

24 **Combustion apparatus**

- 24a **Furnaces for solid fuels, in general**
 - 24b **Furnaces for liquid fuels**
 - 24c **Gas furnaces including regenerative furnaces and accessories, retorts and muffle furnaces, reverberatory furnaces**
 - 24d **Crematories and refuse burning devices**
 - 24e **Gas producers or generators, gasification of solid fuels by means of gasification agents**
 - 24f **Furnace grates, grate cleaning and agitating devices**
 - 24g **Smokestack equipment, cleaning doors for smokestacks, stack sweeping implements, cleaning of boiler tubes and flue-gas preheaters, furnace and heating flues of combustion residues; collection, slaking, comminution and removal of combustion residues, separation of solid, liquid and gaseous products from flue gases**
 - 24h **Stokers, underfeed furnaces**
 - 24i **Equipment for the regulation of combustion air feed and of the draft in the smokestack**
 - 24k **Fire doors, fire bridges, fire tube and flue inserts, air preheaters for boiler furnaces, steam boiler masonry, igniting and extinguishing apparatus, protection against furnace gases at operator and observation stations**
 - 24l **Pulverised coal furnaces**
 - 24m **Automatic regulation and supervision of the combustion processes in furnaces for solid, pulverised, liquid and gaseous fuels**
 - 24m **(IPC: F23N) Regulating or controlling combustion**
 - 24n **Heat generation by special means**
-
- 24a **Furnaces for solid fuels, in general, for industrial purposes, for steam boilers of all kinds, for the firing of shaft furnaces, kilns and ovens as well as for brewing kettles and steam cookers (for space-heating and cooking stoves 36a)**
 - Furnaces for solid fuels in general**
 - 24a-1 External furnaces and grate furnaces for steam boilers
 - 24a-2 Internal furnaces for steam boilers
 - 24a-3 Water-tube boiler furnaces
 - 24a-4 Tenbrink furnaces
 - 24a-5 Locomotive furnaces in general
 - Components of locomotive furnaces
 - 24a-6/01 Fire screens, fire bridges
 - 24a-6/02 Equipment for air preheating

- 24a-7 Pressurised furnaces
- 24a-8 Alternately firing furnaces
- 24a-9 Miscellaneous steam-boiler furnaces
- 24a-10 Steam-boiler furnaces for burning peat, sawdust, pulverised coal, etc.
Shaft furnaces for boilers
- 24a-11/01 General
- 24a-11/02 Trough grate furnaces
- 24a-12 Steam-boiler furnaces with pre-drying of the fuel in the feeding unit of the furnace
- 24a-13 Furnaces for brewing kettles, steam cookers, etc. (6b-13)
- 24a-14 Reverberatory furnaces
- Air feed**
- 24a-15 for external furnaces and grate furnaces, details
- 24a-16 for internal furnaces
- 24a-17 in general
- Smoke consuming**
- 24a-18 by post-combustion
- 24a-19 by separate degasification and gasification
- 24a-20 by steam admission (24i-7)
- 24a-21 by recirculating the furnace gases to the combustion space
- 24a-22 by various means
- 24a-23 Miscellaneous industrial furnaces and their apparatus
- 24b Furnaces for liquid fuels (preparation of oil gas and natural gas 26a)**
Furnaces for liquid fuels in general
- 24b-1/01 General
- 24b-1/02 Firing of ovens, smelting furnaces, steam boilers, etc.
- 24b-1/03 Firing of regenerative furnaces
- 24b-1/04 Feeding devices
- 24b-1/05 Preheating devices
- 24b-1/06 Complete plants
- 24b-1/07 Miscellaneous
Gasification burners for liquid fuels
- 24b-2/01 Without addition of water or water vapour
- 24b-2/02 With addition of water or water vapour
- 24b-3 Furnaces for the simultaneous combustion of solid and liquid fuels
- 24b-4 Locomotive furnaces for liquid fuels
Pot-type burners for liquid fuels
- 24b-5/01 without addition of water or water vapour
- 24b-5/02 with addition of water or water vapour
- 24b-5/03 with a fuel-absorbing agent
- 24b-6 Automobile steam-boiler furnaces for liquid fuels
- 24b-7/01 Fixed furnace fronts
- 24b-7/02 Detachable furnace fronts
Spray burners for liquid fuels with fuel spraying by means of a gaseous or vaporous agent
- 24b-8/01 General
- 24b-8/02 Flat burners
- 24b-8/03 Ring burners
- 24b-8/04 Burners with rotary parts and horizontal axis of rotation

