SECTION F — MECHANICAL ENGINEERING; LIGHTING; HEATING; WEAPONS; BLASTING

F22 STEAM GENERATION

Note(s)

In this class, the following term is used with the meaning indicated:

- "steam" covers also other condensable vapours, e.g. mercury, diphenyl, diphenyl oxide.

F22B **METHODS OF STEAM GENERATION; STEAM BOILERS** (steam engine plants where engine aspects predominate F01K; removal of combustion products or residues, e.g. cleaning of the combustion contaminated surfaces of tubes of boilers, F23J 3/00; domestic central-heating systems using steam F24D; heat exchange or heat transfer in general F28; generation of vapour in the cores of nuclear reactors G21)

Note(s)

This subclass covers only methods of, or apparatus for, the generation of steam under pressure for heating or power purposes.

Subclass index

1/00 **Methods of steam generation characterised by form of heating method** (use of solar heat F24J 2/00; jackets or other cooling means in which steam is generated and which serve for cooling other apparatus, see the subclasses for such apparatus)

1/02 • by exploitation of the heat content of hot heat carriers

1/04 • • the heat carrier being hot slag, hot residues, or heated blocks, e.g. iron blocks

1/06 • • the heat carrier being molten; Use of molten metal, e.g. zinc, as heat transfer medium

1/08 • • the heat carrier being steam

1/10 • • • released from heat accumulators

1/12 • • • produced by an indirect cyclic process

1/14 • • • coming in direct contact with water in bulk or in sprays

1/16 • • the heat carrier being hot liquid or hot vapour, e.g. waste liquid, waste vapour

1/18 • • the heat carrier being a hot gas, e.g. waste gas such as exhaust gas of internal-combustion engines (use of waste heat of combustion engines, in general, F02)

1/20 • using heat evolved in a solution absorbing steam; Soda steam boilers

1/22 • using combustion under pressure substantially exceeding atmospheric pressure

1/24 • • Pressure-fired steam boilers, e.g. using turbo air compressors actuated by hot gases from boiler furnace

1/26 • • Steam boilers of submerged-flame type, i.e. the flame being surrounded by, or impinging on, the water to be vaporised

1/28 • in boilers heated electrically

1/30 • • Electrode boilers

3/00 **Other methods of steam generation; Steam boilers not provided for in other groups of this subclass**

3/02 • involving the use of working media other than water

3/04 • by drop in pressure of high-pressure hot water within pressure-reducing chambers, e.g. in accumulators (steam accumulators per se F01K 1/00)

3/06 • by transformation of mechanical, e.g. kinetic, energy into heat energy

3/08 • at critical or supercritical pressure values

5/00 Steam boilers of drum type, i.e. without internal furnace or fire tubes, the boiler body being contacted externally by flue gas

5/02 • with auxiliary water tubes outside the boiler body
5/04 • Component parts thereof; Accessories therefor (covers or similar closure members for pressure vessels in general F16J 13/00)

7/00 Steam boilers of furnace-tube type, i.e. the combustion of fuel being performed inside one or more furnace tubes built-in in the boiler body

7/02 • without auxiliary water tubes
7/04 • with auxiliary water tubes
7/06 • • inside the furnace tube in transverse arrangement
7/08 • • inside the furnace tube in longitudinal arrangement
7/10 • • outside the boiler body
7/12 • with auxiliary fire tubes; Arrangement of header boxes providing for return diversion of flue gas flow
7/14 • with both auxiliary water tubes and auxiliary fire tubes
7/16 • Component parts thereof; Accessories therefor, e.g. stay-bolt connections
7/18 • • Walling of flues; Flue-gas header boxes
7/20 • • Furnace tubes

9/00 Steam boilers of fire-tube type, i.e. the flue gas from a combustion chamber outside the boiler body flowing through tubes built-in in the boiler body

