

## F23C

### METHODS OR APPARATUS FOR COMBUSTION USING FLUID FUEL OR SOLID FUEL SUSPENDED IN {A CARRIER GAS OR} AIR (burners [F23D](#))

#### Definition statement

*This place covers:*

General function-oriented aspects of methods and apparatus for combustion of

- Fluid fuels or solid fuels suspended in a carrier gas, alone or in combination with other fluid or non-fluid fuels
- Fluid fuels or solid fuels suspended in a carrier gas, alternately with other fuels
- Pulverised solid fuel suspended in a stream of air or other gas, e.g. combustion in fluidised beds or combustion of pulverised fuel using burners where the fuel is transported into the combustion chamber by an air stream
- Solid fuel suspended in a liquid, e.g. combustion of coal-water slurry

#### Relationships with other classification places

##### **Relationship between this subclass and application subclasses of class [F23](#)**

[F23G](#), (Cremation furnaces; Consuming waste by combustion) is to be seen as an application place in relation to the function-oriented aspects of combustion covered by this subclass. In case of doubt, classification should be made in both subclasses, or in both [F23G](#) and detail subclasses of class [F23](#).

Classification is made in [F23C](#) if the methods or apparatus:

- are of general interest for combustion of different types of fluid fuels or solid fuel suspended in a carrier gas, for example not specially adapted for a particular fuel, or
- specially adapted for fluid fuels or solid fuel suspended in a carrier gas other than those provided for in [F23G](#), (see the list below), for example "normal" commercial fluid fuel, such as oil, natural gas or pulverised coal.

Classification is made in [F23G](#) if the methods or apparatus are specially adapted for combustion of the following types of substances:

- Fuels, e.g. waste, presenting particular fuel-related environmental problems requiring specially adapted methods or apparatus for combustion, for example toxic, explosive, radioactive or corrosive fuels
- Waste having a special physical form requiring specially adapted methods or apparatus for combustion, for example packaged waste
- Low-grade fuels presenting particular problems of combustion requiring specially adapted methods or apparatus for combustion, for example contaminated oil or gas of low heating value.

[F23R](#), (Generating combustion products of high pressure or high velocity), is also to be seen as an application place in relationship to this subclass.

Classification is made in [F23R](#) if the apparatus or method is specially adapted for generating combustion products of high pressure or high velocity.

##### **Relationship between this subclass and other application places**

Combustion is often used for the purpose of heating or performing different operations. Apparatus for combustion can be self-contained devices, but are often part of, or used in connection with, heat-consuming apparatus, such as heating boilers. This subclass is therefore related to several places providing for uses of heat. In many of these fields the combustion apparatus can be considered a detail of a bigger entity. A non-exhaustive list of examples of such classes or subclasses will be found under the heading "Informative references" below.

Combinations of combustion apparatus with other apparatus, where the combustion apparatus can be seen as a detail of the complete apparatus, e.g. a steam boiler, are classified as a whole, in the place for the other apparatus. Additional classification is made in this subclass only if features relating to the combustion apparatus per se are of interest apart from its application.

#### **Relationship between this subclass and detail subclasses of class F23**

Subclass [F23D](#) covers burners per se, as defined in the section "Glossary" below. Classification is made in [F23C](#) if the subject matter to be classified, in addition to a burner, includes further features that are of interest, such as a particular form of combustion chamber or a particular arrangement of burners in a combustion chamber. Air supply means that are arranged in immediate connection with the fuel-feeding conduit of a burner, for example concentric with it, should be considered to be part of the burner. Means for feeding air otherwise than in immediate connection with the fuel-feeding conduit of a burner are classified in [F23C](#) or [F23L](#), for example arrangements for feeding secondary air at points distant from a burner.

Subclasses [F23J](#) - [F23Q](#) are to be seen as detail places in relation to this subclass. Classification is made in this subclass if the apparatus as a whole is of interest, or if a detail is of use only for a particular type of combustion apparatus and not specifically provided for in any of subclasses [F23J](#) - [F23Q](#). If a detail of a combustion apparatus is of interest, classification is made in the relevant subclass providing for such matter.

