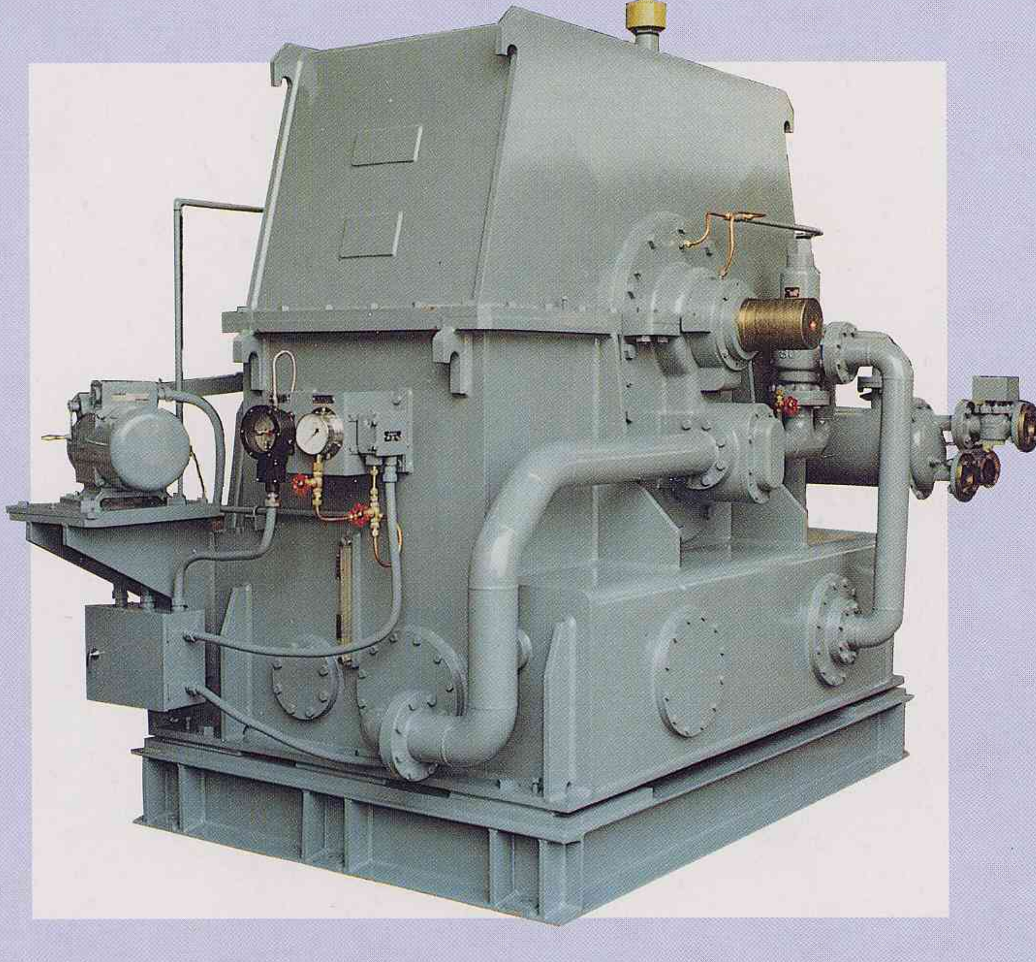
EBARA

CS5130EI

Variable Speed Fluid Coupling

Save energy in pumps and fans!

Model HCLV



Introduction

Is your rotary machinery (pumps, fans and the like) being operated at full capacity?
If so, why not consider using equipment that will make their operation more efficient.
If many machines have a small but unneeded extra power requirement, the total annual power cost for all the machines will add up to a large sum of money, even though the individual extra power requirements are small.
Usually, the flow and pressure of pumps and fans are controlled by means of valves and bypasses, or in some cases pumps or fans are arranged in parallel to cope with large loads. However, a speed control system is much more efficient than these methods and can achieve considerable savings in electric power.
The ideal equipment for speed control is the EBARA Variable Speed Fluid Coupling. EBARA has sold a great many of these couplings, which are now in use in many fields of industry and have received much praise as energy-saving devices.

Contents

Features

1 Stepless speed control over a wide speed range

When combined with an inexpensive constant-speed type squirrel cage motor, the EBARA fluid coupling provides stepless control of the speed of the driven machine (pump or fan). This is achieved by using a scoop tube to increase or decrease the amount of oil inside the fluid coupling.
Speed control range is 100%-25% (in the case of parabolic torque characteristics)

2 Reduced Motor Costs

When starting a fan which has large inertia, the oil level of the EBARA fluid coupling can be reduced almost to zero, by setting the scoop tube in the minimum speed position. As a result, the motor can be started under near-zero load conditions. This permits the use of an inexpensive squirrel-cage motor.

3 Easy Maintenance

The EBARA Fluid Coupling transmits power through a fluid (turbine oil), and has no wearing parts, in contrast to a variable speed clutch. Therefore, the fluid coupling is easy to maintain and inspect and is highly reliable.

4 Cushion Effect

Power is transmitted through a fluid (turbine oil), so the cushioning effect of the fluid absorbs vibrations and shocks from the motor and the driven machine, providing smooth power transmission and greatly prolonging the service life of the machinery coupled by the coupling.

5 Clutch Function

By adjusting the volume of the circulation oil, the level of the oil inside the coupling can be reduced almost to zero. When this happens, the speed of the driven machine can be reduced to less than 10% of its rated speed, which means that the coupling can also function as a clutch.

6 Higher Efficiency

Power transmission loss in the EBARA fluid coupling consists only of slip loss and bearing loss. This means it can achieve efficiency as high as 96 or 97% under rated conditions.

7 Simple Control

The EBARA Fluid Coupling can be automatically controlled by a 4-20mA control signal sent to the actuator.
Remote control can be easily applied.

8 No Need for Auxiliary Power Supply

The EBARA Fluid Coupling is equipped with a highly reliable gear-type oil pump which does not require a special power supply.

9 Reduced Fan Maintenance Costs

Wear of the fan vanes caused by dust increases proportionally as the cube of the fan speed, so wear is reduced by applying speed control. This prolongs the service life of the vanes.

