

CPC COOPERATIVE PATENT CLASSIFICATION

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

LIGHTING; HEATING

F23 COMBUSTION APPARATUS; COMBUSTION PROCESSES (NOTE omitted)

F23C METHODS OR APPARATUS FOR COMBUSTION USING FLUID FUEL OR SOLID FUEL SUSPENDED IN {A CARRIER GAS OR} AIR (burners [F23D](#))

NOTE

In this subclass, methods are classified in the groups that cover the apparatus used.

WARNINGS

- The following IPC groups are not in the CPC scheme. The subject matter for these IPC groups is classified in the following CPC groups:
[F23C 101/00](#) covered by [F23C 2206/101](#)
- 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.

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|-------------|---|-------------|--|
| 1/00 | Combustion apparatus specially adapted for combustion of two or more kinds of fuel simultaneously or alternately, at least one kind of fuel being either a fluid fuel or a solid fuel suspended in {a carrier gas or} air (combustion apparatus characterized by the combination of two or more combustion chambers F23C 6/00; pilot flame igniters F23Q 9/00) | 5/24 | . . to obtain a loop flame |
| | | 5/28 | . . to obtain flames in opposing directions, e.g. impacting flames |
| | | 5/32 | . . to obtain rotating flames, i.e. flames moving helically or spirally |
| | | 6/00 | Combustion apparatus characterised by the combination of two or more combustion chambers {or combustion zones, e.g. for staged combustion} |
| 1/02 | . lump and liquid fuel | 6/02 | . in parallel arrangement |
| 1/04 | . lump and gaseous fuel | 6/04 | . in series connection (consuming smoke or fumes in separate combustion apparatus F23G 7/06) |
| 1/06 | . lump and pulverulent fuel | 6/042 | . . {with fuel supply in stages (for staged combustion F23C 6/047)} |
| 1/08 | . liquid and gaseous fuel | 6/045 | . . {with staged combustion in a single enclosure} |
| 1/10 | . liquid and pulverulent fuel | 6/047 | . . . {with fuel supply in stages} |
| 1/12 | . gaseous and pulverulent fuel | | |
| 3/00 | Combustion apparatus characterised by the shape of the combustion chamber | 7/00 | Combustion apparatus characterised by arrangements for air supply (inlets for fluidisation air F23C 10/20; baffles or shields with air supply passages F23M 9/04) |
| 3/002 | . {the chamber having an elongated tubular form, e.g. for a radiant tube} | 7/002 | . {the air being submitted to a rotary or spinning motion (cyclonic combustion chamber F23C 3/006)} |
| 3/004 | . {the chamber being arranged for submerged combustion (F23C 3/002 takes precedence)} | 7/004 | . . {using vanes} |
| 3/006 | . {the chamber being arranged for cyclonic combustion (for waste F23G 5/32)} | 7/006 | . . . {adjustable} |
| 3/008 | . . {for pulverulent fuel} | 7/008 | . {Flow control devices (F23C 7/006 takes precedence)} |
| 5/00 | Disposition of burners with respect to the combustion chamber or to one another; Mounting of burners in combustion apparatus (F23C 1/00, F23C 15/00 take precedence) | 7/02 | . Disposition of air supply not passing through burner (to obtain a cyclonic tapering flame when burning pulverulent fuel F23C 5/32) |
| 5/02 | . Structural details of mounting | 7/04 | . . to obtain maximum heat transfer to wall of combustion chamber |
| 5/06 | . . Provision for adjustment of burner position during operation | 7/06 | . . for heating the incoming air (arrangements of regenerators and recuperators F23L 15/00) |
| 5/08 | . Disposition of burners | 7/08 | . . . indirectly by a secondary fluid other than the combustion products |
| 5/10 | . . {to obtain a flame ring} | | |
| 5/12 | . . . {for pulverulent fuel} | | |
| 5/14 | . . to obtain a single flame of concentrated or substantially planar form, e.g. pencil or sheet flame (F23C 5/32 takes precedence) | | |

