Hydraulically Actuated Clutch/Brake Combinations

HERION *Systemtechnik GmbH*

Series KB 03 - KB 600
Operating pressure: 60 bar (70 bar)

750**3099**.06.11.06

Application

Clutch/brake combinations for the operation of eccentric presses and similar mechanically-driven machines.

Torque capacities:

Clutch	**T_{CL} = 3000 - 670000 Nm**
Brake	**T_{BK} = 1200 - 250000 Nm**

Technical features

- Type-tested
- Virtually wear-free
- Low operating noise level
- Short switching times
- Constant braking angle
- High permissible switching frequency
- Low intrinsic moment of inertia
- Low energy consumption
- Low maintenance costs
- No pollution in the form of abraded particles
- No oily compressed air
- Leakproof piston/cylinder system, resulting in low consumption of hydraulic fluid
- Available on request as clamp-fitting version
- Special internal cooling to deal with high thermal loads

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Contents

General remarks

Wet-running clutch/brake combinations of multi-plate design.
Hydraulic clutch operation, braking by spring force.
One fitted brake.
Splash cooling or internal oil cooling.
Versions available with stationary and rotating housing.

Type-tested in accordance with EN 692 “Safety of Mechanical Presses” and EU Machinery Directive 89/392.

Safety instructions

These hydraulic clutch/brake combinations (referred to in the following as CBCs) are highly versatile and can be fitted to a very wide range of machines.
Please therefore observe the safety regulations applicable to your particular application.

When operating a CBC, and during all installation, servicing and maintenance work, be sure to observe the following instructions in order to avoid the risk of accidents and injury:

- During all maintenance and repair work on the CBC, ensure that the machine to which the combination is fitted is at a standstill and that the machine’s master switch is off and secured against unintentional reclosure.
- The press ram must be locked into place during all work on the CBC.
- Be sure to observe not only the European standard EN 692 governing mechanical presses but also the EU machinery directive 89/392 and the European standards EN 574 for two-hand controls or EN 954-1 covering machine safety.
- Do not exceed the maximum permissible speed.
- Do not allow the fluid temperature in the clutch housing to exceed 80 °C.
- Do not exceed an operating pressure of 60 bar (70). Excessive pressure may lead to irreparable damage to the CBC. Do not use excess pressure for even a short time, for example to free jammed tools.
- Ensure that the pressure and cooling fluid lines are free of leaks.
- Observe the relevant safety and operating instructions when fitting accessories for the supply of pressure and cooling fluid.
- Rotating components must be covered to prevent persons from touching these.
- There is a risk of scalding if repair or maintenance work is carried out on the CBC when this is at working temperature.
- Careless dismantling of the CBC may lead to injury. Not when dismantling the CBC that the unit is subject to considerable spring tension.
- The brake may fail to operate if bolts are allowed to work loose. Ensure that all tightening torque values are correct.
- Ensure that bolt-securing devices are used.

Modifications to the CBC may be carried out only with the express permission of the manufacturer.
If operators intend to exceed the specified load limits, they must consult the CBC manufacturer beforehand. The manufacturer will on request provide technicians to carry out repair and servicing work. This prevents faults which could result from work carried out by untrained personnel.

Design and operation

The CBC is a hydraulically-actuated wet-running clutch/brake combination consisting of a spring-loaded brake and a hydraulically-operated clutch, each of multiplate design.

The clutch and brake have a common piston and are actuated in alternation.

In the braking position, the cylinder chamber is relieved of pressure; the brake is operated by spring assemblies acting via the piston.

During clutch engagement, the piston is pressurised. The force of the piston acts against the spring forces. When these have been overcome, the brake is released.

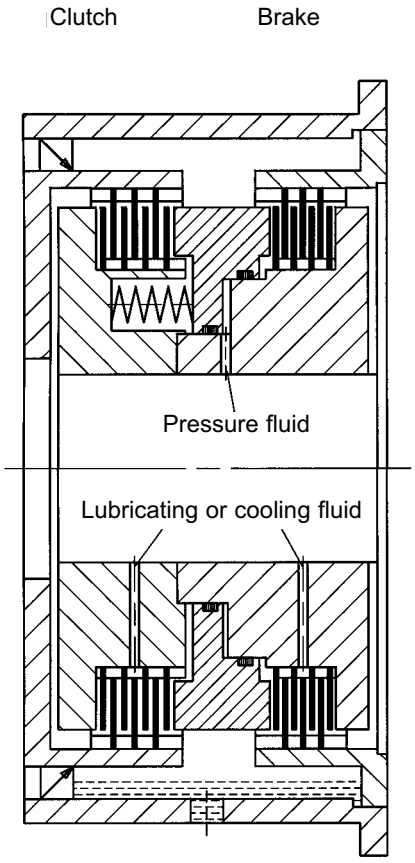
As the pressure continues to rise, the clutch is engaged.

