

ECLA EUROPEAN CLASSIFICATION

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

[N: **WARNING**

- 1.
2. The following IPC groups are not used in the internal ECLA classification system. Subject matter covered by these groups is classified in the following ECLA groups:

[F01D5/32](#) covered by [F01D5/30](#)

]

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.

- F01D1/00 Non-positive-displacement machines or engines, e.g. steam turbines (with working-fluid flows in opposite axial directions for balancing axial thrust [F01D3/02](#); with other than pure rotation [F01D23/00](#); turbines characterised by their use in special steam systems, cycles, or processes, regulating devices therefor F01K)**
- F01D1/02 . with stationary working-fluid guiding means and bladed or like rotor, [N: e.g. multi-bladed impulse steam turbines] ([F01D1/24](#) takes precedence; without stationary working-fluid guiding means [F01D1/18](#))
- F01D1/02B . . [N: the working-fluid being divided into several separate flows ([F01D3/02](#) 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]
- F01D1/02D . . [N: Impact turbines with buckets, i.e. impulse turbines e.g. Pelton turbines ([F01D1/16](#), [F01D1/34](#) take precedence)]
- F01D1/04 . . traversed by the working-fluid substantially axially
- F01D1/06 . . traversed by the working-fluid substantially radially
- F01D1/08 . . . having inward flow
- F01D1/10 . . having two or more stages subjected to working-fluid flow without essential intermediate pressure change, i.e. with velocity stages ([F01D1/12](#) takes

- precedence)
- F01D1/12 . . with repeated action on same blade ring
 - F01D1/14 . . . traversed by the working-fluid substantially radially
 - F01D1/16 . . characterised by having both reaction stages and impulse stages

 - F01D1/18 . without stationary working-fluid guiding means; ([F01D1/24](#), [F01D1/32](#), [F01D1/34](#) take precedence; [N: with pressure-velocity transformation exclusively in rotor [F01D1/32](#)])
 - F01D1/20 . . traversed by the working-fluid substantially axially
 - F01D1/22 . . traversed by the working-fluid substantially radially

 - F01D1/24 . characterised by counter-rotating rotors subjected to same working fluid stream without intermediate stator blades or the like
 - F01D1/26 . . traversed by the working-fluid substantially axially
 - F01D1/28 . . traversed by the working-fluid substantially radially

 - F01D1/30 . characterised by having a single rotor operable in either direction of rotation, e.g. by reversing of blades ([combinations of machines or engines F01D13/00](#))

 - F01D1/32 . with pressure velocity transformation exclusively in rotor, e.g. the rotor rotating under the influence of jets issuing from the rotor, [N: e.g. Heron turbines (the working fluid being a combustion products [F02C3/16B](#); jet propulsion plants per se [F02K](#))]

 - F01D1/34 . characterised by non-bladed rotor, e.g. with drilled holes ([F01D1/32](#) takes precedence; [sirens G10K7/00](#) [N: impact turbines with buckets [F01D1/02D](#); hand-held tools with a non-bladed rotor [F01D15/06D](#)])
 - F01D1/36 . . using fluid friction
 - F01D1/38 . . of the screw type [[N9510](#)]

 - F01D3/00 Machines or engines with axial-thrust balancing effected by working-fluid**

 - F01D3/02 . characterised by having one fluid flow in one axial direction and another fluid flow in the opposite direction
 - F01D3/02B . . [[N: with a centrally disposed radial stage](#)]
 - F01D3/04 . axial thrust being compensated by thrust-balancing dummy piston or the like

 - F01D5/00 Blades; Blade-carrying members ([nozzle boxes F01D9/02](#)); Heating, heat-insulating, cooling or anti-vibration means on the blades or the members [N: special arrangements in rotors dealing with breaking off of part thereof [F01D21/04B](#)]**

