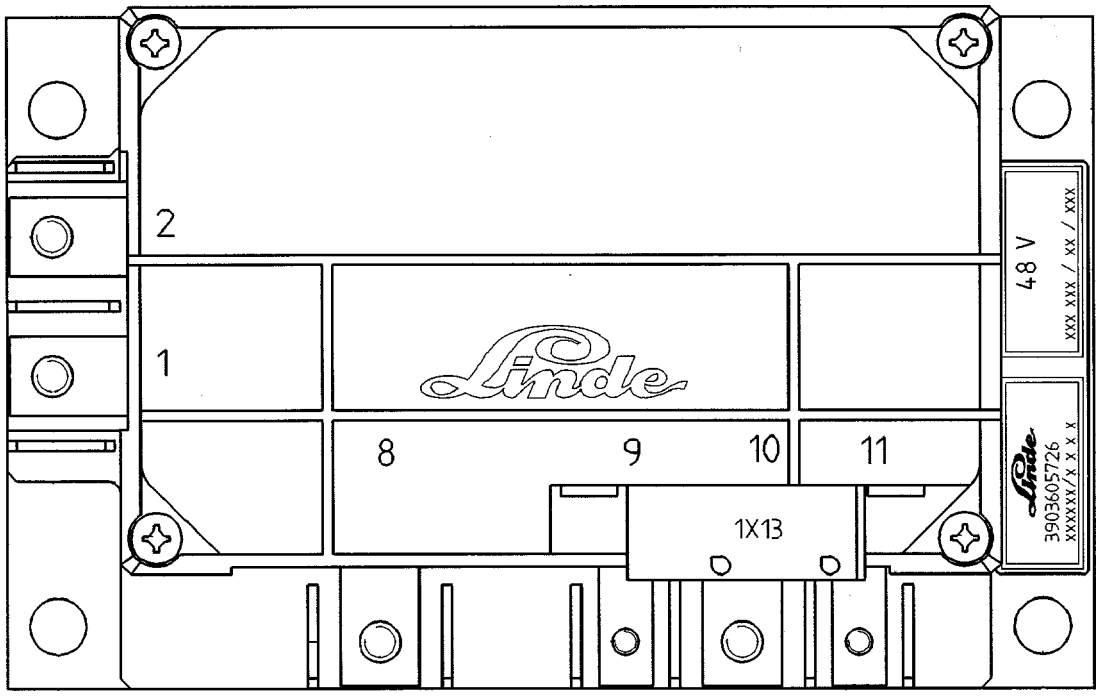
13 0V for PWM transistors signal for traction motor 1M2
14 Voltage of armature at top of traction motor 1M2
15 Voltage of armature at bottom of traction motor 1M2
16 Chip temperature 1M2
17 Heat sensor for chip temperature 2M1
18 Not allocated
19 0V for heat sensor for chip temperature 2M1
20 PWM transistor signal for armature at bottom of traction motor 1M2
21 PWM transistor signal for field S9/S12 of traction motor 1M2
22 PWM transistor signal for field S11/S10 of traction motor 1M2
23 Not allocated
24 Not allocated
25 Fault signal for power unit 1M2
26 Fault signal for power unit 2M1
27 Not allocated
28 +24V power supply from voltage transformer
29 Negative power supply from voltage transformer

6.1.2.2 POWER UNIT 1A1



Main circuit connections

1 Negative connection for the power unit (source for the power transistors)
2 Positive connection for the power unit
8 Armature connection A1 for the right traction motor
9 Field winding connection E2 for the right traction motor
10 Armature connection A2 for the right traction motor
11 Field winding connection E1 for the drive traction motor

Connector allocation 1X13

1 PWM transistor signal for armature at top of traction motor 1M1
2 PWM transistor signal for armature at bottom of traction motor 1M1
3 0V for heat sensor for chip temperature and actual current indicator 1M1
4 Actual current indicator signal for traction motor 1M1
5 Voltage of armature at bottom of traction motor 1M1
6 Fault signal for power unit 1M1
7 Not allocated
8 Internal battery voltage
9 PWM transistor signal for field S5/S8 of traction motor 1M1
10 PWM transistor signal for field S7/S6 of traction motor 1M1
11 0V for PWM transistors signal for traction motor 1M1
12 Not allocated
13 Voltage of armature at top of traction motor 1M1
14 Chip temperature 1M1
15 +24V power supply from voltage transformer
16 Negative power supply from voltage transformer

