CPC COOPERATIVE PATENT CLASSIFICATION

F25J LIQUEFACTION, SOLIDIFICATION OR SEPARATION OF GASES OR GASEOUS { or liquefied gaseous } MIXTURES BY PRESSURE AND COLD TREATMENT { or by bringing them into the supercritical state (cryogenic pumps F04B 37/08; gas storage vessels, gas holders F17; filing vessels with, or discharging from vessels, compressed, liquefied or solidified gases F17C; refrigeration machines, plants, or systems F25B)}

F25J 1/00 **Processes or apparatus for liquefying or solidifying gases or gaseous mixtures** {(for ammonia in general C01C 1/00; solidification of carbonic acid C01B 31/22; recovering volatile solvents by condensation B01D 5/00; vapor recovery systems combined with filling nozzles B67D 7/54)(not used)}

F25J 1/0002 . { characterised by the fluid to be liquefied (not used)}
F25J 1/0005 . . { Light or noble gases (F25J 1/0012 takes precedence)}
F25J 1/0007 . . . { Helium }
F25J 1/001 . . . { Hydrogen }
F25J 1/0012 . . { Primary atmospheric gases, e.g. air }
F25J 1/0015 . . . { Nitrogen }
F25J 1/0017 . . . { Oxygen }
F25J 1/002 . . . { Argon }
F25J 1/0022 . . { Hydrocarbons, e.g. natural gas }
F25J 1/0025 . . . { Boil-off gases "BOG" from storages }
F25J 1/0027 . . { Oxides of carbon e.g. CO2 }

F25J 1/003 . { characterised by the kind of cold generation within the liquefaction unit for compensating heat leaks and liquid production (not used)}
F25J 1/0032 . . { using the feed stream itself or separated fractions from it, i.e. "internal refrigeration" (not used)}
F25J 1/0035 . . . { by gas expansion with extraction of work }
F25J 1/0037 . . . . { of a return stream }
F25J 1/004 . . . { by flash gas recovery (F25J 1/0267 takes precedence)}
F25J 1/0042 . . . { by liquid expansion with extraction of work }
F25J 1/0045 . . . { by vaporising a liquid return stream }
F25J 1/0047 . . { using an "external" refrigerant stream in a closed vapor compression cycle (F25J 1/0221, F25J 1/0225 take precedence) (not used)}
F25J 1/005 . . . { by expansion of a gaseous refrigerant stream with extraction of work }
F25J 1/0052 . . . { by vaporising a liquid refrigerant stream }
F25J 1/0055 . . . . { originating from an incorporated cascade }
F25J 1/0057 . . . . { after expansion of the liquid refrigerant stream with extraction of work }

F25J 1/006 . { characterised by the refrigerant fluid used (refrigerants in vapor compression cycles F25B 9/002, refrigerant materials per se C09K 5/00) (not used)}
F25J 1/0062 . . { Light or noble gases, mixtures thereof (F25J 1/007 takes precedence)}

F25J 1/0065 . . . { Helium }
F25J 1/0067 . . . { Hydrogen }
F25J 1/007 . . { Primary atmospheric gases, mixtures thereof }
F25J 1/0072 . . . { Nitrogen }
F25J 1/0075 . . . { Oxygen }
F25J 1/0077 . . . { Argon }
F25J 1/008 . . { Hydrocarbons (not used)}
F25J 1/0082 . . . { Methane }
F25J 1/0085 . . . { Ethane; Ethylene }
F25J 1/0087 . . . { Propane; Propylene }
F25J 1/009 . . . { Hydrocarbons with four or more carbon atoms }
F25J 1/0092 . . . { Mixtures of hydrocarbons comprising possibly also minor amounts of nitrogen }
F25J 1/0095 . . { Oxides of carbon, e.g. CO2 }
F25J 1/0097 . . { Others, e.g. F-, Cl-, HF-, HClF-, HCl-hydrocarbons etc. or mixtures thereof }

F25J 1/02 . requiring the use of refrigeration, e.g. of helium or hydrogen { Details and kind of the refrigeration system used; Integration with other units or processes; Controlling aspects of the process (not used)}
F25J 1/0201 . . { using only internal refrigeration means, i.e. without external refrigeration }
F25J 1/0202 . . . { in a quasi-closed internal refrigeration loop (F25J 1/0208, F25J 1/0219, F25J 1/0224 take precedence)}
F25J 1/0203 . . { using a single-component refrigerant (SCR) fluid in a closed vapor compression cycle (F25J 1/0211 takes precedence) (not used)}
F25J 1/0204 . . . { as a single flow SCR cycle }
F25J 1/0205 . . . { as a dual level SCR refrigeration cascade }
F25J 1/0207 . . . { as at least a three level SCR refrigeration cascade }
F25J 1/0208 . . . { in combination with an internal quasi-closed refrigeration loop e.g. with deep flash recycle loop (F25J 1/021 takes precedence)}
F25J 1/0209 . . . . { as at least a three level refrigeration cascade }
F25J 1/021 . . . . . { using a deep flash recycle loop }
F25J 1/0211 . . { using a multi-component refrigerant (MCR) fluid in a closed vapor compression cycle (not used)}
F25J 1/0212 . . . { as a single flow MCR cycle }
F25J 1/0214 . . . { as a dual level refrigeration cascade with at least one MCR cycle }
F25J 1/0215 . . . . { with one SCR cycle }
F25J 1/0216 . . . . . { using a C3 pre-cooling cycle }
F25J 1/0217 . . . { as at least a three level refrigeration cascade with at least one MCR cycle }
F25J 1/0218 . . . . { with one or more SCR cycles e.g. with a C3 pre-cooling cycle }
F25J 1/0219 . . . { in combination with an internal quasi-closed refrigeration loop, e.g. using a deep flash recycle loop }
F25J 1/0221 . . { using the cold stored in an external cryogenic component in an open refrigeration loop }
F25J 1/0222 . . . { in combination with an intermediate heat exchange fluid between the cryogenic component and the fluid to be liquefied (F25J 1/0224 takes precedence)}

F25J 1/0223 . . . { in combination with the subsequent re-vaporisation of the originally liquefied gas at a second location to produce the external cryogenic component }

F25J 1/0224 . . . { in combination with an internal quasi-closed refrigeration loop (F25J 1/0208, F25J 1/0219 take precedence)}

F25J 1/0225 . . { using other external refrigeration means not provided before, e.g. heat driven absorption chillers }

F25J 1/0227 . . . { within a refrigeration cascade }

F25J 1/0228 . . { Coupling of the liquefaction unit to other units or processes, so-called integrated processes (combined plants, e.g. engine plant combined with an industrial process F01K 23/064; gas turbine plants in combination with other processes F02C 6/00)}

F25J 1/0229 . . . { Integration with a unit for using hydrocarbons, e.g. consuming hydrocarbons as feed stock }

F25J 1/023 . . . . { for the combustion as fuels, i.e. integration with the fuel gas system }

F25J 1/0231 . . . . { for the working-up of the hydrocarbon feed, e.g. reinjection of heavier hydrocarbons into the liquefied gas }

