**COOPERATIVE PATENT CLASSIFICATION**

**F**  
MECHANICAL ENGINEERING; LIGHTING; HEATING; WEAPONS; BLASTING  
*(NOTE omitted)*

**LIGHTING; HEATING**

**F22**  
STEAM GENERATION  
*(NOTE omitted)*

**F22B**  
METHODS OF STEAM GENERATION; STEAM BOILERS *(steam engine plants where engine aspects predominate F01K; 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**

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

**WARNING**

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.

**General aspects of, or methods for, steam generation**

1/00  
Methods of steam generation characterised by form of heating method *(solar heating F24S; jackets or other cooling means in which steam is generated and which serve for cooling other apparatus, see the subclasses for such apparatus)*

1/003  
- [using combustion of hydrogen with oxygen *(power plants using steam created by combustion of hydrogen with oxygen F01K 25/005)*]

1/006  
- [using solar heat *(solar heat collectors per se F24S; devices for producing mechanical power from solar energy F03G 6/00)*]

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

1/021  
- [with heating tubes in which flows a non-specified heating fluid *(for nuclear reactors F22B 1/023, for hot gas F22B 1/184)*]

1/023  
- [with heating tubes, for nuclear reactors as far as they are not classified, according to a specified heating fluid, in another group]

1/025  
- [with vertical U shaped tubes carried on a horizontal tube sheet]

1/026  
- [with vertical tubes between to horizontal tube sheets]

1/028  
- [Steam generation using heat accumulators *(F22B 27/14 takes precedence)*]

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]

1/063  
- [for metal cooled nuclear reactors *(heat-exchangers having a liquid metal as heat exchange medium F28D7/00C)*]

1/066  
- [with double-wall tubes having a third fluid between these walls, e.g., helium for leak detection *(heat-exchangers with double-wall tubes F28D 7/10; double-wall pipes per se F16L 9/18)*]

1/08  
- the heat carrier being steam

1/10  
- released from heat accumulators

1/12  
- produced by an indirect cyclic process

1/123  
- [Steam generators downstream of a nuclear boiling water reactor]

1/126  
- [Steam generators of the Schmidt-Hartmann type]

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

1/143  
- [in combination with a nuclear installation]

1/146  
- [Loffler boilers]

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

1/162  
- [in combination with a nuclear installation]

1/165  
- [using heat pipes *(heat pipes per se F28D 15/02)*]

1/167  
- [using an organic fluid]

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, F02G)*

1/1807  
- [using the exhaust gases of combustion engines]

1/1815  
- [using the exhaust gases of gas-turbines]

1/1823  
- [for gas-cooled nuclear reactors]

1/183  
- [in combination with metallurgical converter installations]

1/1838  
- [the hot gas being under a high pressure, e.g. in chemical installations]

1/1846  
- [the hot gas being loaded with particles, e.g. waste heat boilers after a coal gasification plant]
Kinds of steam boilers

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

5/005 . . . [with rotating drums]

5/02 . . . with auxiliary water tubes outside the boiler body

5/04 . . . Component parts thereof; Accessories therefor (covers or similar closure members 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 arrangements

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

13/005 . . . [with flues, other than fire tubes]

13/02 . . . mounted in fixed position with the boiler body disposed upright

13/023 . . . [with auxiliary water tubes inside the fire-box, e.g. vertical tubes (F22B 13/10 takes precedence)]

13/026 . . . [the tubes being in substantially horizontal arrangement]

13/04 . . . mounted in fixed position with the boiler body disposed substantially horizontally

13/06 . . . Locomotive, traction-engine, steam-roller, or locomotive boilers
Kinds of steam boilers

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, e.g. 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

17/105 with tubes in series flow arrangement

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

21/002 involving a single upper drum [F22B 21/36 takes precedence]

21/005 involving a central vertical drum, header or downcomer

21/007 specially adapted for locomotives

21/009 built-up from substantially straight water tubes

21/01 involving a single upper drum and a single lower drum, e.g. the drums being arranged transversely

