# 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 Gas-turbine plants characterised by the use of hot gases or unheated pressurised gases, as the working fluid** (by the use of combustion products F02C 3/00, F02C 5/00) **[1, 3, 2006.01]**

1/02 • the working fluid being an unheated pressurised gas **[1, 3, 2006.01]**

1/04 • the working fluid being heated indirectly **[1, 3, 2006.01]**

1/05 • • characterised by the type or source of heat, e.g. using nuclear or solar energy **[3, 2006.01]**

1/06 • • • using reheated exhaust gas (F02C 1/08 takes precedence) **[1, 3, 2006.01]**

1/08 • • Semi-closed cycles **[3, 2006.01]**

1/10 • • Closed cycles **[3, 2006.01]**

**3/00 Gas-turbine plants characterised by the use of combustion products as the working fluid** (generated by intermittent combustion F02C 5/00) **[1, 2006.01]**

3/02 • using exhaust-gas pressure in a pressure exchanger to compress combustion-air (pressure exchangers per se F04F 13/00) **[1, 2006.01]**

3/04 • having a turbine driving a compressor (power transmission arrangements F02C 7/36; control of working fluid flow F02C 9/16) **[1, 5, 2006.01]**

3/045 • • having compressor and turbine passages in a single rotor (F02C 3/073 takes precedence) **[3, 2006.01]**

3/05 • • • the compressor and the turbine being of the radial flow type **[3, 2006.01]**

3/055 • • the compressor being of the positive-displacement type **[3, 2006.01]**

3/06 • • the compressor comprising only axial stages (F02C 3/10 takes precedence) **[1, 3, 2006.01]**

3/067 • • • having counter-rotating rotors (F02C 3/073 takes precedence) **[3, 2006.01]**

3/073 • • • the compressor and turbine stages being concentric **[3, 2006.01]**

3/08 • • the compressor comprising at least one radial stage (F02C 3/10 takes precedence) **[1, 3, 2006.01]**

3/09 • • • of the centripetal type **[3, 2006.01]**

3/10 • • with another turbine driving an output shaft but not driving the compressor **[1, 2006.01]**

3/107 • • with two or more rotors connected by power transmission **[5, 2006.01]**

3/113 • • • with variable power transmission between rotors **[5, 2006.01]**

3/13 • • having variable working fluid interconnections between turbines or compressors or stages of different rotors **[5, 2006.01]**

3/14 • characterised by the arrangement of the combustion chamber in the plant (combustion chambers per se F23R) **[1, 3, 2006.01]**

3/16 • • the combustion chambers being formed at least partly in the turbine rotor **[1, 2006.01]**

3/20 • using a special fuel, oxidant, or dilution fluid to generate the combustion products **[1, 3, 2006.01]**

3/22 • • the fuel or oxidant being gaseous at standard temperature and pressure (F02C 3/28 takes precedence) **[1, 3, 2006.01]**

3/24 • • the fuel or oxidant being liquid at standard temperature and pressure **[1, 3, 2006.01]**

3/26 • • the fuel or oxidant being solid or pulverulent, e.g. in slurry or suspension **[1, 2006.01]**

3/28 • • • using a separate gas producer for gasifying the fuel before combustion **[3, 2006.01]**

3/30 • • 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, 2006.01]**

3/32 • Inducing air flow by fluid jet, e.g. ejector action **[3, 2006.01]**

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, 2006.01]**

3/36 • Open cycles **[3, 2006.01]**

**5/00 Gas-turbine plants characterised by the working fluid being generated by intermittent combustion [1, 2006.01]**

5/02 • characterised by the arrangement of the combustion chamber in the plant (combustion chambers per se F23R) **[1, 3, 2006.01]**

5/04 • • the combustion chambers being formed at least partly in the turbine rotor **[1, 2006.01]**

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) **[1, 2006.01]**

5/08 • • the gas generator being of the free-piston type **[1, 2006.01]**

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 **[1, 3, 2006.01]**

5/11 • • using valveless combustion chambers **[3, 2006.01]**

5/12 • the combustion chambers having inlet or outlet valves, e.g. Holzwarth gas-turbine plants **[1, 2006.01]**

**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, 2006.01]**

6/02 • Plural gas-turbine plants having a common power output **[3, 2006.01]**

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, 2006.01]**

6/06 • • providing compressed gas (F02C 6/10 takes precedence) **[3, 2006.01]**

6/08 • • • the gas being bled from the gas-turbine compressor **[3, 2006.01]**

6/10 • • supplying working fluid to a user, e.g. a chemical process, which returns working fluid to a turbine of the plant **[3, 2006.01]**

6/12 • • • Turbochargers, i.e. plants for augmenting mechanical power output of internal-combustion piston engines by increase of charge pressure **[3, 2006.01]**

6/14 • Gas-turbine plants having means for storing energy, e.g. for meeting peak loads **[3, 2006.01]**

6/16 • • for storing compressed air **[3, 2006.01]**

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, 2006.01]**

6/20 • Adaptations of gas-turbine plants for driving vehicles **[3, 2006.01]**

**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) **[1, 3, 2006.01]**

7/04 • Air intakes for gas-turbine plants or jet-propulsion plants **[1, 3, 2006.01]**

