Orion alpha

System Overview

motion and progress

Reference: 300-P-9010142-E-01/12.06

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1 Introduction

1.1 General

This frequency-controlled hydraulic drive with hydraulic counterweight system is distinguished from conventional hydraulic drives in that the electric motor and pump set is driven at a variable speed, and a second hydraulic pump is permanently mounted on the common motor/pump shaft. The pressure port of this additional pump is connected via a hydraulic control system to a hydraulic accumulator. A pressure switch is mounted between the control system and the hydraulic accumulator. The switch has two switching points that determine the minimum and maximum pressure levels.

Up travel

- Only the amount of oil actually required to achieve the travel speed is supplied (conventional system: constant quantity/bypass)
- Controlled oil flow = less electrical energy consumption
- No bypass = less heating of the oil
- Additional pump functions as a hydraulic motor. The pressure energy in the accumulator generates a torque that helps to raise the car. The electrical supply rating can thus be reduced to a minimum

Down travel

- Electric motor is driven by the pump, i.e. motor is used as a generator
- Additional pump functions as a pump
- The additional pump converts part of the car's potential energy back to pressure energy, which is then fed to the accumulator
- This pressure energy increases the pressure in the accumulator - it will be used in the next up travel
- Less oil heating

1.2 Beringer system

- System is based on LRV-1 technology
- Simple design and construction, only two sensors (flow meter and encoder)
- Standard pumps and motors are used
- Additional pump mounted on same shaft as main pump and electric motor
- No mechanical counterweight in the shaft is needed
- Cost-effective

2 Functional description

2.1 General

The Beringer frequency-controlled hydraulic drive requires two sensors; the flow sensor (Hall sensor) (29) and an encoder (37) to measure the electric motor speed. Using these sensors, it is possible to always achieve the same travel speed, irrespective of load and viscosity, which results in virtually constant travel times between individual floors.

Control of the travel speed is taken over by a digital electronic card (5), which simultaneously controls the frequency inverter (19) and the valve (3).

A second hydraulic pump (40) is mounted on the common electric motor/pump shaft (21/22). This additional pump (40) therefore always runs at the same speed as the electric motor/hydraulic pump-motor combination. The additional pump (40) operates at a very high pressure, but at a low flow rate.

The pressure port of the additional pump (40) is connected through a 2/2 valve (46) or a check valve (42) to a hydraulic accumulator (43) (spherical accumulator). Between additional pump (40) and hydraulic accumulator (43) are fitted a pressure-relief valve (44) to protect the hydraulic accumulator (43) and additional pump (40), a ball valve (48) to drain hydraulic accumulator (43), and a make-up valve (47) to protect the pump against cavitation.

2.2 Up travel

⇒ **Page 7, Chapter 3.1**

Speed during up travel is controlled purely by varying the electric motor/pump speed by means of the frequency inverter (19) and digital electronic card (5). Throughout the whole travel, the actual travel speed is measured by the flow sensor (29) and controlled by the digital electronic card (5) in accordance with the theoretical travel curve.

At the start of up travel, the electric motor (21) slowly begins to rotate and builds up a gradually rising pressure between pump (22) and valve (3). Via the energised 2/2 valve (46), the pressure energy in hydraulic accumulator (43) acts on additional pump (40). The direction of flow through this pump (40) is opposite to that through main pump (22). The accumulator pressure on pump (40) develops a torque on the drive shaft which helps to drive main pump (22). The torque required from electric motor (21) will be reduced in proportion to the amount that is generated by additional pump (40). Since torque is directly related to current, the current required by the electric motor (21) will be reduced. This reduction is a function of the efficiency of the pumps used, and of the main electric motor. Consequently it may be possible to utilise smaller electric motors, smaller frequency inverters and, above all, lower electrical supply ratings and smaller cable sizes.

Pressure-relief valve (44), make-up valve (47) and pressure switch (45) are responsible for important functional and safety-related features during up travel and during the time that the car is stationary at a landing. Pressure-relief valve (44) protects the hydraulic accumulator (43) and additional pump (40) against excessive pressures, pressure switch (45) monitors the pressure in hydraulic accumulator (43) in normal operation and, if the pressure is too low, initiates charging of the hydraulic accumulator (43). When the maximum pressure is reached, charging of the hydraulic accumulator (43) is terminated by pressure switch (45).