9/02 • the boiler body being disposed upright, e.g. above the combustion chamber
9/04 • • the fire tubes being in upright arrangement
9/06 • • • Arrangement of header boxes providing for return diversion of flue gas flow
9/08 • • the fire tubes being in horizontal arrangement
9/10 • the boiler body being disposed substantially horizontally, e.g. at the side of the combustion chamber
9/12 • • the fire tubes being in substantially-horizontal arrangement
9/14 • • • Arrangement of header boxes providing for return diversion of flue gas flow
9/16 • the boiler body containing fire tubes disposed crosswise in inclined upward arrangement
9/18 • Component parts thereof; Accessories therefor, e.g. stay-bolt connections

11/00 Steam boilers of combined fire-tube type and water-tube type, i.e. steam boilers of fire-tube type having auxiliary water tubes

11/02 • the fire tubes being in upright arrangement
11/04 • the fire tubes being in horizontal arrangement

13/00 Steam boilers of fire-box type, i.e. the combustion of fuel being performed in a chamber or fire-box with subsequent flue(s) or fire tube(s), both chamber or fire-box and flues or fire tubes being built-in in the boiler body

13/02 • mounted in fixed position with the boiler body disposed upright
13/04 • mounted in fixed position with the boiler body disposed substantially horizontally
13/06 • Locomobile, traction-engine, steam-roller, or locomotive boilers
13/08 • • without auxiliary water tubes inside the fire-box
13/10 • • with auxiliary water tubes inside the fire-box
13/12 • • • the auxiliary water tubes lining the fire-box
13/14 • Component parts thereof; Accessories therefor
13/16 • • Stay-bolt connections, e.g. rigid connections
13/18 • • • Flexible connections, e.g. of ball-and-socket type

15/00 Water-tube boilers of horizontal type, i.e. the water-tube sets being arranged horizontally

17/00 Water-tube boilers of horizontally-inclined type, i.e. the water-tube sets being inclined slightly with respect to the horizontal plane

17/02 • built-up from water-tube sets in abutting connection with two header boxes in common for all sets, e.g. with flat header boxes
17/04 • • the water-tube sets being inclined in opposite directions, e.g. crosswise
17/06 • • the water-tube sets being bent angularly
17/08 • • the water-tube sets being curved
17/10 • built-up from water-tube sets in abutting connection with two sectional headers each for every set, i.e. with headers in a number of sections across the width or height of the boiler
17/12 • • the sectional headers being in vertical or substantially-vertical arrangement
17/14 • • the sectional headers being in horizontal or substantially-horizontal arrangement
17/16 • Component parts thereof; Accessories therefor
17/18 • • Header boxes; Sectional headers

19/00 Water-tube boilers of combined horizontally-inclined type and vertical type, i.e. water-tube boilers of horizontally-inclined type having auxiliary water-tube sets in vertical or substantially-vertical arrangement

21/00 Water-tube boilers of vertical or steeply-inclined type, i.e. the water-tube sets being arranged vertically or substantially vertically

21/02 • built-up from substantially-straight water tubes
21/04 • • involving a single upper drum and a single lower drum, e.g. the drums being arranged transversely
21/06 • • • the water tubes being arranged annularly in sets, e.g. in abutting connection with drums of annular shape
21/08 • • • the water tubes being arranged sectionally in groups or in banks, e.g. bent over at their ends
21/10 • • • the water tubes being arranged in staggered rows
21/12 • • involving two or more upper drums and two or more lower drums, e.g. with crosswise-arranged water-tube sets in abutting connection with drums
21/14 • • involving a single upper drum and two or more lower drums
21/16 • • • the lower drums being interconnected by further water tubes
21/18 • • involving two or more upper drums and a single lower drum
21/20 • • involving sectional or subdivided headers in separate arrangement for each water-tube set
21/22 • built-up from water tubes of form other than straight or substantially straight
21/24 • • bent in serpentine or sinuous form
21/26 • • bent helically, i.e. coiled
21/28 • • bent spirally
21/30 • • bent in U-loop form
21/32 • • • disposed horizontally in abutting connection with upright headers or rising water mains