7/042 • • having variable geometry **[3, 2006.01]**

7/045 • • having provisions for noise suppression **[3, 2006.01]**

7/047 • • Heating to prevent icing **[3, 2006.01]**

7/05 • • having provisions for obviating the penetration of damaging objects or particles **[3, 2006.01]**

7/052 • • • with dust-separation devices **[3, 2006.01]**

7/055 • • • with intake grids, screens or guards **[3, 2006.01]**

7/057 • • Control or regulation (conjointly with fuel supply control F02C 9/50, with nozzle area control F02K 1/16) **[3, 2006.01]**

7/06 • Arrangement of bearings (bearings F16C); Lubricating (of engines in general F01M) **[1, 3, 2006.01]**

7/08 • Heating air supply before combustion, e.g. by exhaust gases **[1, 2006.01]**

7/10 • • by means of regenerative heat-exchangers **[1, 2006.01]**

7/105 • • • of the rotary type (rotary heat exchangers per se F28D) **[3, 2006.01]**

7/12 • Cooling of plants (of component parts, see the relevant subclasses, e.g. F01D; cooling of engines in general F01P) **[1, 2006.01]**

7/14 • • of fluids in the plant **[1, 2006.01]**

7/141 • • • of working fluid (F02C 3/30 takes precedence) **[3, 2006.01]**

7/143 • • • • before or between the compressor stages **[3, 2006.01]**

7/16 • • characterised by cooling medium **[1, 2006.01]**

7/18 • • • the medium being gaseous, e.g. air **[1, 2006.01]**

7/20 • Mounting or supporting of plant; Accommodating heat expansion or creep **[1, 2006.01]**

7/22 • Fuel supply systems **[1, 2006.01]**

7/224 • • Heating fuel before feeding to the burner **[3, 2006.01]**

7/228 • • Dividing fuel between various burners **[3, 2006.01]**

7/232 • • Fuel valves; Draining valves or systems (valves in general F16K) **[3, 2006.01]**

7/236 • • Fuel delivery systems comprising two or more pumps **[3, 2006.01]**

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) **[1, 3, 2006.01]**

7/25 • • Fire protection or prevention (in general A62) **[3, 2006.01]**

7/26 • Starting; Ignition **[1, 2006.01]**

7/262 • • Restarting after flame-out **[3, 2006.01]**

7/264 • • Ignition **[3, 2006.01]**

7/266 • • • Electric (sparking plugs H01T) **[3, 2006.01]**

7/268 • • Starting drives for the rotor **[3, 2006.01]**

7/27 • • • Fluid drives (turbine starters F02C 7/277) **[3, 2006.01]**

7/272 • • • • generated by cartridges **[3, 2006.01]**

7/275 • • • Mechanical drives **[3, 2006.01]**

7/277 • • • • the starter being a turbine **[3, 2006.01]**

7/28 • Arrangement of seals **[1, 2006.01]**

7/30 • Preventing corrosion in gas-swept spaces **[1, 2006.01]**

7/32 • Arrangement, mounting, or driving, of auxiliaries **[1, 2006.01]**

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, 2006.01]**

**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) **[1, 3, 2006.01]**

9/16 • Control of working fluid flow (F02C 9/48 takes precedence; control of air-intake flow F02C 7/057) **[3, 2006.01]**

9/18 • • by bleeding, by-passing or acting on variable working fluid interconnections between turbines or compressors or their stages **[3, 5, 2006.01]**

9/20 • • by throttling; by adjusting vanes **[3, 2006.01]**

9/22 • • • by adjusting turbine vanes **[3, 2006.01]**

9/24 • • Control of the pressure level in closed cycles **[3, 2006.01]**

9/26 • Control of fuel supply (F02C 9/48 takes precedence; fuel valves F02C 7/232) **[3, 2006.01]**

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, 2006.01]**

9/30 • • characterised by variable fuel pump output **[3, 2006.01]**

9/32 • • characterised by throttling of fuel (F02C 9/38 takes precedence) **[3, 2006.01]**

9/34 • • • Joint control of separate flows to main and auxiliary burners **[3, 2006.01]**

9/36 • • characterised by returning of fuel to sump (F02C 9/38 takes precedence) **[3, 2006.01]**

9/38 • • characterised by throttling and returning of fuel to sump **[3, 2006.01]**

9/40 • • specially adapted to the use of a special fuel or a plurality of fuels **[3, 2006.01]**

9/42 • • specially adapted for the control of two or more plants simultaneously **[3, 2006.01]**

9/44 • • responsive to the speed of aircraft, e.g. Mach number control, optimisation of fuel consumption **[3, 2006.01]**

9/46 • • Emergency fuel control **[3, 2006.01]**

9/48 • Control of fuel supply conjointly with another control of the plant (with nozzle section control F02K 1/17) **[3, 2006.01]**

9/50 • • with control of working fluid flow **[3, 2006.01]**

9/52 • • • by bleeding or by-passing the working fluid **[3, 2006.01]**

9/54 • • • by throttling the working fluid, by adjusting vanes **[3, 2006.01]**

9/56 • • with power transmission control **[3, 2006.01]**

9/58 • • • with control of a variable-pitch propeller **[3, 2006.01]**