The external ring gear of the clutch engages with the flywheel, and the external ring gear of the brake engages with the machine frame.

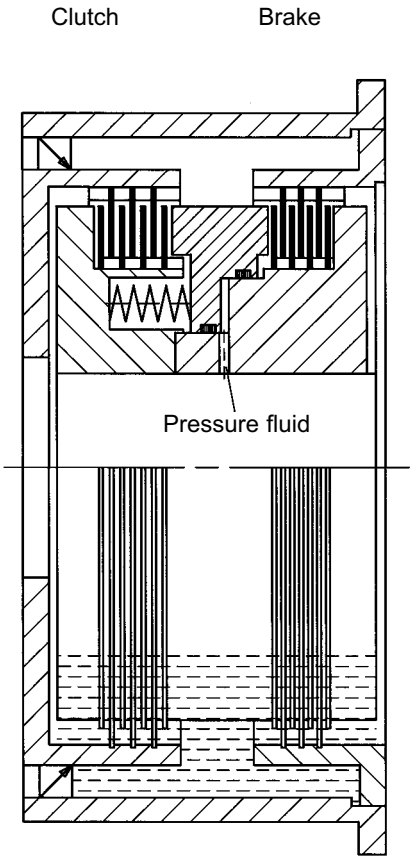
In the case of the version with internal cooling, the plates are lubricated and cooled by a second fluid loop which is independent of the pressure fluid.

In the case of the verion with splash lubrication, the plates are cooled by fluid in the sump of the housing.

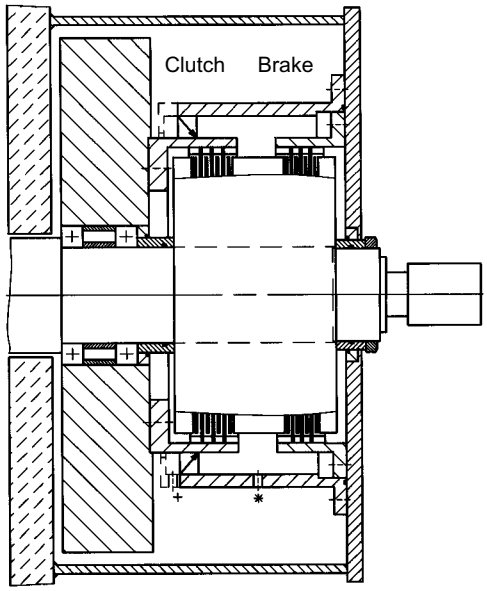
Version with internal cooling

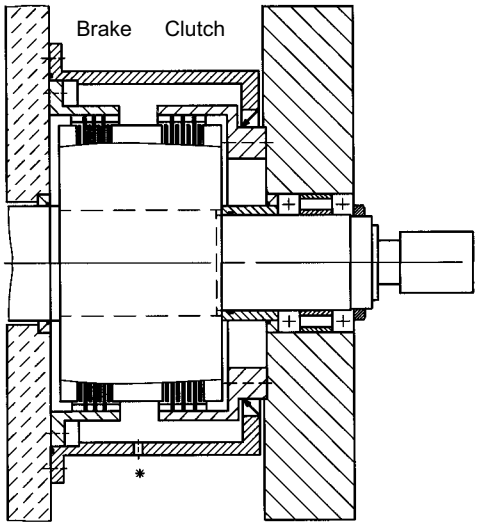


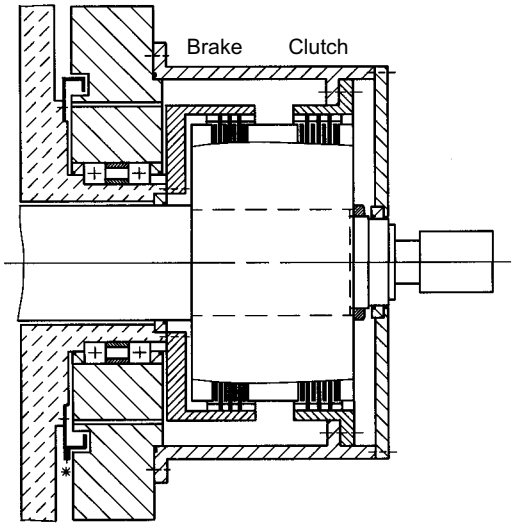
Version with splash lubrication



Installation options







* Lubricating or cooling fluid return line
\+ Leakage line connection

Installation on end of shaft

Example with NON-ROTATING housing

The external ring gear of the brake and the housing are installed on the machine frame. This requires a support which engages in the flywheel.

