

CPC COOPERATIVE PATENT CLASSIFICATION

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

ENGINES OR PUMPS

F01 MACHINES OR ENGINES IN GENERAL (combustion engines [F02](#); machines for liquids [F03](#), [F04](#)); 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.

WARNINGS

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

F01D 5/32	covered by	F01D 5/30
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2. 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)	1/14	• . . . traversed by the working-fluid substantially radially
		1/16	• . characterised by having both reaction stages and impulse stages
		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 })
1/02	• 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)	1/20	• . traversed by the working-fluid substantially axially
		1/22	• . traversed by the working-fluid substantially radially
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}	1/24	• characterised by counter-rotating rotors subjected to same working fluid stream without intermediate stator blades or the like
		1/26	• . 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)}	1/28	• . traversed by the working-fluid substantially radially
		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)
1/04	• . traversed by the working-fluid substantially axially		
1/06	• . traversed by the working-fluid substantially radially	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)}
1/08	• . . . having inward flow		
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)		
1/12	• . with repeated action on same blade ring		

- 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](#))
- 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