F01L

CYCLICALLY OPERATING VALVES FOR MACHINES OR ENGINES

NOTES

1. Groups F01L 1/00 - F01L 13/00 cover only valve-gear or valve arrangements without provision for variable fluid distribution.
2. Valve gear or valve arrangements specially adapted for steam engines are covered by groups F01L 15/00 - F01L 35/00.
3. Valve-gear arrangements specially adapted for machines or engines with variable working-fluid distribution are covered by groups F01L 15/00 - F01L 35/00.
4. Attention is drawn to the notes preceding class F01, especially Note (3).
5. As regards the above-mentioned Note (3), attention is drawn to F01B 3/10, F01B 15/06, F01C 21/18, F02B 53/06, F03C 1/08, F04B 1/18, F04B 7/00, F04B 39/08, F04B 39/10, and F04C 15/06, F04C 29/12.

WARNING

The following IPC groups are not in the CPC scheme. The subject matter for these IPC groups is classified in the following CPC groups:

- F01L 31/20 covered by F01L 31/08 - F01L 31/18
- F01L 31/22 covered by F01L 31/08 - F01L 31/18
- F01L 31/24 covered by F01L 31/08 - F01L 31/18

Valve-gear or valve arrangements for positive-displacement machines or engines other than steam engines, e.g. for internal-combustion piston engines, without provision for variable fluid distribution

1/00 Valve-gear or valve arrangements, e.g. lift-valve gear (lift-valve and valve-seat assemblies per se F01L 3/00; slide-valve gear F01L 5/00; actuated non-mechanically F01L 9/00; valve arrangements in working piston or piston rod F01L 11/00; modifications of valve-gear to facilitate reversing, braking, starting, changing compression ratio, or other specific operations F01L 13/00)

1/02 Valve drive (transmitting-gear between valve drive and valve F01L 1/12)

1/022 (Chain drive)

1/024 (Belt drive)

1/026 (Gear drive)

2001/028 (Pre-assembled timing arrangement, e.g. located in a cassette)

1/04 by means of cams, camshafts, cam discs, eccentrics or the like (F01L 1/10 takes precedence)

1/042 (Cam discs)

1/044 (Reciprocating cams)

WARNING

Group F01L 1/044 is impacted by reclassification into group F01L 1/10.
Groups F01L 1/044 and F01L 1/10 should be considered in order to perform a complete search.

1/047 Camshafts

2001/0471 (Assembled camshafts)

2001/0473 (Composite camshafts, e.g. with cams or cam sleeve being able to move relative to the inner camshaft or a cam adjusting rod)

2001/0475 (Hollow camshafts)

2001/0476 (Camshaft bearings)

2001/0478 (Torque pulse compensated camshafts)

1/053 overhead type

1/0532 (the cams being directly in contact with the driven valve)

2001/0535 (Single overhead camshafts [SOHC])

2001/0537 (Double overhead camshafts [DOHC])

2001/054 (Camshafts in cylinder block)

1/06 the cams, or the like, rotating at a higher speed than that corresponding to the valve cycle, e.g. operating four-stroke engine valves directly from crankshaft

1/08 Shape of cams

1/10 by means of crank- or eccentric-driven rods

WARNING

Group F01L 1/10 is incomplete pending reclassification of documents from group F01L 1/044.
Groups F01L 1/044 and F01L 1/10 should be considered in order to perform a complete search.

1/12 Transmitting gear between valve drive and valve (simultaneously operating two or more valves F01L 1/26)
Valve-gear or valve arrangements for positive-displacement machines or engines other than steam engines, e.g. for...