Installation between press frame and flywheel

The external ring gear of the brake and the housing are directly connected to the press frame.

Example with ROTATING housing. Braking torque absorbed by hollow support (neck journal)

The combination one installed in this case is a mirror image of the installation described above.

The external ring gear of the brake is connected to the press frame via the neck journal.

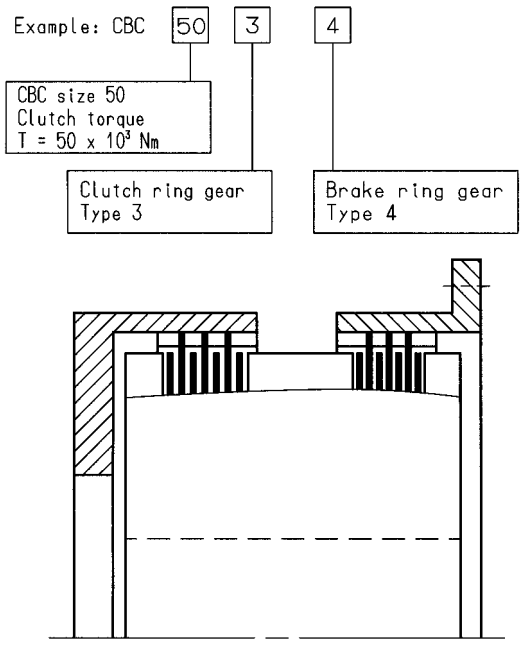
The clutch torque is transmitted via the rotating housing.

This installation option does not require a support around the flywheel to absorb the braking torque.

Types of ring gear

In order to provide a large number of installtion options, four standard ring gears (see page 9) are available for each size of CBC. Each of these ring gears can be fitted to either the clutch or brake. The connecting bores for types 1 to 3 are drilled to customers' specifications.

The clutch torque and the type of clutch and brake ring gear are indicated in the numerical code.



CBC Size	Ring gear (mass of different versions) **1** [kg]	**2** [kg]	**3** [kg]	**4** [kg]
03	11	8.5	6	3.6
05	11.5	9	6.5	4.2
07	20	15.5	11	6
10	21	16.5	12	7
12	42	33	24	13
20	44	35	26	15
25	62	48.5	35	21
40	65	51.5	38	24
50	118	92.5	67	36
80	124	98.5	73	42
100	275	-	-	85
180	310	-	-	137
300	600	-	-	175
600	-	-	-	400

Fitting instructions

Preparatory work for fitting is carried out in the factory.

The ring gears should be bolted to the machine frame or flywheel and pinned in place.

The operating pressure is 60 bar (max. 70 bar).

The spring reset pressure is approx 18 bar.

Installation is possible only with horizontal shaft.

In the standard version, the bore of the clutch/brake combinations has two slots in accordance with DIN 6885 Sheet 1 at 180 intervals (other slots can be provided on request).

A clamp-fitting version is available on request.

Pressure-fluid bores are arranged at 90° to the feather-key slot in each case.

Internal cooling bores are provided in sizes up to 50 on request. In the case of size 50 and larger, they are provided as standard.

In the case of the version with splash lubrication, observe the instructions given on page 10.

Oil recommendation:
Hydraulic oil HL DIN 51524 part 1 viscosity 32 + 46
Alternatively oil: HLP DIN 51524 part 2 can be used if the additive of the oil is on the basis of zincdithio-phosphate.

Selection of clutch/brake combination

This depends essentially on:

- the clutch torque to be transmitted
- the braking angle
- the switching work involved.

The formulae given on the next page are adequate for an approximate selection of a clutch/brake combination.

In order to allow us to offer a CBC matched perfectly to your specific drive conditions, we would ask you to complete the questionnaire on the last page of this brochure and return this to us.

