

CPC**COOPERATIVE PATENT CLASSIFICATION****F27B****FURNACES, KILNS, OVENS, OR RETORTS IN GENERAL; OPEN SINTERING OR LIKE APPARATUS****NOTE**

Attention is drawn to the references and notes following the title of class [F27](#) and the note (par. III) following the Contents of Section H.

WARNING

The following IPC groups are not used in the CPC system. Subject matter covered by these groups is classified in the following CPC groups:

F27B 1/09	covered by	F27B 1/08
F27B 5/05	" "	F27B 5/04
F27B 14/16 , F27B 14/18	" "	F27B 14/0806
F27B 21/08 to F27B 21/14	" "	F27D

F27B 1/00

Shaft or like vertical or substantially vertical furnaces (for preheating, burning, calcining or cooling lime, magnesia or dolomite [C04B 2/12](#))

F27B 1/005

. {wherein no smelting of the charge occurs, e.g. calcining or sintering furnaces}

F27B 1/02

. with two or more shafts or chambers, e.g. multi-storey

F27B 1/025

.. {with fore-hearth}

F27B 1/04

.. Combinations or arrangements of shafts

F27B 1/06

. of other than up-draught type

F27B 1/08

. heated otherwise than by solid fuel mixed with charge

F27B 1/10

. Details, accessories, or equipment peculiar to furnaces of these types

F27B 1/12

.. Shells or casings; Supports therefor

F27B 1/14

... Arrangements of linings ([linings in general F27D 1/00](#))

F27B 1/16

.. Arrangements of tuyeres

F27B 1/18

.. Arrangements of dust collectors

F27B 1/20

.. Arrangements of devices for charging

F27B 1/21

.. Arrangements of devices for discharging

F27B 1/22

.. Arrangements of heat-exchange apparatus ([heat-exchangers in general F28C, F28D](#))

F27B 1/24

.. Cooling arrangements

F27B 1/26

.. Arrangements of controlling devices

F27B 1/28

.. Arrangements of monitoring devices, of indicators, of alarm devices

F27B 3/00

Hearth-type furnaces, e.g. of reverberatory type ([F27B 9/00](#), [F27B 11/00](#), [F27B 13/00](#), [F27B 14/00](#), [F27B 15/00](#), [F27B 21/00](#) take precedence); **Tank furnaces**

F27B 3/002

. {Siemens-Martin type furnaces}

F27B 3/005

.. {Port construction}

- F27B 3/007 . . . {Removable burner head}
- F27B 3/02 . of single-chamber fixed-hearth type
- F27B 3/04 . of multiple-hearth type; of multiple-chamber type; Combinations of hearth-type furnaces
- F27B 3/045 .. {Multiple chambers, e.g. one of which is used for charging}
- F27B 3/06 . with movable working chambers or hearths, e.g. tiltable, {oscillating or describing a composed movement}
- F27B 3/065 .. {tiltable}
- F27B 3/08 . heated electrically, with or without any other source of heat
- F27B 3/085 .. {Arc furnaces}
- F27B 3/10 . Details, accessories, or equipment peculiar to hearth-type furnaces
- F27B 3/105 .. {Slag chamber}
- F27B 3/12 .. Working chambers or casings; Supports therefor
- F27B 2003/125 . . . {Hearths}
- F27B 3/14 . . . Arrangements of linings
- F27B 3/16 . . . Walls; Roofs
- F27B 2003/165 {Roofs}
- F27B 3/18 .. Arrangements of devices for charging
- F27B 3/183 . . . {Charging of arc furnaces vertically through the roof, e.g. in three points}
- F27B 3/186 {Charging in a vertical chamber adjacent to the melting chamber}
- F27B 3/19 .. Arrangements of devices for discharging
- F27B 3/20 .. Arrangements of heating devices
- F27B 3/205 . . . {Burners}
- F27B 3/22 .. Arrangements of air or gas supply devices
- F27B 3/225 . . . {Oxygen blowing}
- F27B 3/24 .. Cooling arrangements
- F27B 3/26 .. Arrangements of heat-exchange apparatus
- F27B 3/263 . . . {Regenerators}
- F27B 3/266 {Exhaust gases reversing flow devices}
- F27B 3/28 .. Arrangement of controlling, monitoring, alarm or the like devices

