

## SECTION F — MECHANICAL ENGINEERING; LIGHTING; HEATING; WEAPONS; BLASTING

### F02 COMBUSTION ENGINES; HOT-GAS OR COMBUSTION-PRODUCT ENGINE PLANTS

**F02C GAS-TURBINE PLANTS; AIR INTAKES FOR JET-PROPULSION PLANTS; CONTROLLING FUEL SUPPLY IN AIR-BREATHING JET-PROPULSION PLANTS** (construction of turbines F01D; jet-propulsion plants F02K; construction of compressors or fans F04; combustion apparatus in which combustion takes place in a fluidised bed of fuel or other particles F23C 10/00; generating combustion products of high pressure or high velocity F23R; using gas turbines in compression refrigeration plants F25B 11/00; using gas-turbine plants in vehicles, see the relevant vehicle classes)

#### Note(s)

1. This subclass covers:
    - combustion product or hot gas turbine plants;
    - internal combustion turbines or turbine plants;
    - turbine plants in which the working fluid is an unheated, pressurised gas.
  2. This subclass does not cover:
    - steam turbine plants, which are covered by subclass F01K;
    - special vapour plants, which are covered by subclass F01K.
  3. In this subclass, the following expression is used with the meaning indicated:
    - "gas-turbine plants" covers all the subject matter of Note (1) above and covers also features of jet-propulsion plants common to gas-turbine plants.
  4. Attention is drawn to the Notes preceding class F01.
- |       |  |       |   |
|-------|--|-------|---|
| 1/00  | <b>Gas-turbine plants characterised by the use of hot gases or unheated pressurised gases, as the working fluid</b> (by the use of combustion products F02C 3/00, F02C 5/00) [3]   | 3/08  | <ul style="list-style-type: none"> <li>• • the compressor comprising at least one radial stage (F02C 3/10 takes precedence) [3]</li> </ul>  |
| 1/02  | <ul style="list-style-type: none"> <li>• the working fluid being an unheated pressurised gas [3]</li> </ul>  | 3/09  | <ul style="list-style-type: none"> <li>• • • of the centripetal type [3]</li> </ul>   |
| 1/04  | <ul style="list-style-type: none"> <li>• the working fluid being heated indirectly [3]</li> </ul>  | 3/10  | <ul style="list-style-type: none"> <li>• • with another turbine driving an output shaft but not driving the compressor</li> </ul>   |
| 1/05  | <ul style="list-style-type: none"> <li>• • characterised by the type or source of heat, e.g. using nuclear or solar energy [3]</li> </ul>  | 3/107 | <ul style="list-style-type: none"> <li>• • with two or more rotors connected by power transmission [5]</li> </ul>   |
| 1/06  | <ul style="list-style-type: none"> <li>• • • using reheated exhaust gas (F02C 1/08 takes precedence) [3]</li> </ul>  | 3/113 | <ul style="list-style-type: none"> <li>• • • with variable power transmission between rotors [5]</li> </ul>   |
| 1/08  | <ul style="list-style-type: none"> <li>• • Semi-closed cycles [3]</li> </ul>   | 3/13  | <ul style="list-style-type: none"> <li>• • having variable working fluid interconnections between turbines or compressors or stages of different rotors [5]</li> </ul>  |
| 1/10  | <ul style="list-style-type: none"> <li>• • Closed cycles [3]</li> </ul>  | 3/14  | <ul style="list-style-type: none"> <li>• characterised by the arrangement of the combustion chamber in the plant (combustion chambers <u>per se</u> F23R) [3]</li> </ul>  |
| 3/00  | <b>Gas-turbine plants characterised by the use of combustion products as the working fluid</b> (generated by intermittent combustion F02C 5/00)                                    | 3/16  | <ul style="list-style-type: none"> <li>• • the combustion chambers being formed at least partly in the turbine rotor</li> </ul>   |
| 3/02  | <ul style="list-style-type: none"> <li>• using exhaust-gas pressure in a pressure exchanger to compress combustion-air (pressure exchangers <u>per se</u> F04F 13/00)</li> </ul>   | 3/20  | <ul style="list-style-type: none"> <li>• using a special fuel, oxidant, or dilution fluid to generate the combustion products [3]</li> </ul>  |
| 3/04  | <ul style="list-style-type: none"> <li>• having a turbine driving a compressor (power transmission arrangements F02C 7/36; control of working fluid flow F02C 9/16) [5]</li> </ul> | 3/22  | <ul style="list-style-type: none"> <li>• • the fuel or oxidant being gaseous at standard temperature and pressure (F02C 3/28 takes precedence) [3]</li> </ul>   |
| 3/045 | <ul style="list-style-type: none"> <li>• • having compressor and turbine passages in a single rotor (F02C 3/073 takes precedence) [3]</li> </ul>                                   | 3/24  | <ul style="list-style-type: none"> <li>• • the fuel or oxidant being liquid at standard temperature and pressure [3]</li> </ul>   |
| 3/05  | <ul style="list-style-type: none"> <li>• • • the compressor and the turbine being of the radial flow type [3]</li> </ul>   | 3/26  | <ul style="list-style-type: none"> <li>• • the fuel or oxidant being solid or pulverulent, e.g. in slurry or suspension</li> </ul>  |
| 3/055 | <ul style="list-style-type: none"> <li>• • the compressor being of the positive-displacement type [3]</li> </ul>   | 3/28  | <ul style="list-style-type: none"> <li>• • • using a separate gas producer for gasifying the fuel before combustion [3]</li> </ul>  |
| 3/06  | <ul style="list-style-type: none"> <li>• • the compressor comprising only axial stages (F02C 3/10 takes precedence) [3]</li> </ul>   | 3/30  | <ul style="list-style-type: none"> <li>• • Adding water, steam or other fluids to the combustible ingredients or to the working fluid before discharge from the turbine (heating of air intakes to prevent icing F02C 7/047) [3]</li> </ul> |
| 3/067 | <ul style="list-style-type: none"> <li>• • • having counter-rotating rotors (F02C 3/073 takes precedence) [3]</li> </ul>   | 3/32  | <ul style="list-style-type: none"> <li>• Inducing air flow by fluid jet, e.g. ejector action [3]</li> </ul>   |
| 3/073 | <ul style="list-style-type: none"> <li>• • • the compressor and turbine stages being concentric [3]</li> </ul>   |       |   |

