Processes or apparatus for liquefying or solidifying gases or gaseous mixtures { (for ammonia in general C01C 1/00; solidification of carbonic acid C01B 32/55: recovering volatile solvents by condensation B01D 5/00; vapor recovery systems combined with filling nozzles B67D 7/54)(not used)}

1/002 . (characterised by the fluid to be liquefied (not used))
1/005 . . . (Light or noble gases (F25J 1/0012 takes precedence))
1/007 . . . [Helium]
1/001 . . . [Hydrogen]
1/0012 . . . [Primary atmospheric gases, e.g. air]
1/0015 . . . [Nitrogen]
1/0017 . . . [Oxygen]
1/002 . . . [Argon]
1/0022 . . . [Hydrocarbons, e.g. natural gas]
1/0025 . . . [Boil-off gases "BOG" from storages]
1/0027 . . . [Oxides of carbon, e.g. CO₂]
1/003 . . . (characterised by the kind of cold generation within the liquefaction unit for compensating heat leaks and liquid production (not used))
1/0032 . . . (using the feed stream itself or separated fractions from it, i.e. "internal refrigeration" (not used))
1/0035 . . . [by gas expansion with extraction of work]
1/0037 . . . . . . . . . . [of a return stream]
1/004 . . . . . . [by flash gas recovery (F25J 1/0267 takes precedence)]
1/0042 . . . [by liquid expansion with extraction of work]
1/0045 . . . . . . [by vaporising a liquid return stream]
1/0047 . . . [using an "external" refrigerant stream in a closed vapor compression cycle (F25J 1/0221, F25J 1/0225 take precedence)(not used)]
1/005 . . . [by expansion of a gaseous refrigerant stream with extraction of work]
1/0052 . . . [by vaporising a liquid refrigerant stream]
1/0055 . . . . . . (originating from an incorporated cascade)
1/0057 . . . . . . (after expansion of the liquid refrigerant stream with extraction of work)
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)]
1/0062 . . . (Light or noble gases, mixtures thereof (F25J 1/007 takes precedence))
1/0065 . . . . . . [Helium]
1/0067 . . . . . . [Hydrogen]
1/007 . . . . . . [Primary atmospheric gases, mixtures thereof]
1/0072 . . . . . . [Nitrogen]
1/0075 . . . . . . [Oxygen]
1/0077 . . . . . . [Argon]
1/008 . . . . . . [Hydrocarbons (not used)]
1/0082 . . . . . . [Methane]
1/0085 . . . . . . [Ethane: Ethylene]
1/0087 . . . . . . [Propane; Propylene]
1/009 . . . . . . [Hydrocarbons with four or more carbon atoms]
1/0092 . . . . . . [Mixtures of hydrocarbons comprising possibly also minor amounts of nitrogen]
1/0095 . . . . . . [Oxides of carbon, e.g. CO₂]
1/0097 . . . . . . [Others, e.g. F-, Cl-, HF-, HClF-, HCl-hydrocarbons etc. or mixtures thereof]
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)]
1/0201 . . . . . . (using only internal refrigeration means, i.e. without external refrigeration)
1/0202 . . . . . . (in a quasi-closed internal refrigeration loop (F25J 1/0208, F25J 1/0219, F25J 1/0224 take precedence))
1/0236 . . . [providing refrigeration for different processes treating not the same feed stream]
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)]
1/0238 . . . . {Purification or treatment step is integrated within one refrigeration cycle only, i.e. the same or single refrigeration cycle provides feed gas cooling (if present) and overhead gas cooling]
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]
1/0241 . . . . {wherein the overhead cooling comprises providing reflux for a fractionation step]
1/0242 . . . . [Waste heat recovery, e.g. from heat of compression]
1/0243 . . . . {Start-up or control of the process; Details of the apparatus used; Details of the refrigerant compression system used (not used)]
1/0244 . . . . {Operation; Control and regulation; Instrumentation (F25J 1/0279 takes precedence)}
1/0245 . . . . {Different modes, i.e. 'runs', of operation; Process control]
1/0247 . . . . {start-up of the process]
1/0248 . . . . {Stopping of the process, e.g. defrosting or deriming, maintenance; Back-up mode or systems]
1/0249 . . . . {Controlling refrigerant inventory, i.e. composition or quantity (charging or discharging refrigerants in cooling systems F25B 45/00)}
1/0250 . . . . . [Details related to the refrigerant production or treatment, e.g. make-up supply from feed gas itself]
1/0251 . . . . . [Intermittent or alternating process, so-called batch process, e.g. "peak-shaving"]
1/0252 . . . . . [Control strategy, e.g. advanced process control or dynamic modeling]
1/0254 . . . . . [controlling particular process parameter, e.g. pressure, temperature]
1/0255 . . . . . [controlling the composition of the feed or liquefied gas, e.g. to achieve a particular heating value of natural gas]
1/0256 . . . . . [Safety aspects of operation (F25J 1/0298 takes precedence)]
1/0257 . . . . . {Construction and layout of liquefaction equipments, e.g. valves, machines (F25J 1/0279 takes precedence)}
1/0258 . . . . . [vertical layout of the equipments within in the cold box]
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"]