Clutch torque capacity

The clutch torque capacity T_{CL} is an important criterion for the selection of an appropriate size of CBC. The following simplified formula can be used for approximate calculation purposes:

$$T_{CL} = F \times \frac{H}{2} \times \sin\alpha \frac{n_{Ex}}{n_{CBC}} \times f\,[Nm]$$

in which

F [kN] = Nominal press force

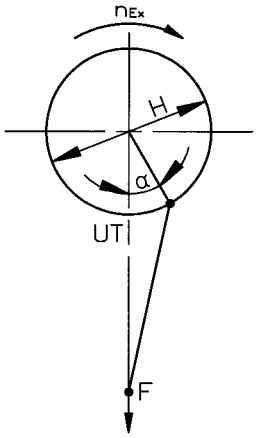
H [mm] = Stroke of eccentric

α [degrees] = Working angle before bottom dead centre

n_{EX} [rpm] = Rotary speed of eccentric press

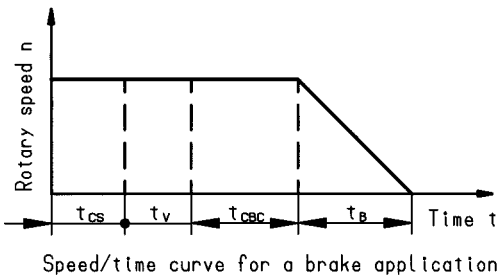
n_{CBC} [rpm] = Rotary speed of CBS

f [-] = Factor for torque losses on press.



Braking angle

If a press is turning at the rotary speed n and a braking command is then received, the result is as follows: The signal passes through the control system, requiring the time t_{St}. When the signal then reached the valve, it requires the time t_v to act on the pressure fluid. The stroke of the piston of the clutch/brake combination takes the time t_{CBC}. The brake slippage time t_{CBC} then starts; this is the phase which produces a change in shaft speed.



Speed/time curve for a brake application

The total braking angle of the clutch/brake combination is calculated as follows:

$$\varphi_{CBC} = 3 \cdot n_{CBC}\,[2 \cdot (t_{cs} + t_V + t_{CBC}) + t_B]\,[\text{degrees}]$$

n_{CBC} [rpm] = Rotary speed of clutch/brake combination

t_{CS} [s] = Control system signal transit time. This value depends on the components used.

t_V [s] = Valve signal transit time. This value also depends on the component used.

t_{CBC} [s] = Clutch/brake combination signal transit time. This value is a design parameter and is used by the factory as appropriate to the application in question.

$$t[s] = \frac{n_{CBC} \times I_{total}}{9.55 \times T_{SB}}$$ Brake slippage time

I_{total} [kgm²] = The moment of inertia of press and CBC to be braked (see “Switching work”).

T_{sB} [Nm] = Switchable braking torque.

The total braking angle for the eccentric shaft φ_{EX} of a back-geared press is calculated as follows:

$$\varphi_{Ex} = \varphi_{CBC} \times \frac{n_{Ex}}{n_{CBC}}\ [\text{degrees}]$$

n_{EX} [rpm] = Rotary speed of eccentric shaft

Switching work

The switching work per hour W_h carried out during clutch operation or braking is represented by this formula:

$$W_h = W_{SWI} \cdot z \cdot 60\ [J]$$

$$W_{SWI}\,[J] = \frac{I_{total} \times n^2_{CBC}}{182.4}$$ Switching work per clutch or brake operation

I_{total} [kgm²] = Moment of inertia of all press masses requiring braking, reduced to the shaft of the CBC plus the moment of inertia of the combination requiring braking

n_{CBC} [rpm] = Rotary speed of CBC

z [1/min] = Number of switching operations per minute

The total heat generation per hour W_{htotal} is calculated from the switching work per hour carried out by the clutch and brake together:

$W_{htotal} = 2 \cdot W_h$ [J]