- F27B 5/00** **Muffle furnaces; Retort furnaces; Other furnaces in which the charge is held completely isolated** (F27B 9/00 takes precedence)
- F27B 5/02 . of multiple-chamber type
- F27B 5/04 . adapted for treating the charge in vacuum or special atmosphere
- F27B 5/06 . Details, accessories, or equipment peculiar to furnaces of these types
- F27B 2005/062 .. {Cooling elements}
- F27B 2005/064 . . . {disposed in the furnace, around the chamber, e.g. coils}
- F27B 2005/066 . . . {disposed around the fan}
- F27B 2005/068 . . . {for external cooling}
- F27B 5/08 .. Arrangements of linings

F27B 5/10	..	Muffles
F27B 5/12	..	Arrangement of devices for charging
F27B 5/13	..	Arrangement of devices for discharging
F27B 5/14	..	Arrangements of heating devices
F27B 2005/143	...	{Heating rods disposed in the chamber}
F27B 2005/146	....	{the heating rods being in the tubes which conduct the heating gases}
F27B 5/16	..	Arrangements of air or gas supply devices
F27B 2005/161	...	{Gas inflow or outflow}
F27B 2005/162	....	{through closable or non-closable openings of the chamber walls}
F27B 2005/163	.....	{Controlled openings, e.g. orientable}
F27B 2005/164	....	{Air supply through a set of tubes with openings}
F27B 2005/165	.....	{Controlled tubes, e.g. orientable or with closable openings}
F27B 2005/166	...	{Means to circulate the atmosphere}
F27B 2005/167	....	{the atmosphere being recirculated through the treatment chamber by a turbine}
F27B 2005/168	.....	{by more than one turbine}
F27B 2005/169	....	{the atmosphere being continuously renewed by exterior means}
F27B 5/18	..	Arrangement of controlling, monitoring, alarm or like devices
F27B 7/00		Rotary-drum furnaces, i.e. horizontal or slightly inclined
F27B 2007/005	.	{for the treatment of slurries or wet materials}
F27B 7/02	.	of multiple-chamber or multiple-drum type
F27B 2007/022	..	{the drum having a non-uniform section along its length}
F27B 2007/025	..	{with different chambers, e.g. treatment zones}
F27B 2007/027	..	{with more than one drum}
F27B 7/04	..	with longitudinal divisions
F27B 2007/041	...	{Longitudinal tubes}
F27B 2007/043	...	{the partition being a cylinder, coaxial to the rotary drum, defining two chambers}
F27B 2007/045	....	{the charge going in one direction in one chamber, then after a turn coming back in the other direction in the other chamber}
F27B 2007/046	...	{Radial partitions}
F27B 2007/048	....	{defining an helical chamber}
F27B 7/06	.	adapted for treating the charge in vacuum or special atmosphere
F27B 7/08	.	externally heated
F27B 7/10	.	internally heated, e.g. by means of passages in the wall
F27B 7/12	.	tiltable
F27B 7/14	.	with means for agitating or moving the charge
F27B 7/16	..	the means being fixed relatively to the drum, {e.g. composite means} (F27B 7/04 takes precedence)
F27B 7/161	...	{the means comprising projections jutting out from the wall}

F27B 7/162	....	{the projections consisting of separate lifting elements, e.g. lifting shovels}
F27B 2007/163	.....	{using only a ring of lifting elements to lift the charge}
F27B 2007/165	....	{forming a helical lifting projection}
F27B 7/166	...	{the means comprising chains}
F27B 7/167	...	{the means comprising partitions}
F27B 2007/168	....	{Annular partition}
F27B 7/18	..	the means being movable within the drum
F27B 7/20	.	Details, accessories, or equipment peculiar to rotary-drum furnaces
F27B 2007/2008	..	{Devices for reintroducing dust in the drum}
F27B 7/2016	..	{Arrangements of preheating devices for the charge}
F27B 7/2025	...	{consisting of a single string of cyclones}
F27B 7/2033	....	{with means for precalcining the raw material}
F27B 7/2041	...	{consisting of at least two strings of cyclones with two different admissions of raw material}
F27B 7/205	....	{with precalcining means on the string supplied with exhaust gases from the cooler}
F27B 7/2058	....	{with precalcining means on each string}
F27B 7/2066	...	{comprising a band transporter}
F27B 7/2075	..	{Removing incrustations}
F27B 7/2083	..	{Arrangements for the melting of metals or the treatment of molten metals}
F27B 2007/2091	..	{Means for eliminating compounds from gases by condensation, e.g. alkali metals}
F27B 7/22	..	Rotary drums; Supports therefor
F27B 7/2206	...	{Bearing rings}
F27B 2007/2213	....	{mounted floatingly on the drum}
F27B 2007/222	.....	{the mounting comprising radially resilient elements, e.g. springs}
F27B 2007/2226	.....	{the mounting comprising elements to maintain the ring between series of abutments}
F27B 2007/2233	....	{the ring being fixed to the drum, e.g. welded}
F27B 7/224	...	{Discharge ends}
F27B 2007/2246	...	{Support rollers}
F27B 2007/2253	....	{mounted movable, e.g. resiliently on the ground}
F27B 2007/226	.....	{constituted of series of two rollers mounted on tiltable support along the drum}
F27B 2007/2266	.....	{the mounting allowing a movement of the rollers support in a horizontal plane}
F27B 2007/2273	....	{with arrangements, e.g. rollers, to maintain the drum against longitudinal movement}
F27B 2007/228	....	{comprising rollable bodies}
F27B 2007/2286	....	{supporting the drum directly, without the use of a bearing ring}
F27B 2007/2293	...	{the furnace being suspended}
F27B 7/24	...	Seals between rotary and stationary parts
F27B 7/26	..	Drives