1/0203 . . . [using a single-component refrigerant [SCR] fluid in a closed vapor compression cycle (F25J 1/0211 takes precedence) (not used)]
1/0204 . . . . . [as a single flow SCR cycle]
1/0205 . . . . . [as a dual level SCR refrigeration cascade]
1/0207 . . . . . [as at least a three level SCR refrigeration cascade]
1/0208 . . . . . [in combination with an internal quasi-closed refrigeration loop, e.g. with deep flash recycle loop (F25J 1/0221 takes precedence)]
1/0209 . . . . . . [as at least a three level refrigeration cascade]
1/021 . . . . . . {using a deep flash recycle loop}
1/0211 . . . . . . {using a multi-component refrigerant [MCR] fluid in a closed vapor compression cycle (not used)}
1/0212 . . . . . [as a single flow MCR cycle]
1/0214 . . . . . [as a dual level refrigeration cascade with at least one MCR cycle]
1/0215 . . . . . . [with one SCR cycle]
1/0216 . . . . . . {using a C3 pre-cooling cycle}
1/0217 . . . . . . [as at least a three level refrigeration cascade with at least one MCR cycle]
1/0218 . . . . . . {with one or more SCR cycles, e.g. with a C3 pre-cooling cycle}
1/0219 . . . . . . [in combination with an internal quasi-closed refrigeration loop, e.g. using a deep flash recycle loop]
1/0221 . . . . . . {using the cold stored in an external cryogenic component in an open refrigeration loop}
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)]
1/0223 . . . . . . [in combination with the subsequent re-vaporation of the originally liquefied gas at a second location to produce the external cryogenic component]
1/0224 . . . . . . [in combination with an internal quasi-closed refrigeration loop (F25J 1/0208; F25J 1/0219 take precedence)]
1/0225 . . . . . . . [using other external refrigeration means not provided before, e.g. heat driven absorption chillers]
1/0227 . . . . . [within a refrigeration cascade]
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)]
1/0229 . . . . . {Integration with a unit for using hydrocarbons, e.g. consuming hydrocarbons as feed stock}
1/023 . . . . . . . . . {for the combustion as fuels, i.e. integration with the fuel gas system]
1/0231 . . . . . . . . . {for the working-up of the hydrocarbon feed, e.g. reinjection of heavier hydrocarbons into the liquefied gas}
1/0232 . . . . . . . . . [integration within a pressure letdown station of a high pressure pipeline system]
1/0234 . . . . . . . . . [Integration with a cryogenic air separation unit (cryogenic separation of air F25J 3/04)]
1/0235 . . . . . . . . . [Heat exchange integration]