F25J 1/0232 . . . { integration within a pressure letdown station of a high pressure pipeline system }

F25J 1/0234 . . . { Integration with a cryogenic air separation unit (cryogenic separation of air F25J 3/04)}

F25J 1/0235 . . . { Heat exchange integration }

F25J 1/0236 . . . . { providing refrigeration for different processes treating not the same feed stream }

F25J 1/0237 . . . . { integrating refrigeration provided for liquefaction and purification/treatment of the gas to be liquefied, e.g. heavy hydrocarbon removal from natural gas (details related to rectification F25J 3/02; details related to partial condensation F25J 3/06; working-up natural gas C10L 3/10)}

F25J 1/0238 . . . . . { Purification/treatment step is integrated within one refrigeration cycle only, i.e. the same or single refrigeration cycle provides feed or overhead gas cooling }

F25J 1/0239 . . . . . { Purification or treatment step being integrated between two refrigeration cycles of a refrigeration cascade, i.e. first cycle providing feed gas cooling and second cycle providing overhead gas cooling }

F25J 1/0241 . . . . . { wherein the overhead cooling comprises providing reflux for a fractionation step }

F25J 1/0242 . . . . { Waste heat recovery, e.g. from heat of compression }

F25J 1/0243 . . { Start-up or control of the process; Details of the apparatus used; Details of the refrigerant compression system used (not used)}

F25J 1/0244 . . . { Operation; Control and regulation; Instrumentation (F25J 1/0279 takes precedence)}

F25J 1/0245 . . . . { Different modes, i.e. 'runs', of operation; Process control }

F25J 1/0247 . . . . . { start-up of the process }

F25J 1/0248 . . . . . { Stopping of the process, e.g. defrosting or deriming, maintenance; Back-up mode or systems }

F25J 1/0249 . . . . . { Controlling refrigerant inventory, i.e. composition or quantity (charging or discharging refrigerants in cooling systems F25B 45/00)}

F25J 1/025 . . . . . { Details related to the refrigerant production or treatment, e.g. make-up supply from feed gas itself }

F25J 1/0251 . . . . . { Intermittent or alternating process, so-called batch process, e.g. "peak-shaving" }

F25J 1/0252 .... { Control strategy, e.g. advanced process control or dynamic modeling }

F25J 1/0254 .... { controlling particular process parameter, e.g. pressure, temperature }

F25J 1/0255 ..... { controlling the composition of the feed or liquefied gas, e.g. to achieve a particular heating value of natural gas }

F25J 1/0256 .... { Safety aspects of operation (F25J 1/0298 takes precedence)}

F25J 1/0257 ... { Construction and layout of liquefaction equipments, e.g. valves, machines (F25J 1/0279 takes precedence)}

F25J 1/0258 .... { vertical layout of the equipments within in the cold box }

F25J 1/0259 .... { Modularity and arrangement of parts of the liquefaction unit and in particular of the cold box e.g. pre-fabrication, assembling and erection, dimensions, horizontal layout "plot" }

F25J 1/0261 .... { Details of cold box insulation, housing and internal structure (buildings forming parts of cooling plants E04H 5/10)}

F25J 1/0262 .... { Details of the cold heat exchange system (constructional details F25J 5/00, construction of cold-exchangers in general F28)}

F25J 1/0263 ..... { using different types of heat exchangers }

F25J 1/0264 ..... { Arrangement of heat exchanger cores in parallel with different functions, e.g. different cooling streams (F25J 1/0272 takes precedence)}

F25J 1/0265 ..... { comprising cores associated exclusively with the cooling of a refrigerant stream, e.g. for auto-refrigeration or economizer }

F25J 1/0267 ..... { using flash gas as heat sink }

F25J 1/0268 ..... { using a dedicated refrigeration means (F25J 1/0296 takes precedence)}

F25J 1/0269 .... { Arrangement of liquefaction units or equipments fulfilling the same process step, e.g. multiple "trains" concept (F25J 1/0294 takes precedence)}

F25J 1/027 ..... { Inter-connecting multiple hot equipments upstream of the cold box }

F25J 1/0271 ..... { Inter-connecting multiple cold equipments within or downstream of the cold box }

F25J 1/0272 ..... { Multiple identical heat exchangers in parallel }

F25J 1/0274 .... { Retrofitting or revamping of an existing liquefaction unit }

F25J 1/0275 .... { adapted for special use of the liquefaction unit, e.g. portable or transportable devices }

F25J 1/0276 ..... { Laboratory or other miniature devices }

F25J 1/0277 ..... { Offshore use, e.g. during shipping }

F25J 1/0278 ..... { Unit being stationary, e.g. on floating barge or fixed platform }

F25J 1/0279 ... { Compression of refrigerant or internal recycle fluid, e.g. kind of compressor, accumulator, suction drum etc. }

F25J 1/0281 .... { characterised by the type of prime driver, e.g. hot gas expander }

F25J 1/0282 ..... { Steam turbine as the prime mechanical driver }

F25J 1/0283 ..... { Gas turbine as the prime mechanical driver }

F25J 1/0284 ..... { Electrical motor as the prime mechanical driver }

F25J 1/0285 .... { Combination of different types of drivers mechanically coupled to the same refrigerant compressor, possibly split on multiple compressor casings }

F25J 1/0287 ..... { including an electrical motor }

F25J 1/0288 ..... { using work extraction by mechanical coupling of compression and expansion of the refrigerant, so-called companders }

F25J 1/0289 .... { Use of different types of prime drivers of at least two refrigerant compressors in a cascade refrigeration system }

F25J 1/029 .... { Mechanically coupling of different refrigerant compressors in a cascade refrigeration system to a common driver }

F25J 1/0291 .... { Refrigerant compression by combined gas compression and liquid pumping }

F25J 1/0292 .... { Refrigerant compression by cold or cryogenic suction of the refrigerant gas }

F25J 1/0294 .... { Multiple compressor casings/strings in parallel, e.g. split arrangement }

F25J 1/0295 .... { Shifting of the compression load between different cooling stages within a refrigerant cycle or within a cascade refrigeration system }

F25J 1/0296 .... { Removal of the heat of compression, e.g. within an inter- or afterstage-cooler against an ambient heat sink }

F25J 1/0297 ..... { using an externally chilled fluid, e.g. chilled water }

F25J 1/0298 .... { Safety aspects and control of the refrigerant compression system, e.g. anti-surge control }

F25J 3/00 **Processes or apparatus for separating the constituents of gaseous** { or liquefied gaseous } **mixtures involving the use of liquefaction or solidification** {(not used)}

F25J 3/02 . by rectification, i.e. by continuous interchange of heat and material between a vapour stream and a liquid stream (F25J 3/08 takes precedence; { purification of hydrocarbons in general C07C 7/00; (not used)})

F25J 3/0204 .. { characterised by the feed stream (for air F25J 3/04) (not used)}