- 24b-8/05 Burners with rotary parts and vertical axis of rotation
- 24b-8/06 Burners with special generators or superheaters for the sprayed steam
- 24b-9 Spray burners for liquid fuels, with fuel spraying by compression and sudden expansion
- 24b-10 Regulating devices for liquid fuel furnaces, when connected to burner (general 24m; 42q; 42r)
- 24b-11 Safety devices for liquid fuel furnaces, when regulating processes are not connected therewith (general 24m)

24c Gas furnaces including regenerative furnaces and accessories, retorts and muffle furnaces, reverberatory furnaces

- 24c-1 Gas furnaces in general
- 24c-2 Mixture regulators for gas furnaces and mixing devices (general 12e-4)
- 24c-3 Safety devices and gas pipes for gas furnaces (4c; 36b-2; 47g)
- 24c-4 Oxyhydrogen furnaces, surface combustion
- Heat accumulators, gas and air preheaters for gas furnaces (10a-4; 18a-11 – 18a-16; 24k-4; 36a-8; 36b-4)
- 24c-5/01 Regenerators
- 24c-5/02 Recuperators
- 24c-6 Regenerative furnaces and recuperative furnaces, general (similar furnaces for chamber kilns also 10a, 80c)
- 24c-7/01 Structure, cooling and packing of valves, dampers, etc., for gas furnaces (4c-6; 47g; 24i-1/01)
- 24c-7/02 Two-way lift valves
- 24c-7/03 Reversing devices for regenerative furnaces (reversing devices for coke ovens 10a-5/20)
- 24c-8 Gas furnaces for retorts (26a)
- 24c-9 Gas furnaces for reverberatory, muffle, and crucible furnaces (18b-14/05; 24a-14; 31a-2; 31a-3; 40a-3 – 40a-10; 40a-37 – 40a-41; 40a-19/00 – 40a-19/38)
- 24c-10 Burners for gas furnaces (4g; 10a-5)

24d Crematories and refuse burning devices

- 24d-1 Crematories
- 24d-2 Refuse burning furnaces in general
- 24d-3 Shaft-furnaces for refuse burning
- 24d-4 Feeding devices for refuse burning furnaces (24h; refuse preparation 1a- 40)
- 24d-5 Slag removing devices for refuse burning furnaces (24f-26)
- 24d-6 Toilets with combustion apparatus
- 24d-7 Miscellaneous equipment in refuse burning furnaces e.g. grates, fire doors, devices for utilising exhaust gases (14h-3/12; 46d-14/02; 46f-5/02; manufacture of cement and artificial stone from refuse slags 80b-3/07, 80b-3/08, 80b-20/01, 80b-22/03)

24e Gas producers or generators, gasification of solid fuels by means of gasification agents, e.g. air, water vapour (underground gasification 26a-9)

Manufacture of water gas

- 24e-1/01 Manufacture of water gas in general, especially in cyclic operation from coke; water-gas producer and accessories (valves and control apparatus 24e-13/02)
- 24e-1/02 Steam generation and vaporisation for water gas installations, steam regulation
- 24e-1/03 Water gas from finely granulated fuels in cyclic operation, especially in a fluidised fuel bed, Winkler process, and in suspension on heated surfaces

Generation of water gas in continuous operation, from lumpy and finely granulated coal

- 24e-1/04 with external heating of the gasification chamber
- 24e-1/05 with internal heating of the gasification chamber by means of a heated gas-steam current
- 24e-1/06 with internal heating by means of molten baths, electricity, etc.
- 24e-1/07 Gas generation by means of pure oxygen mixed with water vapour, etc.

