

# 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.

- |             |   |             |  |
|-------------|---|-------------|--|
| <b>1/00</b> | <b>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 <a href="#">F23C 6/00</a>; pilot flame igniters <a href="#">F23Q 9/00</a>)</b> | 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  |
|             |   | <b>6/00</b> | <b>Combustion apparatus characterised by the combination of two or more combustion chambers {or combustion zones, e.g. for staged combustion}</b>  |
| 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 <a href="#">F23G 7/06</a> )  |
| 1/06        | . lump and pulverulent fuel   | 6/042       | . . {with fuel supply in stages (for staged combustion <a href="#">F23C 6/047</a> )}   |
| 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  |             |  |
| <b>3/00</b> | <b>Combustion apparatus characterised by the shape of the combustion chamber</b>  | <b>7/00</b> | <b>Combustion apparatus characterised by arrangements for air supply (inlets for fluidisation air <a href="#">F23C 10/20</a>; baffles or shields with air supply passages <a href="#">F23M 9/04</a>)</b> |
| 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 <a href="#">F23C 3/006</a> )}   |
| 3/004       | . {the chamber being arranged for submerged combustion ( <a href="#">F23C 3/002</a> takes precedence)}  | 7/004       | . . {using vanes}  |
| 3/006       | . {the chamber being arranged for cyclonic combustion (for waste <a href="#">F23G 5/32</a> )}   | 7/006       | . . . {adjustable}   |
| 3/008       | . . {for pulverulent fuel}  | 7/008       | . {Flow control devices ( <a href="#">F23C 7/006</a> takes precedence)}  |
| <b>5/00</b> | <b>Disposition of burners with respect to the combustion chamber or to one another; Mounting of burners in combustion apparatus (<a href="#">F23C 1/00</a>, <a href="#">F23C 15/00</a> take precedence)</b>   | 7/02        | . Disposition of air supply not passing through burner (to obtain a cyclonic tapering flame when burning pulverulent fuel <a href="#">F23C 5/32</a> )  |
| 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 <a href="#">F23L 15/00</a> )   |
| 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 ( <a href="#">F23C 5/32</a> takes precedence)   |             |  |

<b>9/00</b>	<b>Combustion apparatus characterised by arrangements for returning combustion products or flue gases to the combustion chamber</b> (fluidised bed combustion apparatus with means for recirculation of particles entrained from the bed <a href="#">F23C 10/02</a> ; fluidised bed combustion apparatus with devices for removal and partial reintroduction of material from the bed <a href="#">F23C 10/26</a> )	10/32	. . . . by controlling the rate of recirculation of particles separated from the flue gases
9/003	. {for pulverulent fuel (for fluidized bed <a href="#">F23C 10/02</a> )}	<b>13/00</b>	<b>Apparatus in which combustion takes place in the presence of catalytic material (in a fluidised bed of catalytic particles <a href="#">F23C 10/01</a>; radiant gas burners using catalysis for flameless combustion <a href="#">F23D 14/18</a>)</b>
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
<b>10/00</b>	<b>Fluidised bed combustion apparatus</b>	13/08	. characterised by the catalytic material
10/002	. {for pulverulent solid fuel ( <a href="#">F23C 10/005</a> - <a href="#">F23C 10/32</a> take precedence)}	<b>15/00</b>	<b>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 <a href="#">F23R 7/00</a>; starting devices <a href="#">F23D 11/42</a>)}</b>
10/005	. {comprising two or more beds}	<b>99/00</b>	<b>Subject-matter not provided for in other groups of this subclass</b>
10/007	. {comprising a rotating bed}	99/001	. {Applying electric means or magnetism to combustion (for combustion engines <a href="#">F02B 51/04</a> , <a href="#">F02M 27/04</a> )}
10/01	. in a fluidised bed of catalytic particles	99/003	. {Combustion process using sound or vibrations (for combustion engines <a href="#">F02B 51/06</a> , <a href="#">F02M 27/08</a> ; liquid fuel burners using ultrasonic means for spraying the fuel <a href="#">F23D 11/34</a> )}
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 <a href="#">F23C 10/00</a> )}
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 ( <a href="#">F23C 13/00</a> takes precedence; gas burners with radiant combustion on a porous surface <a href="#">F23D 14/16</a> )}
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	<b>2200/00</b>	<b>Combustion techniques for fluent fuel</b>
10/10	. . . . the separation apparatus being located outside the combustion chamber	<b>2201/00</b>	<b>Staged combustion</b>
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 ( <a href="#">F23C 10/26</a> 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 <a href="#">F23C 10/30</a> )	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	<b>2202/00</b>	<b>Fluegas recirculation</b>
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
		<b>2203/00</b>	<b>Flame cooling methods otherwise than by staging or recirculation</b>
		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 H<sub>2</sub>