 - F01D5/00B . [[N: Repairing methods or devices](#)]
 - F01D5/02 . Blade-carrying members, e.g. rotors ([rotors of non-bladed type F01D1/34](#); [stators F01D9/00](#)) [[N: selecting particular materials F01D5/28](#)]
 - F01D5/02C . . [[N: for flow machines or engines with only one axial stage \(for more than one stage F01D5/06\)](#)]
 - F01D5/02D . . [[N: with concentric rows of axial blades](#)]
 - F01D5/02F . . [[N: of the screw type](#)]
 - F01D5/02G . . [[N: Fixing blade carrying members on shafts \(attachment of a member on a shaft in](#)

- general [F16D1/06](#); for non-positive displacement pumps [F04D29/00](#)]
- F01D5/02J . . [N: Shaft to shaft connections]
- F01D5/02L . . [N: Arrangements for balancing (for balancing rotating bodies in general [F16F15/32](#); for compensating unbalance [G01M1/36](#))]
- F01D5/02M . . [N: the rotor disc being formed of sheet laminae (rotor blade aggregates of unitary construction [F01D5/34](#))]
- F01D5/03 . . Annular blade-carrying members having blades on the inner periphery of the annulus and extending inwardly radially, i.e. inverted rotors [[N9602](#)]
- F01D5/04 . . for radial-flow machines or engines
- F01D5/04B . . . [N: of the Ljungström type]
- F01D5/04C . . . [N: of the axial inlet- radial outlet, or vice-versa, type]
- F01D5/04C2 [N: the wheel comprising two adjacent bladed wheel portions e.g. with interengaging blades for damping vibrations]
- F01D5/04C3 [N: Heating, heat insulation or cooling means]
- F01D5/04C4 [N: Form or construction]
- F01D5/06 . . Rotors for more than one axial stage, e.g. of drum or multiple disc type; Details thereof, e.g. shafts, shaft connections [N: [F01D5/02D](#), [F01D5/02F](#) take precedence]
- F01D5/06B . . . [N: Welded rotors (welding per se [B23K](#))]
- F01D5/06F . . . [N: Connecting means for joining rotor-discs or rotor-elements together, e.g. by a central bolt, by clamps]
- F01D5/08 . . Heating, heat-insulating or cooling means [N: specially adapted for radial flow machines or engines [F01D5/04](#)]
- F01D5/08C . . . [N: Cooling fluid being directed on the side of the rotor disc or at the roots of the blades ([F01D5/08D2](#) takes precedence)]
- F01D5/08C2 [N: on the side of the rotor disc]
- F01D5/08C3 [N: the fluid circulating at the periphery of a multistage rotor, e.g. of drum type]
- F01D5/08D [N: cooling fluid circulating inside the rotor]
- F01D5/08D2 [N: in the radial passages of the rotor disc]
- F01D5/08D3 [N: in a closed cavity]
- F01D5/10 . . Anti- vibration means [N: (specially adapted for radial flow machines or engines [F01D5/04](#))]
- F01D5/12 . . Blades ([N: specially adapted for radial flow machines or engines [F01D5/04](#)]; blade roots [F01D5/30](#); rotors with blades adjustable in operation [F01D7/00](#); stator blades [F01D9/02](#))
- F01D5/14 . . Form or construction (selecting particular materials, measures against erosion or corrosion [F01D5/28](#))
- F01D5/14B . . . [N: Shape, i.e. outer, aerodynamic form ([F01D5/14D](#) to [F01D5/20](#) take precedence; blade construction [F01D5/14C](#))] [[C9702](#)]
- F01D5/14B2 [N: of the blades of successive rotor or stator blade-rows]
- F01D5/14B2B [N: Contour of the outer or inner working fluid flow path wall, i.e. shroud or hub contour] [[N9504](#)]
- F01D5/14B3 [N: Means for influencing boundary layers or secondary circulations (for compressors [F04D29/68](#))] [[C9608](#)]
- F01D5/14B4 [N: of blades with tandem configuration, split blades or slotted blades] [[N9909](#)]