### **References**

#### **Limiting references**

*This place does not cover:*

Burners	<a href="#">F23D</a>
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#### **Application-oriented references**

*Examples of places where the subject matter of this place is covered when specially adapted, used for a particular purpose, or incorporated in a larger system:*

Baking ovens	<a href="#">A21B</a>
Cooking apparatus	<a href="#">A47J</a>
Gas turbine plants	<a href="#">F02C</a>
Lighting	<a href="#">F21</a>
Generating steam	<a href="#">F22B</a>
Combustion specially adapted for waste or low grade fuel	<a href="#">F23G</a>
Generating combustion products of high temperature or high pressure	<a href="#">F23R</a>
Domestic stoves or ranges for cooking or local heating	<a href="#">F24C</a>
Domestic heating systems or space-heating systems	<a href="#">F24D</a>
Heating of fluids, e.g. air or water	<a href="#">F24H</a>
Drying	<a href="#">F26B</a>
Heat treatment of material or articles	<a href="#">F27</a>

#### **Informative references**

*Attention is drawn to the following places, which may be of interest for search:*

Chemical or biological purification of waste gases	<a href="#">B01D 53/34</a>
Chemical or physical processes or apparatus in general	<a href="#">B01J</a>

Combustion using solid fuel only	<a href="#">F23B</a>
Removal or treatment of combustion products, e.g. flue gases or combustion residues, e.g. ash	<a href="#">F23J</a>
Feeding fuel	<a href="#">F23K</a>
Supplying air or other non-combustible liquids or gases, e.g. water or steam	<a href="#">F23L</a>
Constructional details of combustion chambers, not otherwise provided for	<a href="#">F23M</a>
Regulating or controlling combustion	<a href="#">F23N</a>
Ignition	<a href="#">F23Q</a>
Heat-producing reactions of chemical substances, other than combustion (e.g. of hydrogen peroxide and methane, or iron oxide and aluminium)	<a href="#">F24V 30/00</a>

### Special rules of classification

In this subclass methods are classified in the groups that cover the apparatus used.

When classifying in this subclass, add codes [F23C 2200/00](#) - [F23C 2206/103](#) and [F23C 2900/10001](#) - [F23C 2900/09002](#).

Indexing Codes [F23C 2700/00](#) - [F23C 2700/066](#) shall not be used.

### Glossary of terms

*In this place, the following terms or expressions are used with the meaning indicated:*

Air	a mixture of gases containing free oxygen and able to promote or support combustion
Primary air	air supplied to the burning fuel, e.g. together with the fuel in order to liberate combustible gases
Secondary air	air supplied to the combustible gases liberated by the primary air in order to complete their combustion. The expression "secondary air" covers "tertiary air" etc.
Burner	a device by which fluid fuel or solid fuel suspended in air is passed to a combustion space where it burns to produce a self-supporting flame. A burner includes means for feeding air that are arranged in immediate connection with a fuel feeding conduit, for example concentric with it.
Combustion	a heat-producing sequence of chemical reactions between a burnable substance and molecular oxygen, e.g. in air in most cases generating light in the form of flames or a glow
Combustion chamber	a chamber in which fuel is burned to establish a self-supporting fire or flame and which surrounds that fire or flame
Combustion zone	the part of an apparatus where the reaction takes place between air and fuel

### Synonyms and Keywords

*In patent documents, the following abbreviations are often used:*

CFB	Circulating fluidised bed
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CWS	Coal-water slurry
EHC	Electrically-heated catalyst
FBN	Fuel bound nitrogen
HC	Hydrocarbons
NOx	Nitrous oxides
PFBC	Pressurised fluidised bed combustion
SOx	Sulfur oxides
UHC	Unburned hydrocarbons

*In patent documents, the following words/expressions are often used with the meaning indicated:*

"boiler"	"combustion apparatus", even when heating of water or other liquids is of no interest.
"burner"	"combustion apparatus", and not in the restricted meaning defined above.

## 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 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](#))**

### References

#### Limiting references

*This place does not cover:*

Combustion apparatus characterised by the combination of two or more	<a href="#">F23C 6/00</a>
Pilot flame igniters	<a href="#">F23Q 9/00</a>

#### Informative references

*Attention is drawn to the following places, which may be of interest for search:*

Waste incinerators having supplementary heating by gaseous or liquid fuel	<a href="#">F23G 5/12</a>
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## F23C 3/00