Characteristics

1. Principles of speed regulation

In the Variable Speed Fluid Coupling, the oil inside the fluid coupling's vanes (impeller and runner) is increased or decreased, by means of a scoop tube, in order to change the transmission torque. In this way, the speed of the driven machine is controlled.
As shown in Fig. 1, oil flowing into the vane is forced out to the circumference by the centrifugal force of the impeller. The oil flows along the circumference, and when it reaches the runner side, it causes the runner to rotate. In the scoop tube chamber, the oil is formed into a cylindrical layer by centrifugal force, and this oil is scooped into the top end of the scoop tube. The thickness of the oil layer depends on the position of the scoop tube.
In Fig. 1-(1), the scoop tube has its port positioned near the axis of rotation, and the vanes are filled with oil. With the transmission torque maximized, the impeller-to-runner turning speed ratio will reach a maximum of 0.97 or 0.98.
Fig. 1-(2) shows the scoop tube port moved to the circumference. The oil in the vanes is scooped up and reduced, and the transmission torque is minimized, with the ratio dropping to a minimum of 0.2 or 0.3. Changing the position of the scoop tube permits stepless control of the driven machine.

■ Fluid Coupling Operation (Fig. 1)

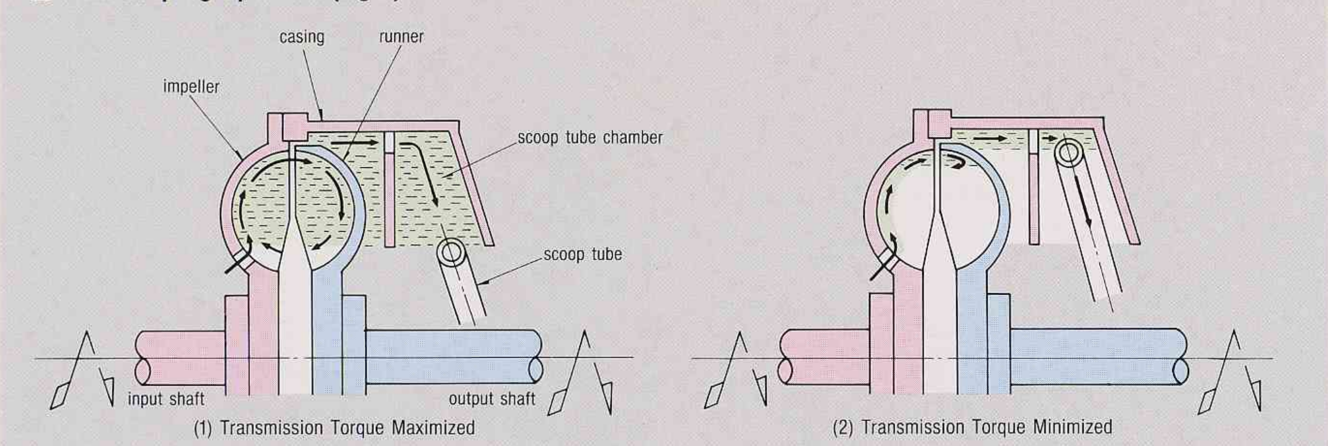


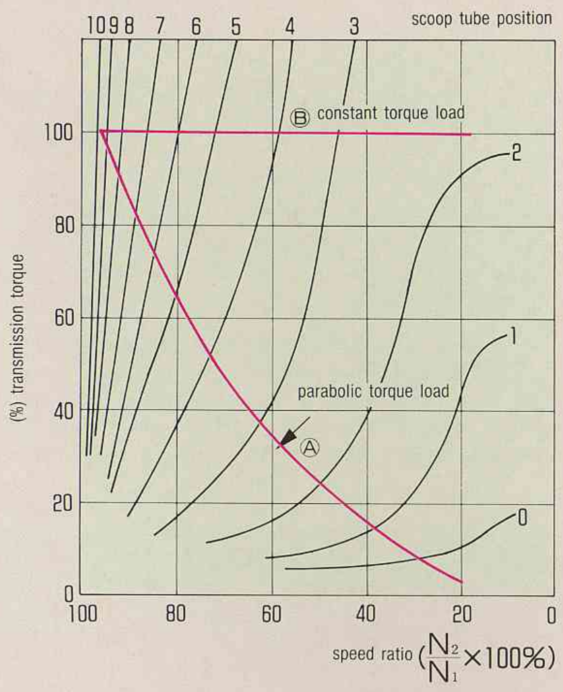
Fig. 2 shows the relation between transmission torque and the speed of the driven machine, when the scoop tube is in different positions.
Curve (A) indicates the torque of a turbo machine with parabolic torque characteristic, e.g. pump or fan.
Curve (B) indicates the torque for a constant-torque load.
The intersection of curves (A) and (B) is the kinetic point.

2. Comparison of Operating Costs

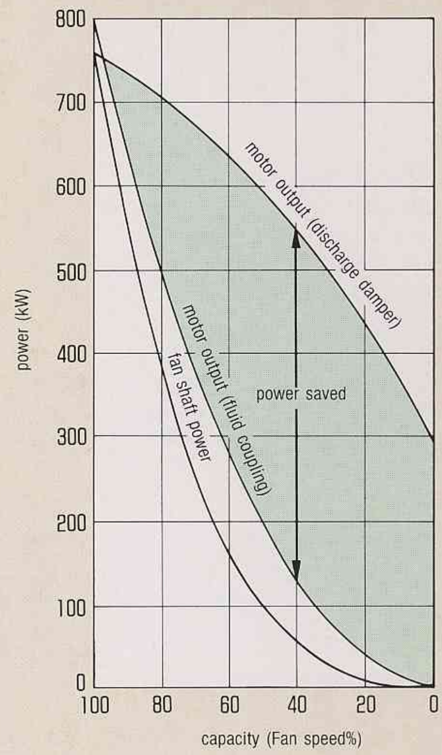
Fig.3 is a comparison between power consumption of the variable speed fluid coupling and that of a discharge damper, both used to control the capacity of a fan.

As shown in the figure, the variable speed fluid coupling saves a considerable amount of power, and effectively contributes to energy saving.

■ Characteristics of Fluid Coupling (Fig.2)



■ A Comparison of Power Consumption (Fig. 3)



3. Calculation of Comparative Operating Costs

Give below is a comparison between the operating costs of a variable speed fluid coupling and a damper, both used with a dust-collecting fan.