1/0236 . . . . . [providing refrigeration for different processes treating not the same feed stream]
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)]
1/0238 . . . . . {Purification or treatment step is integrated within one refrigeration cycle only, i.e. the same or single refrigeration cycle provides feed gas cooling (if present) and overhead gas cooling]
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]
1/0241 . . . . . {wherein the overhead cooling comprises providing reflux for a fractionation step]
1/0242 . . . . . [Waste heat recovery, e.g. from heat of compression]
1/0243 . . . . . {Start-up or control of the process; Details of the apparatus used; Details of the refrigerant compression system used (not used)]
1/0244 . . . . . {Operation; Control and regulation; Instrumentation (F25J 1/0279 takes precedence)}
1/0245 . . . . . {Different modes, i.e. 'runs', of operation; Process control]
1/0247 . . . . . {start-up of the process]
1/0248 . . . . . {Stopping of the process, e.g. defrosting or deriming, maintenance; Back-up mode or systems]
1/0249 . . . . . {Controlling refrigerant inventory, i.e. composition or quantity (charging or discharging refrigerants in cooling systems F25B 45/00)}
1/0250 . . . . . . [Details related to the refrigerant production or treatment, e.g. make-up supply from feed gas itself]
1/0251 . . . . . . [Intermittent or alternating process, so-called batch process, e.g. "peak-shaving"]
1/0252 . . . . . . [Control strategy, e.g. advanced process control or dynamic modeling]
1/0254 . . . . . . [controlling particular process parameter, e.g. pressure, temperature]
1/0255 . . . . . . [controlling the composition of the feed or liquefied gas, e.g. to achieve a particular heating value of natural gas]
1/0256 . . . . . . [Safety aspects of operation (F25J 1/0298 takes precedence)]
1/0257 . . . . . . {Construction and layout of liquefaction equipments, e.g. valves, machines (F25J 1/0279 takes precedence)}
1/0258 . . . . . . [vertical layout of the equipments within in the cold box]
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"]
1/0261 . . . . [Details of cold box insulation, housing and internal structure (buildings forming parts of cooling plants E04H 5/10)]
1/0262 . . . . [Details of the cold heat exchange system (constructional details F25J 5/00, construction of cold-exchangers in general F28)]
1/0263 . . . . [using different types of heat exchangers]
1/0264 . . . . [Arrangement of heat exchanger cores in parallel with different functions, e.g. different cooling streams (F25J 1/0277 takes precedence)]
1/0265 . . . . [comprising cores associated exclusively with the cooling of a refrigerant stream, e.g. for auto-refrigeration or economizer]
1/0267 . . . . [using flash gas as heat sink]
1/0268 . . . . [using a dedicated refrigeration means (F25J 1/0296 takes precedence)]
1/0269 . . . . [Arrangement of liquefaction units or equipments fulfilling the same process step, e.g. multiple "trains" concept (F25J 1/0294 takes precedence)]
1/027 . . . . [Inter-connecting multiple hot equipments upstream of the cold box]
1/0271 . . . . [Inter-connecting multiple cold equipments within or downstream of the cold box]
1/0272 . . . . [Multiple identical heat exchangers in parallel]
1/0274 . . . . [Retrofitting or revamping of an existing liquefaction unit]
1/0275 . . . . [adapted for special use of the liquefaction unit, e.g. portable or transportable devices]
1/0276 . . . . [Laboratory or other miniature devices]
1/0277 . . . . [Offshore use, e.g. during shipping]
1/0278 . . . . [Unit being stationary, e.g. on floating barge or fixed platform]
1/0279 . . . . [Compression of refrigerant or internal recycle fluid, e.g. kind of compressor, accumulator, suction drum etc.]
1/0281 . . . . [characterised by the type of prime driver, e.g. hot gas expander]
1/0282 . . . . [Steam turbine as the prime mechanical driver]
1/0283 . . . . [Gas turbine as the prime mechanical driver]
1/0284 . . . . [Electrical motor as the prime mechanical driver]
1/0285 . . . . [Combination of different types of drivers mechanically coupled to the same refrigerant compressor, possibly split on multiple compressor casings]
1/0287 . . . . [including an electrical motor]
1/0288 . . . . [using work extraction by mechanical coupling of compression and expansion of the refrigerant, so-called companders]
1/0289 . . . . [Use of different types of prime drivers of at least two refrigerant compressors in a cascade refrigeration system]
1/029 . . . . [Mechanically coupling of different refrigerant compressors in a cascade refrigeration system to a common driver]
1/0291 . . . . [Refrigerant compression by combined gas compression and liquid pumping]
1/0292 . . . . [Refrigerant compression by cold or cryogenic suction of the refrigerant gas]
1/0294 . . . . [Multiple compressor casings/strings in parallel, e.g. split arrangement]
1/0295 . . . . [Shifting of the compression load between different cooling stages within a refrigerant cycle or within a cascade refrigeration system]
1/0296 . . . . [Removal of the heat of compression, e.g. within an inter- or after-stage-cooler against an ambient heat sink]
1/0297 . . . . [using an externally chilled fluid, e.g. chilled water]
1/0298 . . . . [Safety aspects and control of the refrigerant compression system, e.g. anti-surge control]