1/14 Tappets \{ (hydraulic tappets for automatically adjusting or compensating clearance $\mathbb{F}01L\, 1/24$) \}; Push rods
1/143 \{ for use with overhead camshafts \}
1/146 \{ Push-rods \}
1/16 Silencing impact; Reducing wear
1/18 Rocking arms or levers
1/181 \{ Centre pivot rocking arms \}
1/182 \{ the rocking arm being pivoted about an individual fulcrum, i.e. not about a common shaft \}
1/183 \{ of the boat type \}
1/185 \{ Overhead end-pivot rocking arms \}
2001/186 \{ Split rocking arms, e.g. rocker arms having two articulated parts and means for varying the relative position of these parts or for selectively connecting the parts to move in unison \}
2001/187 \{ Adjusting or compensating clearance \}
2001/188 \{ Fulcrums at upper surface \}
1/20 by fluid means, e.g. hydraulically
1/2405 \{ by means of a hydraulic adjusting device located between the cylinder head and rocker arm \}
1/2411 \{ by means of a hydraulic adjusting device located between the valve stem and rocker arm \}
1/2416 \{ by means of a hydraulic adjusting device attached to an articulated rocker \}
1/2422 \{ by means of a hydraulic adjusting device located between the push rod and rocker arm \}
2001/2427 \{ by means of an hydraulic adjusting device located between cam and push rod \}
2001/2433 \{ Self contained, e.g. sealed hydraulic lash adjusters \}
2001/2438 \{ with means permitting forced opening of check valve \}
2001/2444 \{ Details relating to the hydraulic feeding circuit, e.g. lifter oil manifold assembly \}$^\text{1/LOMA1}$
1/245 Hydraulic tappets
1/25 \{ between cam and valve stem \}
1/252 \{ for side-valve engines \}
1/255 \{ between cam and rocker arm \}
2001/256 \{ between cam and push rod \}
1/26 \{ characterised by the provision of two or more valves operated simultaneously by same transmitting-gear; peculiar to machines or engines with more than two lift-valves per cylinder \}$^\text{with coaxial valves $\mathbb{F}01L\, 1/28$}$
1/262 \{ with valve stems disposed radially from a centre which is substantially the centre of curvature of the upper wall surface of a combustion chamber \}$^\text{($\mathbb{F}01L\, 1/265$ takes precedence)}$
1/265 \{ peculiar to machines or engines with three or more intake valves per cylinder \}
1/267 \{ with means for varying the timing or the lift of the valves \}
1/28 \{ characterised by the provision of coaxial valves; characterised by the provision of valves cooperating with both intake and exhaust ports \}
1/285 \{ Coaxial intake and exhaust valves \}
1/30 \{ characterised by the provision of positively opened and closed valves, i.e. desmodromic valves \}
1/32 \{ characterised by the provision of means for rotating lift valves, e.g. to diminish wear \}
1/34 \{ characterised by the provision of means for changing the timing of the valves without changing the duration of opening \} and without affecting the magnitude of the valve lift \}
1/344 \{ changing the angular relationship between crankshaft and camshaft, e.g. using helicoidal gear \}
1/34403 \{ using helically toothed sleeve or gear moving axially between crankshaft and camshaft \}
1/34406 \{ the helically toothed sleeve being located in the camshaft driving pulley \}
1/34409 \{ by torque-responsive means \}
1/34413 \{ using composite camshafts, e.g. with cams being able to move relative to the camshaft \}
1/34416 \{ using twisted cams \}
1/3442 \{ using hydraulic chambers with variable volume to transmit the rotating force \}
2001/34423 \{ Details relating to the hydraulic feeding circuit \}
2001/34426 \{ Oil control valves \}
2001/3443 \{ Solenoid driven oil control valves \}
2001/34433 \{ Location oil control valves \}
2001/34436 \{ Features or method for avoiding malfunction due to foreign matters in oil \}
2001/3444 \{ Oil filters \}
2001/34443 \{ Cleaning control of oil control valves \}
2001/34446 \{ Fluid accumulators for the feeding circuit \}
2001/3445 \{ Details relating to the hydraulic means for changing the angular relationship \}
2001/34453 \{ Locking means between driving and driven members \}
2001/34456 \{ Locking in only one position \}
2001/34459 \{ Locking in multiple positions \}
2001/34463 \{ Locking position intermediate between most retarded and most advanced positions \}
2001/34466 \{ with multiple locking devices \}
2001/34469 \{ Lock movement parallel to camshaft axis \}
2001/34473 \{ Lock movement perpendicular to camshaft axis \}
2001/34476 \{ Restrict range locking means \}
2001/34479 \{ Sealing of phaser devices \}
2001/34483 \{ Phaser return springs \}
2001/34486 \{ Location and number of the means for changing the angular relationship \}
2001/34489 \{ Two phasers on one camshaft \}
2001/34493 \{ Dual independent phasing system \}$^\text{[DIPS]}$
2001/34496 \{ Two phasers on different camshafts \}
1/348 \{ by means acting on timing belts or chains \}
1/352 \{ using bevel or epicyclic gear \}
2001/3521 \{ Harmonic drive of flex spline type \}
2001/3522 \{ with electromagnetic brake \}
1/356 \{ making the angular relationship oscillate \}, e.g. non-homokinetic drive \}
1/36 \{ peculiar to machines or engines of specific type other than four-stroke cycle \}

CPC - 2021.02
Valve-gear or valve arrangements for positive-displacement machines or engines other than steam engines, e.g. for...