- F01D5/14C . . . [N: Construction, i.e. structural features, e.g. of weight-saving hollow blades (F01D5/14D, F01D5/16 and F01D5/20 take precedence; blade shape F01D5/14B; blades with cooling or heating channels or cavities F01D5/18; heating, heat-insulating or cooling means on blades F01D5/18)] [C9702]
- F01D5/14D . . . [N: Blades with variable camber, e.g. by ejection of fluid]
- F01D5/16 . . . for counteracting blade vibration
- F01D5/18 . . . Hollow blades, [N: i.e. blades with cooling or heating channels or cavities (structure of hollow blades in general F01D5/14C)]; Heating, heat-insulating or cooling means on blades [C9702]
- F01D5/18B [N: Blades having a closed internal cavity containing a cooling medium, e.g. sodium]
- F01D5/18C [N: Transpiration cooling]
- F01D5/18C2 [N: Blade walls being porous]
- F01D5/18C3 [N: Blade walls being made of perforated sheet laminae]
- F01D5/18D [N: Liquid cooling (F01D5/18B takes precedence)]
- F01D5/18F [N: Film cooling (F01D5/18G takes precedence)]
- F01D5/18G [N: Convection cooling]
- F01D5/18G2 [N: with an insert in the blade cavity to guide the cooling fluid, e.g. forming a separation wall]
- F01D5/18G2C [N: the insert having a tubular cross-section, e.g. airfoil shape]
- F01D5/20 . . . Specially-shaped blade tips to seal space between tips and stator [N: (F01D5/22B takes precedence)]
- F01D5/22 . . Blade-to-blade connections, [N: e.g. for damping vibrations] [C9507]
- F01D5/22B . . . [N: by shrouding]
- F01D5/24 . . . using wire or the like
- F01D5/26 . . Antivibration means not restricted to blade form or construction or to blade-to-blade connections [N: or to the use of particular materials]
- F01D5/28 . . Selecting particular materials; [N: Particular measures relating thereto;] Measures against erosion or corrosion
- F01D5/28B . . . [N: Selecting composite materials, e.g. blades with reinforcing filaments]
- F01D5/28C . . . [N: Selection of ceramic materials]
- F01D5/28D . . . [N: Particular treatment of blades, e.g. to increase durability or resistance against corrosion or erosion (F01D5/28F takes precedence)]
- F01D5/28F . . . [N: Protective coatings for blades]
- F01D5/30 . . Fixing blades to rotors; Blade roots; [N: Blade spacers]
- F01D5/30B . . . [N: of axial insertion type]
- F01D5/30B2 [N: with side plates]
- F01D5/30C . . . [N: of radial insertion type, e.g. in individual recesses]
- F01D5/30C2 [N: in a circumferential slot]
- F01D5/30C2B [N: the slot having inwardly directed abutment faces on both sides]
- F01D5/30C3 [N: the rotor having ribs around the circumference]
- F01D5/30D . . . [N: by means of pins]
- F01D5/30F . . . [N: by welding, brazing]
- F01D5/30G . . . [N: between two discs or rings]
- F01D5/30H . . . [N: Sheet metal discs]