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

3/02 by rectification, i.e. by continuous interchange of heat and material between a vapour stream and a liquid stream (E25J 3/08 takes precedence ; purification of hydrocarbons in general C07C 7/00; not used))
3/0204 . . . . [characterised by the feed stream (for air F25J 3/04)(not used)]
3/0209 . . . . [Natural gas or substitute natural gas]
3/0214 . . . . [Liquefied natural gas]
3/0219 . . . . [Refinery gas, cracking gas, coke oven gas, gaseous mixtures containing aliphatic unsaturated CnHm or gaseous mixtures of undefined nature]
3/0223 . . . . [H2/CO mixtures, i.e. synthesis gas; Water gas or shifted synthesis gas (production of carbon monoxide containing gas in general C01B 32/40, C10J, C10K; production of hydrogen containing gas C01B 3/00)]
3/0228 . . . . [characterised by the separated product stream (not used)]
3/0233 . . . . [separation of Cnm with 1 carbon atom or more]
3/0238 . . . . [separation of Cnm with 2 carbon atoms or more]
3/0242 . . . . [separation of Cnm with 3 carbon atoms or more]
3/0247 . . . . [separation of Cnm with 4 carbon atoms or more]
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 3/06)]
3/0257 . . . . [separation of nitrogen (from air F25J 3/04, production of nitrogen in general C01B 21/00)]
3/0261 . . . . [separation of carbon monoxide (production of carbon monoxide containing gas in general C01B 32/40, C10J, C10K)]
3/0266 . . . . [separation of carbon dioxide (production of carbon dioxide in general C01B 32/00)]
3/04151 . . . [Purification and (pre-)cooling of the feed air; recuperative heat-exchange with product streams (not used)]

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)]

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

3/04169 . . . [by adsorption of the impurities (adsorption in general B01D 53/02)]

3/04175 . . . . (at a pressure of substantially more than the highest pressure column)

3/04181 . . . [Regenerating the adsorbents]

3/04187 . . . [Cooling of the purified feed air by recuperative heat-exchange; Heat-exchange with product streams (arrangements of cold exchangers F25J 5/00)]

3/04193 . . . [Division of the main heat exchange line in consecutive sections having different functions]

3/042 . . . [having an intermediate feed connection]

3/04206 . . . [including a so-called "auxiliary evaporiser" for vapourising and producing a gaseous product]

3/04212 . . . [and simultaneously condensing vapor from a column serving as reflux within the or another column]

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)]

3/04224 . . . [Cores associated with a liquefaction or refrigeration cycle]

3/0423 . . . [Subcooling of liquid process streams]

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

3/04242 . . . [Cold end purification of the feed air]

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

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

3/0426 . . . . [The cryogenic component does not participate in the fractionation]

3/04266 . . . . [and being liquefied hydrocarbons]

3/04272 . . . . [and comprising means for reducing the risk of hydrocarbon leaks into the air fractionation]

3/04278 . . . . [using external refrigeration units, e.g. closed mechanical or regenerative refrigeration units]

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)]

