

CPC COOPERATIVE PATENT CLASSIFICATION

F MECHANICAL ENGINEERING; LIGHTING; HEATING; WEAPONS; BLASTING (NOTE omitted)

ENGINES OR PUMPS

F01 MACHINES OR ENGINES IN GENERAL; ENGINE PLANTS IN GENERAL; STEAM ENGINES

F01D NON-POSITIVE DISPLACEMENT MACHINES OR ENGINES, e.g. STEAM TURBINES (machines or engines for liquids [F03](#); non-positive displacement pumps [F04D](#))

NOTES

1. This subclass covers:
 - non-positive-displacement engines for elastic fluids, e.g. steam turbines;
 - non-positive-displacement engines for liquids and elastic fluids;
 - non-positive-displacement machines for elastic fluids;
 - non-positive-displacement machines for liquids and elastic fluids.
2. Attention is drawn to the Notes preceding class [F01](#), especially as regards the definitions of "reaction type", e.g. with airfoil-like blades, and "impulse type", e.g. bucket turbines.

WARNING

In this subclass non-limiting references (in the sense of paragraph 39 of the Guide to the IPC) may still be displayed in the scheme.

1/00	Non-positive-displacement machines or engines, e.g. steam turbines (with working-fluid flows in opposite axial directions for balancing axial thrust F01D 3/02 ; with other than pure rotation F01D 23/00 ; turbines characterised by their use in special steam systems, cycles, or processes, regulating devices therefor F01K)	1/16	• • characterised by having both reaction stages and impulse stages
1/02	• with stationary working-fluid guiding means and bladed or like rotor, {e.g. multi-bladed impulse steam turbines} (F01D 1/24 takes precedence; without stationary working-fluid guiding means F01D 1/18)	1/18	• without stationary working-fluid guiding means; (F01D 1/24 , F01D 1/32 , F01D 1/34 take precedence; {with pressure-velocity transformation exclusively in rotor F01D 1/32 })
1/023	• • {the working-fluid being divided into several separate flows (F01D 3/02 takes precedence); several separate fluid flows being united in a single flow; the machine or engine having provision for two or more different possible fluid flow paths}	1/20	• • traversed by the working-fluid substantially axially
1/026	• • {Impact turbines with buckets, i.e. impulse turbines, e.g. Pelton turbines (F01D 1/16 , F01D 1/34 take precedence)}	1/22	• • traversed by the working-fluid substantially radially
1/04	• • traversed by the working-fluid substantially axially	1/24	• characterised by counter-rotating rotors subjected to same working fluid stream without intermediate stator blades or the like
1/06	• • traversed by the working-fluid substantially radially	1/26	• • traversed by the working-fluid substantially axially
1/08	• • • having inward flow	1/28	• • traversed by the working-fluid substantially radially
1/10	• • having two or more stages subjected to working-fluid flow without essential intermediate pressure change, i.e. with velocity stages (F01D 1/12 takes precedence)	1/30	• characterised by having a single rotor operable in either direction of rotation, e.g. by reversing of blades (combinations of machines or engines F01D 13/00)
1/12	• • with repeated action on same blade ring	1/32	• with pressure velocity transformation exclusively in rotor, e.g. the rotor rotating under the influence of jets issuing from the rotor, {e.g. Heron turbines (the working fluid being a combustion products F02C 3/165 ; jet propulsion plants per se F02K)}
1/14	• • • traversed by the working-fluid substantially radially	1/34	• characterised by non-bladed rotor, e.g. with drilled holes (F01D 1/32 takes precedence; sirens G10K 7/00 {; impact turbines with buckets F01D 1/026 ; hand-held tools with a non-bladed rotor F01D 15/067 })
		1/36	• • using fluid friction
		1/38	• • of the screw type

