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

1. 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
2. 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.

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)

1/02 . lump and liquid fuel
1/04 . lump and gaseous fuel
1/06 . lump and pulverulent fuel
1/08 . liquid and gaseous fuel
1/10 . liquid and pulverulent fuel
1/12 . gaseous and 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; baffles or shields with air supply passages F23M 9/04)

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 rapes
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 H_2