

**CLASS 148, METAL TREATMENT****SECTION I - CLASS DEFINITION**

A. This is the generic class in the art of treating metal to modify or maintain the internal physical structure (i.e., microstructure) or chemical properties of metal. Most process subject matter under this class relates to treating solid or semisolid metal with heat, without melting a substantial portion thereof, and also includes the combination of significant heating and working not provided for in other metal working classes. However, casting or casting and working of molten metal, if combined with significant heat treatment to change the microstructure of the solid metal resulting therefrom is acceptable in this class. Cooling of metal to produce microstructure change is proper for this class.

B. This class includes processes of treating metal to intentionally develop, improve, modify, or preserve the magnetic properties of a free metal or alloy, occurring alone or mixed with one or more components.

C. This class includes processes of reactive coating of metal wherein an externally supplied carburizing or nitriding agent is combined with the metal substrate to produce a carburized or nitridized or carbonitrided coating thereon or a uniformly carburized, nitrided, or carbonitrided metal alloy containing a metal element from said substrate.

D. This class includes processes of reactive coating of metal wherein an externally supplied agent combines with the metal substrate to produce a coating thereon which contains at least one element from said metal substrate (e.g., oxidizing, boronizing, etc.).

E. This class includes processes of chemical-heat removing (e.g., flame cutting, etc.) or burning (i.e., oxidizing) to remove a portion of a metal workpiece.

F. This class includes: (1) elemental metal, alloy or metallic composition which is a product of a process under section A, above; (2) elemental metal, alloy, or metallic composition or multi-layered products under section B or C above; (3) elemental metal, alloy, or metallic composition which is the product of a significant Class 164 metal founding step; (4) elemental metal, alloy, or metallic composition which is the product of the dispersion of particulate matter in molten metal which particulate matter retains its identification in the final state; and (5) elemental metal, alloy, or metallic composition which contains an amorphous or shape memory property.

G. This class includes compositions employed in the treatment of solid metal and processes for preparing the same when not otherwise classifiable.

H. This class includes electrically conductive semiconductor stock which is essentially homogeneous and has at least two contiguous layers differing in the number of unbound electrons and/or differing in energy gap levels which exhibit a junction between layers (e.g., P-N type, etc.).

For amplification of A-H, see Subclass References to the Current Class, below.

**RULES OF PATENT PLACEMENT**

Patents have been placed in this class employing the so-called "genus-species" rule. Following this rule as between a generic subclass and its indents, a species unprovided in any indented subclass is specifically classified in the generic subclass. Thus, a patent containing claims to both a provided species and an unprovided species is placed as original in the generic subclass as the first (i.e., highest) appearing subclass and cross-referenced to the indented subclass having the provided species. A patent containing claims only for species having provided subclasses is placed as original in the first (i.e., highest) appearing provided subclass and cross-referenced to the other (i.e., lower) appearing subclasses.

Following the "genus-species" rule, all mandatory original and cross-references only appear in the highest subclasses providing therefor. The claims identify the mandatory original and cross-references. However, if the claims are all generic, the specification is used to determine mandatory placement of the disclosed species, only if related to features in the claim language.

**SECTION II - LINES WITH OTHER CLASSES AND WITHIN THIS CLASS****A. METAL CASTING, METAL FUSION BONDING, MACHINING, OR WORKING CLASSES**