21/34 • built-up from water tubes grouped in panel form surrounding the combustion chamber, i.e. radiation boilers
21/36 • • involving an upper drum or headers mounted at the top of the combustion chamber
21/38 • • Component parts thereof, e.g. prefabricated panels
21/40 • built-up from water tubes arranged in a comparatively long vertical shaft, i.e. tower boilers

23/00 Water-tube boilers built-up from sets of spaced double-walled water tubes of return type in unilaterial abutting connection with a boiler drum or with a header box, i.e. built-up from Field water tubes comprising an inner tube arranged within an outer unilaterally-closed tube
23/02 • the water-tube, i.e. Field-tube, sets being horizontal or substantially horizontal
23/04 • the water-tube, i.e. Field-tube, sets being vertical or substantially vertical
23/06 • Component parts thereof, e.g. Field water tubes (heat-exchange tubes in general F28F)

25/00 Water-tube boilers built-up from sets of water tubes with internally-arranged flue tubes, or fire tubes, extending through the water tubes

27/00 Instantaneous or flash steam boilers
27/02 • built-up from fire tubes
27/04 • built-up from water tubes (F22B 27/12-F22B 27/16 take precedence)
27/06 • • bent in serpentine or sinuous form
27/08 • • bent helically, i.e. coiled
27/10 • • bent spirally
27/12 • built-up from rotary heat-exchange elements, e.g. from tube assemblies
27/14 • built-up from heat-exchange elements arranged within a confined chamber having heat-retaining walls
27/16 • involving spray nozzles for sprinkling or injecting water particles on to or into hot heat-exchange elements, e.g. into tubes

29/00 Steam boilers of forced-flow type
29/02 • of forced-circulation type
29/04 • of combined-circulation type, i.e. in which convection circulation due to the difference in specific gravity between cold and hot water is promoted by additional measures, e.g. by injecting pressure-water temporarily
29/06 • of once-through type, i.e. built-up from tubes receiving water at one end and delivering superheated steam at the other end of the tubes (F22B 33/00 takes precedence)
29/08 • • operating with fixed point of final state of complete evaporation
29/10 • • operating with sliding point of final state of complete evaporation
29/12 • • operating with superimposed recirculation during starting and low-load periods, e.g. composite boilers

31/00 Modifications of boiler construction, or of tube systems, dependent on installation of combustion apparatus; Arrangements or dispositions of combustion apparatus (steam generation characterised by heating method F22B 1/00; combustion apparatus per se F23)
31/02 • Installation of water-tube boilers in chimneys, e.g. in converter chimneys
31/04 • Heat supply by installation of two or more combustion apparatus, e.g. of separate combustion apparatus for the boiler and the superheater respectively
31/06 • • Installation of emergency heat supply
31/08 • Installation of heat-exchange apparatus or of means in boilers for heating air supplied for combustion

Steam-generation plants; Control systems

33/00 Steam-generation plants, e.g. comprising steam boilers of different types in mutual association (arrangements or dispositions of steam-generation plants in marine vessels B63H 21/00)
33/02 • Combinations of boilers having a single combustion apparatus in common
33/04 • • of boilers of furnace-tube type with boilers of water-tube type
33/06 • • of boilers of furnace-tube type with boilers of fire-tube type
33/08 • • of boilers of water-tube type with boilers of fire-tube type
33/10 • • of two or more superposed boilers with separate water volumes and operating with two or more separate water levels
33/12 • Self-contained steam boilers, i.e. comprising as a unit the steam boiler, the combustion apparatus, the fuel storage, accessory machines, and equipment
33/14 • Combinations of low- and high-pressure boilers
33/16 • • of forced-flow type
33/18 • Combinations of steam boilers with other apparatus

