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)

F23C 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)

F23C 1/02 . lump or liquid fuel

F23C 1/04 . lump or gaseous fuel

F23C 1/06 . lump or pulverulent fuel

F23C 1/08 . liquid or gaseous fuel

F23C 1/10 . liquid or pulverulent fuel

F23C 1/12 . gaseous or pulverulent fuel

F23C 3/00 **Combustion apparatus characterised by the shape of the combustion chamber**

F23C 3/002 . { the chamber having an elongated tubular form, e.g. for a radiant tube }

F23C 3/004 . { the chamber being arranged for submerged combustion (F23C 3/002 takes precedence) }

F23C 3/006 . { the chamber being arranged for cyclonic combustion (for waste F23G 5/32) }

F23C 3/008 . . { for pulverulent fuel }

F23C 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)

F23C 5/02 . Structural details of mounting

F23C 5/06 . . Provision for adjustment of burner position during operation

F23C 5/08 . Disposition of burners

F23C 5/10 . . to obtain a flame ring

F23C 5/12 . . . for pulverulent fuel

F23C 5/14 . . to obtain a single flame of concentrated or substantially planar form, e.g. pencil or sheet flame (F23C 5/32 takes precedence)

F23C 5/24 . . to obtain a loop flame

F23C 5/28 . . to obtain flames in opposing directions, e.g. impacting flames

F23C 5/32 . . to obtain rotating flames i.e. flames moving helically or spirally

F23C 6/00 **Combustion apparatus characterised by the combination of two or more combustion chambers** { or combustion zones, e.g. for staged combustion }

F23C 6/02 . in parallel arrangement

F23C 6/04 . in series connection (consuming smoke or fumes in separate combustion apparatus F23G 7/06)

F23C 6/042 . . { with fuel supply in stages (for staged combustion F23C 6/047) }

F23C 6/045 . . { with staged combustion in a single enclosure }

F23C 6/047 . . . { with fuel supply in stages }

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

F23C 7/002 . { the air being submitted to a rotary or spinning motion (cyclonic combustion chamber F23C 3/006) }

F23C 7/004 . . { using vanes }

F23C 7/006 . . . { adjustable }

F23C 7/008 . { Flow control devices (F23C 7/006 takes precedence) }

F23C 7/02 . Disposition of air supply not passing through burner (to obtain a cyclonic tapering flame when burning pulverulent fuel F23C 5/32)

F23C 7/04 . . to obtain maximum heat transfer to wall of combustion chamber

F23C 7/06 . . for heating the incoming air (arrangements of regenerators and recuperators F23L 15/00)

F23C 7/08 . . . indirectly by a secondary fluid other than the combustion products

F23C 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)

F23C 9/003 . { for pulverulent fuel (for fluidized bed F23C 10/02) }

F23C 9/006 . { the recirculation taking place in the combustion chamber }

F23C 9/06 . for completing combustion

F23C 9/08 . for reducing temperature in combustion chamber e.g. for protecting walls of combustion chamber

F23C 10/00 **Fluidised bed combustion apparatus**

F23C 10/002 . { for pulverulent solid fuel (F23C 10/005 to F23C 10/32 take precedence) }

F23C 10/005 . { comprising two or more beds }

F23C 10/007 . { comprising a rotating bed }

F23C 10/01 . in a fluidised bed of catalytic particles

F23C 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

F23C 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

F23C 10/06 . . . the circulating movement being promoted by inducing differing degrees of fluidisation in different parts of the bed

F23C 10/08 . . . characterised by the arrangement of separation apparatus, e.g. cyclones, for separating particles from the flue gases

F23C 10/10 . . . . the separation apparatus being located outside the combustion chamber

F23C 10/12 . . the particles being circulated exclusively within the combustion zone

F23C 10/14 . . . the circulating movement being promoted by inducing differing degrees of fluidisation in different parts of the bed

F23C 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

F23C 10/18 . Details ; Accessories

F23C 10/20 . . Inlets for fluidisation air, e.g. grids ; Bottoms

F23C 10/22 . . Fuel feeders specially adapted for fluidised bed combustiuon apparatus (F23C 10/26 takes precedence)

F23C 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)

F23C 10/26 . . . combined with devices for partial reintroduction of material into the bed, e.g. after separation of agglomerated parts

F23C 10/28 . . Control devices specially adapted for fluidised bed, combustion apparatus

F23C 10/30 . . . for controlling the level of the bed or the amount of material in the bed

F23C 10/32 . . . . by controlling the rate of recirculation of particles separated from the flue gases

F23C 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)

F23C 13/02 . characterised by arrangements for starting the operation, e.g. for heating the catalytic material to operating temperature

F23C 13/04 . characterised by arrangements of two or more catalytic elements in series connection

F23C 13/06 . in which non-catalytic combustion takes place in addition to catalytic combustion, e.g. downstream of a catalytic element

F23C 13/08 . characterised by the catalytic material

F23C 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) }

F23C 99/00 **Subject-matter not provided for in other groups of this subclass**

F23C 99/001 . { Applying electric means or magnetism to combustion (for combustion engines F02B 51/04 , F02M 27/04) }

F23C 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) }

F23C 99/005 . { Suspension-type burning, i.e. fuel particles carried along with a gas flow while burning (fluidized-bed combustion apparatus F23C 10/00) }

F23C 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) }

F23C 99/008 . { Combustion methods wherein flame cooling techniques other than fuel or air staging or fume recirculation are used }