F27B 2007/261	...	{working with a ring embracing the drum}
F27B 2007/262	....	{A gear ring combined with a dented wheel drive}
F27B 2007/263	....	{A gear ring combined with a ram drive}
F27B 2007/265	....	{the ring being mounted floatingly}
F27B 2007/266	....	{the ring being a bearing ring}
F27B 2007/267	....	{A gear ring combined with a chain drive}
F27B 2007/268	...	{Details of the motor or the pinions}
F27B 7/28	..	Arrangements of linings
F27B 7/30	..	Arrangements of partitions
F27B 7/32	..	Arrangement of devices for charging
F27B 7/3205	...	{Charging}
F27B 2007/3211	....	{at the open end of the drum}
F27B 2007/3217	.....	{axially, optionally at some distance in the kiln}
F27B 2007/3223	.....	{the charging device being movable axially, e.g. reciprocable}
F27B 2007/3229	.....	{via a centrifugal device}
F27B 2007/3235	.....	{the introducing device comprising a spray or a lance}
F27B 2007/3241	.....	{in the flame of the burner}
F27B 2007/3247	....	{through a lateral opening in the drum}
F27B 2007/3252	.....	{with lifting scoops attached to the drum}
F27B 2007/3258	....	{at the open end of the drum}
F27B 2007/3264	.....	{using special discharge means located around the discharge end, e.g. lifting scoops or a transversal annular partition}
F27B 2007/327	....	{centrifugally through lateral openings in the drum}
F27B 2007/3276	....	{with a collector means extending longitudinally into the drum}
F27B 2007/3282	...	{Details}
F27B 2007/3288	....	{Sieves or grading means}
F27B 2007/3294	....	{Means to fluidise the charge in the air}
F27B 7/33	..	Arrangement of devices for discharging
F27B 7/34	..	Arrangements of heating devices
F27B 7/36	..	Arrangements of air or gas supply devices
F27B 7/362	...	{Introducing gas into the drum axially or through the wall}
F27B 2007/365	....	{longitudinally}
F27B 2007/367	....	{transversally through the wall of the drum}
F27B 7/38	..	Arrangements of cooling devices
F27B 7/383	...	{Cooling devices for the charge}
F27B 7/386	....	{Rotary-drum cooler}
F27B 7/40	...	Planetary coolers
F27B 7/42	..	Arrangement of controlling, monitoring, alarm or like devices