- 9/00 Combustion apparatus characterised by arrangements for returning combustion products or flue gases to the combustion chamber**
(fluidised bed combustion apparatus with means for recirculation of particles entrained from the bed [F23C 10/02](#); fluidised bed combustion apparatus with devices for removal and partial reintroduction of material from the bed [F23C 10/26](#))
- 9/003 . {for pulverulent fuel (for fluidized bed [F23C 10/02](#))}
 - 9/006 . {the recirculation taking place in the combustion chamber}
 - 9/06 . for completing combustion
 - 9/08 . for reducing temperature in combustion chamber, e.g. for protecting walls of combustion chamber
- 10/00 Fluidised bed combustion apparatus**
- 10/002 . {for pulverulent solid fuel ([F23C 10/005](#) - [F23C 10/32](#) take precedence)}
 - 10/005 . {comprising two or more beds}
 - 10/007 . {comprising a rotating bed}
 - 10/01 . in a fluidised bed of catalytic particles
 - 10/02 . with means specially adapted for achieving or promoting a circulating movement of particles within the bed or for a recirculation of particles entrained from the bed
 - 10/04 . . the particles being circulated to a section, e.g. a heat-exchange section or a return duct, at least partially shielded from the combustion zone, before being reintroduced into the combustion zone
 - 10/06 . . . the circulating movement being promoted by inducing differing degrees of fluidisation in different parts of the bed
 - 10/08 . . . characterised by the arrangement of separation apparatus, e.g. cyclones, for separating particles from the flue gases
 - 10/10 the separation apparatus being located outside the combustion chamber
 - 10/12 . . the particles being circulated exclusively within the combustion zone
 - 10/14 . . . the circulating movement being promoted by inducing differing degrees of fluidisation in different parts of the bed
 - 10/16 . specially adapted for operation at superatmospheric pressures, e.g. by the arrangement of the combustion chamber and its auxiliary systems inside a pressure vessel
 - 10/18 . Details; Accessories
 - 10/20 . . Inlets for fluidisation air, e.g. grids; Bottoms
 - 10/22 . . Fuel feeders specially adapted for fluidised bed combustion apparatus ([F23C 10/26](#) takes precedence)
 - 10/24 . . Devices for removal of material from the bed (devices for controlling the level of the bed or the amount of material in the bed [F23C 10/30](#))
 - 10/26 . . . combined with devices for partial reintroduction of material into the bed, e.g. after separation of agglomerated parts
 - 10/28 . . Control devices specially adapted for fluidised bed, combustion apparatus
 - 10/30 . . . for controlling the level of the bed or the amount of material in the bed
- 10/32 by controlling the rate of recirculation of particles separated from the flue gases
- 13/00 Apparatus in which combustion takes place in the presence of catalytic material (in a fluidised bed of catalytic particles [F23C 10/01](#); radiant gas burners using catalysis for flameless combustion [F23D 14/18](#))**
- 13/02 . characterised by arrangements for starting the operation, e.g. for heating the catalytic material to operating temperature
 - 13/04 . characterised by arrangements of two or more catalytic elements in series connection
 - 13/06 . in which non-catalytic combustion takes place in addition to catalytic combustion, e.g. downstream of a catalytic element
 - 13/08 . characterised by the catalytic material
- 15/00 Apparatus in which combustion takes place in pulses influenced by acoustic resonance in a gas mass {(for generating combustion products of high pressure or high velocity [F23R 7/00](#); starting devices [F23D 11/42](#))}**
- 99/00 Subject-matter not provided for in other groups of this subclass**
- 99/001 . {Applying electric means or magnetism to combustion (for combustion engines [F02B 51/04](#), [F02M 27/04](#))}
 - 99/003 . {Combustion process using sound or vibrations (for combustion engines [F02B 51/06](#), [F02M 27/08](#); liquid fuel burners using ultrasonic means for spraying the fuel [F23D 11/34](#))}
 - 99/005 . {Suspension-type burning, i.e. fuel particles carried along with a gas flow while burning (fluidized-bed combustion apparatus [F23C 10/00](#))}
 - 99/006 . {Flameless combustion stabilised within a bed of porous heat-resistant material ([F23C 13/00](#) takes precedence; gas burners with radiant combustion on a porous surface [F23D 14/16](#))}
 - 99/008 . {Combustion methods wherein flame cooling techniques other than fuel or air staging or fume recirculation are used}
- 2200/00 Combustion techniques for fluent fuel**
- 2201/00 Staged combustion**
- 2201/10 . Furnace staging
 - 2201/101 . . in vertical direction, e.g. alternating lean and rich zones
 - 2201/102 . . in horizontal direction
 - 2201/20 . Burner staging
 - 2201/30 . Staged fuel supply
 - 2201/301 . . with different fuels in stages
 - 2201/40 . Intermediate treatments between stages
 - 2201/401 . . Cooling
- 2202/00 Fluegas recirculation**
- 2202/10 . Premixing fluegas with fuel and combustion air
 - 2202/20 . Premixing fluegas with fuel
 - 2202/30 . Premixing fluegas with combustion air
 - 2202/40 . Inducing local whirls around flame
 - 2202/50 . Control of recirculation rate
- 2203/00 Flame cooling methods otherwise than by staging or recirculation**
- 2203/10 . using heat exchanger