Manufacture of hydrocarbon gases and carburetted water gas

- 24e-2/01 Hydrocarbon gases in general, mixed gas [water gas + distillation gas]
- 24e-2/02 Water gas from coal with decomposition of the volatile products in the fire bed
- 24e-2/03 Hydrocarbon gas producers with increased heating of the distillation chamber, especially by means of a circulating gas current
- 24e-2/04 Hydrogen obtained by carburetion of tar from the same gas producer and external oil in heating chambers
- 24e-2/05 Enrichment of hydrocarbon gas with coke or waste gas, the so-called fuel gas process
- 24e-2/06 Carburetted water gas, especially oil water gas, production in carburetting chambers
- 24e-2/07 Carburetion of water gas in the fuel bed

Manufacture of generator gas, mixed gas, etc.

- 24e-3/01 Manufacture of producer gas, general processes
- 24e-3/02 Chemical regeneration of waste gases
- 24e-3/03 Gas producer structures, in general
- 24e-3/04 Tap and molten slag gas generators
- 24e-3/05 Gas producers for vehicles (24e-5; 46c2-120; coolers and purifiers for same 26d-1/50; arrangement on the vehicle 63c-2)
- 24e-3/06 Gasification of coal dust in the suspended state
- 24e-4 Production of generator gas with tar and ammonia recovery, especially with separate removal of the poor and rich gases, also with pre-drying of the fuel in connection with the gas produced
- 24e-5 Production of generator gas, mixed gas, etc. with fixation of the degasification products in the producer by directing the draft from above downward
- 24e-6 Production of generator gas, mixed gas, etc. with fixation of the degasification products in the producer by recycling from the degasification chamber to the gasification chamber
- 24e-7 Production of generator gas, mixed gas etc. with fixation of the degasification products in a second gas producer or shaft
- 24e-8 Production of generator gas, mixed gas, etc. with fixation of the degasification products by means of incombustible materials heated to a high temperature

Equipment and accessories for gas producers

- 24e-9 Charging devices for gas producers, when not also suitable for other shaft furnaces (general 24h-4)
- Equipment for preheating and feeding air and steam for gas producers
- 24e-10/01 Processes and vaporisers in general
- 24e-10/02 Air saturators
- 24e-10/03 Steam boiler generators
- 24e-10/04 Automatic regulation of steam and air
- Grates and hearths for gas producers (24f-14; 24f-15; 24f-25)
- 24e-11/01 in general, especially fixed grates
- 24e-11/02 Movable grates
- 24e-11/03 Rotary grates
- 24e-12 Equipment for agitating gas producers, inclusive of rotary gas producer walls (24f-26)
- 24e-13/01 Safety, regulating and other equipment for gas producers (47g; 42q; 42r)

- 24e-13/02 Control equipment for water gas producers
- 24f Furnace grates, grate cleaning and agitating devices**
- Grates with solid grate bars
- 24f-1/01 Grates in general
- 24f-1/02 Grates with attachments for air feed and air heating
- 24f-1/03 Grates for open fires, e.g. fireplaces
- 24f-1/04 Upright grates
- 24f-1/05 Grates with variable surface
- 24f-1/06 Grates with roof-like or similar grate bars, also with bars with different levels along the fuel bed
- 24f-1/07 Lateral grate sealing
- 24f-2 Double grates
- 24f-3 Grate bars (manufacture of chill-cast grate bars 31c-16; rolling of grate bars 7f-10)
- 24f-4 Grate bars with interchangeable or special faces
- Hollow grates (24i-5)
- 24f-5/01 Hollow grates with air passages
- 24f-5/02 Hollow grates with gas passages
- 24f-6/01 Hollow grates with water circulation
- Dumping and shaking grates
- 24f-7/01 Grates in general
- 24f-7/02 Round and conical grates
- 24f-7/03 Grates shaken as a unit
- Grates with grate bars turning about their axis
- 24f-8/01 Grates with grate bars oscillating about their axis
- 24f-8/02 Grates with grate bars oscillating about their axis and conveying the fuel
- 24f-8/03 Roller grates
- 24f-9 Grates with grate bars vertically or horizontally movable in the same plane
- Inclined grates with fixed grate bars
- 24f-10/01 Grates in general
- 24f-10/02 Grates with longitudinal grate bars
- 24f-10/03 Step grates
- Inclined grates with movable longitudinal grate bars
- 24f-11/01 with grate bars movable along their axis
- 24f-11/02 with grate bars rotating around their axis
- Inclined grates with movable transverse grate bars
- 24f-12/01 with adjustable grate bars
- 24f-12/02 with swingable grate bars
- 24f-12/03 with grate bars which can be adjusted to an upward inclination
- 24f-12/04 with other motion of the grate bars
- 24f-13 Grates with external water cooling
- 24f-14 Rotary grates with horizontal axis of rotation (for gas producers 24e-11)
- 24f-15 Rotary grates with vertical axis of rotation
- Travelling grates
- 24f-16/01 in general
- 24f-16/02 with grate bars arranged in rows on transverse supports
- 24f-16/03 with grate bars relatively movable along the combustion support
- 24f-16/04 with interchangeable combustion support
- 24f-16/05 Pusher-type travelling grates