F23C 2200/00 **Combustion techniques for fluent fuel**

F23C 2201/00 **Staged combustion**

F23C 2201/10 . Furnace staging

F23C 2201/101 . . in vertical direction, e.g. alternating lean and rich zones

F23C 2201/102 . . in horizontal direction

F23C 2201/20 . Burner staging

F23C 2201/30 . Staged fuel supply

F23C 2201/301 . . with different fuels in stages

F23C 2201/40 . Intermediate treatments between stages

F23C 2201/401 . . Cooling

F23C 2202/00 **Fluegas recirculation**

F23C 2202/10 . Premixing fluegas with fuel and combustion air

F23C 2202/20 . Premixing fluegas with fuel

F23C 2202/30 . Premixing fluegas with combustion air

F23C 2202/40 . Inducing local whirls around flame

F23C 2202/50 . Control of recirculation rate

F23C 2203/00 Flame cooling methods otherwise than by staging or recirculation

F23C 2203/10 . using heat exchanger

F23C 2203/20 . using heat absorbing device in flame (F23C 2203/10 takes precedence)

F23C 2203/30 . Injection of tempering fluids

F23C 2205/00 Pulsating combustion

F23C 2205/10 . with pulsating fuel supply

F23C 2205/20 . with pulsating oxidant supply

F23C 2206/00 Fluidised bed combustion

F23C 2206/10 . Circulating fluidised bed
F23C 2206/101 . . Entrained or fast fluidised bed
F23C 2206/102 . . Control of recirculation rate
F23C 2206/103 . . Cooling recirculating particles

F23C 2700/00 Special arrangements for combustion apparatus using fluent fuel

F23C 2700/02 . Combustion apparatus using liquid fuel
F23C 2700/023 . . without pre-vaporising means
F23C 2700/026 . . with pre-vaporising means

F23C 2700/04 . Combustion apparatus using gaseous fuel
F23C 2700/043 . . for surface combustion
F23C 2700/046 . . generating heat by heating radiant bodies

F23C 2700/06 . Combustion apparatus using pulverized fuel
F23C 2700/063 . . Arrangements for igniting, flame-guiding, air supply in
F23C 2700/066 . . Other special arrangements

F23C 2900/00 Special features of, or arrangements for combustion apparatus using fluid fuels or solid fuels suspended in air ; Combustion processes therefor

F23C 2900/01001 . Co-combustion of biomass with coal

F23C 2900/03001 . Miniaturized combustion devices using fluid fuels

F23C 2900/03002 . Combustion apparatus adapted for incorporating a fuel reforming device

F23C 2900/03003 . Annular combustion chambers (for gas turbines F23R 3/50)

F23C 2900/03004 . Tubular combustion chambers with swirling fuel/air flow

F23C 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

F23C 2900/03006 . Reverse flow combustion chambers

F23C 2900/03007 . Sealed combustion chambers with balanced flue

F23C 2900/03008 . Spherical or bulb-shaped combustion chambers

F23C 2900/03009 . Elongated tube-shaped combustion chambers

F23C 2900/05081 . Disposition of burners relative to each other creating specific heat patterns

F23C 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

F23C 2900/06041 . Staged supply of oxidant

F23C 2900/06042 . Annular arrangement of burners in a furnace, e.g. in a gas turbine, operated in alternate lean-rich mode

F23C 2900/06043 . Burner staging, i.e. radially stratified flame core burners

F23C 2900/07001 . Air swirling vanes incorporating fuel injectors

F23C 2900/07002 . Premix burners with air inlet slots obtained between offset curved wall surfaces, e.g. double cone burners

F23C 2900/07021 . Details of lances

F23C 2900/07022 . Delaying secondary air introduction into the flame by using a shield or gas curtain

F23C 2900/09001 . Cooling flue gas before returning them to flame or combustion chamber

F23C 2900/09002 . Specific devices inducing or forcing flue gas recirculation

F23C 2900/10001 . Use of special materials for the fluidized bed

F23C 2900/10002 . Treatment devices for the fluidizing gas, e.g. cooling, filtering

F23C 2900/10003 . Fluidized beds with expanding freeboard, i.e. cross-section increasing upwardly

F23C 2900/10004 . Adding inert bed material to maintain proper fluidized bed inventory

F23C 2900/10005 . Arrangement comprising two or more beds in separate enclosures

F23C 2900/10006 . Pressurized fluidized bed combustors

F23C 2900/10007	.	Spouted fluidized bed combustors
F23C 2900/10008	.	Special arrangements of return flow seal valve in fluidized bed combustors
F23C 2900/13001	.	Details of catalytic combustors
F23C 2900/13002	.	Catalytic combustion followed by a homogeneous combustion phase or stabilizing a homogeneous combustion phase
F23C 2900/99001	.	Cold flame combustion or flameless oxidation processes
F23C 2900/99003	.	Combustion techniques using laser or light beams as ignition, stabilization or combustion enhancing means
F23C 2900/99004	.	Combustion process using petroleum coke or any other fuel with a very low content in volatile matters
F23C 2900/99005	.	Combustion techniques using plasma gas
F23C 2900/99006	.	Arrangements for starting combustion
F23C 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
F23C 2900/99009	.	Combustion process using vegetable derived fuels, e.g. from rapes
F23C 2900/9901	.	Combustion process using hydrogen, hydrogen peroxide water or brown gas as fuel
F23C 2900/99011	.	Combustion process using synthetic gas as a fuel, i.e. a mixture of CO and H2