- F01D5/30K . . [N: the blades being made of ceramics][C9411]
- F01D5/30L . . [N: Protective layers between blade root and rotor disc surfaces, e.g. anti-friction layers ([F01D5/28F](#) takes precedence)][N9411]
- F01D5/32 . Locking, e.g. by final locking blades or keys [N1202]
- F01D5/32B . . [N: Locking of axial insertion type blades by means of a key or the like parallel to the axis of the rotor] [N1202]
- F01D5/32C . . [N: Locking of axial insertion type blades by other means] [N1202]
- F01D5/34 . Rotor-blade aggregates of unitary construction [N: e.g. formed of sheet laminae; (discs formed of sheet laminae [F01D5/02M](#); Ceramic materials [F01D5/28C](#), composite materials [F01D5/28B](#))]
- F01D7/00** **Rotors with blades adjustable in operation; Control thereof (for reversing [F01D1/30](#))**
- F01D7/02 . having adjustment responsive to speed
- F01D9/00** **Stators (non-fluid guiding aspects of casings, regulating, controlling, or safety aspects, see the relevant groups)**
- F01D9/02 . Nozzles; Nozzle boxes; Stator blades; Guide conduits [N: e.g. individual nozzles (nozzle boxes [F01D9/04G](#))]
- F01D9/02B . . [N: Transition ducts between combustor cans and first stage of the turbine in gas-turbine engines; their cooling or sealings]
- F01D9/02C . . [N: Scrolls for radial machines or engines]
- F01D9/04 . . forming ring or sector
- F01D9/04B . . . [N: using blades ([F01D5/14D](#) takes precedence)]
- F01D9/04C . . . [N: fixing blades to stators (fixing stator-rings in the casing or to each other [F01D25/24C](#))]
- F01D9/04C2 [N: permanently, e.g. by welding, brazing, casting or the like]
- F01D9/04D . . . [N: for radial flow machines or engines]
- F01D9/04G . . . [N: Nozzle boxes]
- F01D9/04H . . . [N: for radial admission]
- F01D9/06 . Fluid supply conduits to nozzles or the like
- F01D9/06C . . [N: Fluid supply or removal conduits traversing the working fluid flow, e.g. for lubrication-, cooling- ,or sealing fluids (see also [F01D25/16](#), [F01D25/24](#) and [F01D25/26](#))]
- F01D11/00** **Preventing or minimising internal leakage of working-fluid, e.g. between stages (sealings in general [F16J](#)) [N: sealing arrangements for transition ducts of combustor cans [F01D9/02B](#)]**
- F01D11/00B . [N: for sealing space between stator blade and rotor]
- F01D11/00C . [N: by packing rings; Mechanical seals]
- F01D11/00D . [N: Sealing means between non relatively rotating elements]

- F01D11/00D2 . . [N: Sealing the gap between rotor blades or blades and rotor]
- F01D11/00D2B . . . [N: by spacer elements between the blades, e.g. independent interblade platforms]
- F01D11/02 . by non-contact sealings, e.g. of labyrinth type (for sealing space between rotor blade tips and stator [F01D11/08](#))
- F01D11/02B . . [N: Seal clearance control; Floating assembly; Adaptation means to differential thermal dilatations]
- F01D11/04 . . using sealing fluid, e.g. steam
- F01D11/06 . . . Control thereof
- F01D11/08 . for sealing space between rotor blade tips and stator (specially-shaped blade tips therefor [F01D5/20](#))
- F01D11/10 . . using sealing fluid, e.g. steam
- F01D11/12 . . using a rubstrip, e.g. erodible. deformable or resiliently-biased part [N9602]
- F01D11/12B . . . [N: with erodable or abradable material (blades having cutting or grinding tips [F01D5/20](#))] [N9602]
- F01D11/12B2 [N: with a reinforcing structure] [N9602]
- F01D11/12D . . . [N: with a deformable or crushable structure, e.g. honeycomb] [N9602]
- F01D11/14 . . Adjusting or regulating tip-clearance, i.e. distance between rotor-blade tips and stator casing (rotors with blades adjustable in operation [F01D7/00](#)) [N9602]
- F01D11/16 . . . by self-adjusting means ([F01D11/12](#) takes precedence) [N9602]
- F01D11/18 using stator or rotor components with predetermined thermal response, e.g. selective insulation, thermal inertia, differential expansion [N9602]
- F01D11/20 Actively adjusting tip-clearance [N9602]
- F01D11/22 by mechanically actuating the stator or rotor components, e.g. moving shroud sections relative to the rotor [N9602]
- F01D11/24 by selectively cooling-heating stator or rotor components [N9602]
- F01D13/00** **Combinations of two or more machines or engines** ([F01D15/00](#) takes precedence; regulating or controlling, see the relevant groups; combinations of two or more pumps [F04](#); fluid gearing [F16H](#))
- F01D13/00B . [N: with at least two independent shafts, i.e. cross-compound]
- F01D13/00C . [N: one being a reverse turbine]
- F01D13/02 . Working-fluid interconnection of machines or engines
- F01D15/00** **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)**
- F01D15/00B . [N: Adaptations for refrigeration plants]
- F01D15/02 . Adaptations for driving vehicles, e.g. locomotives (arrangement in vehicles, see the relevant vehicle classes)
- F01D15/04 . . the vehicles being waterborne vessels