F25J 3/0209 ... { Natural gas or substitute natural gas }

F25J 3/0214 .... { Liquefied natural gas }

F25J 3/0219 ... { Refinery gas, cracking gas, coke oven gas, gaseous mixtures containing aliphatic unsaturated CnHm or gaseous mixtures of undefined nature }

F25J 3/0223 ... { H2/CO mixtures, i.e. synthesis gas; Water gas or shifted synthesis gas (production of carbon monoxide containing gas in general C01B 31/18, C10J, C10K; production of hydrogen containing gas C01B 3/00)}

F25J 3/0228 .. { characterised by the separated product stream (not used)}

F25J 3/0233 ... { separation of CnHm with 1 carbon atom or more }

F25J 3/0238 ... { separation of CnHm with 2 carbon atoms or more }

F25J 3/0242 ... { separation of CnHm with 3 carbon atoms or more }

F25J 3/0247 ... { separation of CnHm with 4 carbon atoms or more }

F25J 3/0252 ... { separation of hydrogen (production of hydrogen containing gas in general C01B 3/00, e.g. separation of hydrogen or hydrogen containing gases form gaseous mixtures at low temperatures C01B 3/506)}

F25J 3/0257 ... { separation of nitrogen (from air F25J 3/04, production of nitrogen in general C01B 21/00)}

F25J 3/0261 ... { separation of carbon monoxide (production of carbon monoxide containing gas in general C01B 31/18, C10J, C10K)}

F25J 3/0266 ... { separation of carbon dioxide (production of carbon dioxide in general C01B 31/00)}

F25J 3/0271 ... { separation of H2/CO mixtures, i.e. of synthesis gas (production of carbon monoxide containing gas in general C01B 31/18, C10J, C10K, production of hydrogen containing gas C01B 3/00)}

F25J 3/0276 . . . { separation of H2/N2 mixtures, i.e. of ammonia synthesis gas (in general C01B 3/00)}

F25J 3/028 . . . { separation of noble gases (from air F25J 3/04642; in general C01B 23/00)}

F25J 3/0285 . . . . { of argon }

F25J 3/029 . . . . { of helium }

F25J 3/0295 . . { Start-up or control of the process; Details of the apparatus used, e.g. sieve plates, packings }

F25J 3/04 . . for air {(not used)}

WARNING

The reclassification has, for the moment, been carried out only down to January 1, 1960.

F25J 3/04006 . . . { Providing pressurised feed air or process streams within or from the air fractionation unit (not used)}

F25J 3/04012 . . . . { by compression of warm gaseous streams; details of intake or interstage cooling (F25J 3/04048 takes precedence; operation of compressors F25J 3/04781; particular layout of compressors used in air fractionation units F25J 3/04866)}

F25J 3/04018 . . . . . { of main feed air }

F25J 3/04024 . . . . . { of purified feed air, so-called boosted air }

F25J 3/0403 . . . . . { of nitrogen }

F25J 3/04036 . . . . . { of oxygen }

F25J 3/04042 . . . . . { of argon or argon enriched stream }

F25J 3/04048 . . . . { by compression of cold gaseous streams, e.g. intermediate or oxygen enriched (waste) streams }

F25J 3/04054 . . . . . { of air }

F25J 3/0406 . . . . . { of nitrogen }

F25J 3/04066 . . . . . { of oxygen }

F25J 3/04072 . . . . . { of argon or argon enriched stream }

F25J 3/04078 . . . . { providing pressurized products by liquid compression and vaporisation with cold recovery, i.e. so-called internal compression (operation of pumps F25J 3/04781; particular layout of pumps used in air fractionation units F25J 3/04866)}

F25J 3/04084 . . . . . { of nitrogen }

F25J 3/0409 . . . . . { of oxygen }

F25J 3/04096 . . . . . { of argon or argon enriched stream }

F25J 3/04103 . . . . . { using solely hydrostatic liquid head }

F25J 3/04109 . . . . { Arrangements of compressors and /or their drivers (using work extraction by mechanical coupling of compression and cold expansion F25J 3/04381)}

F25J 3/04115 . . . . . { characterised by the type of prime driver e.g. hot gas expander }

F25J 3/04121 . . . . . { Steam turbine as the prime mechanical driver }

F25J 3/04127 . . . . . { Gas turbine as the prime mechanical driver }

F25J 3/04133 . . . . . { Electrical motor as the prime mechanical driver }

F25J 3/04139 . . . . . { Combination of different types of drivers mechanically coupled to the same compressor, possibly split on multiple compressor casings }

F25J 3/04145 ..... { Mechanically coupling of different compressors of the air fractionation process to the same driver(s) }

F25J 3/04151 ... { Purification and (pre-)cooling of the feed air; recuperative heat-exchange with product streams (not used)}

F25J 3/04157 .... { Afterstage cooling and so-called "pre-cooling" of the feed air upstream the air purification unit and main heat exchange line (F25J 3/04618 takes precedence)}

F25J 3/04163 .... { Hot end purification of the feed air (arrangements of cold regenerators F25J 5/00)}

F25J 3/04169 ..... { by adsorption of the impurities (adsorption in general B01D 53/02)}

F25J 3/04175 ..... { at a pressure of substantially more than the highest pressure column }

F25J 3/04181 ..... { Regenerating the adsorbents }

F25J 3/04187 .... { Cooling of the purified feed air by recuperative heat-exchange; Heat-exchange with product streams (arrangements of cold exchangers F25J 5/002)}

F25J 3/04193 ..... { Division of the main heat exchange line in consecutive sections having different functions }

F25J 3/042 ..... { having an intermediate feed connection }

F25J 3/04206 ..... { including a so-called "auxiliary vaporiser" for vaporising and producing a gaseous product }

F25J 3/04212 ..... { and simultaneously condensing vapor from a column serving as reflux within the or another column }

F25J 3/04218 ..... { Parallel arrangement of the main heat exchange line in cores having different functions e.g. in low pressure and high pressure cores (F25J 3/04503 takes precedence)}

F25J 3/04224 ..... { Cores associated with a liquefaction or refrigeration cycle }

F25J 3/0423 ..... { Subcooling of liquid process streams }

F25J 3/04236 ..... { Integration of different exchangers in a single core, so-called integrated cores (F25J 3/04624 takes precedence)}

F25J 3/04242 .... { Cold end purification of the feed air }

F25J 3/04248 ... { Generation of cold for compensating heat leaks or liquid production, e.g. by Joule-Thompson expansion }

F25J 3/04254 .... { using the cold stored in external cryogenic fluids (closed loop F25J 3/04278)}

F25J 3/0426 ..... { The cryogenic component does not participate in the fractionation }

F25J 3/04266 ..... { and being liquefied hydrocarbons }

F25J 3/04272 ..... { and comprising means for reducing the risk of pollution of hydrocarbons into the air fractionation }

F25J 3/04278 .... { using external refrigeration units, e.g. closed mechanical or regenerative refrigeration units }

F25J 3/04284 .... { using internal refrigeration by open-loop gas work expansion, e.g. of intermediate or oxygen enriched (waste-)streams (F25J 3/04333 takes precedence)}