- 3/00 Machines or engines with axial-thrust balancing effected by working-fluid**
- 3/02 . characterised by having one fluid flow in one axial direction and another fluid flow in the opposite direction
- 3/025 . . {with a centrally disposed radial stage}
- 3/04 . axial thrust being compensated by thrust-balancing dummy piston or the like
- 5/00 Blades; Blade-carrying members (nozzle boxes [F01D 9/02](#)); Heating, heat-insulating, cooling or antivibration means on the blades or the members {(special arrangements in rotors dealing with breaking off of part thereof [F01D 21/045](#))}**
- 5/005 . {Repairing methods or devices}
- 5/02 . Blade-carrying members, e.g. rotors (rotors of non-bladed type [F01D 1/34](#); stators [F01D 9/00](#) ; selecting particular materials [F01D 5/28](#))
- 5/021 . . {for flow machines or engines with only one axial stage (for more than one stage [F01D 5/06](#))}
- 5/022 . . {with concentric rows of axial blades}
- 5/023 . . {of the screw type}
- 5/025 . . {Fixing blade carrying members on shafts (attachment of a member on a shaft in general [F16D 1/06](#); for non-positive displacement pumps [F04D 29/00](#))}
- 5/026 . . {Shaft to shaft connections}
- 5/027 . . {Arrangements for balancing (for balancing rotating bodies in general [F16F 15/32](#); for compensating unbalance [G01M 1/36](#))}
- 5/028 . . {the rotor disc being formed of sheet laminae (rotor blade aggregates of unitary construction [F01D 5/34](#))}
- 5/03 . . Annular blade-carrying members having blades on the inner periphery of the annulus and extending inwardly radially, i.e. inverted rotors
- 5/04 . . for radial-flow machines or engines
- 5/041 . . . {of the Ljungström type}
- 5/043 . . . {of the axial inlet- radial outlet, or vice versa, type}
- 5/045 {the wheel comprising two adjacent bladed wheel portions, e.g. with interengaging blades for damping vibrations}
- 5/046 {Heating, heat insulation or cooling means}
- 5/048 {Form or construction}
- 5/06 . . Rotors for more than one axial stage, e.g. of drum or multiple disc type; Details thereof, e.g. shafts, shaft connections {([F01D 5/022](#), [F01D 5/023](#) take precedence)}
- 5/063 . . . {Welded rotors (welding per se [B23K](#))}
- 5/066 . . . {Connecting means for joining rotor-discs or rotor-elements together, e.g. by a central bolt, by clamps}
- 5/08 . . Heating, heat-insulating or cooling means {(specially adapted for radial flow machines or engines [F01D 5/04](#))}
- 5/081 . . . {Cooling fluid being directed on the side of the rotor disc or at the roots of the blades ([F01D 5/087](#) takes precedence)}
- 5/082 {on the side of the rotor disc}
- 5/084 {the fluid circulating at the periphery of a multistage rotor, e.g. of drum type}
- 5/085 . . . {cooling fluid circulating inside the rotor}
- 5/087 {in the radial passages of the rotor disc}
- 5/088 {in a closed cavity}
- 5/10 . . Anti- vibration means {(specially adapted for radial flow machines or engines [F01D 5/04](#))}
- 5/12 . . Blades {(specially adapted for radial flow machines or engines [F01D 5/04](#)); blade roots [F01D 5/30](#); rotors with blades adjustable in operation [F01D 7/00](#); stator blades [F01D 9/02](#)}
- 5/14 . . Form or construction (selecting particular materials, measures against erosion or corrosion [F01D 5/28](#))
- 5/141 . . . {Shape, i.e. outer, aerodynamic form ([F01D 5/148](#) - [F01D 5/20](#) take precedence; blade construction [F01D 5/147](#))}
- 5/142 {of the blades of successive rotor or stator blade-rows}
- 5/143 {Contour of the outer or inner working fluid flow path wall, i.e. shroud or hub contour}
- 5/145 {Means for influencing boundary layers or secondary circulations (for compressors [F04D 29/68](#))}
- 5/146 {of blades with tandem configuration, split blades or slotted blades}
- 5/147 . . . {Construction, i.e. structural features, e.g. of weight-saving hollow blades ([F01D 5/148](#), [F01D 5/16](#) and [F01D 5/20](#) take precedence; blade shape [F01D 5/141](#); blades with cooling or heating channels or cavities [F01D 5/18](#); heating, heat-insulating or cooling means on blades [F01D 5/18](#))}
- 5/148 . . . {Blades with variable camber, e.g. by ejection of fluid}
- 5/16 . . . for counteracting blade vibration
- 5/18 . . . Hollow blades, {i.e. blades with cooling or heating channels or cavities (structure of hollow blades in general [F01D 5/147](#))}; Heating, heat-insulating or cooling means on blades
- 5/181 {Blades having a closed internal cavity containing a cooling medium, e.g. sodium}
- 5/182 {Transpiration cooling}
- 5/183 {Blade walls being porous}
- 5/184 {Blade walls being made of perforated sheet laminae}
- 5/185 {Liquid cooling ([F01D 5/181](#) takes precedence)}
- 5/186 {Film cooling ([F01D 5/187](#) takes precedence)}
- 5/187 {Convection cooling}
- 5/188 {with an insert in the blade cavity to guide the cooling fluid, e.g. forming a separation wall}
- 5/189 {the insert having a tubular cross-section, e.g. airfoil shape}
- 5/20 . . . Specially-shaped blade tips to seal space between tips and stator {([F01D 5/225](#) takes precedence)}
- 5/22 . . Blade-to-blade connections, {e.g. for damping vibrations}
- 5/225 . . . {by shrouding}
- 5/24 . . . using wire or the like
- 5/26 . . Antivibration means not restricted to blade form or construction or to blade-to-blade connections {or to the use of particular materials}

