

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
- 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 | 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) |
| 3/00 | Combustion apparatus characterised by the shape of the combustion chamber | 7/002 | . {the air being submitted to a rotary or spinning motion (cyclonic combustion chamber F23C 3/006)} |
| 3/002 | . {the chamber having an elongated tubular form, e.g. for a radiant tube} | 7/004 | . . {using vanes} |
| 3/004 | . {the chamber being arranged for submerged combustion (F23C 3/002 takes precedence)} | 7/006 | . . . {adjustable} |
| 3/006 | . {the chamber being arranged for cyclonic combustion (for waste F23G 5/32)} | 7/008 | . {Flow control devices (F23C 7/006 takes precedence)} |
| 3/008 | . . {for pulverulent fuel} | 7/02 | . Disposition of air supply not passing through burner (to obtain a cyclonic tapering flame when burning pulverulent fuel F23C 5/32) |
| 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) | 7/04 | . . to obtain maximum heat transfer to wall of combustion chamber |
| 5/02 | . Structural details of mounting | 7/06 | . . for heating the incoming air (arrangements of regenerators and recuperators F23L 15/00) |
| 5/06 | . . Provision for adjustment of burner position during operation | 7/08 | . . . indirectly by a secondary fluid other than the combustion products |
| 5/08 | . Disposition of burners | | |
| 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) | | |

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| 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) | 10/32 | by controlling the rate of recirculation of particles separated from the flue gases |
| 9/003 | . {for pulverulent fuel (for fluidized bed F23C 10/02)} | 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) |
| 9/006 | . {the recirculation taking place in the combustion chamber} | 13/02 | . characterised by arrangements for starting the operation, e.g. for heating the catalytic material to operating temperature |
| 9/06 | . for completing combustion | 13/04 | . characterised by arrangements of two or more catalytic elements in series connection |
| 9/08 | . for reducing temperature in combustion chamber, e.g. for protecting walls of combustion chamber | 13/06 | . in which non-catalytic combustion takes place in addition to catalytic combustion, e.g. downstream of a catalytic element |
| 10/00 | Fluidised bed combustion apparatus | 13/08 | . characterised by the catalytic material |
| 10/002 | . {for pulverulent solid fuel (F23C 10/005 - F23C 10/32 take precedence)} | 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)} |
| 10/005 | . {comprising two or more beds} | 99/00 | Subject-matter not provided for in other groups of this subclass |
| 10/007 | . {comprising a rotating bed} | 99/001 | . {Applying electric means or magnetism to combustion (for combustion engines F02B 51/04 , F02M 27/04)} |
| 10/01 | . in a fluidised bed of catalytic particles | 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)} |
| 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 | 99/005 | . {Suspension-type burning, i.e. fuel particles carried along with a gas flow while burning (fluidized-bed combustion apparatus F23C 10/00)} |
| 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 | 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)} |
| 10/06 | . . . the circulating movement being promoted by inducing differing degrees of fluidisation in different parts of the bed | 99/008 | . {Combustion methods wherein flame cooling techniques other than fuel or air staging or fume recirculation are used} |
| 10/08 | . . . characterised by the arrangement of separation apparatus, e.g. cyclones, for separating particles from the flue gases | 2200/00 | Combustion techniques for fluent fuel |
| 10/10 | the separation apparatus being located outside the combustion chamber | 2201/00 | Staged combustion |
| 10/12 | . . the particles being circulated exclusively within the combustion zone | 2201/10 | . Furnace staging |
| 10/14 | . . . the circulating movement being promoted by inducing differing degrees of fluidisation in different parts of the bed | 2201/101 | . . in vertical direction, e.g. alternating lean and rich zones |
| 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 | 2201/102 | . . in horizontal direction |
| 10/18 | . Details; Accessories | 2201/20 | . Burner staging |
| 10/20 | . . Inlets for fluidisation air, e.g. grids; Bottoms | 2201/30 | . Staged fuel supply |
| 10/22 | . . Fuel feeders specially adapted for fluidised bed combustion apparatus (F23C 10/26 takes precedence) | 2201/301 | . . with different fuels in stages |
| 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) | 2201/40 | . Intermediate treatments between stages |
| 10/26 | . . . combined with devices for partial reintroduction of material into the bed, e.g. after separation of agglomerated parts | 2201/401 | . . Cooling |
| 10/28 | . . Control devices specially adapted for fluidised bed, combustion apparatus | 2202/00 | Fluegas recirculation |
| 10/30 | . . . for controlling the level of the bed or the amount of material in the bed | 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 ([for gas turbines F23R 3/50](#))
- 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