1/38 . . for engines with other than four-stroke cycle, e.g. with two-stroke cycle (F01L 1/26, F01L 1/28 take precedence)

1/40 . . for engines with scavenging charge near top dead centre position, e.g. by overlapping inlet and exhaust time

1/42 . . for machines or engines characterised by cylinder arrangements, e.g. star or fan

1/44 . Multiple-valve gear or arrangements, not provided for in preceding subgroups, e.g. with lift and different valves

1/443 . . [comprising a lift valve and at least one rotary valve]

1/446 . . [comprising a lift valve and at least one reed valve]

1/46 . Component parts, details, or accessories, not provided for in preceding subgroups

1/462 . . [Valve parts, details, or accessories not provided for in preceding subgroups]

1/465 . . . [Pneumatic arrangements]

2001/467 . . . [Lost motion springs]

3/00 Lift-valve, i.e. cut-off apparatus with closure members having at least a component of their opening and closing motion perpendicular to the closing faces; Parts or accessories thereof

3/02 . Selecting particular materials for valve-members or valve-seats; Valve-members or valve-seats composed of two or more materials

3/04 . . Coated valve members or valve-seats

3/06 . Valve members or valve-seats with means for guiding or deflecting the medium controlled thereby, e.g. producing a rotary motion of the drawn-in cylinder charge (for rotating lift-valves F01L 1/32)

3/08 . Valves guides; Sealing of valve stem, e.g. sealing by lubricant

3/085 . . . [Valve cages]

3/10 . Connecting springs to valve members

2003/11 . . . [Connecting valve members to rocker arm or tappet]

3/12 . Cooling of valves

3/14 . . . by means of a liquid or solid coolant, e.g. sodium, in a closed chamber in a valve

3/16 . . . by means of a fluid flowing through or along a valve, e.g. air

3/18 . . . Liquid cooling of valve

3/20 . Shapes or constructions of valve members, not provided for in preceding subgroups of this group

3/205 . . . [Reed valves]

3/22 . Valve-seats not provided for in preceding subgroups of this group; Fixing of valve-seats

3/24 . Safety means or accessories, not provided for in preceding sub-groups of this group

2003/25 . . . [Valve configurations in relation to engine]

2003/251 . . . [Large number of valves, e.g. five or more]

2003/253 . . [configured parallel to piston axis]

2003/255 . . [configured other than parallel or symmetrical relative to piston axis]

2003/256 . . [configured other than perpendicular to camshaft axis]

2003/258 . . [opening away from cylinder]

5/00 Slide valve-gear or valve-arrangements (with pure rotary or oscillatory movement F01L 7/00)
Valve-gear or valve arrangements for positive-displacement machines or engines other than steam engines, e.g. for...

9/00 Valve-gear or valve arrangements actuated non-mechanically

9/10 . . . by fluid means, e.g. hydraulic
9/11 . . . in which the action of a cam is being transmitted to a valve by a liquid column
9/12 . . . with a liquid chamber between a piston actuated by a cam and a piston acting on a valve stem
9/14 . . . the volume of the chamber being variable, e.g. for varying the lift or the timing of a valve
9/16 . . . Pneumatic means
9/18 . . . Means for increasing the initial opening force on the valve
9/20 . . . by electric means
9/21 . . . actuated by solenoids