- 3/34 • with recycling of part of the working fluid, i.e. semi-closed cycles with combustion products in the closed part of the cycle [3]
- 3/36 • Open cycles [3]
- 5/00 Gas-turbine plants characterised by the working fluid being generated by intermittent combustion**
- 5/02 • characterised by the arrangement of the combustion chamber in the plant (combustion chambers per se F23R) [3]
- 5/04 • • the combustion chambers being formed at least partly in the turbine rotor
- 5/06 • the working fluid being generated in an internal-combustion gas generator of the positive-displacement type having essentially no mechanical power output (internal-combustion engines with prolonged expansion using exhaust gas turbines F02B)
- 5/08 • • the gas generator being of the free-piston type
- 5/10 • the working fluid forming a resonating or oscillating gas column, i.e. the combustion chambers having no positively actuated valves, e.g. using Helmholtz effect [3]
- 5/11 • • using valveless combustion chambers [3]
- 5/12 • the combustion chambers having inlet or outlet valves, e.g. Holzwarth gas-turbine plants
- 6/00 Plural gas-turbine plants; Combinations of gas-turbine plants with other apparatus** (aspects predominantly concerning such apparatus, see the relevant classes for the apparatus); **Adaptations of gas-turbine plants for special use** [3]
- 6/02 • Plural gas-turbine plants having a common power output [3]
- 6/04 • Gas-turbine plants providing heated or pressurised working fluid for other apparatus, e.g. without mechanical power output (F02C 6/18 takes precedence) [3]
- 6/06 • • providing compressed gas (F02C 6/10 takes precedence) [3]
- 6/08 • • • the gas being bled from the gas-turbine compressor [3]
- 6/10 • • supplying working fluid to a user, e.g. a chemical process, which returns working fluid to a turbine of the plant [3]
- 6/12 • • • Turbochargers, i.e. plants for augmenting mechanical power output of internal-combustion piston engines by increase of charge pressure [3]
- 6/14 • Gas-turbine plants having means for storing energy, e.g. for meeting peak loads [3]
- 6/16 • • for storing compressed air [3]
- 6/18 • using the waste heat of gas-turbine plants outside the plants themselves, e.g. gas-turbine power heat plants (using waste heat as source of energy for refrigeration plants F25B 27/02) [3]
- 6/20 • Adaptations of gas-turbine plants for driving vehicles [3]
- 7/00 Features, component parts, details or accessories, not provided for in, or of interest apart from, groups F02C 1/00-F02C 6/00; Air intakes for jet-propulsion plants** (controlling F02C 9/00) [3]
- 7/04 • Air intakes for gas-turbine plants or jet-propulsion plants [3]
- 7/042 • • having variable geometry [3]
- 7/045 • • having provisions for noise suppression [3]
- 7/047 • • Heating to prevent icing [3]
- 7/05 • • having provisions for obviating the penetration of damaging objects or particles [3]
- 7/052 • • • with dust-separation devices [3]
- 7/055 • • • with intake grids, screens or guards [3]
- 7/057 • • Control or regulation (conjointly with fuel supply control F02C 9/50, with nozzle area control F02K 1/16) [3]
- 7/06 • Arrangement of bearings (bearings F16C); Lubricating (of engines in general F01M) [3]
- 7/08 • Heating air supply before combustion, e.g. by exhaust gases
- 7/10 • • by means of regenerative heat-exchangers
- 7/105 • • • of the rotary type (rotary heat exchangers per se F28D) [3]
- 7/12 • Cooling of plants (of component parts, see the relevant subclasses, e.g. F01D; cooling of engines in general F01P)
- 7/14 • • of fluids in the plant
- 7/141 • • • of working fluid (F02C 3/30 takes precedence) [3]
- 7/143 • • • • before or between the compressor stages [3]
- 7/16 • • characterised by cooling medium
- 7/18 • • • the medium being gaseous, e.g. air
- 7/20 • Mounting or supporting of plant; Accommodating heat expansion or creep
- 7/22 • Fuel supply systems
- 7/224 • • Heating fuel before feeding to the burner [3]
- 7/228 • • Dividing fuel between various burners [3]
- 7/232 • • Fuel valves; Draining valves or systems (valves in general F16K) [3]
- 7/236 • • Fuel delivery systems comprising two or more pumps [3]
- 7/24 • Heat or noise insulation (air intakes having provisions for noise suppression F02C 7/045; turbine exhaust heads, chambers, or the like F01D 25/30; silencing nozzles of jet-propulsion plants F02K 1/00) [3]
- 7/25 • • Fire protection or prevention (in general A62) [3]
- 7/26 • Starting; Ignition
- 7/262 • • Restarting after flame-out [3]
- 7/264 • • Ignition [3]
- 7/266 • • • Electric (sparking plugs H01T) [3]
- 7/268 • • Starting drives for the rotor [3]
- 7/27 • • • Fluid drives (turbine starters F02C 7/277) [3]
- 7/272 • • • • generated by cartridges [3]
- 7/275 • • • Mechanical drives [3]
- 7/277 • • • • the starter being a turbine [3]
- 7/28 • Arrangement of seals
- 7/30 • Preventing corrosion in gas-swept spaces
- 7/32 • Arrangement, mounting, or driving, of auxiliaries
- 7/36 • Power transmission between the different shafts of the gas-turbine plant, or between the gas-turbine plant and the power user (F02C 7/32 takes precedence; couplings for transmitting rotation F16D; gearing in general F16H) [3]
- 9/00 Controlling gas-turbine plants; Controlling fuel supply in air-breathing jet-propulsion plants** (controlling air intakes F02C 7/057; controlling turbines F01D; controlling compressors F04D 27/00) [3]
- 9/16 • Control of working fluid flow (F02C 9/48 takes precedence; control of air-intake flow F02C 7/057) [3]
- 9/18 • • by bleeding, by-passing or acting on variable working fluid interconnections between turbines or compressors or their stages [3, 5]