F25J 3/0429 ..... { of feed air, e.g. used as waste or product air or expanded into an auxiliary column }

F25J 3/04296 ..... { Claude expansion, i.e. expanded into the main or high pressure column }

F25J 3/04303 ..... { Lachmann expansion, i.e. expanded into oxygen producing or low

pressure column }

F25J 3/04309 ..... { of nitrogen }

F25J 3/04315 ..... { Lowest pressure or impure nitrogen, so-called waste nitrogen expansion }

F25J 3/04321 ..... { of oxygen }

F25J 3/04327 ..... { of argon or argon enriched stream }

F25J 3/04333 .... { using quasi-closed loop internal vapor compression refrigeration cycles, e.g. of intermediate or oxygen enriched (waste-)streams }

F25J 3/04339 ..... { of air }

F25J 3/04345 ..... { and comprising a gas work expansion loop }

F25J 3/04351 ..... { of nitrogen }

F25J 3/04357 ..... { and comprising a gas work expansion loop }

F25J 3/04363 ..... { of oxygen }

F25J 3/04369 ..... { of argon or argon enriched stream }

F25J 3/04375 .... { Details relating to the work expansion, e.g. process parameter etc. }

F25J 3/04381 ..... { using work extraction by mechanical coupling of compression and expansion so-called companders }

F25J 3/04387 ..... { using liquid or hydraulic turbine expansion }

F25J 3/04393 ..... { using multiple or multistage gas work expansion }

F25J 3/044 ... { using a single pressure main column system only (F25J 3/0446, F25J 3/04624, F25J 3/04636 take precedence)}

F25J 3/04406 ... { using a dual pressure main column system (F25J 3/0446, F25J 3/04624, F25J 3/04636 and F25J 3/04715 take precedence) (not used)}

F25J 3/04412 .... { in a classical double column flowsheet, i.e. with thermal coupling by a main reboiler-condenser in the bottom of low pressure respectively top of high pressure column }

F25J 3/04418 .... { with thermally overlapping high and low pressure columns }

F25J 3/04424 .... { without thermally coupled high and low pressure columns, i.e. a so-called split columns }

F25J 3/0443 .... { A main column system not otherwise provided, e.g. a modified double column flowsheet }

F25J 3/04436 ... { using at least a triple pressure main column system (F25J 3/0446, F25J 3/04624, F25J 3/04636 and F25J 3/04715 take precedence) (not used)}

F25J 3/04442 .... { in a double column flowsheet with a high pressure pre-rectifier }

F25J 3/04448 .... { in a double column flowsheet with an intermediate pressure column }

F25J 3/04454 .... { a main column system not otherwise provided, e.g. serially coupling of columns or more than three pressure levels }

F25J 3/0446 ... { using the heat generated by mixing two different phases }

F25J 3/04466 .... { for producing oxygen as a mixing column overhead gas by mixing gaseous air feed and liquid oxygen }

F25J 3/04472 ... { using the cold from cryogenic liquids produced within the air fractionation unit and stored in internal or intermediate storages (not used)}

F25J 3/04478 .... { for controlling purposes, e.g. start-up or back-up procedures (F25J 3/04496 takes precedence)}

F25J 3/04484 ..... { for purity control during steady state operation }

F25J 3/0449 ..... { for rapid load change of the air fractionation unit }

F25J 3/04496	....	{ for compensating variable air feed or variable product demand by alternating between periods of liquid storage and liquid assist }
F25J 3/04503	.....	{ by exchanging "cold" between at least two different cryogenic liquids, e.g. independently from the main heat exchange line of the air fractionation and/or by using external alternating storage systems }
F25J 3/04509	.....	{ within the cold part of the air fractionation, i.e. exchanging "cold" within the fractionation and/or main heat exchange line }
F25J 3/04515	.....	{ Simultaneously changing air feed and products output }
F25J 3/04521	...	{ Coupling of the air fractionation unit to an air gas-consuming unit, so-called integrated processes (combined plants, e.g. engine plant combined with an industrial process F01K 23/064; gas-turbine plants supplying working fluid to a chemical process F02C 6/10) (not used)}
F25J 3/04527	....	{ Integration with an oxygen consuming unit, e.g. glass facility, waste incineration or oxygen based processes in general }
F25J 3/04533	.....	{ for the direct combustion of fuels in a power plant, so-called "oxyfuel combustion" }
F25J 3/04539	.....	{ for the H2/CO synthesis by partial oxidation or oxygen consuming reforming processes of fuels }
F25J 3/04545	.....	{ for the gasification of solid or heavy liquid fuels, e.g. integrated gasification combined cycle (IGCC) }
F25J 3/04551	.....	{ for the metal production }
F25J 3/04557	.....	{ for pig iron or steel making e.g. blast furnace, Corex }
F25J 3/04563	....	{ Integration with an nitrogen consuming unit, e.g. for purging, inerting, cooling or heating }
F25J 3/04569	.....	{ for enhanced or tertiary oil recovery }
F25J 3/04575	.....	{ for a gas expansion plant e.g. dilution of the combustion gas in a gas turbine }
F25J 3/04581	.....	{ Hot gas expansion of indirect heated nitrogen }
F25J 3/04587	.....	{ for the NH3 synthesis e.g. for adjusting the H2/N2 ratio }
F25J 3/04593	....	{ The air gas consuming unit is also fed by an air stream }
F25J 3/046	.....	{ Completely integrated air feed compression, i.e. common MAC }
F25J 3/04606	.....	{ Partially integrated air feed compression, i.e. independent MAC for the air fractionation unit plus additional air feed from the air gas consuming unit }
F25J 3/04612	....	{ Heat exchange integration with process streams, e.g. from the air gas consuming unit }
F25J 3/04618	.....	{ for cooling an air stream fed to the air fractionation unit }
F25J 3/04624	...	{ using integrated mass and heat exchange, so-called non-adiabatic rectification, e.g. dephlegmator, reflux exchanger }
F25J 3/0463	....	{ Simultaneously between rectifying and stripping sections, i.e. double dephlegmator }
F25J 3/04636	...	{ using a hybrid air separation unit, e.g. combined process by cryogenic separation and non-cryogenic separation techniques (F25J 3/04733 and F25J 3/04757 take precedence)}
F25J 3/04642	...	{ Recovering noble gases from air (from gas mixtures other than air F25J 3/028 or F25J 3/0685)}
F25J 3/04648	....	[argon (not used)]
F25J 3/04654	.....	{ Producing crude argon in a crude argon column }

F25J 3/0466 ..... { as a parallel working rectification column or auxiliary column system in a single pressure main column system }

F25J 3/04666 ..... { as a parallel working rectification column of the low pressure column in a dual pressure main column system }

F25J 3/04672 ..... { having a top condenser }

F25J 3/04678 ..... { cooled by oxygen enriched liquid from high pressure column bottoms }

F25J 3/04684 ..... { and a bottom re-boiler (F25J 3/04696 takes precedence)}

F25J 3/0469 ..... { and an intermediate re-boiler/condenser (F25J 3/04696 takes precedence)}