24f-16/06	Travelling grates with return motion of grate surface
24f-16/07	Travelling grates with auxiliary grate.
24f-16/08	Travelling grates with several, differently moved grate surfaces
24f-16/09	Drives
24f-16/10	Travelling grates with multilayer charge
24f-16/11	Cleaning and stirring devices
24f-16/12	Ash removal
24f-16/13	Lateral grate surface sealing
24f-17	Travelling grates with special air-underfeed devices or special air-regulating equipment (24i-5)
24f-18	Travelling grates with grate bars connected so as to be movable in one direction only
24f-19	Inclined travelling grates and travelling step grates
24f-20/01	Scrapers for travelling grates
24f-20/02	Oscillating slag retainers for travelling grates
24f-20/03	Rotating slag retainers for travelling grates
24f-21	Basket-type grates in general
24f-22	Basket-type grates with shaking apparatus
24f-23	Removable grates
24f-24	Vertically displaceable grates
24f-25	Grates for gas producers, when also usable for furnaces (24e-11)
24f-26	Grate cleaning and stirring devices (24e-12)

24g Smokestack equipment, cleaning doors for smokestacks, stack sweeping implements, cleaning of boiler tubes and flue-gas preheaters, furnace and heating flues of combustion residues; collection, slaking, comminution and removal of combustion residues, separation of solid, liquid and gaseous products from flue gases

24g-1	Smokestack equipment: built-in cleaning implements, connection of flues to stacks, flue gas ducts (heat and flow engineering arrangement), soot arresters in flues, soot collectors and soot discharge devices for chimneys and other flue gas ducts, equipment for blowing and burning off of soot in smokestacks (36a; 36b; 36c; 37f)
24g-2	Cleaning doors for smokestacks (36a; 24k)
24g-3	Stack sweeping implements, not built-in, for mechanical cleaning (2a; 9a; 9b; 9c; 13e; 85e)
	Cleaning of boiler tubes and flues, furnace and heating passages of combustion residues
24g-4/01	by blasting by means of air, water, steam or granular substances (13e; 31c; 67b)
24g-4/02	by mechanical means: brushes, scrapers, beaters (2a; 9a; 9b; 9c; 13e; 85e)
24g-4/03	by burning-off (4g; 13e; 24b)
24g-5/01	Collection, slaking, comminution and removal of combustion residues from furnace installations: ash pits, ash dust suction separators (1a; 5d; 24a; 24d; 24e; 24f; 24h; 24i; 34c-5; 34d; 36a; 37f-6; 50c; 65f2; 81e)
24g-5/02	Collection, slaking, comminution and removal of combustion residues from household stoves and fireplaces: ash pits, ash dust suction separators (1a; 36a; 34c-5; 34d; 37f)
	Flue gas purification (12e-2; 12e-3; 26d; 36d; 50e; 82a-28/02)
24g-6/01	Dry purification by means of apparatus with fixed parts, e.g. settling chambers, filters, screens, impact surfaces
24g-6/10	Dry purification by means of movable, especially rotating, apparatus, e.g. blowers, screen drums
24g-6/20	Wet purification, e.g. by impact on water passing through a water screen, wet filters, etc., also by means of adhesive surfaces