- 5/28 . . Selecting particular materials; {Particular measures relating thereto;} Measures against erosion or corrosion
- 5/282 . . . {Selecting composite materials, e.g. blades with reinforcing filaments}
- 5/284 . . . {Selection of ceramic materials}
- 5/286 . . . {Particular treatment of blades, e.g. to increase durability or resistance against corrosion or erosion ([F01D 5/288 takes precedence](#))}
- 5/288 . . . {Protective coatings for blades}
- 5/30 . Fixing blades to rotors; Blade roots {; Blade spacers}
- 5/3007 . . {of axial insertion type}
- 5/3015 . . . {with side plates}
- 5/3023 . . {of radial insertion type, e.g. in individual recesses}
- 5/303 . . . {in a circumferential slot}
- 5/3038 {the slot having inwardly directed abutment faces on both sides}
- 5/3046 . . . {the rotor having ribs around the circumference}
- 5/3053 . . {by means of pins}
- 5/3061 . . {by welding, brazing}
- 5/3069 . . {between two discs or rings}
- 5/3076 . . {Sheet metal discs}
- 5/3084 . . {the blades being made of ceramics}
- 5/3092 . . {Protective layers between blade root and rotor disc surfaces, e.g. anti-friction layers ([F01D 5/288 takes precedence](#))}
- 5/32 . . Locking, e.g. by final locking blades or keys
- 5/323 . . . {Locking of axial insertion type blades by means of a key or the like parallel to the axis of the rotor}
- 5/326 . . . {Locking of axial insertion type blades by other means}
- 5/34 . Rotor-blade aggregates of unitary construction {, e.g. formed of sheet laminae; (discs formed of sheet laminae [F01D 5/028](#); ceramic materials [F01D 5/284](#), composite materials [F01D 5/282](#))}
- 7/00 Rotors with blades adjustable in operation; Control thereof (for reversing [F01D 1/30](#))**
- 7/02 . having adjustment responsive to speed
- 9/00 Stators (non-fluid guiding aspects of casings, regulating, controlling, or safety aspects, see the relevant groups)**
- 9/02 . Nozzles; Nozzle boxes; Stator blades; Guide conduits {, e.g. individual nozzles ([nozzle boxes \[F01D 9/047\]\(#\)](#))}
- 9/023 . . {Transition ducts between combustor cans and first stage of the turbine in gas-turbine engines; their cooling or sealings}
- 9/026 . . {Scrolls for radial machines or engines}
- 9/04 . . forming ring or sector
- 9/041 . . . {using blades ([F01D 5/148 takes precedence](#))}
- 9/042 . . . {fixing blades to stators ([fixing stator-rings in the casing or to each other \[F01D 25/246\]\(#\)](#))}
- 9/044 {permanently, e.g. by welding, brazing, casting or the like}
- 9/045 . . . {for radial flow machines or engines}
- 9/047 . . . {Nozzle boxes}
- 9/048 . . . {for radial admission}
- 9/06 . Fluid supply conduits to nozzles or the like
- 9/065 . . {Fluid supply or removal conduits traversing the working fluid flow, e.g. for lubrication-, cooling-, or sealing fluids ([see also \[F01D 25/16\]\(#\), \[F01D 25/24\]\(#\) and \[F01D 25/26\]\(#\)](#))}
- 11/00 Preventing or minimising internal leakage of working-fluid, e.g. between stages (sealings in general [F16J](#) {; sealing arrangements for transition ducts of combustor cans [F01D 9/023](#))}**
- 11/001 . {for sealing space between stator blade and rotor}
- 11/003 . {by packing rings; Mechanical seals}
- 11/005 . {Sealing means between non relatively rotating elements}
- 11/006 . . {Sealing the gap between rotor blades or blades and rotor}
- 11/008 . . . {by spacer elements between the blades, e.g. independent interblade platforms}
- 11/02 . by non-contact sealings, e.g. of labyrinth type ([for sealing space between rotor blade tips and stator \[F01D 11/08\]\(#\)](#))
- 11/025 . . {Seal clearance control; Floating assembly; Adaptation means to differential thermal dilatations}
- 11/04 . . using sealing fluid, e.g. steam
- 11/06 . . . Control thereof
- 11/08 . for sealing space between rotor blade tips and stator ([specially-shaped blade tips therefor \[F01D 5/20\]\(#\)](#))
- 11/10 . . using sealing fluid, e.g. steam
- 11/12 . . using a rubstrip, e.g. erodible. deformable or resiliently-biased part
- 11/122 . . . {with erodable or abradable material ([blades having cutting or grinding tips \[F01D 5/20\]\(#\)](#))}
- 11/125 {with a reinforcing structure}
- 11/127 . . . {with a deformable or crushable structure, e.g. honeycomb}
- 11/14 . . Adjusting or regulating tip-clearance, i.e. distance between rotor-blade tips and stator casing ([rotors with blades adjustable in operation \[F01D 7/00\]\(#\)](#))
- 11/16 . . . by self-adjusting means ([F01D 11/12 takes precedence](#))
- 11/18 using stator or rotor components with predetermined thermal response, e.g. selective insulation, thermal inertia, differential expansion
- 11/20 . . . Actively adjusting tip-clearance
- 11/22 by mechanically actuating the stator or rotor components, e.g. moving shroud sections relative to the rotor
- 11/24 by selectively cooling-heating stator or rotor components
- 13/00 Combinations of two or more machines or engines ([F01D 15/00 takes precedence](#); regulating or controlling, see the relevant groups; combinations of two or more pumps [F04](#); fluid gearing [F16H](#))**
- 13/003 . {with at least two independent shafts, i.e. cross-compound}
- 13/006 . {one being a reverse turbine}
- 13/02 . Working-fluid interconnection of machines or engines
- 15/00 Adaptations of machines or engines for special use; Combinations of engines with devices driven thereby (regulating or controlling see the relevant groups; aspects predominantly concerning driven devices, see the relevant classes for the devices)**