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

3/04296 . . . [Claude expansion, i.e. expanded into the main or high pressure column]
3/04303 . . . . . {Lachmann expansion, i.e. expanded into oxygen producing or low pressure column}
3/04309 . . . . . {of nitrogen}
3/04315 . . . . . {Lowest pressure or impure nitrogen, so-called waste nitrogen expansion}
3/04321 . . . . . {of oxygen}
3/04327 . . . . . {of argon or argon enriched stream}
3/04333 . . . . . {using quasi-closed loop internal vapor compression refrigeration cycles, e.g. of intermediate or oxygen enriched (waste-)streams}
3/04339 . . . . . {of air}
3/04345 . . . . . {and comprising a gas work expansion loop}
3/04351 . . . . . {of nitrogen}
3/04357 . . . . . {and comprising a gas work expansion loop}
3/04363 . . . . . {of oxygen}
3/04369 . . . . . {of argon or argon enriched stream}
3/04375 . . . . . {Details relating to the work expansion, e.g. process parameter etc.}
3/04381 . . . . . {using work extraction by mechanical coupling of compression and expansion so-called componders}
3/04387 . . . . . {using liquid or hydraulic turbine expansion}
3/04393 . . . . . {using multiple or multistage gas work expansion}
3/044 . . . . . {using a single pressure main column system only (F25J 3/0446, F25J 3/04624, F25J 3/04636 take precedence)}
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}
3/04418 . . . . . {with thermally overlapping high and low pressure columns}
3/04424 . . . . . {without thermally coupled high and low pressure columns, i.e. a so-called split columns}
3/0443 . . . . . {A main column system not otherwise provided, e.g. a modified double column flowsheet}
3/04442 . . . . . {in a double column flowsheet with a high pressure pre-rectifier}
3/04448 . . . . . {in a double column flowsheet with an intermediate pressure column}
3/04454 . . . . . {a main column system not otherwise provided, e.g. serially coupling of columns or more than three pressure levels}
3/0446 . . . . . {using the heat generated by mixing two different phases}
3/04466 . . . . . {for producing oxygen as a mixing column overhead gas by mixing gaseous air feed and liquid oxygen}
3/04472 . . . . . {using the cold from cryogenic liquids produced within the air fractionation unit and stored in internal or intermediate storages (not used)}
3/04478 . . . . . {for controlling purposes, e.g. start-up or back-up procedures (F25J 3/04496 takes precedence)}
3/04484 . . . . . {for purity control during steady state operation}
3/0449 . . . . . {for rapid load change of the air fractionation unit}
3/04496 . . . . . {for compensating variable air feed or variable product demand by alternating between periods of liquid storage and liquid assist}
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}
3/04509 . . . . . {within the cold part of the air fractionation, i.e. exchanging "cold" within the fractionation and/or main heat exchange line}
3/04515 . . . . . {Simultaneously changing air feed and products output}
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 P01K23/064; gas-turbine plants supplying working fluid to a chemical process F02C6/10)(not used)}
3/04527 . . . . . {Integration with an oxygen consuming unit, e.g. glass facility, waste incineration or oxygen based processes in general}
3/04533 . . . . . {for the direct combustion of fuels in a power plant, so-called "oxyfuel combustion"}
3/04539 . . . . . {for the H2/N2 synthesis by partial oxidation or oxygen consuming reforming processes of fuels}
3/04545 . . . . . {for the gasification of solid or heavy liquid fuels, e.g. integrated gasification combined cycle [IGCC]}
3/04551 . . . . . {for the metal production}
3/04557 . . . . . {for pig iron or steel making, e.g. blast furnace, Corex}
3/04563 . . . . . {Integration with a nitrogen consuming unit, e.g. for purging, inerting, cooling or heating}
3/04569 . . . . . {for enhanced or tertiary oil recovery}
3/04575 . . . . . {for a gas expansion plant, e.g. dilution of the combustion gas in a gas turbine}