For purposes of distinguishing over the metal casting, metal fusion bonding, machining, or working classes, significant heat treatment must be present to be proper for Class 148. Significant heat treatment occurs when temperature or heating or cooling rate is provided in a nonworking, noncasting, nonfusion-bonding, or nonmachining related step or when microstructure description

is utilized in the claim to describe the result of the heating or cooling treatment of solid or semisolid metal. Working at a specified temperature without mention of microstructure is not significant heat treatment for Class 148. The mere use of the term “ageing” or “tempering” will be considered significant heat treatment. Except for “workhardening”, the use of the term “hardening” will be considered significant heat treatment. “Quenching” will be considered significant heat treatment lacking an indication that it means simply returning to a convenient working temperature. “Stress-relief-annealing” will remain in the metal working classes. Working metal in the “superplastic” state or during “dynamic-recrystallization” remains in the working classes unless a temperature is provided. “Ion implantation” of a metal substrate will be a sufficient indication of microstructural change to place classification in Class 148. High frequency vibration of solid metal for purposes of changing the microstructure thereof is sufficient to take a combination thereof with the above operations to Class 148 as an original. When combined with working, “annealing”, per se, will remain in the metal working classes. However, annealing at a specified temperature goes in Class 148. Merely, heating or cooling a metal to a working temperature is not significant heat treatment. In summary, the presence in any step of a significant heat treatment as hereinabove described is sufficient to place the classification in Class 148.

#### B. CHEMICAL PROCESSES OF MANUFACTURING METALS OR ALLOYS, METALLIC COMPOSITIONS AND METALLIC STOCK CLASSES IN ORDER OF SUPERIORITY.

Historically, placement of originals among the classes for chemical processes of manufacturing metals or alloys, metallic compositions classes and metallic stock classes did not depend upon the most comprehensive claims and did not follow superiority of statutory categories of invention (i.e., process of using, product or manufacture, process of making, apparatus for performing a process and material). Within these metallurgical processes, metallic composition and metallic stock classes, placement depends upon complex lines established through experience. To simplify placement, the following hierarchy containing the essence of historical placement for these classes was previously established to settle conflicts between the classes listed thereunder with the first listed or higher class controlling placement, if claims are present therefor and regardless of statutory category. If a class other than those listed hereinunder is involved, consideration of the other class is based upon relevant lines, comprehensiveness, and superiority of statutory categories of invention only with

respect to the other class. Having determined the controlling class, placement of the original goes by the hierarchy within the class and not according to the following list.

The superiority among the various metal, alloy, and metal stock areas, and chemical methods of manufacturing them, is provided in order under the search class notes as follows:

Class 419, Powder Metallurgy Processes, appropriate subclasses for processes of treating metal powder utilizing a sintering or compacting operation and including post-treatment operations if combined with the sintering or compacting operation. If the starting material is pre-consolidated, and there is no actual sintering or consolidating step present, placement goes as original to Class 148, subclass 514 provided hierarchically hereinbelow.

Class 148, Metal Treatment, subclasses 22-30 for compositions for treatment of solid metal.

Class 75, Specialized Metallurgical Processes, Compositions for Use Therein, Consolidated Metal Powder Compositions, and Loose Metal Particulate Mixtures, subclasses 300, 301, and 303+ for gaseous, liquid, or solid treating compositions for liquid metal or charges, and subclass 302 welding rod defined by composition.

Class 75, Specialized Metallurgical Processes, Compositions for Use Therein, Consolidated Metal Powder Compositions, and Loose Metal Particulate Mixtures, subclasses 228-250, consolidated metal powder compositions and subclasses 252-255, loose metal particulate mixtures.

Class 420, Alloys or Metallic Compositions, claimed as products.

Class 148, Metal Treatment, subclasses 95-122, 194-287, and 500-714 providing for processes of modifying or maintaining the internal physical structure (i.e., microstructure) or chemical properties of metal, processes of reactive coating of metal and processes of chemical-heat removing (e.g., flame-cutting) or burning of metal. However, if metal casting, fusion bonding, machining or working is involved, there is a requirement of significant heat treatment as described in “A. Metal Casting, Metal Fusion Bonding, etc.” above.

Class 148, Metal Treatment, subclasses 33-33.6, barrier layer stock material and subclasses 300-337 and\_400-442, stock.