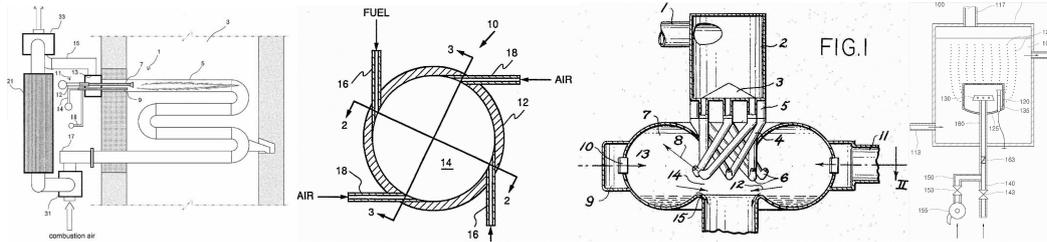
**Combustion apparatus characterised by the shape of the combustion chamber**

### Definition statement

*This place covers:*

Combustion apparatus wherein the shape or the location of the combustion chamber is of particular relevance, e.g. radiant tubes, cyclonic combustors and submerged combustors

Illustrative example: EP2299175, US547981, US2900930, WO2010/090453



**References**

**Informative references**

Attention is drawn to the following places, which may be of interest for search:

Cyclonic combustion for waste	<a href="#">F23G 5/32</a>
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**F23C 3/004**

{the chamber being arranged for submerged combustion ([F23C 3/002](#) takes precedence)}

**References**

**Limiting references**

This place does not cover:

Combustion apparatus wherein the chamber having an elongated tubular form, e.g. for a radiant tube	<a href="#">F23C 3/002</a>
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**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)

**References**

**Informative references**

Attention is drawn to the following places, which may be of interest for search:

Arrangements or dispositions of combustion apparatus in steam boilers	<a href="#">F22B 31/00</a>
Arrangement or mounting of burners in fluid heaters	<a href="#">F24H 9/18</a>

## 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)

### References

#### Limiting references

*This place does not cover:*

Disposition of burners to obtain rotating flames, i.e. flames moving helically or spirally	<a href="#">F23C 5/32</a>
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## F23C 6/00

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

### References

#### Limiting references

*This place does not cover:*

Consuming smoke or fumes in separate combustion apparatus	<a href="#">F23G 7/06</a>
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#### Informative references

*Attention is drawn to the following places, which may be of interest for search:*

Heat supply in steam boilers by installation of two or more combustion apparatus	<a href="#">F22B 31/04</a>
Waste incinerators with secondary combustion in a separate combustion chamber	<a href="#">F23G 5/16</a>
Water heaters having plural combustion chambers	<a href="#">F24H 1/46</a>

### Special rules of classification

When classifying in this group, add codes [F23C 2201/10](#) - [F23C 2201/401](#).

## F23C 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](#))

### Definition statement

*This place covers:*

Aspects of the air supply related to the introduction of the combustion air into the combustion chamber in proximity of the burner, e.g. passages, swirling vanes, flow controlling means, limited to apparatus of methods for fluid fuels only.

## References

### Limiting references

*This place does not cover:*

Inlets for fluidisation air	<a href="#">F23C 10/20</a>
Baffles or shields with air supply passages	<a href="#">F23M 9/04</a>

### Special rules of classification

Multiple classification should be applied when:

the subject matter to be classified deals with air supply means which are part of a burner and no relevant subgroup is available in [F23D](#), e.g. arrangements of swirling vanes in a premix gas burner have to be classified in [F23C 7/004](#) and [F23D 14/02](#);

the subject matter to be classified, in addition to a burner, includes further features of the air supply means that are of interest, for example a particular form of a swirling vane, even if a relevant subgroup is available in [F23D](#), e.g. an arrangement of adjustable swirling vanes in a non-premix gas burner having separate air and gas feed conduits have to be classified in [F23C 7/006](#) and [F23D 14/24](#)

## 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](#))**

## References

### Limiting references

*This place does not cover:*

Fluidised beds 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	<a href="#">F23C 10/02</a>
Combined with devices for partial reintroduction of material into the bed, e.g. after separation of agglomerated parts	<a href="#">F23C 10/26</a>
Fluidised bed incinerators 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	<a href="#">F23G 5/30</a>

### Informative references

*Attention is drawn to the following places, which may be of interest for search:*

Combustion apparatus using solid fuel with means for returning combustion products or flue gases	<a href="#">F23B 70/00</a> , <a href="#">F23B 80/02</a>
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### Special rules of classification

When classifying in this group, add codes [F23C 2202/10](#) - [F23C 2202/50](#).