- F01D15/04B . . . [N: Control thereof]
- F01D15/06 . Adaptations for driving, or combinations with, hand-held tools or the like [N: control thereof]
- F01D15/06B . . [N: Controlling means specially adapted therefor]
- F01D15/06C . . [N: with pressure-velocity transformation exclusively in rotor]
- F01D15/06D . . [N: characterised by non-bladed rotor]
- F01D15/08 . Adaptations for driving, or combinations with, pumps
- F01D15/10 . Adaptations for driving, or combinations with, electric generators
- F01D15/12 . Combinations with mechanical gearing (driven by multiple engines [F01D13/00](#))
- F01D17/00** **Regulating or controlling by varying flow** (for reversing [F01D1/30](#); by varying rotor-blade position [F01D7/00](#); specially for starting [F01D19/00](#); shutting-down [21/00](#); regulating or controlling in general [G05](#)) [N: specially adapted for hand-held tools or the like [F01D15/06](#)]
- F01D17/02 . Arrangement of sensing elements (sensing elements per se: see the relevant subclasses)
- F01D17/04 . . responsive to load
- F01D17/06 . . responsive to speed
- F01D17/08 . . responsive to condition of working-fluid, e.g. pressure
- F01D17/08B . . . [N: to temperature]
- F01D17/10 . Final actuators (valves in general [F16K](#)) [N: blades with variable camber [F01D5/14D](#)]
- F01D17/10B . . [N: by passing part of the fluid]
- F01D17/12 . . arranged in stator parts
- F01D17/14 . . . varying effective cross-sectional area of nozzles or guide conduits
- F01D17/14B [N: by means of shiftable members or valves obturating part of the flow path]
- F01D17/14B2 [N: the shiftable member being a wall, or part thereof of a radial diffuser]
- F01D17/14B3 [N: by means of valves, e.g. for steam turbines (valves in general [F16K](#))]
- F01D17/14C [N: by throttling the volute inlet of radial machines or engines]
- F01D17/14D [N: by means of rotatable members, e.g. butterfly valves]
- F01D17/16 by means of nozzle vanes
- F01D17/16B [N: for axial flow; i.e. the vanes turning around axes which are essentially perpendicular to the rotor centre line ([F01D17/16D](#) takes precedence)]
- F01D17/16C [N: for radial flow; i.e. the vanes turning around axes which are essentially parallel to the rotor centre line ([F01D17/16D](#) takes precedence)]
- F01D17/16D [N: of vanes moving in translation]
- F01D17/18 . . . varying effective number of nozzles or guide conduits [N: e.g. sequentially operable valves for steam turbines]
- F01D17/20 . Devices dealing with sensing elements or final actuators or transmitting means between them, e.g. power-assisted (sensing elements alone [F01D17/02](#); final actuators alone [F01D17/10](#))

- F01D17/20B . . [N: Centrifugal governors directly linked to valves]
- F01D17/22 . . the operation or power assistance being predominantly non-mechanical
- F01D17/24 . . . electrical
- F01D17/26 . . . fluid, e.g. hydraulic

- F01D19/00** **Starting of machines or engines; Regulating, controlling, or safety means in connection therewith (warming-up before starting [F01D25/10](#); turning or inching gear [F01D25/34](#))**

- F01D19/02 . dependent on temperature of component parts, e.g. of turbine-casing

- F01D21/00** **Shutting-down of machines or engines, e.g. in emergency; Regulating, controlling, or safety means not otherwise provided for**