■ Specifications of fan

- 2200m^3/min × 1700mmAq [16.67kPa] × 1725min^{-1} × 850kW
- Motor speed: 1780min^{-1}
- Below shaft output: 760kW
- Shaft power at 40% capacity as controlled by a damper: 547kW

■ Operating conditions:

10 minutes in a cycle of 35 minutes at 100% in capacity
25 minutes in a cycle of 35 minutes at 40% in capacity
Operation time: 8000hours/a year

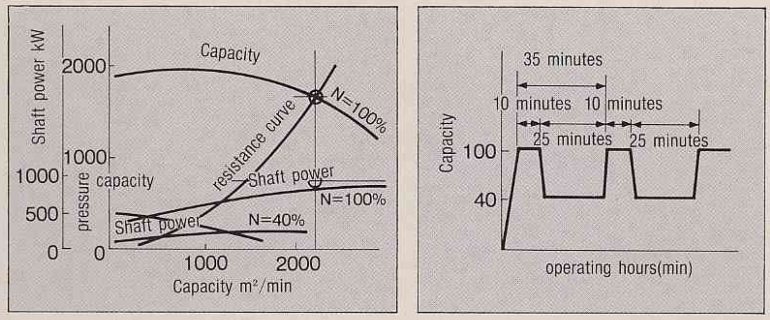
■ Fluid Coupling

Model: HCLV63
Slip: 3.1%

■ Caluculation

Item	Fluid Coupling control		Damper control	
Capacity	100%	40	100	40
Fan shaft power	760kW	49	760	547
Fluid Coupling efficiency	96%	38	——	——
Motor output	792kW	129	760	547
Annual operation hours	2286	5714	2286	5714
Annual power	2,548,000kW·h		4,863,000kW·h	
Power saved	2,315,000kW·h			

■ Fan Performance Curves



SELECTION CHART

EBARA Variable Speed Fluid Coupling

Remarks

1) Codes in capitals (HCLV75, for example) represent the model numbers of EBARA Variable Speed Fluid coupling.
2) Every model allows a maximum slip of approximately 3.5% and a minimum of approximately 2%.
3) An example of fluid coupling selection:
   Motor 800kW × 1780min^{-1}
   Fluid coupling model HCLV63
   Slip approximately 3%
   Output speed $N_2 = 1780 \times (1-0.03) = 1726\text{min}^{-1}$
4) Also available are large-capacity and high-speed fluid coupling which exceed the specifications given in the present Selection chart. Please enquire directly concerning any special requirements.

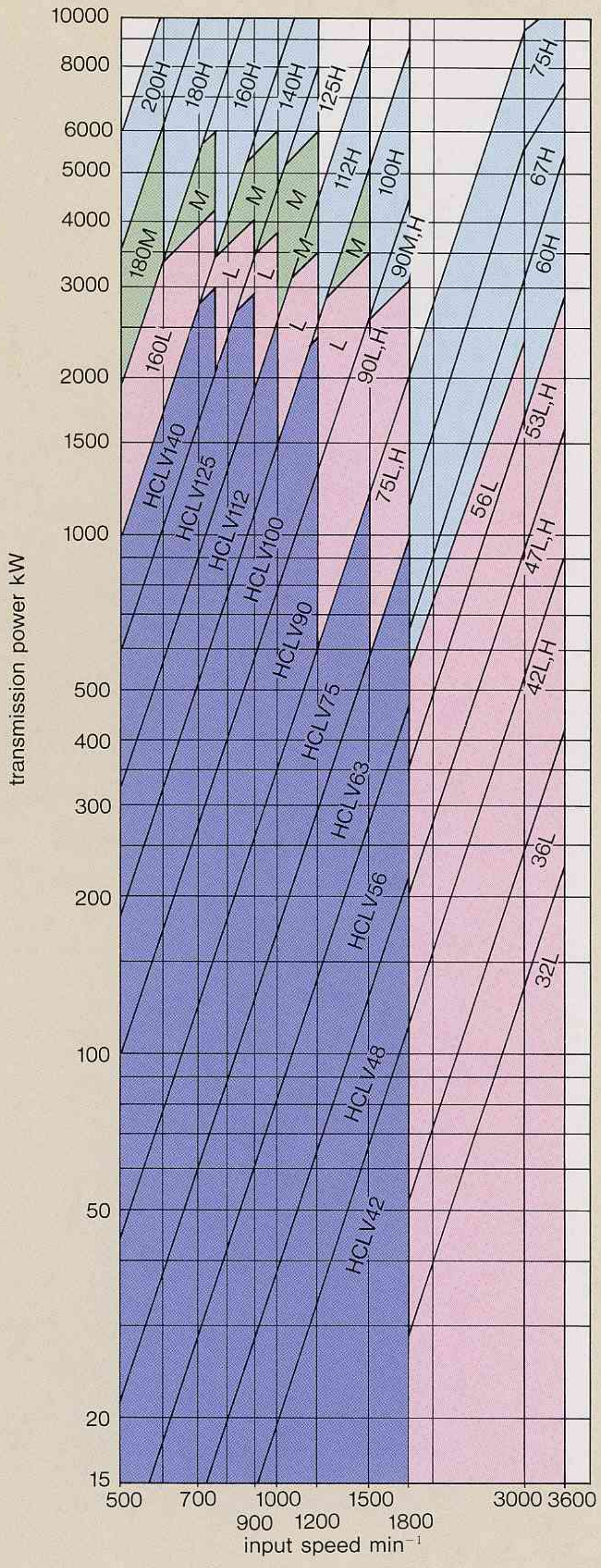
■ **Applications**

(Given below are some typical applications of models supplied to various users.)

Field	Applications	Transmission power (kW)	Speed (min^{-1})
Termnal power plant	Forced draft fan for boiler	2500	1180
	Induced draft fan for boiler	2600	890
	Boiler exhaust gas mixing fan	4220	985
	Boiler gas recycle fan	1380	980
	Boiler feed water pump	9100	5300
Iron works	Draft fan for sintering ignition furnace	1700	990
	Main induced draft fan for converter	5400	1200
	Blast furnace induced draft fan	1600	990
	Main exhaust dust-collecting fan for converter	3200	990
	Booster fan for electric furnace	1500	1180
	Main dust-collecting fan for electric furnace	2350	710
	Descaling pump	4000	6800
	Atomize pump	2050	6600
Public facilities	Incinerator induced draft fan	1620	980
	Drainage pump	6200PS	422
	Ditto	5800PS	720
Metal and mining	SO_2 gas forced draft blower	6400	3455
	Kiln gas induced draft fan	1600	1175
Farming	Pump for renewing top soil	75	1450
Civil engineering	Dredger pump	1050	1485
Petro Chemistry	Chemical gas blower	900	1770

In addition to the applications included above, the EBARA Variable Speed Fluid Coupling can be used with all types of rotary machines:

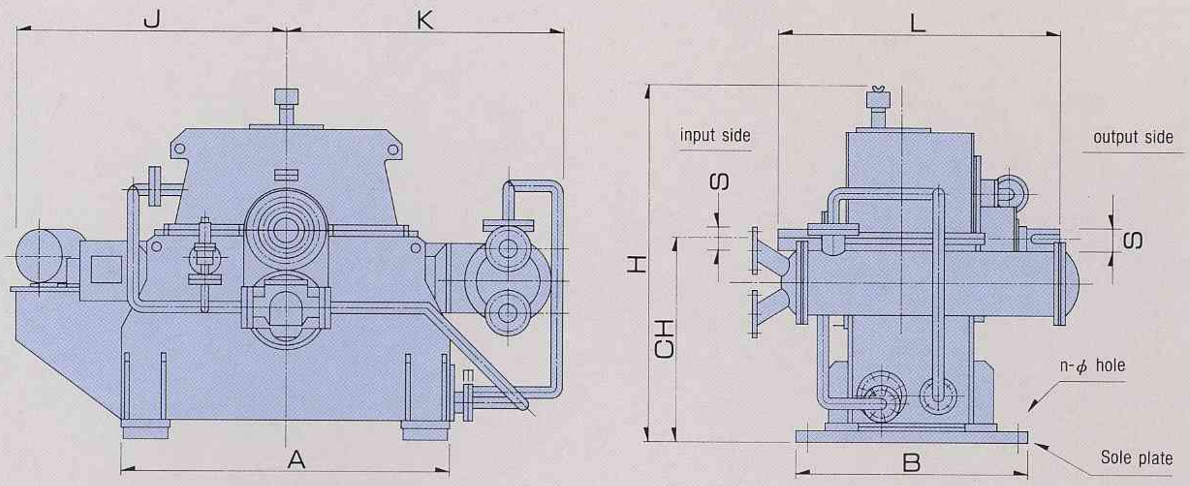
- Parabolic torque machines: various fans, blowers and pumps
- Constant-torque machines: reciprocating pumps, reciprocating-compressors, crushers, ball mills, etc.



We also make smaller fluid couplings with capacities less than 600kW. See the catalog for our Model HCLV-E.

DIMENSIONS

■ Model HCLV/HCLV-L/HCLV-M



Demensions : mm

model	L	CH	H	A	B	J	K	S	n-ϕZ	weight(kg)
HCLV42	755	480	940	730	610	700	800	45	4-28	650
48	850	555	1055	870	655	710	850	55	4-28	800
56	925	660	1200	1100	750	740	1000	70	4-28	1250
63	1075	810	1410	1350	845	850	1100	85	4-35	1800
75	1130	890	1550	1350	895	900	1100	100	4-35	2200
90	1240	990	1730	1600	960	1030	1350	110	4-35	3100
100	1395	1105	1955	1800	1100	1300	1500	130	4-42	4700
112	1525	1195	2115	2000	1230	1220	1600	140	4-42	6100
125	1615	1345	2415	2300	1255	1360	1750	150	4-42	7700
140	1840	1445	2545	2500	1400	1720	1850	170	6-42	10500
HCLV32L	750	555	1035	1250	720	850	900	45	4-28	1300
36L	750	555	1035	1250	720	850	900	55	4-28	1350
42L	1000	790	1260	1250	720	850	900	70	6-35	2000
47L	1150	790	1260	1300	1000	900	1000	90	6-35	2500
53L	1300	850	1450	1300	1150	1000	1250	100	8-35	2800
56L	1300	850	1450	1300	1150	1000	1250	100	8-35	2900
HCLV75L	1400	910	1660	1550	1100	1750	1200	110	6-35	5000
90L	1500	1010	1860	1800	1200	1950	1500	140	6-42	6200
100L	1700	1120	2030	2000	1400	2000	1600	150	6-42	7500
112L	1850	1210	2170	2150	1550	2150	1700	160	6-42	9000
125L	1950	1360	2470	2300	1650	2250	1850	170	6-42	10800
140L	2200	1470	2740	2500	1900	3000	1950	190	6-42	14000
160L	2400	1570	2980	2700	2100	3300	2050	200	6-42	19000
HCLV90M	1900	1010	1900	1800	1600	2050	1600	150	6-42	6500
100M	2100	1120	2100	2000	1800	2100	1700	170	8-42	8000
112M	2200	1210	2200	2150	1900	2250	1800	180	8-42	10000
125M	2300	1360	2500	2300	2000	2350	1950	190	8-42	12000
140M	2500	1470	2800	2500	2150	3100	2050	210	8-48	15000
160M	2650	1570	3000	2700	2300	3400	2150	220	8-48	21000
180M	2850	1670	3200	2900	2500	3600	2250	240	8-48	25000

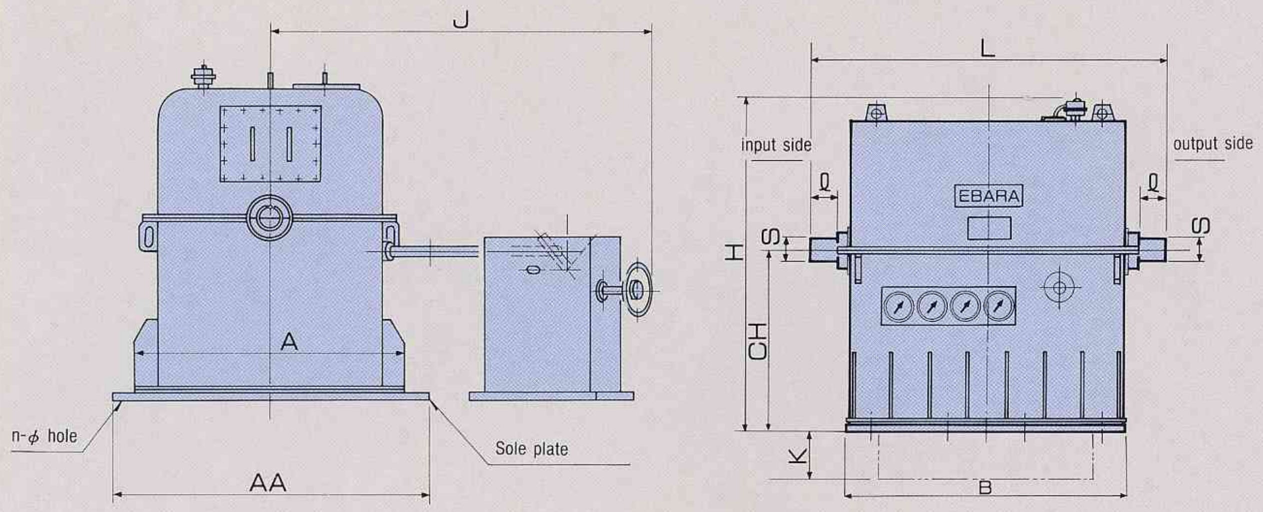
Note:

1) Dimensions specified above may be subject to change without notice. When making a plan, consult us for details.