- 24g-6/30 Combination of several purification methods, cleaning in stages and in partial flows
- 24g-6/40 Cleaning of the purification equipment, extraction or removal of residues
- 24g-6/50 Combination of purification devices with heat exchange and similar devices
- 24g-6/80 Chemical smoke purification, especially the elimination of carbon monoxide and sulfur-containing gases (12e-1)
- 24g-6/90 Electrical smoke purification (12e-5)
- Spark arresters for locomotive and other mobile furnace
- 24g-7/01 in the smokebox
- 24g-7/10 in the smokestack
- 24g-7/20 on or atop the smokestack
- 24g-7/30 Wet spark arresters

24h Stokers, underfeed furnaces

- 24h-1/01 Stokers for steam boiler furnaces in general
- 24h-1/02 Pneumatic stokers
- 24h-1/03 Locomotive stokers
- 24h-2 Stokers with magazines or sliding devices moving along above the grate (18b-15; 24d-4; 26e-1; 26e-4; 32a-5; 32a-5/00; 40a-10; 80c-16)
- 24h-3 Blade-thrower stokers
- 24h-4 Stokers for shaft furnaces and stoves, general (10a-11; 12f-4; 18a-6; 18a-56; 24d-4; 24e-9; 26b-29; 26e-1 – 26e-4; 80a-6; 80c-16)
- 24h-6/01 Underfeed furnaces with piston conveyers (24e-9)
- 24h-6/02 Underfeed furnaces with worm conveyers
- 24h-7/01 Stokers for furnaces with moving grate bars
- 24h-7/02 Fuel bed thickness regulators
- 24h-8 Fuel metering devices

24i Equipment for the regulation of combustion air feed and of the draft in the smokestack (smoke disposal 24a-18 – 24a-22; regulating devices for heating furnaces 36a-5)

- 24i-1/01 Flue gas registers, flue gas dampers (24c-7; 47g)
- 24i-1/02 Draft regulators in general; hand-operated or connected to parts of the furnace systems, e, g, the fire door, and moving with these parts
- 24i-2 Automatic draft regulators
- 24i-3 Draft regulators with draft-retarding apparatus, especially when connected to the fire door
- 24i-4 Injector apparatus, also for locomotives
- 24i-5/01 Apparatus for increasing the draft in smokestacks
- 24i-5/02 Underdraft furnaces, when the underdraft equipment is not arranged in the grate (24f-5)
- 24i-7 Automatic feeding of steam and air to furnaces
- 24i-8/01 Draft regulators with automatic feed of auxiliary air into the flue gas duct
- 24i-8/02 Other devices fixed to the flue gas duct and affecting the furnace
- 24i-9 Fixed tops: suction heads, also brick shapes (36d-4/33; 37b-1/01; 37f-5; smoke vent pipes for locomotive sheds 24g-1)
- 24i-10 Tops with wind-driven parts, e.g. rotating hoods, flaps, wheels (36d-4/33)

24k Fire doors, fire bridges, fire tube and flue inserts, air preheaters for boiler furnaces, steam boiler masonry, igniting and extinguishing apparatus, protection against furnace gases at operator and observation stations

- 24k-1 Doors and casings for furnaces (10a; 18c; 20b; 24a; 24b; 24c; 24g; 24l; 36a)
- 24k-2 Fire bridges for grate furnaces (24a; 36a)

- 24k-3 Fire tube and flue inserts (13a; 24a)
- 24k-4/01 Recuperative air preheaters for utilising the waste heat in boiler furnaces (17f; 18a; 24c; 36a; 36c; 82a)
- 24k-4/02 Regenerative air preheaters for utilising the waste heat in boiler furnaces; metal regenerators (17f; 18a; 24c)
- 24k-4/03 Air preheaters for utilising the waste gas heat in locomotive furnaces (20b)
- Steam boiler masonry
- 24k-5/01 Furnace walls (8d; 13a; 24a; 24l; 37a; 37b)
- 24k-5/02 Furnace roofs (18b; 18c; 32a; 37a; 37b)
- 24k-5/03 Lining of furnace walls with protective layers (18b; 18c; 24l; 37e; 80b)
- 24k-6 Devices for igniting and promoting combustion (10b; 34d)
- 24k-7 Devices for the automatic extinction of furnaces
- 24k-8 Protection against furnace gases at operator or observation stations (2a)