F25J 3/04696 ..... { a bottom re-boiler and an intermediate re-boiler/condenser }

F25J 3/04703 ..... { being arranged in more than one vessel }

F25J 3/04709 ..... { as an auxiliary column system in at least a dual pressure main column system }

F25J 3/04715 ..... { The auxiliary column system simultaneously produces oxygen }

F25J 3/04721 ..... { Producing pure argon, e.g. recovered from a crude argon column }

F25J 3/04727 ..... { using an auxiliary pure argon column for nitrogen rejection (F25J 3/04739 takes precedence)}

F25J 3/04733 ..... { using a hybrid system, e.g. using adsorption, permeation or catalytic reaction }

F25J 3/04739 ..... { in combination with an auxiliary pure argon column }

F25J 3/04745 .... { Krypton and/or Xenon }

F25J 3/04751 ..... { Producing pure krypton and/or xenon recovered from a crude krypton/xenon mixture }

F25J 3/04757 ..... { using a hybrid system, e.g. using adsorption, permeation or catalytic reaction }

F25J 3/04763 ... { Start-up or control of the process; Details of the apparatus used (not used)}

F25J 3/04769 .... { Operation, control and regulation of the process; Instrumentation within the process }

F25J 3/04775 ..... { Air purification and pre-cooling }

F25J 3/04781 ..... { Pressure changing devices, e.g. for compression, expansion, liquid pumping }

F25J 3/04787 ..... { Heat exchange, e.g. main heat exchange line; Subcooler, external reboiler-condenser (F25J 3/04793 and F25J 3/0486 take precedence)}

F25J 3/04793 ..... { Rectification, e.g. columns; Reboiler-condenser (F25J 3/0486 takes precedence)}

F25J 3/048 ..... { Argon recovery }

F25J 3/04806 ..... { High purity argon purification }

F25J 3/04812 ..... { Different modes, i.e. "runs" of operation (F25J 3/04472 takes precedence)}

F25J 3/04818 ..... { Start-up of the process }

F25J 3/04824 ..... { Stopping of the process, e.g. defrosting or deriming; Back-up procedures }

F25J 3/0483 ..... { Rapid load change of the air fractionation unit }

F25J 3/04836 ..... { Variable air feed, i.e. "load" or product demand during specified periods e.g. during periods with high respectively low power costs (F25J 3/0483 takes precedence)}

F25J 3/04842 . . . . . { Intermittent process, so-called batch process }
F25J 3/04848 . . . . . { Control strategy, e.g. advanced process control or dynamic modeling }
F25J 3/04854 . . . . . { Safety aspects of operation }
F25J 3/0486 . . . . . { of vaporisers for oxygen enriched liquids, e.g. purging of liquids }
F25J 3/04866 . . . . { Construction and layout of air fractionation equipments, e.g. valves, machines (F25J 5/00 takes precedence)}
F25J 3/04872 . . . . . { Vertical layout of cold equipments within in the cold box, e.g. columns, heat exchangers etc. }
F25J 3/04878 . . . . . { Side by side arrangement of multiple vessels in a main column system, wherein the vessels are normally mounted one upon the other or forming different sections of the same column (multiple vessels of a crude argon column F25J 3/04703)}
F25J 3/04884 . . . . . { Arrangement of reboiler-condensers }
F25J 3/0489 . . . . . { Modularity and arrangement of parts of the air fractionation unit, in particular of the cold box, e.g. pre-fabrication, assembling and erection, dimensions, horizontal layout "plot" (F25J 3/04872 takes precedence)}
F25J 3/04896 . . . . . { Details of columns, e.g. internals, inlet/outlet devices }
F25J 3/04903 . . . . . { Plates or trays }
F25J 3/04909 . . . . . { Structured packings }
F25J 3/04915 . . . . . { Combinations of different material exchange elements, e.g. within different columns }
F25J 3/04921 . . . . . { within the same column }
F25J 3/04927 . . . . . { Liquid or gas distribution devices }
F25J 3/04933 . . . . . { Partitioning walls or sheets }
F25J 3/04939 . . . . . { Vertical, e.g. dividing wall columns (details of dephlegmators F25J 5/007)}
F25J 3/04945 . . . . . { Details of internal structure; insulation and housing of the cold box }
F25J 3/04951 . . . . . { Arrangements of multiple air fractionation units or multiple equipments fulfilling the same process step, e.g. multiple trains in a network (F25J 3/04636 takes precedence)}
F25J 3/04957 . . . . . { and inter-connecting equipments upstream of the fractionation unit (s), i.e. at the "front-end" }
F25J 3/04963 . . . . . { and inter-connecting equipment within or downstream of the fractionation unit(s) (F25J 3/04393 takes precedence)}
F25J 3/04969 . . . . . { Retrofitting or revamping of an existing air fractionation unit }
F25J 3/04975 . . . . . { adapted for special use of the air fractionation unit, e.g. transportable devices by truck or small scale use }
F25J 3/04981 . . . . . { for portable medical or home use }
F25J 3/04987 . . . . . { for offshore use }
F25J 3/04993 . . . . . { for space applications, e.g. for rocket use }

F25J 3/06 . by partial condensation (F25J 3/08 takes precedence; by rectification F25J 3/02; { purification of hydrocarbons in general C07C 7/00; (not used)})
F25J 3/0605 . . { characterised by the feed stream (for air F25J 3/04) (not used)}
F25J 3/061 . . . { Natural gas or substitute natural gas }
F25J 3/0615 . . . . { Liquefied natural gas }
F25J 3/062 . . . { Refinery gas, cracking gas, coke oven gas, gaseous mixtures containing

aliphatic unsaturated CnHm or gaseous mixtures of undefined nature }

F25J 3/0625 ... { H2/CO mixtures, i.e. synthesis gas; Water gas or shifted synthesis gas (production of carbon monoxide containing gas in general C01B 31/18, C10J, C10K; production of hydrogen containing gas C01B 3/00)}

F25J 3/063 .. { characterised by the separated product stream (not used)}

F25J 3/0635 ... { separation of CnHm with 1 carbon atom or more }

F25J 3/064 ... { separation of CnHm with 2 carbon atoms or more }

F25J 3/0645 ... { separation of CnHm with 3 carbon atoms or more }

F25J 3/065 ... { separation of CnHm with 4 carbon atoms or more }

F25J 3/0655 ... { separation of hydrogen (production of hydrogen containing gas in general C01B 3/00, e.g. separation of hydrogen or hydrogen containing gases form gaseous mixtures at low temperatures C01B 3/506)}

F25J 3/066 ... { separation of nitrogen (from air F25J 3/04, production of nitrogen in general C01B 21/00)}

F25J 3/0665 ... { separation of carbon monoxide (production of carbon monoxide containing gas in general C01B 31/18, C10J, C10K)}

F25J 3/067 ... { separation of carbon dioxide (production of carbon dioxide in general C01B 31/00)}

F25J 3/0675 ... { separation of H2/CO mixtures, i.e. of synthesis gas (production of carbon monoxide containing gas in general C01B 31/18, C10J, C10K, production of hydrogen containing gas C01B 3/00)}