2) Dimensions specified above represent the HCLV Series with an electric actuator used.

DIMENSIONS

■ Model HCLV-H



■ **Speed below 1800min^{-1}**

Demensions : mm

units	L	CH	AA	A	B	H	J	S	ℓ	n-ϕZ	weight (kg)
HCLV 75H	2100	1000	1700	1500	1650	1700	1700	120	165	6-M30	4500
HCLV 90H	2450	1060	1850	1650	1850	1810	2050	150	230	8-M30	5500
HCLV100H	2700	1120	1950	1750	2100	1970	2250	170	240	8-M30	7000
HCLV112H	3100	1220	2180	1940	2300	2120	2450	200	330	10-M36	10000
HCLV125H	3300	1320	2280	2040	2500	2320	2750	210	330	10-M36	12000
HCLV140H	3500	1390	2430	2190	2700	2440	2950	230	330	10-M36	14000
HCLV160H	3950	1520	2630	2390	3050	2670	3250	250	390	12-M36	17500
HCLV180H	4400	1670	2830	2590	3300	2920	3600	260	480	12-M36	21000
HCLV200H	4850	1770	3030	2790	3600	3120	3900	280	550	12-M36	26000

■ **Speed of 3000min^{-1}～3600min^{-1}**

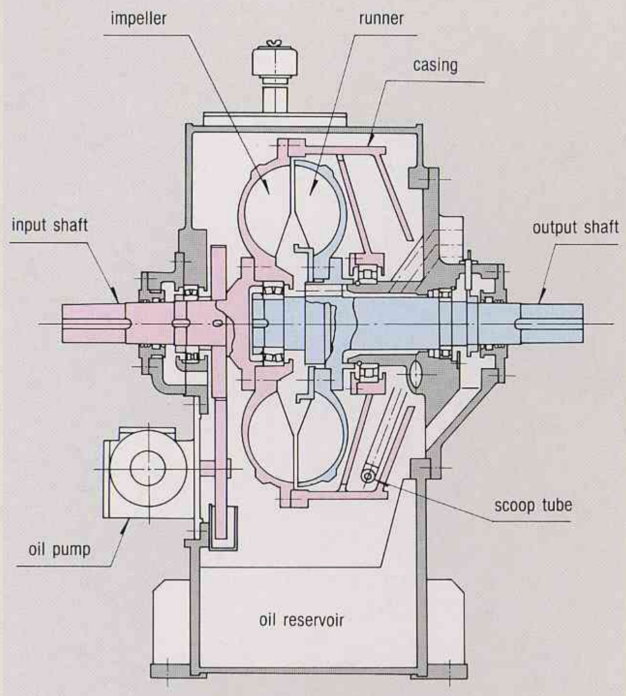
Demensions : mm

units	L	CH	AA	A	B	H	J	K	S	ℓ	n-ϕZ	weight (kg)
HCLV42H	1280	760	1400	1200	880	1260	1200	—	70	105	6-M30	3000
HCLV47H	1450	800	1450	1250	1100	1330	1300	—	90	105	6-M30	3600
HCLV53H	1600	850	1500	1300	1200	1420	1350	—	110	130	6-M30	4000
HCLV60H	1950	750	—	1400	1600	1350	1650	900	130	180	10-M36	5200
HCLV67H	2100	750	—	1500	1700	1400	1750	1000	140	200	10-M36	5500
HCLV75H	2400	750	—	1550	2000	1450	1850	1100	170	230	10-M36	6300

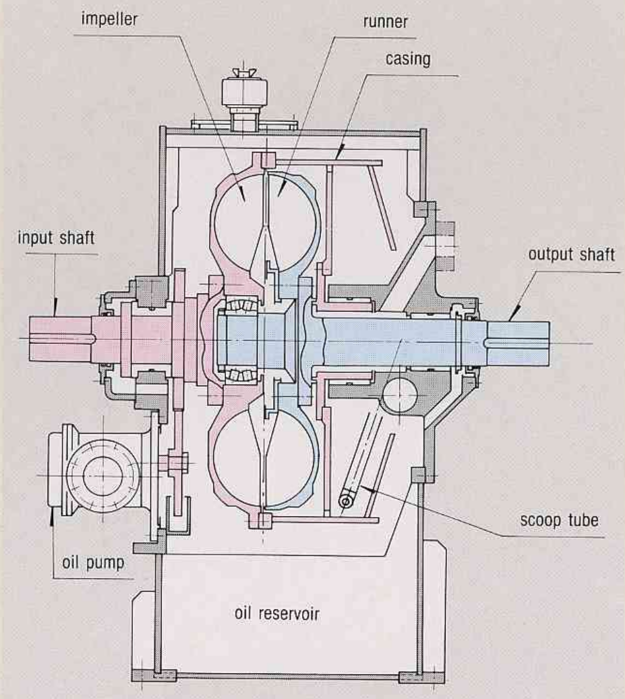
Note: 1) Dimensions specified above may be subject to change without notice. When making a plan, consult us for details.