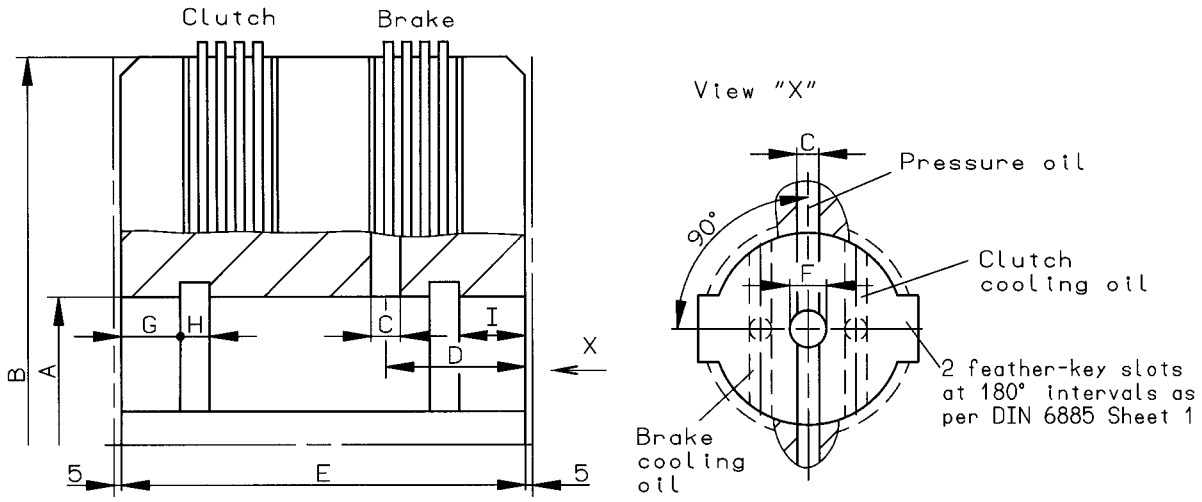
This does not include allowance for heat generation at idle running. This results with the clutch plates open from the fluid passing through. The value depends on a number of factors and is therefore calculated by the factory on a case-by-case basis.

The heat generated is discharged to the atmosphere via the surface of the hydraulic system. If it is not possible to discharge all the heat in this way, a suitably-dimensioned cooler must be fitted.

Selection table showing available sizes

Clutch/brake combination	Torque Clutch (T_C)	Brake (T_B)	Max. rotary speed	Cylinder volume	I internal	Mass of internal clutch	Brake spring force
Size	[Nm]	[Nm]	[rpm]	[cm^3]	[kgm^2]	[kg]	[bar]
03	3250 3500	1200 1000	1700	10	0.09	17.5	17 14
05	4800 5200	1700 1400	1700	14	0.1	21	17 14
07	6800 7250 7700 8200	2350 1950 1560 1170	1300	17	0.32	37	16 14 11 8
10	10000 10700 11500 12200	3300 2750 2200 1650	1300	23	0.36	44	16 14 11 8
12	13700 14800 15900 17000	5300 4420 3530 2650	1000	27	1.1	75	18 15 12 9
20	20200 21950 23650 25300	7400 6180 4950 3700	1000	38	1.2	90	18 15 12 9
25	26700 28800 30900 33000	10200 8500 6800 5100	850	49	3.0	136	18 15 12 9
40	40000 42700 45900 49100	14300 11900 9520 7140	850	69	3.3	164	18 15 12 9
50	53500 57650	20300 16900	680	93	8.0	250	17 14
80	80000 85500	28400 23670	680	130	9.0	303	17 14
100 100 L	100000 122800 113000	45700 34300 59800	500	170 280	22.0 27.8	685 870	20 15 16
180 180 K	180000 215600 180000	71500 53680 42940	500	280	33.5 27.8	1050 870	19 14 19
300 300 K	390000 390000	145650 72825	420 420	450 450	115 95	1780 1490	19 19
600 600 K	670000 670000	250000 125000	350 350	610 610	276 234	3050 2585	19 19