24I Pulverised coal furnaces

Preparation, storage and distribution of the pulverised coal when structurally related to the furnace

- 24I-1 Preparing and obtaining pulverised coal in general (coal preparation 1a)
- 24I-2 Grinding or pulverisation and crushing, in connection with the furnace (crushing 50c)
- 24I-3 Distribution of pulverised fuel to individual furnaces (conveying, general, also pneumatic 81e; coal dust cars 20c-9)

Pulverised coal furnaces and accessories

- 24I-4 Pulverised coal feeding devices, e.g. feeders, distributors, mixers
- 24I-5 Burners
- 24I-6 Ignition, combustion and flame guidance, also air supply in pulverised coal furnaces
- 24I-7 Combustion chambers with special structure of the enclosing walls, e.g. with heat reflection from the walls, with cooling and design of the walls as steam producers (13a-27; lining in general 24k)
- 24I-8 Ash and slag removal, also measures to facilitate the melting or solidification of slag, granulating grates (granulating grates as elements of steam boilers 13a)
- 24I-9 Pulverised coal furnaces in combination with other types, especially grate furnaces (24a-9; 24a-10)
- 24I-10 Miscellaneous equipment and methods related to pulverised coal furnaces, e.g. recycling of waste gases to the furnace, safety systems against explosion

24m Automatic regulation and supervision of the combustion processes in furnaces for solid, pulverised, liquid and gaseous fuels (implements and measuring devices 42d, 42e, 42f, 42i, 42k, 42l)

- 24m-1/01 Fuel feed regulation
- 24m-1/02 Fuel and air-feed regulation
- 24m-1/03 Regulating the supply of operating medium and the fuel and/or the combustion air
- 24m-2 Automatic combustion regulators, preferably controlled by the composition of waste gases
- 24m-3 Safety devices controlled by and controlling the furnace
- 24m-4 Devices for indicating or supervising the economical operation of furnaces; devices for indicating and measuring the loss of waste gas

24m (IPC: F23N) Regulating or controlling combustion (regulating in general 42r)

24m-1/00 Regulating fuel supply

- 24m-1/02 . conjointly with air supply
- 24m-1/04 . conjointly with air supply and with draught
- 24m-1/06 . conjointly with draught

24m-1/08	. conjointly with another medium, e.g. boiler water
24m-1/10	. . and with air supply or draught
24m-3/00	Regulating air supply or draught (conjointly with fuel supply 24m-1/00)
24m-3/02	. Regulating draught by direct pressure operation of single valves or dampers
24m-3/04	. by operation of single valves or dampers by temperature-sensitive elements
24m-3/06	. by conjoint operation of two or more valves or dampers (24m-3/08 takes precedence)
24m-3/08	. by power-assisted systems
24m-5/00	Systems for controlling combustion (24m-1/00, 24m-3/00 take precedence)
24m-5/02	. using devices responsive to thermal changes or to thermal expansion of a medium
24m-5/04	. . using bimetallic elements
24m-5/06	. . using bellows; using diaphragms
24m-5/08	. . using light-sensitive elements
24m-5/10	. . using thermocouples
24m-5/12	. . using ionisation-sensitive elements, i.e. flame rods
24m-5/14	. . using thermo-sensitive resistors
24m-5/16	. using noise-sensitive detectors
24m-5/18	. using detectors sensitive to rate of flow of air or fuel
24m-5/20	. with a time programme acting through electrical means, e.g. using time-delay relays
24m-5/22	. with a time programme acting through mechanical means, e.g. using cams
24m-5/24	. Preventing development of abnormal or undesired conditions, i.e. safety arrangements (24m-5/02 to 24m-5/18 take precedence)
24m-5/26	. Details

24n Heat generation by special means (13g; 17a; 46d)

24n-1	Heat generation by mechanical and heat-engineering means (13g; 20c-21; 30d-25; 34l-9; 46d; 46e; 63c-73; simultaneous production of cold and heat by means of refrigerating machinery 17a-21)
24n-2	Heat generation through special materials, using chemical, physical or biological processes (by combustion 10b-6, 10b-12; 12a; 12g; 13g; 20c-21; 30d-25; 34l-9; 45f; 47f-27; 63c-73)