3/04581 . . . . . {Hot gas expansion of indirect heated nitrogen}
3/04587 . . . . . {for the NH3 synthesis, e.g. for adjusting the H2/N2 ratio}
3/04593 . . . . . {The air gas consuming unit is also fed by an air stream}
3/0446 . . . . . {Completely integrated air feed compression, i.e. common MAC}
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)
3/04612 . . . . . . [Heat exchange integration with process streams, e.g. from the air gas consuming unit]
3/04618 . . . . . . (for cooling an air stream fed to the air fractionation unit)
3/04624 . . . . . . [using integrated mass and heat exchange, so-called non-adiabatic rectification, e.g. dephlegmator, reflux exchanger]
3/0463 . . . . . . (Simultaneously between rectifying and stripping sections, i.e. double dephlegmator)
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)]
3/04642 . . . . . . [Recovering noble gases from air (from gas mixtures other than air F25J 3/028 or F25J 3/0685)]
3/04648 . . . . . . [argon (not used)]
3/04654 . . . . . . [Producing crude argon in a crude argon column]
3/0466 . . . . . . [as a parallel working rectification column or auxiliary column system in a single pressure main column system]
3/04666 . . . . . . [as a parallel working rectification column of the low pressure column in a dual pressure main column system]
3/04672 . . . . . . [having a top condenser]
3/04678 . . . . . . [cooled by oxygen enriched liquid from high pressure column bottoms]
3/04684 . . . . . . [and a bottom re-boiler (F25J 3/04696 takes precedence)]
3/0469 . . . . . . [and an intermediate re-boiler/condenser (F25J 3/04696 takes precedence)]
3/04696 . . . . . . [a bottom re-boiler and an intermediate re-boiler/condenser]
3/04703 . . . . . . [being arranged in more than one vessel]
3/04709 . . . . . . [as an auxiliary column system in at least a dual pressure main column system]
3/04715 . . . . . . [The auxiliary column system simultaneously produces oxygen]
3/04721 . . . . . . [Producing pure argon, e.g. recovered from a crude argon column]
3/04727 . . . . . . [using an auxiliary pure argon column for nitrogen rejection (F25J 3/04739 takes precedence)]
3/04733 . . . . . . [using a hybrid system, e.g. using adsorption, permeation or catalytic reaction]
3/04739 . . . . . . [in combination with an auxiliary pure argon column]
3/04745 . . . . . . [Krypton and/or Xenon]
3/04751 . . . . . . [Producing pure krypton and/or xenon recovered from a crude krypton/xenon mixture]
3/04757 . . . . . . [using a hybrid system, e.g. using adsorption, permeation or catalytic reaction]
3/04763 . . . . . . [Start-up or control of the process; Details of the apparatus used (not used)]
3/04769 . . . . . . [Operation, control and regulation of the process; Instrumentation within the process]
3/04775 . . . . . . [Air purification, pre-cooling]
3/04781 . . . . . . [Pressure changing devices, e.g. for compression, expansion, liquid pumping]
3/04787 . . . . . . [Heat exchange, e.g. main heat exchange line; Subcooler, external reboiler-condenser (F25J 3/04793 and F25J 3/0486 take precedence)]
3/04793 . . . . . . [Rectification, e.g. columns; Reboiler-condenser (F25J 3/0486 takes precedence)]
3/048 . . . . . . [Argon recovery]
3/04806 . . . . . . [High purity argon purification]
3/04812 . . . . . . [Different modes, i.e. "runs" of operation (F25J 3/04472 takes precedence)]
3/04818 . . . . . . [Start-up of the process]
3/04824 . . . . . . [Stopping of the process, e.g. defrosting or deriming; Back-up procedures]
3/0483 . . . . . . [Rapid load change of the air fractionation unit]
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)]
3/04842 . . . . . . [Intermittent process, so-called batch process]
3/04848 . . . . . . [Control strategy, e.g. advanced process control or dynamic modeling]
3/04854 . . . . . . [Safety aspects of operation]
3/0486 . . . . . . [of vapourisers for oxygen enriched liquids, e.g. purging of liquids]
3/04866 . . . . . . [Construction and layout of air fractionation equipments, e.g. valves, machines (F25J 3/00 takes precedence)]