F25J 3/068 ... { separation of H2/N2 mixtures, i.e. of ammonia synthesis gas (in general C01B 3/00)}

F25J 3/0685 ... { separation of noble gases (from air F25J 3/04642; in general C01B 23/00)}

F25J 3/069 .... { of helium }

F25J 3/0695 .. { Start-up or control of the process; Details of the apparatus used }

F25J 3/08 . Separating gaseous impurities from gases or gaseous mixtures { or from liquefied gases or liquefied gaseous mixtures } (cold traps B01D 8/00)

F25J 5/00 **Arrangements of cold exchangers or cold accumulators in separation or liquefaction plants** (heat exchangers F28C, F28D, F28F)

F25J 5/002 . { for continuously recuperating cold, i.e. in a so-called recuperative heat exchanger }

F25J 5/005 .. { in a reboiler-condenser e.g. within a column }

F25J 5/007 .. { combined with mass exchange, i.e. in a so-called dephlegmator }

F25J 2200/00 **Processes or apparatus using separation by rectification** (not used)

F25J 2200/02 . in a single pressure main column system

F25J 2200/04 . in a dual pressure main column system

F25J 2200/06 .. in a classical double column flow-sheet, i.e. with thermal coupling by a main reboiler-condenser in the bottom of low pressure respectively top of high pressure column

F25J 2200/08 . in a triple pressure main column system

F25J 2200/10 . in a quadruple, or more, column or pressure system

F25J 2200/20 . in an elevated pressure multiple column system wherein the lowest pressure column is at a pressure well above the minimum pressure needed to overcome pressure drop to reject the products to atmosphere

F25J 2200/30 . using a side column in a single pressure column system

F25J 2200/32 . using a side column fed by a stream from the high pressure column

F25J 2200/34 . using a side column fed by a stream from the low pressure column

F25J 2200/38 . using pre-separation or distributed distillation before a main column system, e.g. in a at least a double column system

F25J 2200/40 . Features relating to the provision of boil-up in the bottom of a column

F25J 2200/50 . using multiple (re-)boiler-condensers at different heights of the column

F25J 2200/52 . . in the high pressure column of a double pressure main column system

F25J 2200/54 . . in the low pressure column of a double pressure main column system

F25J 2200/70 . Refluxing the column with a condensed part of the feed stream, i.e. fractionator top is stripped or self-rectified

F25J 2200/72 . Refluxing the column with at least a part of the totally condensed overhead gas

F25J 2200/74 . Refluxing the column with at least a part of the partially condensed overhead gas

F25J 2200/76 . Refluxing the column with condensed overhead gas being cycled in a quasi-closed loop refrigeration cycle

F25J 2200/78 . Refluxing the column with a liquid stream originating from an upstream or downstream fractionator column

F25J 2200/80 . using integrated mass and heat exchange, i.e. non-adiabatic rectification in a reflux exchanger or dephlegmator

F25J 2200/90 . Details relating to column internals, e.g. structured packing, gas or liquid distribution

F25J 2200/92 . . Details relating to the feed point

F25J 2200/94 . . Details relating to the withdrawal point

F25J 2200/96 . . Dividing wall column

Guidance heading: **<NO TITLE>**

F25J 2205/00 **Processes or apparatus using other separation and/or other processing means**
(not used)

F25J 2205/02 . using simple phase separation in a vessel or drum

F25J 2205/04 . . in the feed line, i.e. upstream of the fractionation step

F25J 2205/10 . using combined expansion and separation, e.g. in a vortex tube, "Ranque tube" or a "cyclonic fluid separator", i.e. combination of an isentropic nozzle and a cyclonic

separator; Centrifugal separation

F25J 2205/20 . using solidification of components

F25J 2205/24 . using regenerators, cold accumulators or reversible heat exchangers.

F25J 2205/30 . using a washing, e.g. "scrubbing" or bubble column for purification purposes

F25J 2205/32 . . as direct contact cooling tower to produce a cooled gas stream, e.g. direct contact after cooler (DCAC)

F25J 2205/34 . . as evaporative cooling tower to produce chilled water , e.g. evaporative water chiller [EWC]

F25J 2205/40 . using hybrid system, i.e. combining cryogenic and non-cryogenic separation techniques

F25J 2205/50 . using absorption, i.e. with selective solvents or lean oil, heavier CnHm and including generally a regeneration step for the solvent or lean oil

F25J 2205/60 . using adsorption on solid adsorbents, e.g. by temperature-swing adsorption (TSA) at the hot or cold end

F25J 2205/62 . . Purifying more than one feed stream in multiple adsorption vessels, e.g. for two feed streams at different pressures

F25J 2205/64 . . by pressure-swing adsorption (PSA) at the hot end

F25J 2205/66 . . Regenerating the adsorption vessel, e.g. kind of reactivation gas

F25J 2205/68 . . . Cooling the adsorption vessel

F25J 2205/70 . . . Heating the adsorption vessel

F25J 2205/72 . . . Pressurising or depressurising the adsorption vessel

F25J 2205/80 . using membrane, i.e. including a permeation step

F25J 2205/82 . using a reactor with combustion or catalytic reaction

F25J 2205/84 . using filter

F25J 2205/86 . using electrical phenomena, e.g. Corona discharge, electrolysis or magnetic field

F25J 2205/90 . Mixing of components

F25J 2210/00 **Processes characterised by the type or other details of the feed stream** (not used)

F25J 2210/02 . Multiple feed streams e.g. originating from different sources

F25J 2210/04 . Mixing or blending of fluids with the feed stream

F25J 2210/06 . Splitting of the feed stream, e.g. for treating or cooling in different ways

F25J 2210/12 . Refinery or petrochemical off-gas

F25J 2210/14 . Coke-ovens gas

F25J 2210/18 . H2/CO mixtures, i.e. synthesis gas; Water gas, shifted synthesis gas or purge gas from HYCO synthesis

F25J 2210/20 . H2/N2 mixture, i.e. synthesis gas for or purge gas from ammonia synthesis

F25J 2210/40 . Air or oxygen enriched air, i.e. generally less than 30mol% of O2

F25J 2210/42 . Nitrogen

F25J 2210/50 . Oxygen

F25J 2210/58 . Argon

F25J 2210/60 . Natural gas or synthetic natural gas (SNG)

F25J 2210/62 . Liquefied natural gas (LNG); Natural gas liquids (NGL); Liquefied petroleum gas (LPG)

F25J 2210/66 . Landfill or fermentation off-gas, e.g. "Bio-gas"

F25J 2210/70 . Flue or combustion exhaust gas

F25J 2210/80 . Carbon dioxide

F25J 2210/90 . Boil-off gas from storage

F25J 2215/00 **Processes characterised by the type or other details of the product stream** (not used)

