

CPC COOPERATIVE PATENT CLASSIFICATION

F23C **COMBUSTION APPARATUS USING FLUENT FUEL** (combustion apparatus for solid fuel only [F23B](#); burners [F23D](#); constructional details of combustion chambers not otherwise provided for [F23M](#); combustion chambers for generating combustion products of high pressure or high velocity [F23R](#))

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 fluent** (combustion apparatus characterised by the combination of two or more combustion chambers [F23C 6/00](#); pilot flame igniters [F23Q 9/00](#))

- 1/02 . lump or liquid fuel
- 1/04 . lump or gaseous fuel
- 1/06 . lump or pulverulent fuel
- 1/08 . liquid or gaseous fuel
- 1/10 . liquid or pulverulent fuel
- 1/12 . gaseous or pulverulent fuel

3/00 **Combustion apparatus characterised by the shape of the combustion chamber**

- 3/002 . {the chamber having an elongated tubular form, e.g. for a radiant tube}
- 3/004 . {the chamber being arranged for submerged combustion ([F23C 3/002](#) takes precedence)}
- 3/006 . {the chamber being arranged for cyclonic combustion (for waste [F23G 5/32](#))}
- 3/008 . . {for pulverulent fuel}

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)

- 5/02 . Structural details of mounting
- 5/06 . . Provision for adjustment of burner position during operation
- 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)
- 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}**

- 6/02 . in parallel arrangement
- 6/04 . in series connection (consuming smoke or fumes in separate combustion apparatus [F23G 7/06](#))
- 6/042 . . {with fuel supply in stages (for staged combustion [F23C 6/047](#))}
- 6/045 . . {with staged combustion in a single enclosure}
- 6/047 . . . {with fuel supply in stages}

7/00 **Combustion apparatus characterised by arrangements for air supply** (inlets for fluidisation air [F23C 10/20](#))

- 7/002 . {the air being submitted to a rotary or spinning motion (cyclonic combustion chamber [F23C 3/006](#))}
- 7/004 . . {using vanes}
- 7/006 . . . {adjustable}
- 7/008 . {Flow control devices ([F23C 7/006](#) takes precedence)}
- 7/02 . Disposition of air supply not passing through burner (to obtain a cyclonic tapering flame when burning pulverulent fuel [F23C 5/32](#))
- 7/04 . . to obtain maximum heat transfer to wall of combustion chamber
- 7/06 . . for heating the incoming air (arrangements of regenerators and recuperators [F23L 15/00](#))
- 7/08 . . . indirectly by a secondary fluid other than the combustion products

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 ([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