

# CPC COOPERATIVE PATENT CLASSIFICATION

## 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

The following IPC groups are not used in the CPC system. Subject matter covered by these groups is classified in the following CPC groups:

[F01D 5/32](#) covered by [F01D 5/30](#)

<b>1/00</b>	<b>Non-positive-displacement machines or engines, e.g. steam turbines (with working-fluid flows in opposite axial directions for balancing axial thrust <a href="#">F01D 3/02</a>; with other than pure rotation <a href="#">F01D 23/00</a>; turbines characterised by their use in special steam systems, cycles, or processes, regulating devices therefor <a href="#">F01K</a>)</b>	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
		1/28	• . traversed by the working-fluid substantially radially
1/02	• with stationary working-fluid guiding means and bladed or like rotor, {e.g. multi-bladed impulse steam turbines} ( <a href="#">F01D 1/24</a> takes precedence; without stationary working-fluid guiding means <a href="#">F01D 1/18</a> )	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 <a href="#">F01D 13/00</a> )
1/023	• . {the working-fluid being divided into several separate flows ( <a href="#">F01D 3/02</a> 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}	1/32	• 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 <a href="#">F02C 3/165</a> ; jet propulsion plants <a href="#">per se</a> <a href="#">F02K</a> )}
1/026	• . {Impact turbines with buckets, i.e. impulse turbines, e.g. Pelton turbines ( <a href="#">F01D 1/16</a> , <a href="#">F01D 1/34</a> take precedence)}	1/34	• characterised by non-bladed rotor, e.g. with drilled holes ( <a href="#">F01D 1/32</a> takes precedence; sirens <a href="#">G10K 7/00</a> {impact turbines with buckets <a href="#">F01D 1/026</a> ; hand-held tools with a non-bladed rotor <a href="#">F01D 15/067</a> })
1/04	• . traversed by the working-fluid substantially axially	1/36	• . using fluid friction
1/06	• . traversed by the working-fluid substantially radially	1/38	• . of the screw type
1/08	• . . having inward flow	<b>3/00</b>	<b>Machines or engines with axial-thrust balancing effected by working-fluid</b>
1/10	• . having two or more stages subjected to working-fluid flow without essential intermediate pressure change, i.e. with velocity stages ( <a href="#">F01D 1/12</a> takes precedence)	3/02	• characterised by having one fluid flow in one axial direction and another fluid flow in the opposite direction
1/12	• . with repeated action on same blade ring	3/025	• . {with a centrally disposed radial stage}
1/14	• . . traversed by the working-fluid substantially radially	3/04	• axial thrust being compensated by thrust-balancing dummy piston or the like
1/16	• . characterised by having both reaction stages and impulse stages	<b>5/00</b>	<b>Blades; Blade-carrying members (nozzle boxes <a href="#">F01D 9/02</a>; Heating, heat-insulating, cooling or anti-vibration means on the blades or the members {special arrangements in rotors dealing with breaking off of part thereof <a href="#">F01D 21/045</a>})</b>
1/18	• without stationary working-fluid guiding means; ( <a href="#">F01D 1/24</a> , <a href="#">F01D 1/32</a> , <a href="#">F01D 1/34</a> take precedence; {with pressure-velocity transformation exclusively in rotor <a href="#">F01D 1/32</a> })	5/005	• {Repairing methods or devices}
1/20	• . traversed by the working-fluid substantially axially	5/02	• Blade-carrying members, e.g. rotors (rotors of non-bladed type <a href="#">F01D 1/34</a> ; stators <a href="#">F01D 9/00</a> {selecting particular materials <a href="#">F01D 5/28</a> })
1/22	• . traversed by the working-fluid substantially radially	5/021	• . {for flow machines or engines with only one axial stage (for more than one stage <a href="#">F01D 5/06</a> )}

- 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