F25J 2215/02 . Mixing or blending of fluids to yield a certain product

F25J 2215/04 . Recovery of liquid products

F25J 2215/10 . Hydrogen

F25J 2215/14 . Carbon monoxide

F25J 2215/18 . HYCO synthesis gas, e.g. H2/CO mixture

F25J 2215/20 . Ammonia synthesis gas, e.g. H2/N2 mixture

F25J 2215/30 . Helium

F25J 2215/32 . Neon

F25J 2215/34 . Krypton

F25J 2215/36 . Xenon

F25J 2215/40 . Air or oxygen enriched air, i.e. generally less than 30mol% of O2

F25J 2215/42 . Nitrogen or special cases, e.g. multiple or low purity N2

F25J 2215/44 . . Ultra high purity nitrogen, i.e. generally less than 1 ppb impurities

F25J 2215/50 . Oxygen or special cases, e.g. isotope-mixtures or low purity O2
F25J 2215/52 . . Oxygen production with multiple purity O2
F25J 2215/54 . . Oxygen production with multiple pressure O2
F25J 2215/56 . . Ultra high purity oxygen, i.e. generally more than 99,9% O2

F25J 2215/58 . Argon

F25J 2215/60 . Methane

F25J 2215/62 . Ethane or ethylene

F25J 2215/64 . Propane or propylene

F25J 2215/66 . Butane or mixed butanes

F25J 2215/80 . Carbon dioxide

F25J 2220/00 **Processes or apparatus involving steps for the removal of impurities** (not used)

F25J 2220/02 . Separating impurities in general from the feed stream

F25J 2220/04 . Separating impurities in general from the product stream

F25J 2220/40 . Separating high boiling, i.e. less volatile components from air, e.g. CO2, hydrocarbons

F25J 2220/42 . Separating low boiling i.e. more volatile components from nitrogen, e.g. He, H2, Ne

F25J 2220/44 . Separating high boiling, i.e. less volatile components from nitrogen, e.g. CO, Ar, O2, hydrocarbons

F25J 2220/50 . Separating low boiling, i.e. more volatile components from oxygen, e.g. N2, Ar

F25J 2220/52 . Separating high boiling, i.e. less volatile components from oxygen, e.g. Kr, Xe, Hydrocarbons, Nitrous oxides, O3

F25J 2220/60 . Separating impurities from natural gas, e.g. mercury, cyclic hydrocarbons
F25J 2220/62 . . Separating low boiling components, e.g. He, H2, N2, Air
F25J 2220/64 . . Separating heavy hydrocarbons, e.g. NGL, LPG, C4+ hydrocarbons or heavy condensates in general
F25J 2220/66 . . Separating acid gases, e.g. CO2, SO2, H2S or RSH
F25J 2220/68 . . Separating water or hydrates

F25J 2220/80 . Separating impurities from carbon dioxide, e.g. H2O or water-soluble contaminants
F25J 2220/82 . . Separating low boiling, i.e. more volatile components, e.g. He, H2, CO, Air gases, CH4
F25J 2220/84 . . Separating high boiling, i.e. less volatile components, e.g. NOx, SOx, H2S

F25J 2220/90 . Separating isotopes of a component, e.g. H2, O2

F25J 2230/00 **Processes or apparatus involving steps for increasing the pressure of gaseous process streams** (not used)

F25J 2230/02 . Compressor intake arrangement, e.g. filtering or cooling.

F25J 2230/04 . Compressor cooling arrangement, e.g. inter- or after-stage cooling or condensate removal

F25J 2230/06 . Adiabatic compressor, i.e. without interstage cooling

F25J 2230/08 . Cold compressor, i.e. suction of the gas at cryogenic temperature and generally without afterstage-cooler

F25J 2230/20 . Integrated compressor and process expander; Gear box arrangement; Multiple compressors on a common shaft

F25J 2230/22 . Compressor driver arrangement, e.g. power supply by motor, gas or steam turbine

F25J 2230/24 . Multiple compressors or compressor stages in parallel

F25J 2230/30 . Compression of the feed stream

F25J 2230/32 . Compression of the product stream

F25J 2230/40 . the fluid being air

F25J 2230/42 . the fluid being nitrogen

F25J 2230/50 . the fluid being oxygen

F25J 2230/52 . the fluid being oxygen enriched compared to air, e.g. "crude oxygen"

F25J 2230/58 . the fluid being argon or crude argon

F25J 2230/60 . the fluid being hydrocarbons or a mixture of hydrocarbons

F25J 2230/80 . the fluid being carbon dioxide

F25J 2235/00 **Processes or apparatus involving steps for increasing the pressure or for conveying of liquid process streams** (not used)

F25J 2235/02 . using a pump in general or hydrostatic pressure increase

F25J 2235/04 . using a pressure accumulator

F25J 2235/06 . Lifting of liquids by gas lift, e.g. "Mammutpumpe"

F25J 2235/42 . the fluid being nitrogen

F25J 2235/50 . the fluid being oxygen

F25J 2235/52 . the fluid being oxygen enriched compared to air ("crude oxygen")

F25J 2235/58 . the fluid being argon or crude argon

F25J 2235/60 . the fluid being (a mixture of) hydrocarbons

F25J 2235/80 . the fluid being carbon dioxide

F25J 2240/00 **Processes or apparatus involving steps for expanding of process streams** (not used)

F25J 2240/02 . Expansion of a process fluid in a work-extracting turbine (i.e. isentropic expansion), e.g. of the feed stream

F25J 2240/04 . . Multiple expansion turbines in parallel

F25J 2240/10 . . the fluid being air

F25J 2240/12 . . the fluid being nitrogen

F25J 2240/20 . . the fluid being oxygen

F25J 2240/22 . . the fluid being oxygen enriched compared to air, e.g. "crude oxygen"

F25J 2240/28 . . the fluid being argon or crude argon

F25J 2240/30 . Dynamic liquid or hydraulic expansion with extraction of work, e.g. single phase or two-phase turbine

F25J 2240/40 . Expansion without extracting work, i.e. isenthalpic throttling, e.g. JT valve, regulating valve or venturi, or isentropic nozzle, e.g. Laval

F25J 2240/42 . . the fluid being air

F25J 2240/44 . . the fluid being nitrogen

F25J 2240/46 . . the fluid being oxygen

F25J 2240/48 . . the fluid being oxygen enriched compared to air, e.g. "crude oxygen"

F25J 2240/60 . Expansion by ejector or injector, e.g. "Gasstrahlpumpe", "venturi mixing", "jet pumps"

F25J 2240/70 . Steam turbine, e.g. used in a Rankine cycle

F25J 2240/80 . Hot exhaust gas turbine combustion engine

F25J 2240/82 . . with waste heat recovery, e.g. in a combined cycle, i.e. for generating steam used in a Rankine cycle

F25J 2240/90 . Hot gas waste turbine of an indirect heated gas for power generation

F25J 2245/00 **Processes or apparatus involving steps for recycling of process streams** (not used)

F25J 2245/02 . Recycle of a stream in general, e.g. a by-pass stream

F25J 2245/40 . the recycled stream being air

F25J 2245/42 . the recycled stream being nitrogen

F25J 2245/50 . the recycled stream being oxygen

F25J 2245/58 . the recycled stream being argon or crude argon

F25J 2245/90 . the recycled stream being boil-off gas from storage

F25J 2250/00 **Details related to the use of reboiler-condensers** (not used)