## F23C 10/00

### Fluidised bed combustion apparatus

#### References

##### Informative references

Attention is drawn to the following places, which may be of interest for search:

Fluidised bed apparatus comprising two or more beds	<a href="#">F23C 10/005</a>
Fluidised bed apparatus comprising a rotating bed	<a href="#">F23C 10/007</a>
Fluidised bed apparatus comprising a bed of catalytic particles	<a href="#">F23C 10/01</a>
Fluidised bed apparatus comprising 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	<a href="#">F23C 10/02</a> - <a href="#">F23C 10/14</a>
Fluidised bed apparatus specially adapted for operation at super-atmospheric pressures, e.g. by the arrangement of the combustion chamber and its auxiliary systems inside a pressure vessel	<a href="#">F23C 10/16</a>
Details and/or accessories for fluidised bed apparatus, e.g. inlets for fluidizing air, fuel feeders, controlling devices	<a href="#">F23C 10/18</a> - <a href="#">F23C 10/32</a>
Devices for removal of material from the bed combined with devices for partial reintroduction of material into the bed, e.g. after separation of agglomerated parts	<a href="#">F23C 10/26</a>
Chemical or physical processes according to "fluidised-bed" technique in general	<a href="#">B01J 8/24</a>
Waste incinerators having a fluidised bed	<a href="#">F23G 5/30</a>
Fluidised bed furnaces or other similar apparatus for heat treatment of materials or articles	<a href="#">F27B 15/00</a>

#### Special rules of classification

When classifying in this group, add codes [F23C 2206/10](#) - [F23C 2206/103](#).

## 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](#))

#### References

##### Limiting references

This place does not cover:

Combustion 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>

**Informative references**

Attention is drawn to the following places, which may be of interest for search:

Incinerators for waste gases or noxious gases in which combustion takes place in the presence of catalytic material	<a href="#">F23G 7/07</a>
Combustion chambers for generating combustion products of high pressure or high velocity, characterised by the use of catalytic means	<a href="#">F23R 3/40</a>

**F23C 13/08**

**characterised by the catalytic material**

**References****Informative references**

Attention is drawn to the following places, which may be of interest for search:

Catalysts per se	<a href="#">B01J 21/00</a> - <a href="#">B01J 38/00</a>
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**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](#))}**

**References****Informative references**

Attention is drawn to the following places, which may be of interest for search:

Starting devices	<a href="#">F23D 11/42</a>
Intermittent or explosive combustion chambers for generating combustion products of high pressure or high velocity	<a href="#">F23R 7/00</a>

**Special rules of classification**

When classifying in this group, add codes [F23C 2205/10](#) - [F23C 2205/20](#) if appropriate.

**F23C 99/00**

**Subject-matter not provided for in other groups of this subclass**

**References****Informative references**

Attention is drawn to the following places, which may be of interest for search:

Applying electric means or magnetism to combustion in combustion engines	<a href="#">F02B 51/04</a> , <a href="#">F02M 27/04</a>
Using sound or vibrations in combustion engines	<a href="#">F02B 51/06</a> , <a href="#">F02M 27/08</a>

### Special rules of classification

**F23C11/00 - F23C11/00M** are not used anymore for classification, please refer to subgroups [F23C 99/00](#) - **F23C99/40** instead.

### F23C 99/001

{Applying electric means or magnetism to combustion (for combustion engines [F02B 51/04](#), [F02M 27/04](#))}

#### References

##### Informative references

Attention is drawn to the following places, which may be of interest for search:

Applying electric means or magnetism to combustion in combustion engines	<a href="#">F02B 51/04</a> , <a href="#">F02M 27/04</a>
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### 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](#))}

#### References

##### Informative references

Attention is drawn to the following places, which may be of interest for search:

Using sound or vibrations in 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>

### 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](#))}

#### References

##### Limiting references

This place does not cover:

Fluidised bed apparatus	<a href="#">F23C 10/00</a>
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**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](#))}

**References****Limiting references**

*This place does not cover:*

Apparatus in which combustion takes place in the presence of catalytic material	<a href="#">F23C 13/00</a>
Radiant gas burners with combustion on or in a porous body	<a href="#">F23D 14/16</a>
Radiant gas burner with a catalyst flameless combustion	<a href="#">F23D 14/18</a>

**F23C 99/008**

{Combustion methods wherein flame cooling techniques other than fuel or air staging or fume recirculation are used}

**Special rules of classification**

When classifying in this subgroup, add codes [F23C 2203/10](#) - [F23C 2203/30](#) if appropriate.