Class 75, Specialized Metallurgical Processes, Compositions for Use Therein, Consolidated Metal Powder Compositions, and Loose Metal Particulate Mixtures, subclasses 331+, processes of making solid particulate alloys directly from liquid metal, and subclasses 343+, processes of producing or purifying alloys in powder form.

Class 75, Specialized Metallurgical Processes, Compositions for Use Therein, Consolidated Metal Powder Compositions, and Loose Metal Particulate Mixtures, subclasses 10.1-10.66 and 10.67+, processes of making alloys by electrothermic, electromagnetic, or electrostatic processes.

Class 420, Alloys or Metallic Compositions, for processes of manufacture.

Class 75, Specialized Metallurgical Processes, Compositions for Use Therein, Consolidated Metal Powder Compositions, and Loose Metal Particulate Mixtures, subclasses 330+, processes of making metal and processes of treating liquid metals and liquid alloys and consolidating metalliferous material.

205, Electrolysis: Processes, Compositions Used Therein, and Methods of Preparing the Compositions, particularly for processes of electrocoating of metal. At this time, Class 205 is a subdivision of Class 204 and therefore all notes concerning Class 204 should be consulted when determining the relationship to Class 148.

204, Chemistry: Electrical and Wave Energy, processes. Combinations of reactive coating of metal and electrocoating of metal go to Class 204 as original. See C, Chemical Coating, Cleaning, Etching And Manufacturing Classes, below for the line between Class 148 and Class 204. If metal casting, fusion bonding, machining, or working is included see "A. Metal Casting, Metal Fusion Bonding, etc." above to determine if this is proper for Class 148.

164, Metal Founding, subclasses 1-138, processes. See the line between Class 164 and Class 148 under A, Metal Casting, Metal Fusion Bonding, Machining, Or Working Classes, above.

266, Metallurgical Apparatus, subclasses 44-47, processes of operating metallurgical apparatus.

#### C. CHEMICAL COATING, CLEANING, ETCHING AND MANUFACTURING CLASSES.

If there is a combination of chemical coating, cleaning, etching or chemical treating of metal and metal casting, fusion bonding, machining, or working with significant heat treatment in any step of metal to modify or maintain the internal physical structure (i.e., microstructure) or chemical property of metal, the combination goes in Class 148 as an original. To determine what constitutes significant heat treatment refer to "A. Metal Casting, Metal Fusion Bonding, etc." above. In the absence of casting, welding, machining, or working, the combination of treating metal with chemicals or chemical compositions and a separate step heat treatment to modify or maintain the internal physical structure or chemical property of metal, placement as an original goes to Class 148 except as indicated in the following lines. It is noted that heat treatment includes a cooling of metal for Class 148 purposes. If chemical heat-cutting (e.g., flame cutting) or burning (i.e., oxidizing), ion implantation, high frequency vibration to change microstructure, carburizing, nitriding, or reactive coating of metal is claimed, combinations with other classes involving treating metal with chemicals or chemical compositions will go to Class 148, subject to the following exceptions.

Also see References to Other Classes, below, that reference this section.

#### D. SEMICONDUCTOR DEVICE MAKING AND SEMICONDUCTOR STOCK

Class 438 is the residual class for (a) multiple operations (steps) for producing a semiconductor having a junction or semiconductor device having a junction, usually between P-type and N-type material or (b) an unit operation involving semiconductor material, not elsewhere provided. Class 438, subclasses 795-799, provides for processes of heat treatment of semiconductor material to change some characteristic thereof. Since in certain instances semiconductor material could include metallic compositions containing metal, placement goes to Class 438 as original over Class 148 if during the heat treatment there is either a change in the internal physical structure (i.e., microstructure) or chemical properties since that is in essence a change in the property of the semiconductor materials overall properties whether those properties are expressed in terms of a change in conductance or not. However, it is required that the metal composition undergoing the heat treatment must be identified or perceived as semiconductor material. If perceived, a mandatory cross is made in Class 148.