2.3 Down travel

⇒ **Page 8, Chapter 3.2**

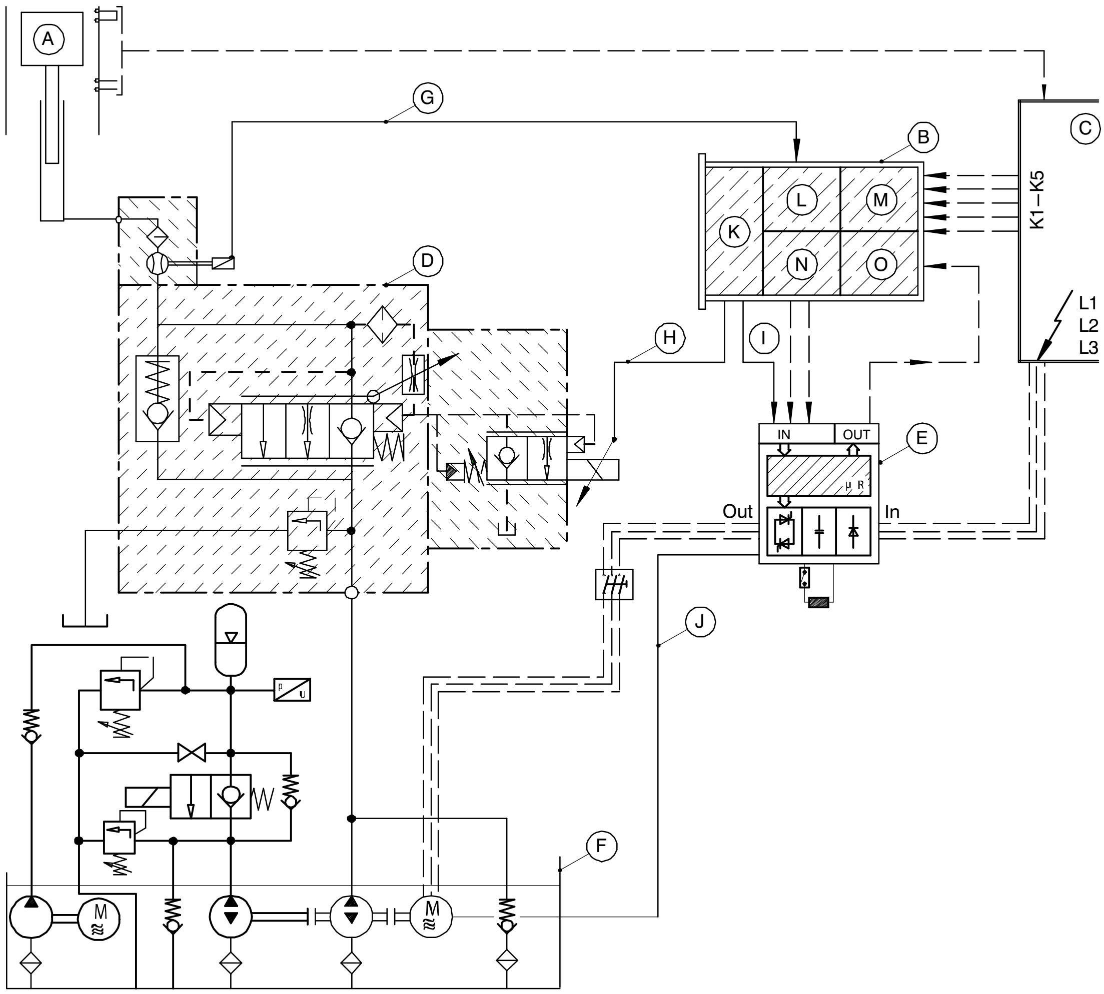
During the starting and stopping phases of down-travel, the speed is controlled by valve (3). During all other phases of down travel, it is achieved by controlling the speed of the electric motor and hydraulic pump-motor. Throughout the whole travel, the actual travel speed is measured by the flow sensor (29) and controlled by the digital electronic card (5) in accordance with the theoretical travel curve.

At the beginning of down travel, proportional solenoid (35) opens pilot control valve (34), which in turn opens main control valve (33). During this phase, electric motor (21) rotates backwards at a low, constant speed, and additional pump (40) rotates forward at the same speed.

Via check valve (42), the pressure in hydraulic accumulator (43) is increased. In order to protect pump (22), a make-up valve (24) is fitted to allow pump (22) to draw up oil at the beginning of travel. When a preset travel speed is reached, the main control valve (33) is completely opened by pilot control valve (34), and from that point onwards the travel speed is controlled by pump (22), electric motor (21) and frequency inverter (19).

Pump (22) functions as a hydraulic motor, and the torque developed by pump-motor (22) is then used to boost the pressure in accumulator (43). The lift car's potential energy is not converted into electrical energy, but is instead used to increase the pressure in hydraulic accumulator (43). This pressure energy is used to reduce energy consumption during the subsequent up travel. During deceleration, pilot control valve (34) progressively closes main control valve (33) until it once again takes over control of the travel speed until the car stops.