F27B 9/00	Furnaces through which the charge is moved mechanically, e.g. of tunnel type (F27B 7/14 takes precedence); Similar furnaces in which the charge moves by gravity
F27B 9/02	. of multiple-track type; of multiple-chamber type; Combinations of furnaces
F27B 9/021	.. {having two or more parallel tracks}
F27B 9/022	... {With two tracks moving in opposite directions}
F27B 9/023	.... {with a U turn at one end}
F27B 9/024	..... {with superimposed tracks}
F27B 9/025	... {having two or more superimposed tracks (F27B 9/024 takes precedence)}
F27B 2009/026	.. {Two or more conveyers, e.g. mounted successively}
F27B 2009/027	... {working in parallel}
F27B 9/028	.. {Multi-chamber type furnaces, (F27B 9/029 takes precedence)}
F27B 9/029	.. {Multicellular type furnaces constructed with add-on modules}
F27B 9/04	. adapted for treating the charge in vacuum or special atmosphere
F27B 9/042	.. {Vacuum furnaces}
F27B 9/045	.. {Furnaces with controlled atmosphere}
F27B 9/047	... {the atmosphere consisting of protective gases}
F27B 9/06	. heated without contact between combustion gases and charge; electrically heated
F27B 9/061	.. {with at least two longitudinal chambers carrying combustion gases, i.e of the Dressler type}
F27B 9/062	.. {electrically heated}
F27B 9/063	... {Resistor heating, e.g. with resistors also emitting IR rays}
F27B 9/065	.... {the resistance being transported by the conveyer}
F27B 9/066	... {heated by lamps}
F27B 9/067	... {heated by induction}
F27B 9/068	.. {heated by radiant tubes, the tube being heated by a hot medium, e.g. hot gases}
F27B 9/08	.. heated through chamber walls
F27B 9/082	... {Muffle furnaces}
F27B 9/084	.... {the muffle being fixed and in a single piece}
F27B 9/086	.... {with two or more fixed muffles}
F27B 9/088	.... {Series of separate muffles conveyed through the furnace}
F27B 9/10	.. heated by hot air or gas
F27B 9/12	. with special arrangements for preheating or cooling the charge
F27B 2009/122	.. {Preheating}
F27B 2009/124	.. {Cooling}
F27B 2009/126	... {involving the circulation of cooling gases, e.g. air}
F27B 2009/128	.... {the gases being further utilised as oxidants in the burners}
F27B 9/14	. characterised by the path of the charge during treatment; characterised by the means by which the charge is moved during treatment (F27B 9/28 takes precedence; travelling or movable supports or containers for the charge F27D 3/12)
F27B 9/142	.. {the charge moving along a vertical axis}

F27B 9/145	..	{the charge moving along a serpentine path}
F27B 9/147	..	{the charge moving on an inclined floor}
F27B 9/16	..	the charge moving in a circular or arcuate path
F27B 9/18	...	under the action of scrapers or pushers
F27B 9/185	....	{multiple hearth type furnaces}
F27B 9/20	..	the charge moving in a substantially straight path {tunnel furnace}
F27B 9/201	...	{walking beam furnace}
F27B 9/202	....	{Conveyer mechanisms therefor}
F27B 9/203	.....	{having ramps (F27B 9/206 takes precedence)}
F27B 9/205	.....	{having excentrics or lever arms (F27B 9/206 takes precedence)}
F27B 9/206	.....	{consisting of a single central beam}
F27B 9/207	.....	{consisting of two or more conveyers}
F27B 9/208	....	{the workpieces being rotated during their advance}
F27B 9/22	...	{on rails, e.g.} under the action of scrapers or pushers (F27B 9/26 takes precedence)
F27B 9/222	....	{the path comprising a section specially adapted for effecting equalisation of the temperature of the charge}
F27B 9/225	....	{the charge being subjected to an additional manipulation along the path}
F27B 9/227	....	{with rotation of the charge (F27B 9/147 takes precedence)}
F27B 9/24	...	being carried by a conveyer {(transport by conveyers in general B65G)}
F27B 9/2407	....	{the conveyer being constituted by rollers (roller hearth furnace)}
F27B 9/2415	.....	{the charge rotating about an axis transversal to the axis of advancement of the charge}
F27B 9/2423	.....	{the charge rotating about an axis parallel to the axis of advancement of the charge}
F27B 9/243	....	{Endless-strand conveyer}
F27B 2009/2438	.....	{with means to transfer the heat from the outcoming band to the incoming band}
F27B 2009/2446	.....	{with means to control the tension of the band}
F27B 9/2453	....	{Vibrating conveyer (shaker hearth furnace)}
F27B 9/2461	....	{the charge being suspended from the conveyer}
F27B 9/2469	....	{the conveyer being constituted by rollable bodies}
F27B 9/2476	....	{the conveyer being constituted by air cushion}
F27B 2009/2484	....	{the conveyer being a helical device}
F27B 2009/2492	....	{the conveyer being constituted by series of little rams or ratchets, moving the charge along}
F27B 9/26	...	on or in trucks, sleds, or containers
F27B 9/262	....	{on or in trucks}
F27B 2009/264	.....	{the truck carrying a partition}
F27B 2009/266	.....	{the truck having conducts for guiding the oven atmosphere}
F27B 2009/268	.....	{through the structure of the car and through the charge}
F27B 9/28	.	for treating continuous lengths of work