21/016 the water tubes being arranged annularly in sets, e.g. in abutting connection with drums of annular shape

21/065 involving an upper and lower drum of annular shape

21/08 the water tubes being arranged sectionally in annular shape

21/081 involving a combustion chamber, placed at the side and built-up from water tubes

21/083 involving an upper drum and a lower drum and a fire-place between the two drums

21/085 the tubes being placed in layers

21/086 Frames built-up from water tubes

21/088 involving an upper drum and a lower drum and two lateral drums

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 connections with drums

21/123 involving crossed water tubes

21/126 involving more than two lower or upper 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

21/184 involving more than two 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 sinusous 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

21/341 Vertical radiation boilers with combustion in the lower part

21/343 the vertical radiation combustion chamber being connected at its upper part to a sidewardly convection chamber

21/345 with a tube bundle between an upper and a lower drum in the convection pass

21/346 Horizontal radiation boilers

21/348 Radiation boilers with a burner at the top

21/36 involving an upper drum or headers mounted at the top of the combustion chamber

21/363 involving a horizontal drum mounted in an upper corner of the boiler

21/366 involving a horizontal drum mounted in the middle of the boiler

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
Kinds of steam boilers

27/00 Instantaneous or flash steam boilers
27/02 built-up from fire tubes
27/04 built-up from water tubes
27/06 bent in serpentine or sinusoidal 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
27/165 with film flow of water on heated surfaces

29/00 Steam boilers of forced-flow type
29/02 of forced-circulation type
29/03 [heat-exchange tubes in general F28F]
29/06 operating with drums, i.e. without hot water storage in the boiler
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
29/061 construction of tube walls
29/062 involving vertically-disposed water tubes
29/064 involving horizontally- or helically-disposed water tubes
29/065 involving upper vertically disposed water tubes and lower horizontally- or helically disposed water tubes
29/067 operating at critical or supercritical pressure
29/068 operating with superimposed recirculation
29/08 operating with fixed point of final state of complete evaporation
29/10 operating with sliding point of final state of complete evaporation

31/00 Modifications of boiler construction, or of tube systems, dependent on installation of combustion apparatus: Arrangements of dispositions of combustion apparatus (steam generation characterised by heating method F22B 1/00; combustion apparatus per se F23)
31/007 with combustion in a fluidized bed
31/008 for boilers of the shell type, e.g. with furnace box
31/009 with auxiliary water tubes
31/016 constructional features of bed cooling
31/009 Systems therefor
31/0076 controlling processes for fluidized bed boilers not related to a particular type
31/0084 with recirculation of separated solids or with cooling of the bed particles outside the combustion bed
31/0092 with a fluidized heat exchange bed and a fluidized combustion bed separated by a partition, the bed particles circulating around or through that partition
31/012 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
31/045 steam generators specially adapted for burning refuse
31/006 installation of emergency heat supply
31/008 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
Steam-generation plants; Control systems

Component parts or details of steam boilers
(venting devices F16K 24/00; steam traps or like apparatus F16T)

{ [Steam generators built-up from pre-fabricated elements] }
Steam-generation plants; Control systems