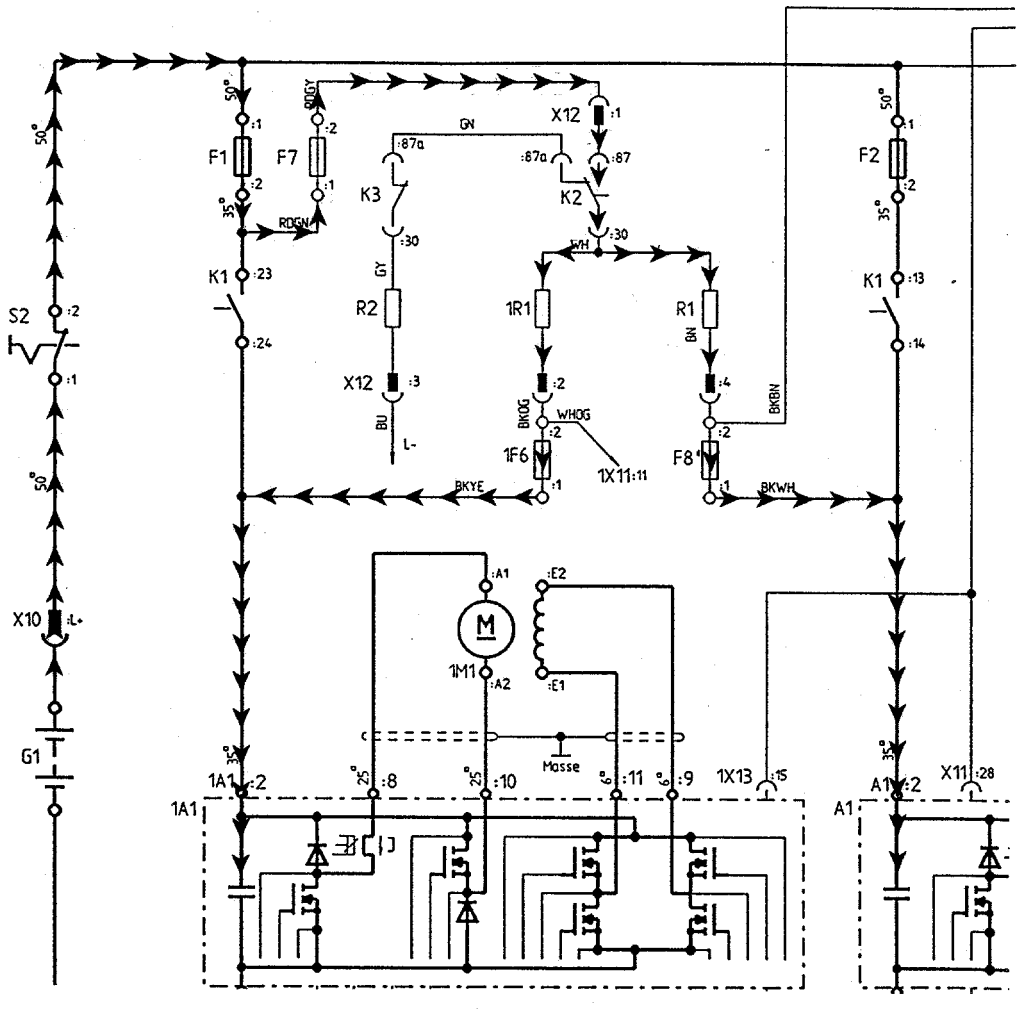
6.1.3 MAIN CURRENT UNIT

6.1.3.1 SWITCHING ON AND CHARGING THE INTERMEDIATE CIRCUIT CAPACITORS

The intermediate circuit capacitors are located in the two power units. In order to prevent a very strong charging current flowing across the contactor contacts when the main contactor K1 is switched on, the capacitors are pre-charged before the contacts of K1 are closed.

This pre-charging is carried out via a charging circuit or via the relays K2 and K3. The charging circuit with the charging and discharging resistors is located in an aluminium housing in the counterweight, together with the electrical system. When the key switch is turned on, the relay K3 is activated via the voltage transformer U1. The relay K2 is directly activated by the drive electronics 1A2. As soon as the two relays are activated, the capacitors in the power units can charge up via the charging resistors 1R1 and R1.

Only when the intermediate circuit capacitors are charged (this is detected via the connection to 1X11:11 and 1X11:1 of the drive electronics) can the activation of the main contactor K1 take place. After that relay K2 is switched off again, since the capacitors are now receiving their charging voltage via the contacts of the main current contactor K1.



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