- 15/005 . {Adaptations for refrigeration plants}
- 15/02 . Adaptations for driving vehicles, e.g. locomotives (arrangement in vehicles, see the relevant vehicle classes)
- 15/04 . . the vehicles being waterborne vessels
- 15/045 . . . {Control thereof}
- 15/06 . Adaptations for driving, or combinations with, hand-held tools or the like {control thereof}
- 15/062 . . {Controlling means specially adapted therefor}
- 15/065 . . {with pressure-velocity transformation exclusively in rotor}
- 15/067 . . {characterised by non-bladed rotor}
- 15/08 . Adaptations for driving, or combinations with, pumps
- 15/10 . Adaptations for driving, or combinations with, electric generators
- 15/12 . Combinations with mechanical gearing (driven by multiple engines F01D 13/00)
- 17/00 Regulating or controlling by varying flow (for reversing F01D 1/30; by varying rotor-blade position F01D 7/00; specially for starting F01D 19/00; shutting-down F01D 21/00; regulating or controlling in general G05 {; specially adapted for hand-held tools or the like F01D 15/06})**
- 17/02 . Arrangement of sensing elements (sensing elements per se: see the relevant subclasses)
- 17/04 . . responsive to load
- 17/06 . . responsive to speed
- 17/08 . . responsive to condition of working-fluid, e.g. pressure
- 17/085 . . . {to temperature}
- 17/10 . Final actuators (valves in general F16K {; blades with variable camber F01D 5/148})
- 17/105 . . {by passing part of the fluid}
- 17/12 . . arranged in stator parts
- 17/14 . . . varying effective cross-sectional area of nozzles or guide conduits
- 17/141 {by means of shiftable members or valves obturating part of the flow path}
- 17/143 {the shiftable member being a wall, or part thereof of a radial diffuser}
- 17/145 {by means of valves, e.g. for steam turbines (valves in general F16K)}
- 17/146 {by throttling the volute inlet of radial machines or engines}
- 17/148 {by means of rotatable members, e.g. butterfly valves}
- 17/16 by means of nozzle vanes
- 17/162 {for axial flow, i.e. the vanes turning around axes which are essentially perpendicular to the rotor centre line (F01D 17/167 takes precedence)}
- 17/165 {for radial flow, i.e. the vanes turning around axes which are essentially parallel to the rotor centre line (F01D 17/167 takes precedence)}
- 17/167 {of vanes moving in translation}
- 17/18 . . . varying effective number of nozzles or guide conduits {, e.g. sequentially operable valves for steam turbines}
- 17/20 . Devices dealing with sensing elements or final actuators or transmitting means between them, e.g. power-assisted (sensing elements alone F01D 17/02; final actuators alone F01D 17/10)
- 17/205 . . {Centrifugal governors directly linked to valves}
- 17/22 . . the operation or power assistance being predominantly non-mechanical
- 17/24 . . . electrical
- 17/26 . . . fluid, e.g. hydraulic
- 19/00 Starting of machines or engines; Regulating, controlling, or safety means in connection therewith (warming-up before starting F01D 25/10; turning or inching gear F01D 25/34)**
- 19/02 . dependent on temperature of component parts, e.g. of turbine-casing
- 21/00 Shutting-down of machines or engines, e.g. in emergency; Regulating, controlling, or safety means not otherwise provided for**
- 21/003 . {Arrangements for testing or measuring (for measuring vibrations G01H)}
- 21/006 . {Arrangements of brakes (brakes per se F16D)}
- 21/02 . Shutting-down responsive to overspeed
- 21/04 . responsive to undesired position of rotor relative to stator {or to breaking-off of a part of the rotor}, e.g. indicating such position
- 21/045 . . {special arrangements in stators or in rotors dealing with breaking-off of part of rotor}
- 21/06 . . Shutting-down
- 21/08 . . Restoring position
- 21/10 . responsive to unwanted deposits on blades, in working-fluid conduits or the like
- 21/12 . responsive to temperature
- 21/14 . responsive to other specific conditions
- 21/16 . Trip gear
- 21/18 . . involving hydraulic means
- 21/20 . Checking operation of shut-down devices
- 23/00 Non-positive-displacement machines or engines with movement other than pure rotation, e.g. of endless-chain type**
- 25/00 Component parts, details, or accessories, not provided for in, or of interest apart from, other groups**
- 25/002 . {Cleaning of turbomachines}
- 25/005 . {Selecting particular materials}
- 25/007 . {Preventing corrosion}
- 25/02 . De-icing means for engines having icing phenomena
- 25/04 . Antivibration arrangements
- 25/06 . . for preventing blade vibration (means on blade-carrying members or blades F01D 5/00)
- 25/08 . Cooling (of machines or engines in general F01P); Heating; Heat-insulation (of blade-carrying members, of blades F01D 5/00)
- 25/10 . . Heating, e.g. warming-up before starting
- 25/12 . . Cooling
- 25/125 . . . {of bearings}
- 25/14 . . Casings modified therefor (double casings F01D 25/26)
- 25/145 . . . {Thermally insulated casings}
- 25/16 . Arrangement of bearings; Supporting or mounting bearings in casings (bearings per se F16C)