SECTIONAL VIEW

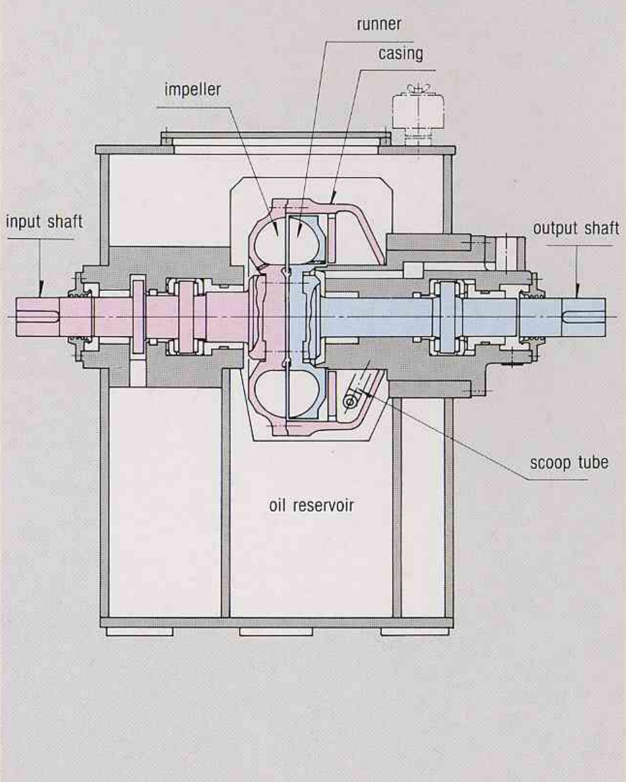
■ **HCLV · HCLV-L**



■ **HCLV-M**



■ **HCLV-H**



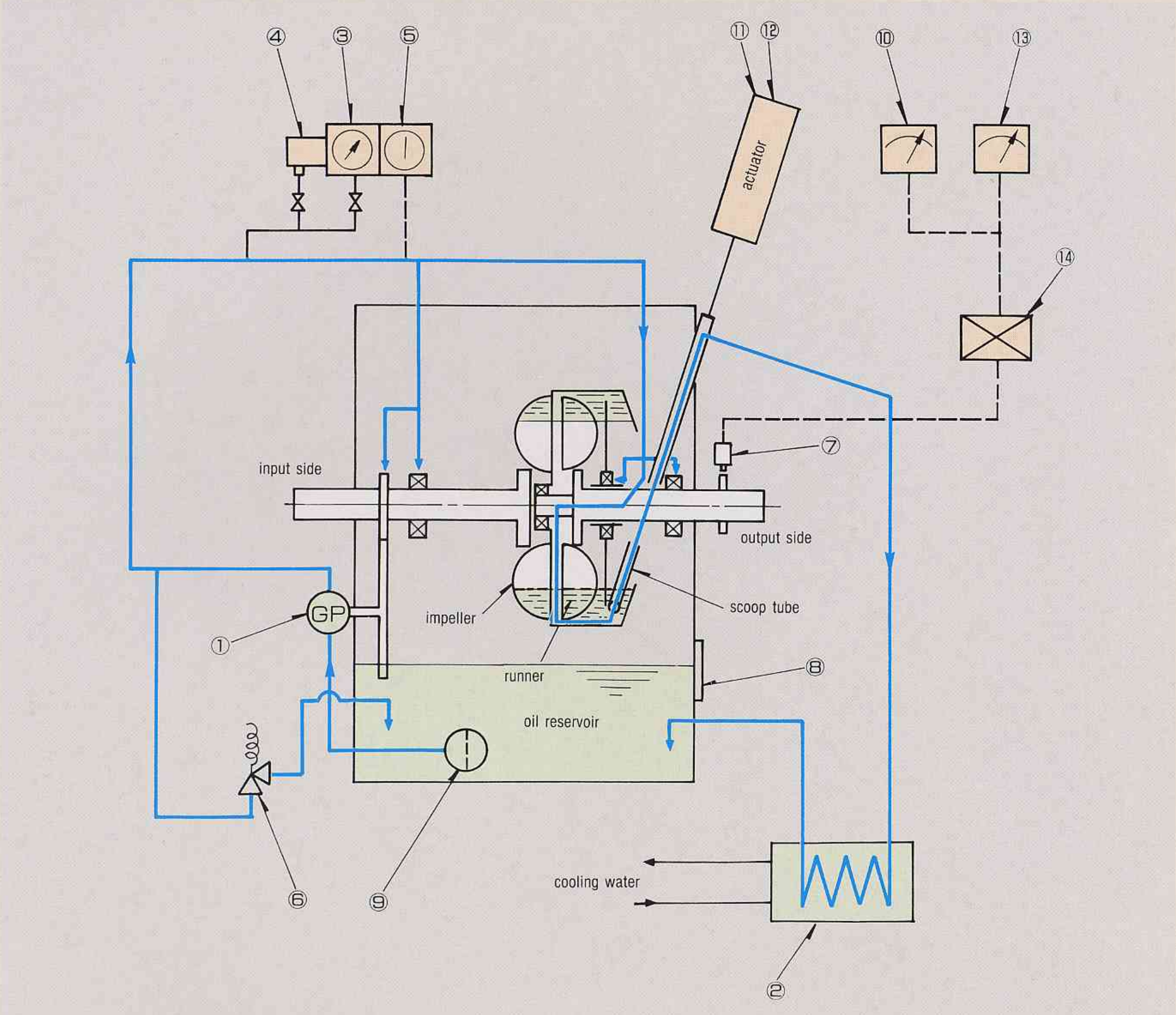
COOLING WATER QUANTITY

The cooling water quantity in the oil cooler can be obtained with the formula given below.

(1) If the load is of parabolic torque type, such as pump or fan, it is assumed that:
  Cooling water quantity = 0.37Pl/min
  P: rated motor output in kW
  Cooling water inlet temperature = 35℃
  Cooling water outlet temperature = 42℃

(2) If the load is of constant-torque type, it is assumed that:
  Cooling water quantity = 0.0205 × (100−N)Pl/min
  N: operating minimum speed in %

OIL CIRCUIT DIAGRAM



1. Standard Accessories

1. Oil pump (built-in type)
2. Oil cooler (with flange fitting)
3. Pressure gauge
4. Pressure switch (to detect oil pressure drop)
5. Dial type temperature gauge with contact (to detect oil temperature rise)
6. Pressure control valve
7. Speed detector (non-contact type)
8. Oil level gauge
9. Suction strainer
10. Speed indicator (to be installed on control panel)