3/04872 . . . . . . [Vertical layout of cold equipments within the cold box, e.g. columns, heat exchangers etc.]
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)]
3/04884 . . . . . . [Arrangement of reboiler-condensers]
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)]
3/04896 . . . . . . [Details of columns, e.g. internals, inlet/outlet devices]
3/04903 . . . . . . [Plates or trays]
3/04909 . . . . . . [Structured packings]
3/04915 . . . . . . {Combinations of different material exchange elements, e.g. within different columns}
3/04921 . . . . . . [within the same column]
3/04927 . . . . . . {Liquid or gas distribution devices}
3/04933 . . . . . . {Partitioning walls or sheets}
3/04939 . . . . . . {Vertical, e.g. dividing wall columns (details of dephlegmators F25J 5/007)}
3/04945 . . . . . . {Details of internal structure; insulation and housing of the cold box}
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)}
3/04957 . . . . . . {and inter-connecting equipments upstream of the fractionation unit(s), i.e. at the “front-end”}
3/04963 . . . . . . {and inter-connecting equipment within or downstream of the fractionation unit(s) (F25J 3/04393 takes precedence)}
3/04969 . . . . . . {Retrofitting or revamping of an existing air fractionation unit}
3/04975 . . . . . . {adapted for special use of the air fractionation unit, e.g. transportable devices by truck or small scale use}
3/04981 . . . . . . {for portable medical or home use}
3/04987 . . . . . . {for offshore use}
3/04993 . . . . . . {for space applications, e.g. for rocket use}
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)}
3/0605 . . . . . . {characterised by the feed stream (for air F25J 3/04)(not used)}
3/061 . . . . . . {Natural gas or substitute natural gas}
3/0615 . . . . . . {Liquefied natural gas}
3/062 . . . . . . {Refinery gas, cracking gas, coke oven gas, gaseous mixtures containing aliphatic unsaturated CnHm or gaseous mixtures of undefined nature}
3/0625 . . . . . . {H2/CO mixtures, i.e. synthesis gas; Water gas or shifted synthesis gas (production of carbon monoxide containing gas in general C01B 32/40, C10J, C10K; production of hydrogen containing gas C01B 3/00)}
3/063 . . . . . . {characterised by the separated product stream (not used)}
3/0635 . . . . . . {separation of CnHm with 1 carbon atom or more}
3/064 . . . . . . {separation of CnHm with 2 carbon atoms or more}
3/0645 . . . . . . {separation of CnHm with 3 carbon atoms or more}
3/065 . . . . . . {separation of CnHm with 4 carbon atoms or more}
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 3/006)}
3/066 . . . . . . {separation of nitrogen (from air F25J 3/04, production of nitrogen in general C01B 21/00)}
3/0665 . . . . . . {separation of carbon monoxide (production of carbon monoxide containing gas in general C01B 32/40, C10J, C10K)}
3/067 . . . . . . {separation of carbon dioxide (production of carbon dioxide in general C01B 32/00)}
3/0675 . . . . . . {separation of H2/CO mixtures, i.e. of synthesis gas (production of carbon monoxide containing gas in general C01B 32/40, C10J, C10K; production of hydrogen containing gas C01B 3/00)}
3/068 . . . . . . {separation of H2/N2 mixtures, i.e. of ammonia synthesis gas (in general C01B 3/00)}
3/0685 . . . . . . {separation of noble gases (from air F25J 3/04642; in general C01B 23/00)}
3/069 . . . . . . {of helium}
3/0695 . . . . . . {Start-up or control of the process; Details of the apparatus used}
3/08 . . . . . . {Separating gaseous impurities from gases or gaseous mixtures (or from liquefied gases or liquefied gaseous mixtures) (cold traps B01D 8/00)}
5/00 Arrangements of cold exchangers or cold accumulators in separation or liquefaction plants (heat exchangers F28C, F28D, F28F)
5/002 . . . . . . {for continuously recuperating cold, i.e. in a so-called recuperative heat exchanger}
5/005 . . . . . . {in a reboiler-condenser, e.g. within a column}
5/007 . . . . . . {combined with mass exchange, i.e. in a so-called dephlegmator}