37/165 . . . . [Closures for access openings in return bends (boiler plugs for drums or headers F22B 37/223)]
37/18 . . . Inlets, 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)
37/201 . . . [Suspension and securing arrangements for walls built-up from tubes]
37/202 . . . [Suspension and securing arrangements for contact heating surfaces]
37/203 . . . [Horizontal tubes supported only away from their ends on vertical support tubes]
37/204 . . . [Supporting arrangements for individual tubes, e.g. for securing tubes to a refractory wall]
37/205 . . . [Supporting and spacing arrangements for tubes of a tube bundle]
37/206 . . . [Anti-vibration supports for the bends of U-tube steam generators]
37/207 . . . [Supporting arrangements for drums and collectors]
37/208 . . . [Backstay arrangements]
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 F16J 13/00)
37/221 . . . [Covers for drums, collectors, manholes or the like (in general F16J 13/00)]
37/222 . . . [Nozzle dams introduced through a smaller manway, e.g. foldable]
37/223 . . . [Boiler plugs, e.g. for handholes (closures for access openings in return bends F22B 37/165)]
37/225 . . . [Arrangements on drums or collectors for fixing tubes or for connecting collectors to each other]
37/226 . . . [Protection of drums against combustion]
37/227 . . . [Drums and collectors for mixing]
37/228 . . . [Headers for distributing feedwater into steam generator vessels; Accessories therefor]
37/24 . . . [Supporting, suspending, or setting arrangements, e.g. heat shielding (frames, engine beds F16M)]
37/242 . . . [for bottom supported water-tube steam generators]
37/244 . . . [for water-tube steam generators suspended from the top]
37/246 . . . [for steam generators of the reservoir type, e.g. nuclear steam generators]
37/248 . . . [with a vertical cylindrical wall]
37/26 . . . Steam-separating arrangements (vapour-liquid separators, e.g. for drying steam, B01D; B04)
37/261 . . . [specially adapted for boiler drums]
37/263 . . . [Valves with water separators]
37/265 . . . [Apparatus for washing and purifying steam]
37/266 . . . [Separator reheaters]
37/268 . . . [specially adapted for steam generators of nuclear power plants]
37/28 . . . involving reversal of direction of flow
37/283 . . . [specially adapted for boiler drums]
37/286 . . . [specially adapted for steam generators of nuclear power plants]
37/30 . . . using impingement against baffle separators
37/303 . . . [specially adapted for boiler drums]
37/306 . . . [specially adapted for steam generators of nuclear power plants]
37/32 . . . using centrifugal force
37/322 . . . [specially adapted for boiler drums]
37/325 . . . [using a revolving element]
37/327 . . . [specially adapted for steam generators of nuclear power plants]
37/34 . . . Adaptations of boilers for promoting water circulation (F22B 13/135 takes precedence); auxiliary devices for promoting water circulation F22D 7/00)
37/36 . . . Arrangements for sheathing or casing boilers
37/365 . . . [Casings of metal sheets, e.g. expansion plates, expansible joints]
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 ; emergency feed-water supply F22D 11/003); alarms responsive to undesired or abnormal conditions (G08B)
37/421 . . . [Arrangements for detecting leaks]
37/423 . . . [Valves for testing steam generators]
37/425 . . . [Feed-water supply alarm devices using floats]
37/426 . . . [Feed-water supply alarm devices using electric signals]
37/428 . . . [Feed-water supply alarm devices using dilatation of solids or liquids]
37/44 . . . [of safety valves (safety valves per se F16K)]
37/443 . . . [Safety devices extinguishing the fire]
37/446 . . . [Safety devices responsive to overpressure]
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)
37/475 . . . [Safety devices with fusible plugs]
37/478 . . . [Devices for removing water, salt, or sludge from boilers (cleaning internal or external surfaces of water tubes F28G); Arrangements of cleaning apparatus in boilers (cleaning external surfaces of tubes by soot blowers F23J); Combinations thereof with boilers]
37/483 . . . [specially adapted for nuclear steam generators]
37/486 . . . [Devices for removing water, salt, or sludge from boilers (F22B 37/483, F22B 37/50, F22B 37/52 and F22B 37/54 take precedence)]
37/50 . . . for draining or expelling water
37/52 . . . [Washing-out devices]
37/54 . . . [De-sludging or blow-down devices (F22B 37/565 takes precedence)]
37/545 . . . [Valves specially adapted therefor (valves in general F16K)]
37/56 . . . Boiler cleaning control devices, e.g. for ascertaining proper duration of boiler blow-down
37/565 . . . {Blow-down control, 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)
37/645 . . . {involving upper vertically-disposed water
       tubes and lower horizontally- or helically disposed water tubes}
37/66 . . . involving vertically-disposed water tubes
       (F22B 37/645 takes precedence)
37/68 . . . involving horizontally-disposed water tubes
       (F22B 37/645 takes precedence)
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 G01P)