- 9/20 • • by throttling; by adjusting vanes [3]
- 9/22 • • • by adjusting turbine vanes [3]
- 9/24 • • Control of the pressure level in closed cycles [3]
- 9/26 • Control of fuel supply (F02C 9/48 takes precedence; fuel valves F02C 7/232) [3]
- 9/28 • • Regulating systems responsive to plant or ambient parameters, e.g. temperature, pressure, rotor speed (F02C 9/30-F02C 9/38, F02C 9/44 take precedence) [3]
- 9/30 • • characterised by variable fuel pump output [3]
- 9/32 • • characterised by throttling of fuel (F02C 9/38 takes precedence) [3]
- 9/34 • • • Joint control of separate flows to main and auxiliary burners [3]
- 9/36 • • characterised by returning of fuel to sump (F02C 9/38 takes precedence) [3]
- 9/38 • • characterised by throttling and returning of fuel to sump [3]
- 9/40 • • specially adapted to the use of a special fuel or a plurality of fuels [3]
- 9/42 • • specially adapted for the control of two or more plants simultaneously [3]
- 9/44 • • responsive to the speed of aircraft, e.g. Mach number control, optimisation of fuel consumption [3]
- 9/46 • • Emergency fuel control [3]
- 9/48 • Control of fuel supply conjointly with another control of the plant (with nozzle section control F02K 1/17) [3]
- 9/50 • • with control of working fluid flow [3]
- 9/52 • • • by bleeding or by-passing the working fluid [3]
- 9/54 • • • by throttling the working fluid, by adjusting vanes [3]
- 9/56 • • with power transmission control [3]
- 9/58 • • • with control of a variable-pitch propeller [3]