F27B 9/30	. Details, accessories, or equipment peculiar to furnaces of these types
F27B 9/3005	.. {arrangements for circulating gases}
F27B 9/3011	... {arrangements for circulating gases transversally}
F27B 2009/3016	.... {with arrangements to circulate gases through the charge}
F27B 2009/3022	.... {with arrangements to maintain oxidising reducing or neutral zones}
F27B 2009/3027	... {Use of registers, partitions}
F27B 2009/3033	... {Fumes circulating in the same direction as the charge}
F27B 2009/3038	... {Fumes or gases alternatively changing their longitudinal direction}
F27B 9/3044	.. {Furnace regenerators}
F27B 2009/305	.. {Particular conformation of the furnace}
F27B 2009/3055	... {Non-uniform section through the length of the furnace}
F27B 2009/3061	... {Furnaces with longitudinal grooves}
F27B 2009/3066	.. {Cooling the under-structure of the kiln, e.g. under the cars}
F27B 2009/3072	.. {Balancing the pressure between the upper part and the lower part of the kiln, above and under the track}
F27B 9/3077	.. {Arrangements for treating electronic components, e.g. semiconductors}
F27B 2009/3083	.. {Arrangements to handle skid marks}
F27B 2009/3088	.. {Drying arrangements}
F27B 2009/3094	.. {Means to store a part of the charge in the furnace}
F27B 9/32	.. Casings
F27B 9/34	... Arrangements of linings
F27B 9/36	.. Arrangements of heating devices
F27B 2009/3607	... {Heaters located above the track of the charge}
F27B 2009/3615	.... {Burner in the ceiling directed vertically downwards}
F27B 2009/3623	... {Heaters located under the track}
F27B 2009/363	.... {Burners in the hearth directed towards the ceiling}
F27B 2009/3638	... {Heaters located above and under the track}
F27B 2009/3646	... {Heating the ceiling or the walls for a reverberatory effect}
F27B 2009/3653	... {Preheated fuel}
F27B 2009/3661	.... {preheated with the exhaust gases}
F27B 2009/3669	.... {preheated with the gases of the cooling zone}
F27B 2009/3676	.... {preheated with the gases of the preheating zone}
F27B 2009/3684	... {Combustion within a combustion chamber with outlets in the kiln chamber}
F27B 2009/3692	... {The charge containing combustible materials}
F27B 9/38	.. Arrangements of devices for charging
F27B 2009/382	... {Charging}
F27B 2009/384	... {Discharging}
F27B 2009/386	... {Lateral intake or outtake}
F27B 2009/388	.... {Centrally in the lateral wall}
F27B 9/39	.. Arrangements of devices for discharging

F27B 9/40	.. Arrangements of controlling or monitoring devices
F27B 11/00	Bell-type furnaces (for treating metal strips or wire C21D 9/663)
F27B 13/00	Furnaces with both stationary charge and progression of heating, e.g. of ring type, of type in which segmental kiln moves over stationary charge
F27B 13/02	. of multiple-chamber type with permanent partitions; Combinations of furnaces
F27B 13/04	. of single-chamber type with temporary partitions
F27B 13/06	. Details, accessories, or equipment peculiar to furnaces of this type
F27B 13/08	.. Casings
F27B 13/10	... Arrangements of linings
F27B 13/12	.. Arrangements of heating devices
F27B 13/14	.. Arrangement of controlling, monitoring, alarm or like devices
F27B 14/00	Crucible or pot furnace
F27B 2014/002	. {Smelting process, e.g. sequences to melt a specific material}
F27B 2014/004	.. {Process involving a smelting step, e.g. vaporisation}
F27B 2014/006	.. {involving a salt bath or help metal bath}
F27B 2014/008	. {Continuous casting}
F27B 14/02	. with tilting or rocking arrangements (F27B 14/04 takes precedence)
F27B 14/04	. adapted for treating the charge in vacuum or special atmosphere
F27B 2014/045	.. {Vacuum}
F27B 14/06	. heated electrically, e.g. induction crucible furnaces with or without any other source of heat (F27B 14/04 takes precedence)
F27B 14/061	.. {Induction furnaces}
F27B 14/063	... {Skull melting type}
F27B 14/065	... {Channel type}
F27B 2014/066	... {Construction of the induction furnace}
F27B 2014/068	.. {with the use of an electrode producing a current in the melt}
F27B 14/08	. Details peculiar to crucible or pot furnaces
F27B 14/0806	.. {Charging or discharging devices}
F27B 2014/0812	... {Continuously charging}
F27B 2014/0818	... {Discharging}
F27B 2014/0825	.. {Crucible or pot support}
F27B 2014/0831	... {Support or means for the transport of crucibles}
F27B 2014/0837	.. {Cooling arrangements}
F27B 2014/0843	.. {Lining or casing}
F27B 2014/085	.. {Preheating of the charge}
F27B 2014/0856	... {Preheating of the crucible}
F27B 2014/0862	.. {Flux guides}
F27B 2014/0868	.. {Magnetic shields}
F27B 2014/0875	.. {Two zones or chambers, e.g. one used for charging}