(T_C) = Static coupling torque at 60 bar. (T_B) = Dynamic braking torque

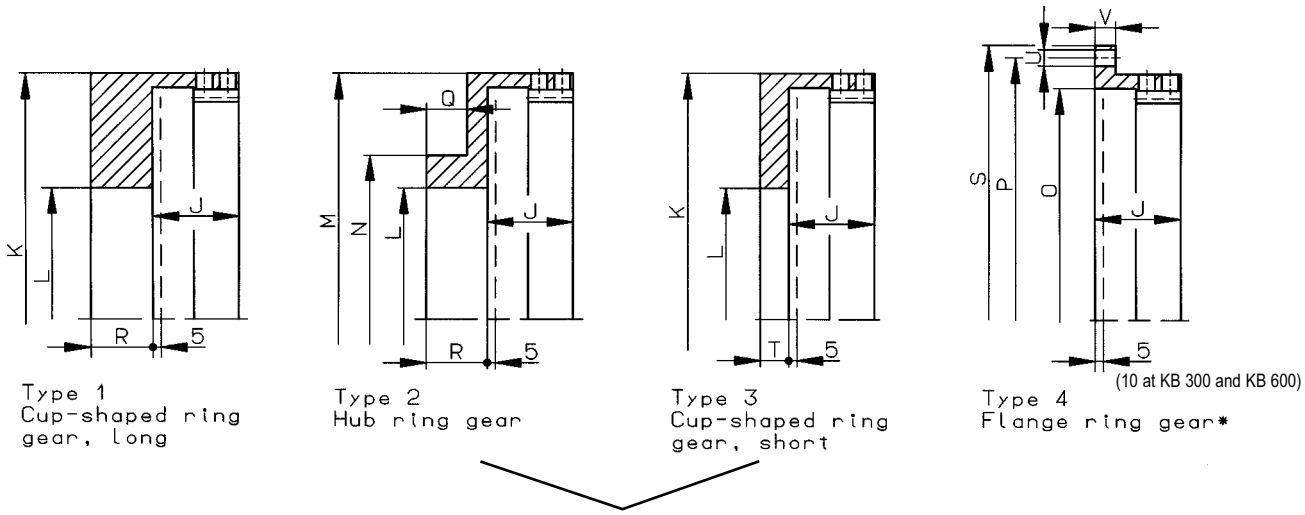


Dimensional table for internal clutch (mm)

CBC size	Internal clutch dimensions Option							Optional internal oil cooling *		
	A min.	A max.	B	C	D	E	F	G	H	I
03	45	80	196	6	31	110	8.5	20	10	12
05	45	80	196	6	31	126.5	8.5	20	10	12
07	60	100	254	8	36	135	12	25	12	14
10	60	100	254	8	36	158	12	20	12	14
12	75	125	320	10	48	170	14	30	15	23
20	75	125	320	10	48	196	14	30	15	23
25	95	160	394	12	60	205	16	42	15	25
40	95	160	394	12	60	237	16	40	15	25
50	145	200	496	15	65	230	18	64	15	23
80	145	200	496	15	65	266	18	88	15	23
100	180	250	600	18	82	290	24	72	22	38
180	180	250	600	18	160	445	24	115	20	43
300	250	310	780	24	195	530	30	74	24	41
600	280	380	930	28	232	640	32	83	24	58

*) See installation instructions page 5.

Standard ring gears



Dimensional table for standard ring gears (mm)

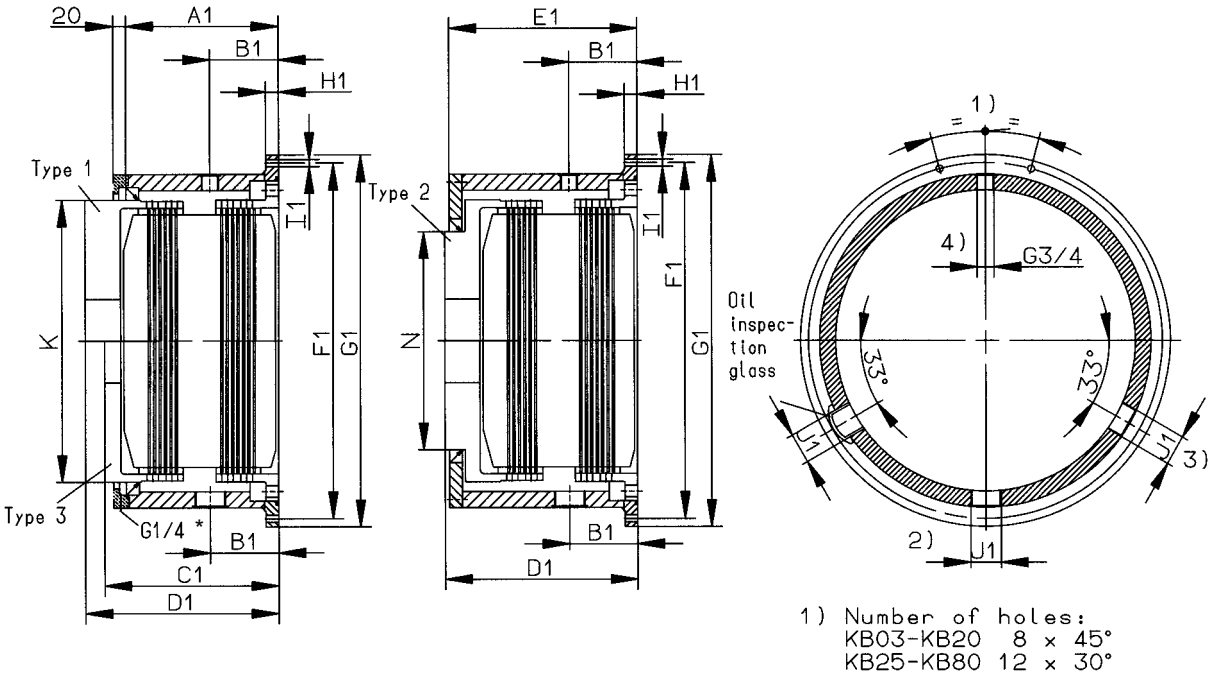
CBC size	Ring gear dimensions												
	J	K f7	L min.	M	N f7	O H7	P	Q	R	S f7	T	U*) 12 x	V
03	44	230	80	232	160	215	245	23	35	260	16	9	11
05	53	230	80	232	160	215	245	22	35	260	16	9	11
07	57	290	80	292	200	275	310	22	40	330	18	11	12
10	69	290	80	292	200	275	310	22	40	330	18	11	12
12	65	380	100	382	250	350	400	25	45	425	20	14	16
20	82	380	100	382	250	350	400	25	45	425	20	14	16
25	81	440	130	442	300	415	470	30	55	500	25	18	20
40	98	440	130	442	300	415	470	30	55	500	25	18	20
50	93	560	165	562	360	530	590	30	65	630	30	22	25
80	115	560	165	562	360	530	590	30	65	630	30	22	25
100	132	702	250	-	-	670	750	-	80	800	-	30 [1)]	30
180	210	702	250	-	-	670	750	-	80	800	-	30 [2)]	30
300	248	872	350	-	-	830	930	-	120	990	-	33 [2)]	40
600	305	-	-	-	-	1000	1115	-	-	1180	-	36 [2)]	50