35/00 Control systems for steam boilers (regulation or control of steam power plants F01K 7/00; for regulating feed-water supply F22D; for controlling superheat temperature F22G 5/00; control of combustion F23N)
35/02 • for steam boilers with natural convection circulation
35/04 • • during starting-up periods, i.e. during the periods between the lighting of the furnaces and the attainment of the normal operating temperature of the steam boilers
35/06 • for steam boilers of forced-flow type
35/08 • • of forced-circulation type
35/10 • • of once-through type
35/12 • • • operating at critical or supercritical pressure
35/14 • • during the starting-up periods, i.e. during the periods between the lighting of the furnaces and the attainment of the normal operating temperature of the steam boilers
35/16 • • responsive to the percentage of steam in the mixture of steam and water
35/18 • Applications of computers to steam-boiler control

37/00 Component parts or details of steam boilers (venting devices F16K 24/00; steam traps or like apparatus F16T)
37/02 • applicable to more than one kind or type of steam boiler
37/04 • • and characterised by material, e.g. use of special steel alloy
37/06 • • Flue or fire tubes; Accessories therefor, e.g. fire-tube inserts
37/08 • • • Fittings preventing burning-off of the tube edges

37/10 • • Water tubes; Accessories therefor (working of metal tubes B21D; pipes in general F16L; repairing leaks in water tubes F16L 55/16, F28F 11/00; cleaning water tubes of boilers F23J, F28G; baffles, screens, or deflectors formed of water tubes F23M 9/10)

37/12 • • • Forms of water tubes, e.g. of varying cross-section

37/14 • • • Supply mains, e.g. rising mains, down-comers, in connection with water tubes

37/16 • • • Return bends

37/18 • • • Inserts, e.g. for receiving deposits from water

37/20 • • • Supporting arrangements, e.g. for securing water-tube sets (construction of tube walls of furnaces including boiler furnaces F23M 5/08)

37/22 • • Drums; Headers; Accessories therefor (making boilers from sheet metal B21D 51/24; pressure vessels in general F16J 12/00; covers or similar closure members for pressure vessels in general F16J 13/00)

37/24 • • Supporting, suspending, or setting arrangements, e.g. heat shielding (frames, engine beds F16M)

37/26 • • Steam-separating arrangements (vapour-liquid separators, e.g. for drying steam, B01D, B04)

37/28 • • • involving reversal of direction of flow

37/30 • • • using impingement against baffle separators

37/32 • • • using centrifugal force

37/34 • • Adaptations of boilers for promoting water circulation (auxiliary devices for promoting water circulation F22D 7/00)

37/36 • • Arrangements for sheathing or casing boilers

37/38 • • Determining or indicating operating conditions in steam boilers, e.g. monitoring direction or rate of water flow through water tubes (measuring or indicating instruments in general G01)

37/40 • • Arrangements of partition walls in flues of steam boilers, e.g. built-up from baffles (in flues or chimneys F23J 13/00)

37/42 • • Applications, arrangements, or dispositions of alarm or automatic safety devices (for feed-water heaters F22D 1/14; alarms responsive to undesired or abnormal conditions G08B)

37/44 • • • of safety valves (safety valves per se F16K)

37/46 • • • responsive to low or high water level, e.g. for checking, suppressing, extinguishing combustion in boilers (fire-fighting, fire extinction in general A62)

37/47 • • • responsive to abnormal temperature, e.g. actuated by fusible plugs (such alarms or devices per se G08B)

37/48 • • Devices or arrangements for removing water, minerals, or sludge from boilers (cleaning water tubes, furnace tubes, or the like of boilers F23J, F28G)

Note(s)

Group F22B 37/48 covers only systems used while the boiler is in operation, or which remain in position while the boiler is in operation, or are specifically adapted to boilers without any other utility.