F25J 2250/02 . Bath type boiler-condenser using thermo-siphon effect, e.g. with natural or forced circulation or pool boiling, i.e. core-in-kettle heat exchanger

F25J 2250/04 . Down-flowing type boiler-condenser, i.e. with evaporation of a falling liquid film

F25J 2250/10 . Boiler-condenser with superposed stages

F25J 2250/20 . Boiler-condenser with multiple exchanger cores in parallel or with multiple re-boiling or condensing streams

F25J 2250/30 . External or auxiliary boiler-condenser in general, e.g. without a specified fluid or one fluid is not a primary air component or an intermediate fluid

F25J 2250/40 . . One fluid being air

F25J 2250/42 . . One fluid being nitrogen

F25J 2250/50 . . One fluid being oxygen

F25J 2250/52 . . One fluid being oxygen enriched compared to air, e.g. "crude oxygen"

F25J 2250/58 . . One fluid being argon or crude argon

F25J 2260/00 **Coupling of processes or apparatus to other units; Integrated schemes** (not used)

F25J 2260/02 . Integration in an installation for exchanging heat, e.g. for waste heat recovery

F25J 2260/10 . Integration in a gas transmission system at a pressure reduction, e.g. "let down" station

F25J 2260/20 . Integration in an installation for liquefying or solidifying a fluid stream

F25J 2260/30 . Integration in an installation using renewable energy

F25J 2260/42 . Integration in an installation using nitrogen, e.g. as utility gas, for inerting or purging purposes in IGCC, POX, GTL, PSA, float glass forming, incineration processes, for heat recovery or for enhanced oil recovery

F25J 2260/44 . . using nitrogen for cooling purposes

F25J 2260/50 . Integration in an installation using oxygen, e.g. in the burner of a glass facility, waste incineration or oxygen based process (OBP) in general

F25J 2260/58 . Integration in an installation using argon

F25J 2260/60 . Integration in an installation using hydrocarbons, e.g. for fuel purposes

F25J 2260/80 . Integration in an installation using carbon dioxide, e.g. for EOR, sequestration,

refrigeration etc.

F25J 2270/00 **Refrigeration techniques used** (not used)

F25J 2270/02 . Internal refrigeration with liquid vaporising loop

F25J 2270/04 . Internal refrigeration with work-producing gas expansion loop

F25J 2270/06 . . with multiple gas expansion loops

F25J 2270/08 . Internal refrigeration by flash gas recovery loop

F25J 2270/12 . External refrigeration with liquid vaporising loop

F25J 2270/14 . External refrigeration with work-producing gas expansion loop

F25J 2270/16 . . with mutliple gas expansion loops of the same refrigerant

F25J 2270/18 . External refrigeration with incorporated cascade loop

F25J 2270/20 . Quasi-closed internal or closed external hydrogen refrigeration cycle

F25J 2270/24 . Quasi-closed internal or closed external carbon monoxide refrigeration cycle

F25J 2270/30 . Quasi-closed internal or closed external helium refrigeration cycle

F25J 2270/40 . Quasi-closed internal or closed external air refrigeration cycle

F25J 2270/42 . Quasi-closed internal or closed external nitrogen refrigeration cycle

F25J 2270/50 . Quasi-closed internal or closed external oxygen refrigeration cycle

F25J 2270/58 . Quasi-closed internal or closed external argon refrigeration cycle

F25J 2270/60 . Closed external refrigeration cycle with single component refrigerant (SCR), e.g. C1-, C2- or C3-hydrocarbons

F25J 2270/66 . Closed external refrigeration cycle with multi component refrigerant (MCR), e.g. mixture of hydrocarbons

F25J 2270/80 . Quasi-closed internal or closed external carbon dioxide refrigeration cycle

F25J 2270/88 . Quasi-closed internal refrigeration or heat pump cycle, if not otherwise provided

F25J 2270/90 . External refrigeration, e.g. conventional closed-loop mechanical refrigeration unit using Freon or NH3, unspecified external refrigeration

F25J 2270/902 . . Details about the refrigeration cycle used, e.g. composition of refrigerant, arrangement of compressors or cascade, make up sources, use of reflux exchangers etc.

F25J 2270/904 . . by liquid or gaseous cryogen in an open loop

F25J 2270/906 . . by heat driven absorption chillers

F25J 2270/908 . . by regenerative chillers, i.e. oscillating or dynamic systems, e.g. Stirling

refrigerator, thermoelectric ("Peltier") or magnetic refrigeration

F25J 2270/91 . . . using pulse tube refrigeration

F25J 2270/912 . . Liquefaction cycle of a low-boiling (feed) gas in a cryocooler, i.e. in a closed-loop refrigerator

F25J 2280/00 **Control of the process or apparatus** (not used)

F25J 2280/02 . Control in general, load changes, different modes ("runs"), measurements

F25J 2280/10 . Control for or during start-up and cooling down of the installation

F25J 2280/20 . Control for stopping, deriming or defrosting after an emergency shut-down of the installation or for back up system

F25J 2280/30 . Control of a discontinuous or intermittent ("batch") process

F25J 2280/40 . Control of freezing of components

F25J 2280/50 . Advanced process control, e.g. adaptive or multivariable control

F25J 2290/00 **Other details not covered by groups F25J 2200/00 to F25J 2280/00** (not used)

F25J 2290/02 . Comparison of processes or apparatuses

F25J 2290/10 . Mathematical formulae, modeling, plot or curves; Design methods

F25J 2290/12 . Particular process parameters like pressure, temperature, ratios

F25J 2290/20 . Particular dimensions; Small scale or micro devices

F25J 2290/30 . Details about heat insulation or cold insulation

F25J 2290/32 . Details on header or distribution passages of heat exchangers, e.g. of reboiler-condenser or plate heat exchangers

F25J 2290/34 . Details about subcooling of liquids

F25J 2290/40 . Vertical layout or arrangement of cold equipments within in the cold box, e.g. columns, condensers, heat exchangers etc.

F25J 2290/42 . Modularity, pre-fabrication of modules, assembling and erection, horizontal layout, i.e. plot plan, and vertical arrangement of parts of the cryogenic unit, e.g. of the cold box

F25J 2290/44 . Particular materials used, e.g. copper, steel or alloys thereof or surface treatments used, e.g. enhanced surface

F25J 2290/50 . Arrangement of multiple equipments fulfilling the same process step in parallel

F25J 2290/60 . Details about pipelines, i.e. network, for feed or product distribution

F25J 2290/62 . Details of storing a fluid in a tank.

F25J 2290/70 . Processing device is mobile or transportable, e.g. by hand, car, ship, rocket engine etc.

F25J 2290/72 . Processing device is used off-shore, e.g. on a platform or floating on a ship or barge

F25J 2290/80 . Retrofitting, revamping or debottlenecking of existing plant

F25J 2290/90 . Details about safety operation of the installation