- 2203/20 . using heat absorbing device in flame ([F23C 2203/10 takes precedence](#))
- 2203/30 . Injection of tempering fluids
- 2205/00 Pulsating combustion**
- 2205/10 . with pulsating fuel supply
- 2205/20 . with pulsating oxidant supply
- 2206/00 Fluidised bed combustion**
- 2206/10 . Circulating fluidised bed
- 2206/101 . . Entrained or fast fluidised bed
- 2206/102 . . Control of recirculation rate
- 2206/103 . . Cooling recirculating particles
- 2700/00 Special arrangements for combustion apparatus using fluent fuel**
- 2700/02 . Combustion apparatus using liquid fuel
- 2700/023 . . without pre-vaporising means
- 2700/026 . . with pre-vaporising means
- 2700/04 . Combustion apparatus using gaseous fuel
- 2700/043 . . for surface combustion
- 2700/046 . . generating heat by heating radiant bodies
- 2700/06 . Combustion apparatus using pulverized fuel
- 2700/063 . . Arrangements for igniting, flame-guiding, air supply in
- 2700/066 . . Other special arrangements
- 2900/00 Special features of, or arrangements for combustion apparatus using fluid fuels or solid fuels suspended in air; Combustion processes therefor**
- 2900/01001 . Co-combustion of biomass with coal
- 2900/03001 . Miniaturized combustion devices using fluid fuels
- 2900/03002 . Combustion apparatus adapted for incorporating a fuel reforming device
- 2900/03003 . Annular combustion chambers
- 2900/03004 . Tubular combustion chambers with swirling fuel/air flow
- 2900/03005 . Burners with an internal combustion chamber, e.g. for obtaining an increased heat release, a high speed jet flame or being used for starting the combustion
- 2900/03006 . Reverse flow combustion chambers
- 2900/03007 . Sealed combustion chambers with balanced flue
- 2900/03008 . Spherical or bulb-shaped combustion chambers
- 2900/03009 . Elongated tube-shaped combustion chambers
- 2900/05081 . Disposition of burners relative to each other creating specific heat patterns
- 2900/05082 . Disposition of radial jet burners in relation to an impingement surface, e.g. a heat transfer surface, to obtain flame re-attachment combustion
- 2900/06041 . Staged supply of oxidant
- 2900/06042 . Annular arrangement of burners in a furnace, e.g. in a gas turbine, operated in alternate lean-rich mode
- 2900/06043 . Burner staging, i.e. radially stratified flame core burners
- 2900/07001 . Air swirling vanes incorporating fuel injectors
- 2900/07002 . Premix burners with air inlet slots obtained between offset curved wall surfaces, e.g. double cone burners
- 2900/07021 . Details of lances
- 2900/07022 . Delaying secondary air introduction into the flame by using a shield or gas curtain
- 2900/09001 . Cooling flue gas before returning them to flame or combustion chamber
- 2900/09002 . Specific devices inducing or forcing flue gas recirculation
- 2900/10001 . Use of special materials for the fluidized bed
- 2900/10002 . Treatment devices for the fluidizing gas, e.g. cooling, filtering
- 2900/10003 . Fluidized beds with expanding freeboard, i.e. cross-section increasing upwardly
- 2900/10004 . Adding inert bed material to maintain proper fluidized bed inventory
- 2900/10005 . Arrangement comprising two or more beds in separate enclosures
- 2900/10006 . Pressurized fluidized bed combustors
- 2900/10007 . Spouted fluidized bed combustors
- 2900/10008 . Special arrangements of return flow seal valve in fluidized bed combustors
- 2900/13001 . Details of catalytic combustors
- 2900/13002 . Catalytic combustion followed by a homogeneous combustion phase or stabilizing a homogeneous combustion phase
- 2900/99001 . Cold flame combustion or flameless oxidation processes
- 2900/99003 . Combustion techniques using laser or light beams as ignition, stabilization or combustion enhancing means
- 2900/99004 . Combustion process using petroleum coke or any other fuel with a very low content in volatile matters
- 2900/99005 . Combustion techniques using plasma gas
- 2900/99006 . Arrangements for starting combustion
- 2900/99008 . Unmixed combustion, i.e. without direct mixing of oxygen gas and fuel, but using the oxygen from a metal oxide, e.g. FeO
- 2900/99009 . Combustion process using vegetable derived fuels, e.g. from rapeseeds
- 2900/9901 . Combustion process using hydrogen, hydrogen peroxide water or brown gas as fuel
- 2900/99011 . Combustion process using synthetic gas as a fuel, i.e. a mixture of CO and H₂