2009/2103 . . . [comprising one coil]
2009/2105 . . . [comprising two or more coils]
2009/2107 . . . [being disposed coaxially to the armature shaft]
2009/2109 . . . [The armature being actuated perpendicularly to the coils axes]
2009/2115 . . . [Moving coil actuators]
2009/2117 . . . [Floating actuators for varying the valve stroke]
2009/2125 . . . [Shaft and armature construction]
2009/2126 . . . [Arrangements for amplifying the armature stroke]
2009/2128 . . . [Core and coil construction]
2009/213 . . . [Casing construction]
2009/2132 . . . [Biasing means]
2009/2134 . . . [Helical springs]
2009/2136 . . . [Two opposed springs for intermediate resting position of the armature]
2009/2138 . . . [Torsion springs]
2009/214 . . . [Pneumatic springs]
2009/2142 . . . [Means for varying the spring bias]
2009/2144 . . . [Means for connecting springs to valve or anchor]
2009/2146 . . . [Latching means]
2009/2148 . . . [using permanent magnet]
2009/2149 . . . [Means for varying the air gap]
2009/2151 . . . [Damping means]
2009/2153 . . . [Means for counteracting cylinder pressure]
2009/2155 . . . [Lash adjusting means]
2009/2157 . . . [Actuator cooling means]
2009/2159 . . . [Means for facilitating assembly]
2009/2161 . . . [Wiring]
2009/2163 . . . [Connectors]
2009/2165 . . . [Harnesses]
2009/2167 . . . [Sensing means]
2009/2169 . . . [Position sensors]
2009/2171 . . . [Vibration sensors]
2009/2173 . . . [Temperature sensors]
2009/2174 . . . [Flux sensors]
2009/2176 . . . [Spring force sensors]

9/22 . . . actuated by rotary motors
9/24 . . . Piezo-electric actuators

2009/25 . . . [Mixed arrangement with both mechanically and electromagnetically actuated valves]
9/26 . . . Driving circuits therefor
9/30 . . . Arrangements for setting the actuator position, e.g. the initial position
9/40 . . . Methods of operation thereof; Control of valve actuation, e.g. duration or lift

11/00 Valve arrangements in working piston or piston-rod
11/02 . . . in piston
11/04 . . . operated by movement of connecting-rod
11/06 . . . operating oscillatory valve

13/00 Modifications of valve-gear to facilitate reversing, braking, starting, changing compression ratio, or other specific operations

13/0005 . . . [Deactivating valves]
2013/001 . . . [Deactivating cylinders]
13/0015 . . . [for optimising engine performances by modifying valve lift according to various working parameters, e.g. rotational speed, load, torque]
13/0021 . . . [by modification of rocker arm ratio]
13/0026 . . . [by means of an eccentric]
13/0031 . . . [by modification of tappet or pushrod length]
13/0036 . . . [the valves being driven by two or more cams with different shape, size or timing or a single cam profiled in axial and radial direction]
13/0042 . . . [with cams being profiled in axial and radial direction]
13/0047 . . . [the movement of the valves resulting from the sum of the simultaneous actions of at least two cams, the cams being independently variable in phase in respect of each other]
13/0052 . . . [with cams provided on an axially slidable sleeve]
13/0057 . . . [by splittable or deformable cams]
13/0063 . . . [by modification of cam contact point by displacing an intermediate lever or wedge-shaped intermediate element, e.g. Tourtelot]
13/0068 . . . [with an oscillating cam acting on the valve of the "BMW-Valvetronic" type]
13/0073 . . . [with an oscillating cam acting on the valve of the "Delphi" type]
13/0078 . . . [by modification of cam contact point by axially displacing the camshaft]
13/0084 . . . [by modification of cam contact point by radially displacing the camshaft]
Valve-gear or valve arrangements for positive-displacement machines or engines other than steam engines, e.g. for...

Valve-gear or valve arrangements specially adapted for steam engines, or specially adapted for other positive-displacement machines or engines with variable working-fluid distribution

NOTES

1. Groups F01L 15/00 - F01L 31/00 cover:
   - valve drive or means external to valves for adjustment during operation;
   - tripping-gear;
   - reversing-gear;
   - use of pistons or piston-rods as valves or as valve-supporting elements;
   - valve-gear or valve arrangements peculiar to free-piston machines or engines.

2. Groups F01L 15/00 - F01L 31/00 do not fully cover subject matter restricted to rotary, oscillatory, or lift-valve gear or valve arrangements, which is covered by group F01L 33/00 or F01L 35/00.