*) Plus 2 dowel pins of same diameter as bolts (holes pre-drilled).
If the design 4 will be used for the clutch, the number of bolts has to be calculated according the clutch torque.

[1)] Clutch 16 x
Brake 8 x

[2)] Clutch 24 x
Brake 12 x

Clutch housing



* Leakage-oil discharge possible with CB sizes 03-20 only with type 1

Dimensional table for clutch housing

CB size	Clutch housings with standard ring gears												Mass of type 2
	K f7	N f7	I 1	F 1	G 1 f7	H 1	A 1	B1	C 1	D 1	E 1	J 1	kg
03	230	160	9	305	325	11	122	60	136	155	150	G 3/4	20
05	230	160	9	305	325	11	138.5	60	152.5	171.5	166,5	G 3/4	22
7	290	200	11	385	410	12	139	70	163	185	180	G 1	37
10	290	200	11	385	410	12	160	70	186	208	201	G 1	41
12	380	250	11	480	505	16	186	90	200	225	220	G 1 1/4	50
20	380	250	11	480	505	16	212	90	226	251	246	G 1 1/4	64
25	440	300	11	555	580	20	206	107	240	270	265	G 1 1/2	97
40	440	300	11	555	580	20	238	107	240	302	297	G 1 1/2	107
50	560	360	11	685	710	25	236	107	270	305	300	G 1 1/2	147
80	560	360	11	685	710	25	272	107	306	341	336	G 1 1/2	160

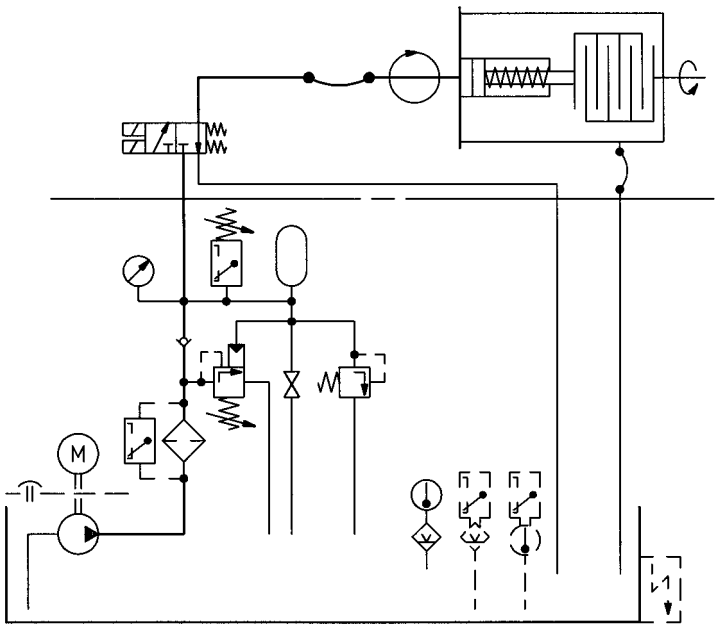
Max. peripheral speed at shaft seal 10 m/s.