F27B 2014/0881	..	{Two or more crucibles}
F27B 2014/0887	..	{Movement of the melt}
F27B 2014/0893	..	{Heat-conductive material disposed on the surface of the melt}
F27B 14/10	..	Crucibles
F27B 2014/102	...	{Form of the crucibles}
F27B 2014/104	...	{Crucible linings}
F27B 2014/106	...	{Ladles}
F27B 2014/108	...	{Cold crucibles (transparent to electromagnetic radiations)}
F27B 14/12	...	Covers therefor
F27B 14/14	..	Arrangements of heating devices
F27B 14/143	...	{Heating of the crucible by convection of combustion gases}
F27B 2014/146	...	{Recuperation of lost heat, e.g. regenerators}
F27B 14/20	..	Arrangement of controlling, monitoring, alarm or like devices
F27B 15/00		Fluidised-bed furnaces; Other furnaces using or treating finely-divided materials in dispersion {(apparatus in general for carrying out chemical or physical processes in a fluidised bed reactor B01J 8/24 to B01J 8/44)}
F27B 15/003	.	{Cyclones or chain of cyclones}
F27B 15/006	.	{Equipment for treating dispersed material falling under gravity with ascending gases}
F27B 15/02	.	Details, accessories, or equipment peculiar to furnaces of these types
F27B 15/04	..	Casings; Supports therefor
F27B 15/06	...	Arrangements of linings
F27B 15/08	..	Arrangements of devices for charging
F27B 15/09	..	Arrangements of devices for discharging
F27B 15/10	..	Arrangements of air or gas supply devices
F27B 15/12	..	Arrangements of dust collectors
F27B 15/14	..	Arrangements of heating devices
F27B 15/16	..	Arrangements of cooling devices
F27B 15/18	..	Arrangements of controlling devices
F27B 15/20	..	Arrangements of monitoring devices, of indicators, of alarm devices
F27B 17/00		Furnaces of a kind not covered by any preceding group (structural combinations of furnaces F27B 19/02)
F27B 17/0008	.	{Open field furnace for burning bricks}
F27B 17/0016	.	{Chamber type furnaces}
F27B 17/0025	..	{Especially adapted for treating semiconductor wafers}
F27B 17/0033	..	{the floor of the furnaces consisting of the support carrying the charge, e.g. car type furnaces}
F27B 17/0041	..	{specially adapted for burning bricks or pottery (F27B 17/0033 takes precedence)}
F27B 17/005	...	{with cylindrical chambers}
F27B 17/0058	....	{with superposed cylindrical chambers}
F27B 17/0066	...	{arrangement of the charge, e.g. bricks}

F27B 17/0075	. . . {Heating devices therefor}
F27B 17/0083	. . {with means for circulating the atmosphere}
F27B 2017/0091	. . {Series of chambers, e.g. associated in their use}
F27B 17/02	. specially designed for laboratory use
F27B 17/025	. . {for dental workpieces}
F27B 19/00	Combinations of furnaces of kinds not covered by a single preceding main group
F27B 19/02	. combined in one structure
F27B 19/04	. arranged for associated working
F27B 21/00	Open or uncovered sintering apparatus; Other heat-treatment apparatus of like construction
F27B 21/02	. Sintering grates or tables
F27B 21/04	. Sintering pots or sintering pans
F27B 21/06	. Endless-strand sintering machines