3. Valve-gear or valve arrangements, e.g. with reciprocatory slide valves, other than provided for in groups F01L 17/00 - F01L 29/00 (valve drive or external valve-adjustment during operation, tripping-gear or tripping of valves F01L 31/000)

   15/00 Valve-gear or valve arrangements, e.g. with reciprocatory slide valves only

   15/02 . . . with valves other than cylindrical, sleeve, or partly-annularly-shaped, e.g. flat D-valves

   15/04 . . . main valve being combined with auxiliary valve (of drag valve type F01L 15/10)

   15/06 . . . of Meyer or Rider type, i.e. in which the expansion is varied at the expansion valve itself

   15/08 . . . with cylindrical, sleeve, or partly-annularly-shaped valves; Such main valves combined with auxiliary valves

   15/10 . . . with main slide valve and auxiliary valve dragged thereby

   15/12 . . . characterised by having means for effecting pressure equilibrium between two different cylinder spaces at idling

   15/14 . . . Arrangements with several co-operating main valves, e.g. reciprocatory and rotary

   15/16 . . . with reciprocatory slide valves only

   15/18 . . . Valves arrangements not provided for in preceding subgroups of this main group

   15/20 . . . Component parts, details, or accessories, not provided for in preceding subgroups of this main group

17/00 Slide-valve-gear or valve arrangements with cylindrical, sleeve, or partly-annularly-shaped valves surrounding working cylinder or piston

   17/02 . . . Drive or adjustment during operation, peculiar thereto, e.g. for reciprocating and oscillating movements or for several valves one inside the other

19/00 Slide-valve-gear or valve arrangements with reciprocatory and other movement of same valve, other than provided for in F01L 17/00, e.g. longitudinally of working cylinder and in cross direction

   19/02 . . . Drive or adjustment during operation, peculiar thereto

21/00 Use of working pistons or piston-rods as fluid-distributing valves or as valve-supporting elements, e.g. in free-piston machines

   21/02 . . . Piston or piston-rod used as valve members {F01L 25/066 takes precedence}

   21/04 . . . Valves arranged in or on piston or piston-rod

23/00 Valves controlled by impact by piston, e.g. in free-piston machines

25/00 Drive, or adjustment during the operation, or distribution or expansion valves by non-mechanical means

   25/02 . . . by fluid means

   25/04 . . . by working-fluid of machine or engine, e.g. free-piston machine

   25/06 . . . . Arrangements with main and auxiliary valves, at least one of them being fluid-driven

   25/063 . . . . . . [the auxiliary valve being actuated by the working motor-piston or piston-rod]

   25/066 . . . . . . [piston or piston-rod being used as auxiliary valve]

   25/08 . . . by electric or magnetic means

27/00 Distribution or expansion valve-gear peculiar to free-piston machines or engines and not provided for in F01L 21/00 - F01L 25/00

   27/02 . . . the machine or engine having rotary or oscillatory valves

   27/04 . . . . Delayed-action controls, e.g. of cataract or dashpot type

29/00 Reversing-gear

   29/02 . . . by displacing eccentric

   29/04 . . . by links or guide rods

   29/06 . . . by interchanging inlet and exhaust ports

   29/08 . . . specially for rotary or oscillatory valves

   29/10 . . . Details, e.g. drive

   29/12 . . . Powered reverse gear

31/00 Valve drive, valve adjustment during operation, or other valve control, not provided for in groups F01L 15/00 - F01L 29/00 (sensing elements measuring the variable or condition to be controlled or regulated F01B 25/04)
Valve-gear or valve arrangements specifically adapted for steam engines, or specially adapted for other...  

31/02 . with tripping-gear (for oscillatory valves  
F01L 31/06) . Tripping of valves  
31/04 . . with positively-driven trip levers  
31/06 . with tripping-gear specially for oscillatory valves;  
Oscillatory tripping-valves, e.g. of Corliss type  
31/08 . Valve drive or valve adjustment, apart from tripping  
aspects; Positively-driven gear  
31/10 . . the drive being effected by eccentrics  
(F01L 31/14 takes precedence)  
31/12 . . . Valve adjustment by displacing eccentric  
31/14 . . . Valve adjustment by links or guide rods, e.g. in  
valve-gears with eccentric drive  
31/16 . . . the drive being effected by specific means other  
than eccentric, e.g. cams; Valve adjustment in  
connection with such drives  
31/18 . . . specially for rotary or oscillatory valves  

Rotary or oscillatory slide valve-gear or lift-valve-gear or such  
valve arrangements especially for steam engines or specially  
for other machines or engines with variable working-fluid  
distribution (drive adjustment during operation, tripping-gear,  
reversing-gear, use of working pistons or piston-rods as valves  
or as valves-supporting elements, valve-gear or valve arrangements  
peculiar to free-piston machines or engines F01L 15/00 - F01L 31/00)  