37/50 • • • for draining or expelling water

37/52 • • • Washing-out devices

37/54 • • • De-sludging or blow-down devices

37/56 • • Boiler-cleaning control devices, e.g. for ascertaining proper duration of boiler blow-down

37/58 • • Removing tubes from headers or drums; Extracting tools

37/60 • specially adapted for steam boilers of instantaneous or flash type

37/62 • specially adapted for steam boilers of forced-flow type

37/64 • • Mounting of, or supporting arrangements for, tube units (construction of tube walls of furnaces, e.g. boiler furnaces F23M 5/08)

37/66 • • • involving vertically-disposed water tubes

37/68 • • • involving horizontally-disposed water tubes

37/70 • • Arrangements for distributing water into water tubes

37/72 • • • involving injection devices

37/74 • • • Throttling arrangements for tubes or sets of tubes

37/76 • Adaptations or mounting of devices for observing existence or direction of fluid flow (devices per se G01P)

37/78 • Adaptations or mounting of level indicators (level indicators per se G01F)

F22D PREHEATING, OR ACCUMULATING PREHEATED, FEED-WATER; FEED-WATER SUPPLY; CONTROLLING WATER LEVEL; AUXILIARY DEVICES FOR PROMOTING WATER CIRCULATION WITHIN BOILERS (chemical treatment of water, e.g. purification, C02F; enclosed heat-exchange apparatus in general F28D; controlling in general G05)

1/00 Feed-water heaters, e.g. preheaters

1/02 • with water tubes arranged in the boiler furnace, fire tubes, or flue ways (heat-exchange tubes in general F28F)

1/04 • • the tubes having plain outer surfaces, e.g. in vertical arrangement

1/06 • • • in horizontal arrangement

1/08 • • the tubes having fins, ribs, gills, corrugations, or the like on their outer surfaces, e.g. in vertical arrangement

1/10 • • • in horizontal arrangement (hollow fire-bars, grates, or the like used as water tubes F23H 3/02)

1/12 • • Control devices, e.g. for regulating steam temperature

1/14 • • Safety or venting devices (safety devices for boilers in general F22B 37/42)

1/16 • with water tubes arranged otherwise than in the boiler furnace, fire tubes, or flue ways

1/18 • • and heated indirectly

1/20 • • and directly connected to boilers

1/22 • • and provided for rotary movement

1/24 • with fire tubes or flue ways traversing feed-water vessels

1/26 • with means, other than tubes, to separate water and heating medium, e.g. bulk heaters without internal flues or tubes, jacketted smoke-boxes or flues

1/28 • for direct heat transfer, e.g. by mixing water and steam

1/30 • • with stages, steps, baffles, dishes, circular troughs, or other means to cause interrupted or cascading fall of water

1/32 • arranged to be heated by steam, e.g. bled from turbines

1/34 • • and returning condensate to boiler with main feed supply
1/36 • Water and air preheating systems
1/38 • • Constructional features of water and air preheating systems
1/40 • Combinations of exhaust-steam and smoke-gas preheaters (for locomotives F22D 1/42)
1/42 • specially adapted for locomotives
1/44 • • Smoke-gas preheaters
1/46 • • Exhaust-steam preheaters
1/48 • • Details
1/50 • incorporating thermal de-aeration of feed-water (de-aeration produced in the course of direct heat transfer F22D 1/28; thermal de-aeration of water per se B01D 19/00, C02F 1/20; valves for venting F16K 24/04) **[3]**

3/00 Accumulators for preheated water
3/02 • arranged within combustion chambers
3/04 • combined with steam accumulators
3/06 • directly connected to boilers
3/08 • specially adapted for locomotives (locomotive boilers F22B 13/06)
3/10 • • Control devices (controlling water feed to boilers, or water level F22D 5/00)