2. Optional Accessories

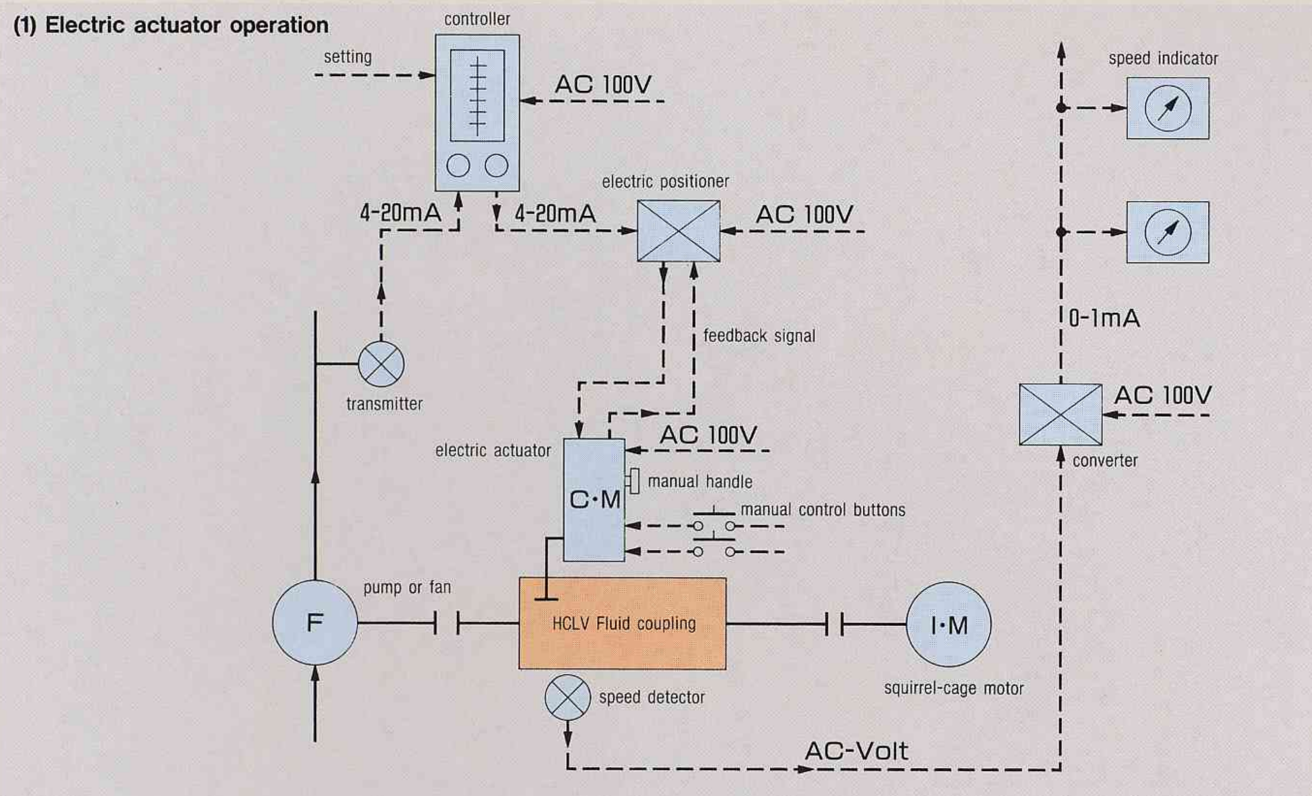
11. Electrical actuator (with electric positioner and limit switch)
12. Pneumatic type actuator
13. Speed indicator (to be installed on remote control panel)
14. Speed converter
15. Cooling water flow relay
16. Input/output shaft coupling (with coupling guard)
17. Oil (turbine oil ISO VG32)
18. Base plate, foundation bolts and nuts
19. Control panel

FUNDAMENTAL CONTROL SYSTEMS

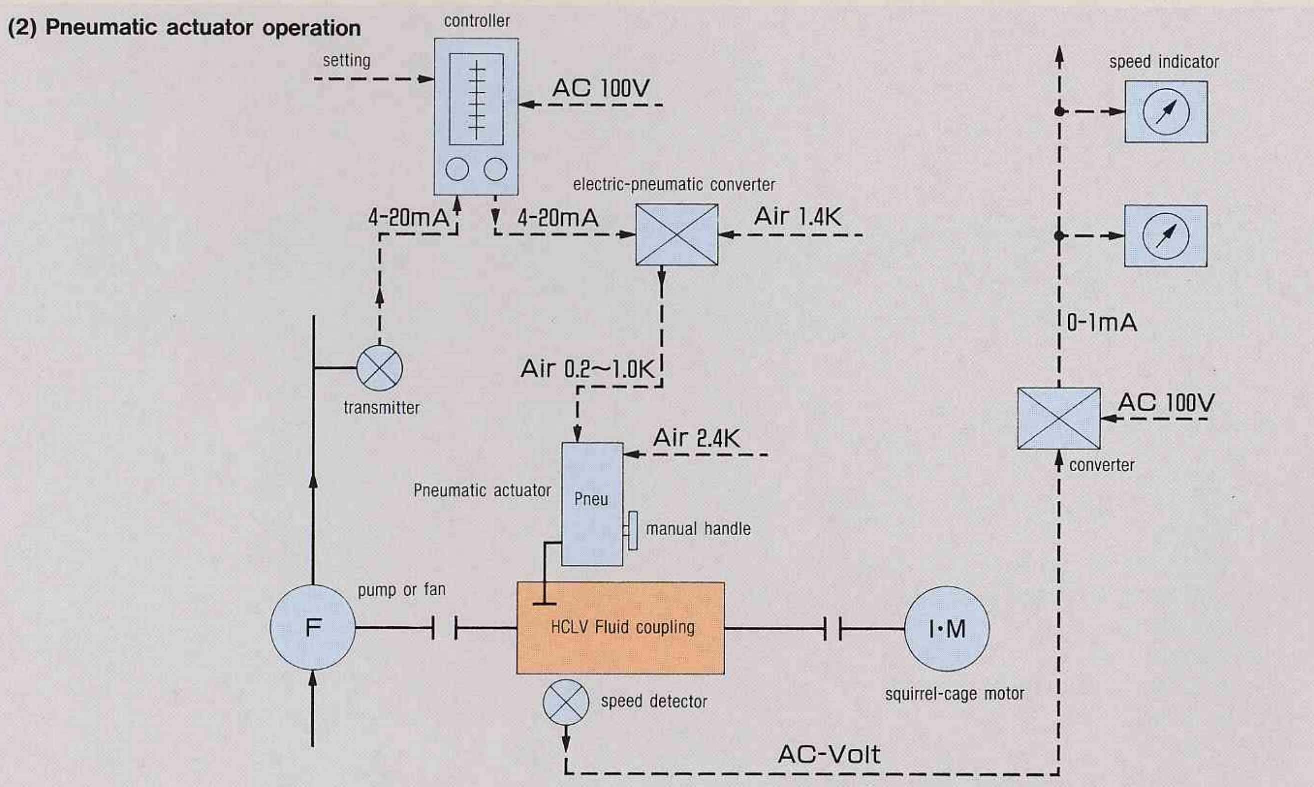
Fluid coupling speed is controlled by changing the oil level in the coupling through operation of a scoop tube. The scoop tube can be locally and remotely controlled either manually or automatically. The actuator which controls the scoop tube is available in three types; electric pneumatic and hydraulic. Typical fundamental control systems are illustrated below.