33/00 Rotary or oscillatory slide valve-gear or valve  
arrangements, specially adapted for machines  
or engines with variable fluid distribution (drive,  
adjustment during operation, tripping-gear, reversing-  
gear, use of working pistons or piston-rods as valves  
or as valve-supporting elements, valve-gear or valve  
arrangements peculiar to free-piston machines or  
engines F01L 15/00 - F01L 31/00)  
33/02 . rotary  
33/04 . oscillatory  

35/00 Lift valve-gear or valve arrangements specially  
adapted for machines or engines with variable  
fluid distribution (drive, adjustment during  
operation, tripping-gear, reversing-gear, use of  
working pistons or piston-rods as valves or as  
valve-supporting elements, valve-gear or valve  
arrangements peculiar to free-piston machines or  
engines F01L 15/00 - F01L 31/00)  
35/02 . Valves  
35/04 . Arrangements of valves in the machine or engine,  
e.g. relative to working cylinder  

2201/00 Electronic control systems; Apparatus or methods  
thereof  

2250/00 Camshaft drives characterised by their  
transmission means  
2250/02 . the camshaft being driven by chains  
2250/04 . the camshaft being driven by belts  
2250/06 . the camshaft being driven by gear wheels  

2301/00 Using particular materials  
2301/02 . Using ceramic materials  

2303/00 Manufacturing of components used in valve  
arrangements  
2303/01 . Tools for producing, mounting or adjusting, e.g.  
some part of the distribution  

2303/02 . Initial camshaft settings  
2305/00 Valve arrangements comprising rollers  
2305/02 . Mounting of rollers  
2307/00 Preventing the rotation of tappets  
2309/00 Self-contained lash adjusters  
2311/00 Differential gears located between crankshafts and  
cams shafts for varying the timing of valves  

2313/00 Rotary valve drives  
2710/00 Control of valve gear, speed or power  
2710/003 . Control of valve gear for two stroke engines  
2710/006 . Safety devices therefor  

2740/00 Control of slide-valve gear; Control pistons  
2740/003 . more than one slide-valve, e.g. for four stroke  
engines  
2740/006 . more than one slide-valve, e.g. for two stroke  
engines  

2750/00 Control of valve gear for four stroke engines  
directly driven by the crankshaft  
2760/00 Control of valve gear to facilitate reversing,  
starting, braking of four stroke engines  
2760/001 . for starting four stroke engines  
2760/002 . for reversing or starting four stroke engines  
2760/003 . for switching to compressor action in order to brake  
2760/004 . whereby braking is exclusively produced by  
compression in the cylinders  
2760/005 . in cooperation with vehicle transmission  
or brakes; devices to facilitate switching to  
compressor action by means of other control  
devices, e.g. acceleration pedal or clutch  

2760/006 . for reversing two stroke engines  
2760/007 . for starting two stroke engines  
2760/008 . for reversing and restarting two stroke engines  

2800/00 Methods of operation using a variable valve timing  
mechanism  
2800/01 . Starting  
2800/02 . Cold running  
2800/03 . Stopping; Stalling  
2800/04 . Timing control at idling  
2800/05 . Timing control under consideration of oil condition  
2800/06 . Timing or lift different for valves of same cylinder  
2800/08 . Timing or lift different for valves of different  
cylinders  
2800/09 . Calibrating  
2800/10 . Providing exhaust gas recirculation [EGR]  
2800/11 . Fault detection, diagnosis  
2800/12 . Fail safe operation  
2800/13 . Throttleless  
2800/14 . Determining a position, e.g. phase or lift  
2800/15 . Balancing of rotating parts  
2800/16 . Preventing interference  
2800/17 . Maintenance; Servicing  
2800/18 . Testing or simulation  
2800/19 . Valves opening several times per stroke  

2810/00 Arrangements solving specific problems in relation  
with valve gears  
2810/01 . Cooling  
2810/02 . Lubrication
Reducing vibration
Reducing noise
Related to pressure difference on both sides of a valve

Details on specific features characterising valve gear arrangements

Absolute values
Formulas
Auxiliary actuators
Electromagnets
Electric motors
Hydraulic engines
Pneumatic engines
Centrifugal forces
Sensors
Camshafts position or phase sensors
Crankshafts position
Pressure
Temperature
Valve lift