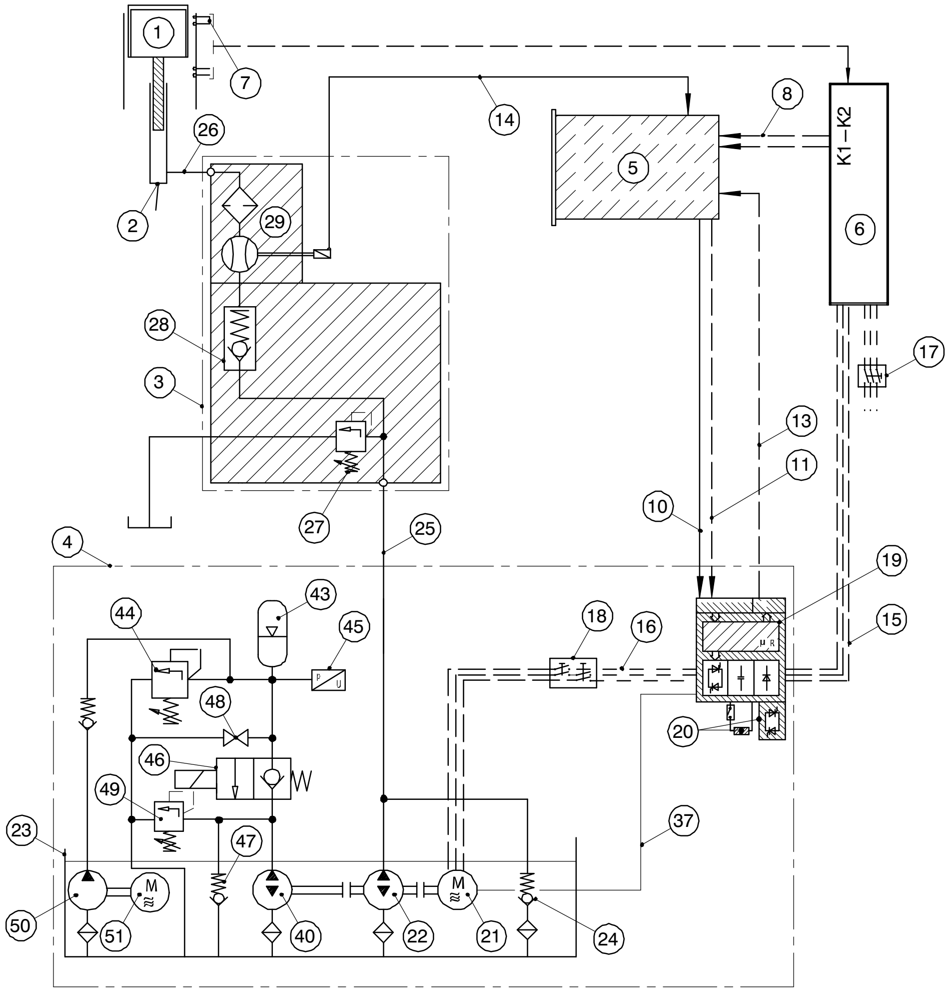
Pressure-relief valve (44), make-up valve (47) (⇒ page 7) and pressure switch (45) are responsible for important functional and safety-related features during up travel and during the time that the car is stationary at a landing. Pressure-relief valve (44) protects the hydraulic accumulator (43) and additional pump (40) against excessive pressures, pressure switch (45) monitors the pressure in hydraulic accumulator (43) in normal operation and, if the pressure is too low, initiates charging of the hydraulic accumulator (43). When the maximum pressure is rea-ched, charging of the hydraulic accumulator (43) is terminated by pressure switch (45).