F01D

- 25/162 . . {Bearing supports}
- 25/164 . . . {Flexible supports; Vibration damping means associated with the bearing}
- 25/166 . . {Sliding contact bearing (gas bearings [F01D 25/22](#))}
- 25/168 . . . {for axial load mainly}
- 25/18 . . Lubricating arrangements (of machines or engines in general [F01M](#))
- 25/183 . . {Sealing means}
- 25/186 . . . {for sliding contact bearing}
- 25/20 . . using lubrication pumps
- 25/22 . . using working-fluid or other gaseous fluid as lubricant
- 25/24 . . Casings (modified for heating or cooling [F01D 25/14](#)); Casing parts, e.g. diaphragms, casing fastenings (casings for rotary machines or engines in general [F16M](#) {; special arrangements in stators dealing with breaking-off of part of rotor [F01D 21/045](#)})
- 25/243 . . {Flange connections; Bolting arrangements ([F01D 25/265](#) takes precedence)}
- 25/246 . . {Fastening of diaphragms or stator-rings}
- 25/26 . . Double casings; Measures against temperature strain in casings
- 25/265 . . . {Vertically split casings; Clamping arrangements therefor}
- 25/28 . . Supporting or mounting arrangements, e.g. for turbine casing
- 25/285 . . {Temporary support structures, e.g. for testing, assembling, installing, repairing; Assembly methods using such structures}
- 25/30 . . Exhaust heads, chambers, or the like
- 25/305 . . {with fluid, e.g. liquid injection}
- 25/32 . . Collecting of condensation water; Drainage {Removing solid particles}
- 25/34 . . Turning or inching gear
- 25/36 . . using electric motors