5/00 Controlling water feed or water level; Automatic water feeding or water-level regulators (steam traps F16T; measuring or indicating instruments G01; for indicating water level G01F; level control in general G05D 9/00)
5/02 • with an intermediate compartment from which the water is fed by gravity after mechanically moving the compartment, the movement being controlled according to water level
5/04 • with pivoting buckets
5/06 • with receptacles external to, but in free communication with, the boilers and adapted to move up and down in accordance with change in water level
5/08 • with float-actuated valves
5/10 • • and with pistons or membranes unitary with the feed inlet valves
5/12 • • and with dipping tubes
5/14 • responsive to thermal expansion and contraction, e.g. of solid elements
5/16 • • of fluids
5/18 • for varying the speed or delivery pressure of feed pumps
5/20 • • without floats
5/22 • • with floats
5/24 • with electric switches
5/26 • Automatic feed-control systems (automatic safety devices F22B 37/42; controlling in general G05)
5/28 • • responsive to amount of steam withdrawn; responsive to steam pressure
5/30 • • responsive to both water level and amount of steam withdrawn or steam pressure
5/32 • • influencing the speed or delivery pressure of the feed pumps
5/34 • • Applications of valves (valves per se F16K)
5/36 • • for feeding a number of steam boilers designed for different ranges of temperature and pressure

7/00 Auxiliary devices for promoting water circulation (adaptation of boilers for promoting water circulation F22B 37/34)
7/02 • Saddles or like directing plates fitted to furnace tubes
7/04 • Injectors for water or steam
7/06 • Rotary devices, e.g. propellers
7/08 • • Arrangements of pumps, e.g. outside the boilers
7/10 • • • within the boilers
7/12 • Control devices
7/14 • specially adapted for locomotive boilers

11/00 Feed-water supply not provided for in other main groups
11/02 • Arrangements of feed-water pumps (F22D 11/06 takes precedence; pumps per se F04)
11/04 • • with means to eliminate steam formation
11/06 • • for returning condensate to boiler

F22G SUPERHEATING OF STEAM (steam-separating arrangements in boilers F22B 37/26; removal of combustion products or residues, e.g. cleaning of the combustion contaminated surfaces of tubes of boilers, F23J 3/00)

1/00 Steam superheating characterised by heating method (exothermal chemical reactions not involving a supply of free oxygen gas, apparatus or devices for using the heat therefrom F24J)
1/02 • with heat supply by hot flue gases from the furnace of the steam boiler
1/04 • • by diverting flow or hot flue gases to separate superheaters operating in reheating cycle, e.g. for reheating steam between a high-pressure turbine stage and an intermediate turbine stage
1/06 • with heat supply predominantly by radiation
1/08 • • from heated brickwork or the like
1/10 • with provision for superheating by throttling
1/12 • by mixing steam with furnace gases or other combustion products
1/14 • using heat generated by chemical reactions
1/16 • by using a separate heat source independent from heat supply of the steam boiler, e.g. by electricity, by auxiliary combustion of fuel oil

3/00 Steam superheaters characterised by constructional features; Details or component parts thereof (general aspects of enclosed heat-exchangers F28D)

5/00 Controlling superheat temperature (control systems for steam boilers F22B; regulating or controlling in general G05)
5/02 • Applications of combustion-control devices, e.g. tangential-firing burners, tilting burners
5/04 • by regulating flue gas flow, e.g. by proportioning or diverting
5/06 • by recirculating flue gases
5/08 • • preventing furnace gas backflow through recirculating fan
5/10 • by displacing superheater sections
5/12 • by attemperating the superheated steam, e.g. by injected water sprays (spray-mixers B01F 5/18)
5/14 • • by live steam
5/16 • by indirectly cooling or heating the superheated steam in auxiliary enclosed heat-exchanger

5/18 • by by-passing steam around superheater sections
5/20 • by combined controlling procedures

7/00 Steam superheaters characterised by location, arrangement, or disposition

7/02 • in fire tubes
7/04 • in jackets around fire tubes
7/06 • in furnace tubes
7/08 • in fire-boxes
7/10 • in smoke-boxes
7/12 • in flues
7/14 • in water-tube boilers, e.g. between banks of water tubes