2) Return line in the case of internal cooling
3) Return line in the case of immersion cooling. Depending on the cooling fluid return line, the inspection glass can be fitted on the left or right. Before commissioning, the housing must be filled with fluid up to the inspection glass. The return line connection which is not being used must be blanked off.
4) Connection to switching chamber of clutch/brake combination to allow fluid exchange in the case of immersion lubrication or for external cooling.

If the installation option with rotating housing is selected, we supply special dimensional drawings for the application in question.

Housings for CB 100, CB 180, CB 300 and CB 600 on request.

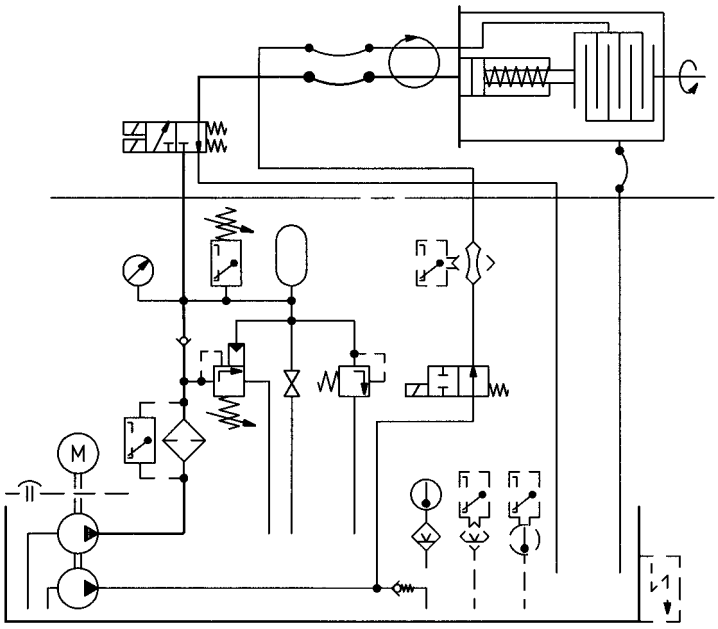
A 1



Connection diagram 1

Standard circuit for clutch/brake combinations with splash lubrication

A 2



Connection diagram 2

Standard circuit for clutch/brake combinations with separate lubricating or cooling oil circuit.

The circuit diagrams shown are standard circuits which can be adapted to any given application.

HERION System Technology can supply a complete system:

- **Clutch/brake combinations (CBCs)**
- **Housings**
- **Oil supply systems**
- **Press safety valves**
- **Hydraulic power units**
- **Cushioning modules for smooth clutch and brake operation**

++ Fax to HERION Systemtechnik GmbH: 07 11 / 5 20 93 85 ++

Questionnaire for hydraulically-actuated clutch/brake combination

Supplier

HERION Systemtechnik GmbH
Unter Talstraße 65
71263 Weil der Stadt (Merklingen)
Germany

Fax: 07 11 / 5 20 93 85

Customer's address:

Tel.:

Department:

Contact person:

Date:

Description

Type of press:

Model:

Installation/combination

- ❒ On end of shaft
- ❒ Brake fitted to next journal
- ❒ Between frame and flywheel

Technical data for press

Max. press force	F	=		kN
Eccentric stroke	H	=		mm
Connecting-rod length	l	=		mm
Working angle before bottom dead centre	α	=		degrees
or: Working stroke	h	=		mm
Min. speed of eccentric shaft	Min. n_{Ex}	=		rpm
Max. speed of eccentric shaft	Max. n_{Ex}	=		rpm
Speed of eccentric shaft during setting-up	n_{Ex}	=		rpm
Min. speed of clutch/brake combination	Min. n_{CBC}	=		rpm
Max. speed of clutch/brake combination	Max. n_{CBC}	=		rpm
Moment of inertia of all press masses requiring braking reduced to the shaft of the clutch/brake combination but without the moments of inertia of the combination	I	=		kgm^2
Electrical control system reaction time	t_E	=		s
or: Type of control system, e.g. contactor, relay or electronic control				
Switching frequency per minute with single stroke operation at max. speed	z	=		cycles/min

Braking data

Desired total braking angle for eccentric shaft including allowance for electrical control system reaction time	φ_{Ex}	=		degrees
Desired total braking time including allowance for electrical control system reaction time	t_{total}	=		s

Description of press operating mode