1. Process Control System

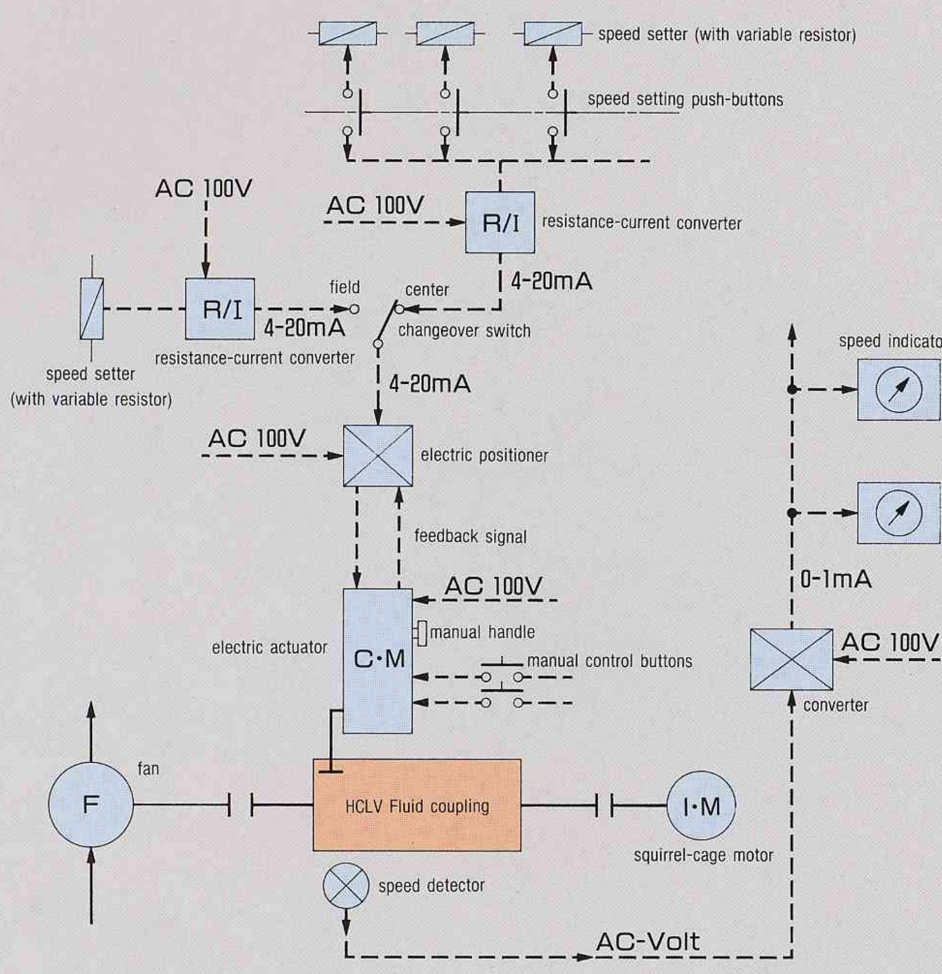
(1) Electric actuator operation



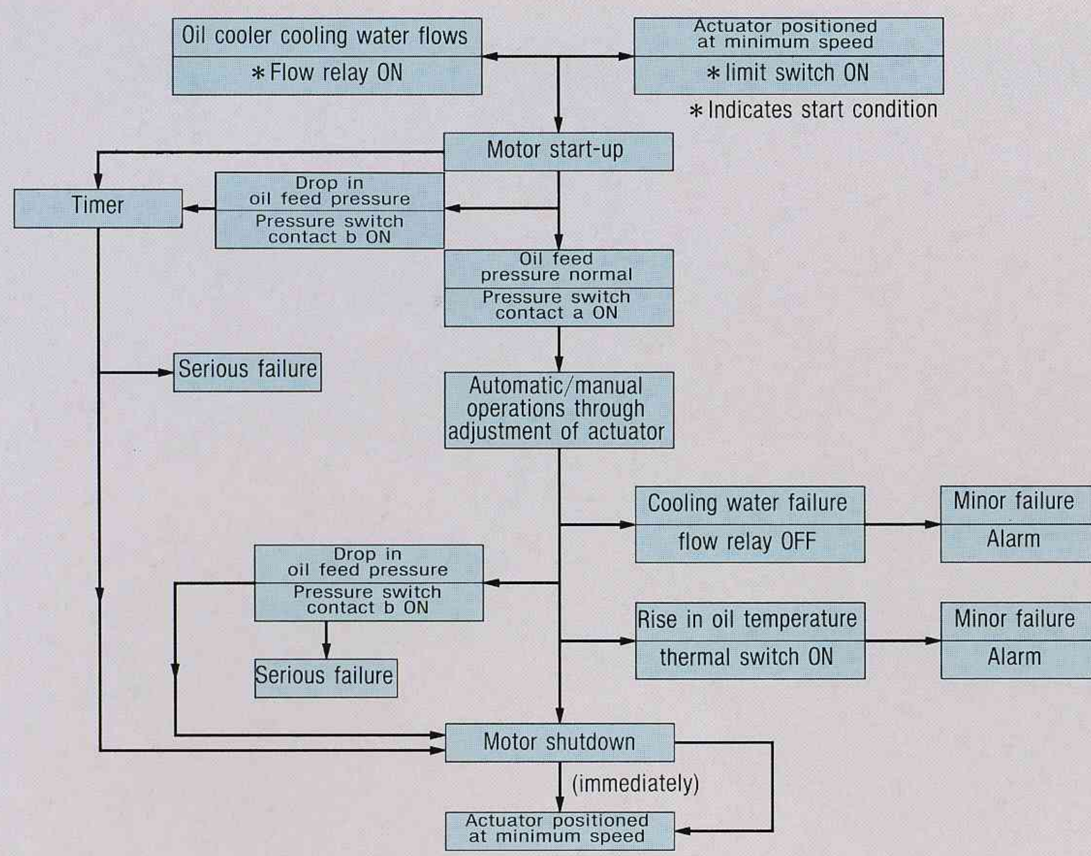
(2) Pneumatic actuator operation



2. An Example of a fluid Coupling Control System for Dust-collecting Fan



3. Operation Block Diagram



ENQUIRIES CONCERNING EBARA FLUID COUPLING

Please give the following information

(1) Type and model of motor

(2) Type and model of driven machine
Direction of rotation

(3) characteristics of driven machine
- 3-1 maximum working transmission power and speed
- 3-2 Load characteristics
- 3-3 Controllable range of speed (Operating pattern)
- 3-4 Starting torque and GD^2

(4) Control system

(5) Type of actuator
Electric, pneumatic or hydraulic

(6) Operating hours (hours/day, hours/year)

(7) Location details
- 7-1 Indoor or outdoor
- 7-2 Ambient temperature (maximum and minimum temperature)
- 7-3 Atmosphere (dusty, salty etc.)
- 7-4 Electrical parts required to be explosion-proof

(8) Type and temperature of cooling water

(9) Optional accessories required

(10) Spare parts required

(11) Other comments

∗The contents of this catalogue may be altered in the indicates of improving product quality.

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