3 System overview

Fig. 1 300-4-10010514

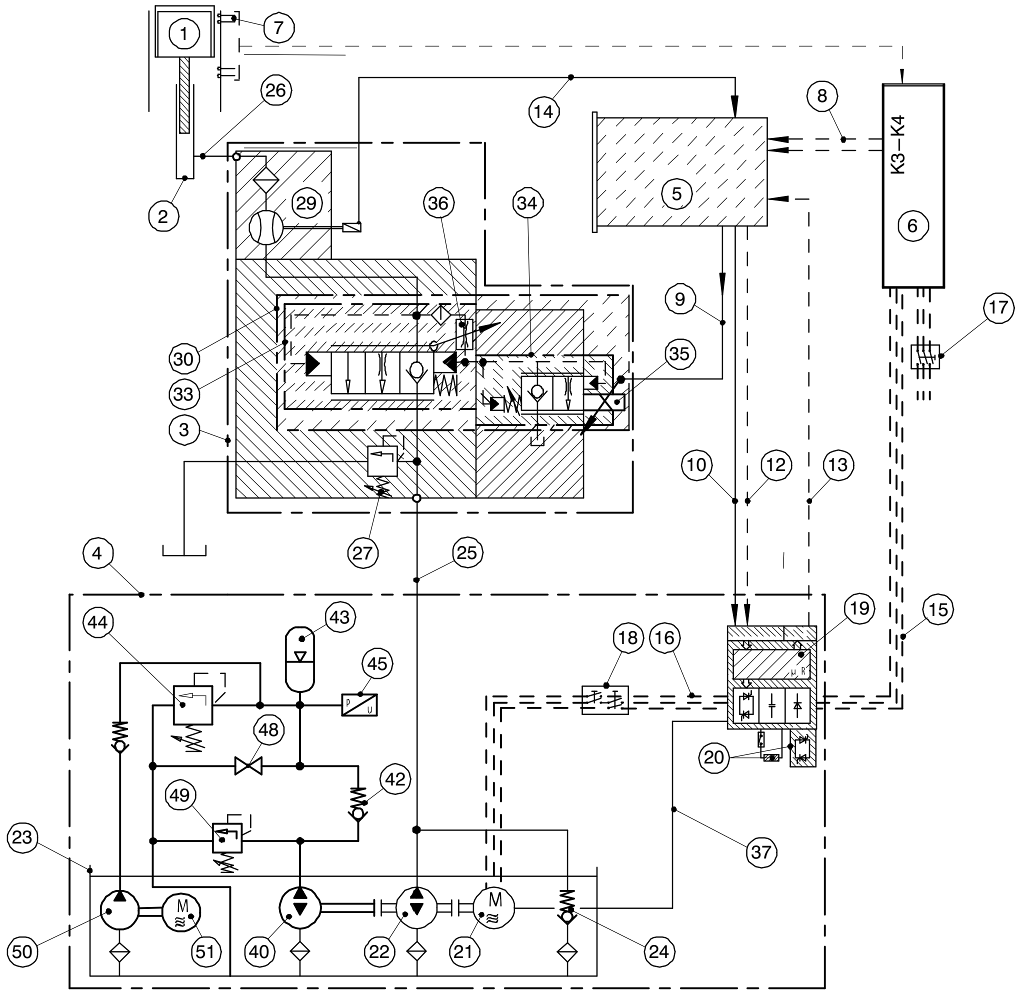
Legend				
	A	Car	**I**	Inverter frequency setting
	B	DELCON	**J**	Encoder
	C	Lift controller	**K**	Power
	D	VF-LRV	**L**	Controller
	E	Frequency inverter	**M**	Logic
	F	Hydraulic power unit	**N**	Sequencer
	G	Flow feedback	**O**	Safety
	H	Current to proportional solenoid		



3.1 Schematic diagram - up travel

Fig. 2 300-4-10010529

1	Car	**16**	Motor power supply	**28**	Check valve
2	Cylinder	**17**	Main switch	**29**	Flow meter
3	Valve	**18**	Motor contactors	**37**	Encoder
4	Hydraulic power unit	**19**	Frequency inverter	**40**	Additional pump
5	DELCON	**20**	Braking resistor or regeneration unit	**43**	Hydraulic accumulator
6	Lift controller			**44**	Pressure relief valve
7	Shaft switches	**21**	Electric motor	**45**	Pressure switch
8	Travel command	**22**	Pump	**46**	2/2 solenoid valve
10	Control signal to inverter	**23**	Oil tank	**47**	Make-up valve
11	Forward signal	**24**	Make-up valve	**48**	Shut off valve
13	Safety signal	**25**	Pump pipe/hose	**49**	Pressure relief valve
14	Flow feedback	**26**	Cylinder pipe/hose	**50**	Leakage oil pump
15	Mains power supply	**27**	Pressure relief valve	**51**	Leakage oil motor



3.2 Schematic diagram - down travel

Fig. 3 300-4-10010532

1	Car	**16**	Motor power supply	**30**	Down valve
2	Cylinder	**17**	Main switch	**33**	Main control valve
3	Valve	**18**	Motor contactors	**34**	Pilot valve
4	Hydraulic power unit	**19**	Frequency inverter	**35**	Proportional solenoid
5	DELCON	**20**	Braking resistor or regeneration unit	**36**	Special jet
6	Lift controller			**37**	Encoder
7	Shaft switches	**21**	Electric motor	**40**	Additional pump
8	Travel command	**22**	Pump	**42**	Check valve
9	Control signal to solenoid	**23**	Oil tank	**43**	Hydraulic accumulator
10	Control signal to inverter	**24**	Make-up valve	**44**	Pressure relief valve
12	Reverse signal	**25**	Pump pipe/hose	**45**	Pressure switch
13	Safety signal	**26**	Cylinder pipe/hose	**48**	Shut off valve
14	Flow feedback	**27**	Pressure relief valve	**49**	Pressure relief valve
15	Mains power supply	**29**	Flow meter	**50**	Leakage oil pump
				51	Leakage oil motor

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