- F01D21/00B . [N: Arrangements for testing or measuring (for measuring vibrations [G01H](#))]
- F01D21/00C . [N: Arrangements of brakes (brakes per se [F16D](#))]
- F01D21/02 . Shutting-down responsive to overspeed
- F01D21/04 . responsive to undesired position of rotor relative to stator [N: or to breaking-off of a part of the rotor], e.g. indicating such position
- F01D21/04B . . [N: special arrangements in stators or in rotors dealing with breaking-off of part of rotor]
- F01D21/06 . . Shutting-down
- F01D21/08 . . Restoring position
- F01D21/10 . responsive to unwanted deposits on blades, in working-fluid conduits or the like
- F01D21/12 . responsive to temperature
- F01D21/14 . responsive to other specific conditions
- F01D21/16 . Trip gear
- F01D21/18 . . involving hydraulic means
- F01D21/20 . Checking operation of shut-down devices

- F01D23/00** **Non-positive-displacement machines or engines with movement other than pure rotation, e.g. of endless-chain type**

- F01D25/00** **Component parts, details, or accessories, not provided for in, or of interest apart from, other groups**

- F01D25/00B . [N: Cleaning of turbomachines]
- F01D25/00C . [N: Selecting particular materials]
- F01D25/00D . [N: Preventing corrosion]

- F01D25/02 . De-icing means for engines having icing phenomena
- F01D25/04 . Antivibration arrangements
- F01D25/06 . . for preventing blade vibration (means on blade-carrying members or blades 5/00)
- F01D25/08 . Cooling (of machines or engines in general [F01P](#)); Heating; Heat-insulation (of blade-carrying members, of blades [F01D5/00](#))
- F01D25/10 . . Heating, e.g. warming-up before starting
- F01D25/12 . . Cooling
- F01D25/12B . . . [\[N: of bearings\]](#)
- F01D25/14 . . Casings modified therefor (double casings [F01D25/26](#))
- F01D25/14C . . . [\[N: Thermally insulated casings\]](#)
- F01D25/16 . Arrangement of bearings; Supporting or mounting bearings in casings (bearings per se [F16C](#))
- F01D25/16B . . [\[N: Bearing supports\]](#)
- F01D25/16B2 . . . [\[N: Flexible supports; Vibration damping means associated with the bearing\]](#)
- F01D25/16C . . [\[N: Sliding contact bearing \(gas bearings \[F01D25/22\]\(#\)\)\]](#)
- F01D25/16C2 . . . [\[N: for axial load mainly\]](#)
- F01D25/18 . Lubricating arrangements (of machines or engines in general [F01M](#))
- F01D25/18B . . [\[N: Sealing means\]](#)
- F01D25/18B2 . . . [\[N: for sliding contact bearing\]](#)
- F01D25/20 . . using lubrication pumps
- F01D25/22 . . using working-fluid or other gaseous fluid as lubricant
- F01D25/24 . Casings (modified for heating or cooling [F01D25/14](#)); Casing parts, e.g. diaphragms, casing fastenings (casings for rotary machines or engines in general [F16M](#)) [\[N: special arrangements in stators dealing with breaking-off of part of rotor \[F01D21/04B\]\(#\)\]](#)
- F01D25/24B . . [\[N: Flange connections; Bolting arrangements \(\[F01D25/26B\]\(#\) takes precedence\)\]](#)
- F01D25/24C . . [\[N: Fastening of diaphragms or stator-rings\]](#)
- F01D25/26 . . Double casings; Measures against temperature strain in casings
- F01D25/26B . . . [\[N: Vertically split casings; Clamping arrangements therefor\]](#)
- F01D25/28 . Supporting or mounting arrangements, e.g. for turbine casing
- F01D25/28B . . [\[N: Temporary support structures, e.g. for testing, assembling, installing, repairing; Assembly methods using such structures\]](#)
- F01D25/30 . Exhaust heads, chambers, or the like
- F01D25/30B . . [\[N: with fluid, e.g. liquid injection\]](#)
- F01D25/32 . Collecting of condensation water; Drainage [\[N: Removing solid particles\]](#)
- F01D25/34 . Turning or inching gear
- F01D25/36 . . using electric motors