2200/00 Processes or apparatus using separation by rectification (not used)
2200/02 . . . in a single pressure main column system
2200/04 . . . in a dual pressure main column system
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
2200/08 . . . in a triple pressure main column system
2200/10 . . . in a quadruple, or more, column or pressure system
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
2200/30 . . . using a side column in a single pressure column system
2200/32 . . . using a side column fed by a stream from the high pressure column
2200/34 . . . using a side column fed by a stream from the low pressure column
2200/38 . . . using pre-separation or distributed distillation before a main column system, e.g. in a at least a double column system
2200/40 . . . Features relating to the provision of boil-up in the bottom of a column
2200/50 . . . using multiple (re-)boiler-condensers at different heights of the column
2200/52 . . . in the high pressure column of a double pressure main column system
2200/54 . . . in the low pressure column of a double pressure main column system
Processes or apparatus using other separation and/or other processing means

2205/00  Processes characterised by the type or other details of the feed stream (not used)

2205/02  Mixing of components

2205/04  Recovery of liquid products

2205/10  Hydrogen

2205/14  Carbon monoxide

2205/18  HYCO synthesis gas, e.g. H₂/CO mixture

2205/20  Ammonia synthesis gas, e.g. H₂/N₂ mixture

2205/30  Helium

2205/32  Neon

2205/34  Krypton

2205/36  Xenon

2205/40  Air or oxygen enriched air, i.e. generally less than 30 mol% of O₂

2205/42  Nitrogen or special cases, e.g. multiple or low purity N₂

2205/44  Ultra high purity nitrogen, i.e. generally less than 1 ppb impurities

2205/50  Oxygen or special cases, e.g. isotope-mixtures or low purity O₂

2205/52  Oxygen production with multiple purity O₂

2205/54  Oxygen production with multiple pressure O₂

2205/56  Ultra high purity oxygen, i.e. generally more than 99.9% O₂

2205/68  Cooling the adsorption vessel

2205/70  Heating the adsorption vessel

2205/72  Pressurising or depressurising the adsorption vessel

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

2205/82  using a reactor with combustion or catalytic reaction

2205/84  using filter
### 2220/00 Processes or apparatus involving steps for the removal of impurities (not used)

2220/02 Separating impurities in general from the feed stream

2220/04 Separating impurities in general from the product stream

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

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

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

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

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

2220/60 Separating impurities from natural gas, e.g. mercury, cyclic hydrocarbons

2220/62 . . Separating low boiling components, e.g. He, H₂, N₂, Air

2220/64 . . Separating heavy hydrocarbons, e.g. NGL, LPG, C₄+ hydrocarbons or heavy condensates in general

2220/66 . . Separating acid gases, e.g. CO₂, SO₂, H₂S or RSH

2220/68 . . Separating water or hydrates

2220/80 Separating impurities from carbon dioxide, e.g. H₂O or water-soluble contaminants

2220/82 . . . Separating low boiling, i.e. more volatile components, e.g. He, H₂, CO, Air gases, CH₄

2220/84 . . . Separating high boiling, i.e. less volatile components, e.g. NOₓ, SOₓ, H₂S

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

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

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

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

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

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

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

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

2230/24 Multiple compressors or compressor stages in parallel

2230/30 Compression of the feed stream

2230/32 Compression of the product stream

2230/40 . . the fluid being air

2230/42 . . the fluid being nitrogen

2230/50 . . the fluid being oxygen

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

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

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

2230/80 . the fluid being carbon dioxide

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

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

2235/04 . using a pressure accumulator

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

2235/42 . the fluid being nitrogen

2235/50 . the fluid being oxygen

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

2235/58 . the fluid being argon or crude argon

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

2235/80 . the fluid being carbon dioxide

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

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

2240/04 . . Multiple expansion turbines in parallel

2240/10 . . the fluid being air

2240/12 . . the fluid being nitrogen

2240/20 . . the fluid being oxygen

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

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

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

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

2240/42 . . the fluid being air

2240/44 . . the fluid being nitrogen

2240/46 . . the fluid being oxygen

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

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

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

2240/80 Hot exhaust gas turbine combustion engine

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

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

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

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

2245/40 . the recycled stream being air

2245/42 . the recycled stream being nitrogen

2245/50 . the recycled stream being oxygen

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

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

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

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
<NO TITLE>
<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2290/44</td>
<td>Particular materials used, e.g. copper, steel or alloys thereof or surface treatments used, e.g. enhanced surface</td>
</tr>
<tr>
<td>2290/50</td>
<td>Arrangement of multiple equipments fulfilling the same process step in parallel</td>
</tr>
<tr>
<td>2290/60</td>
<td>Details about pipelines, i.e. network, for feed or product distribution</td>
</tr>
<tr>
<td>2290/62</td>
<td>Details of storing a fluid in a tank</td>
</tr>
<tr>
<td>2290/70</td>
<td>Processing device is mobile or transportable, e.g. by hand, car, ship, rocket engine etc.</td>
</tr>
<tr>
<td>2290/72</td>
<td>Processing device is used off-shore, e.g. on a platform or floating on a ship or barge</td>
</tr>
<tr>
<td>2290/80</td>
<td>Retrofitting, revamping or debottlenecking of existing plant</td>
</tr>
<tr>
<td>2290/90</td>
<td>Details about safety operation of the installation</td>
</tr>
</tbody>
</table>