Semiconductor stock in Class 148, subclasses 33-33.6,

must be essentially homogeneous and have at least two contiguous layers differing in the number of unbound electrons and/or differing in energy gap levels, which exhibit a junction between the layers. Class 252, subclass 62.3, is the location of compositions specialized and designed for use as one layer which when combined with another such layer would provide an interface exhibiting barrier layer properties (e.g., as could exist in Class 148, subclasses 33-33.6, stock, if the junction thereof were between P-type and N-type semiconducting materials, etc.).

#### LINE WITH CLASS 29 AND CLASS 164

Combinations of casting and working are located in Class 29. However, combinations of casting and heat treatment for purposes of modifying or maintaining the internal physical structure (i.e., microstructure) or chemical properties of metal go as original to Class 148. Combinations of casting and metal fusion bonding, machining, or working go to Class 148, if there is significant heat treatment as defined hereinabove. In continuous casting operations, wherein the contiguous product is still connected to the casting surface, a step involving significant heat treatment of the solid or semi-solid metal which occurs outside or away from the molding surface goes to Class 148. However, chemical heat removing (e.g., flame-cutting, etc.) or burning (i.e., oxidation) of a continuously cast metal goes to Class 164, if some of the continuously cast and contiguous product is connected to the shaping surface. Cutting operations in the mold go to Class 164. Combinations of reactive coating, ion implantation or high frequency vibration to change microstructure and casting go to Class 148 if they occur outside the mold.

#### LINE WITH CLASS 204 AND CLASS 427

While the combination of etching and electrocoating or sputter-coating or the combination of electrocoating or sputter-coating and a Class 427 coating operation is proper for Class 204, the inclusion of a post-treatment involving a separate Class 148 operation to modify or maintain the internal physical structure or chemical properties of metal deposited by the Class 427 operation takes the overall combination to Class 148 as original.

It is further noted that the other areas of Class 204, follow a different line than the electrocoating or sputter-coating with respect to Class 148. The presence in any step of an operation proper for Class 148, if claimed independently, is sufficient to take the noncoating Class 204 operation to Class 148 as original. In the context of Class 204, electrorefining to recover metal from solu-

tion is not considered electrocoating even though an electrode is plated.

#### LINE WITH CLASS 205 AND CLASS 204

See Class 205, Electrolysis: Processes, Compositions Used Therein, and Methods of Preparing the Compositions, particularly subclasses for processes of electrocoating of metal. At this time, Class 205 is a subdivision of Class 204 and therefore all notes concerning Class 204 should be consulted when determining the relationship to Class 148.

#### LINE WITH CLASS 427 AND CLASS 204

Class 148 provides for certain coating processes, per se, if the substrate is metal. The species of coating, per se, proper for Class 148 include carburizing, nitriding, carbonitriding, or reactive coating of a metal substrate. If there is a combination coating operation for Class 427 and a Class 148 treatment of solid or semi-solid metal in a step separate from the coating step to modify or maintain the internal physical structure (i.e., microstructure) or chemical properties of metal, the combination goes as original to Class 148 whether or not the treatment is preparatory to the Class 427 coating operation or is a post-treatment of the coating or substrate or both. The line to Class 204 must be followed as between Class 427, Class 204, and Class 148. Moreover, if metal casting, fusion bonding, machining, or working is involved in the combination, placement goes to Class 148 only if the heat treatment is a significant heat treatment as defined in the Class 148 definition, "A. Metal Casting, Metal Fusion Bonding, etc., above." A combination of a metal working step proper for one of the metal working classes and ion implantation for coating purposes will be proper for Class 148. See particularly subclass 239 of Class 148 for ion implantation of a metal substrate according to these distinctions. See also the Class 427 definition "Search Class" notes.

### SECTION III - SUBCLASS REFERENCES TO THE CURRENT CLASS

#### SEE OR SEARCH THIS CLASS, SUBCLASS:

- 22, see the notes for amplification of statement G of the Class Definition.
- 33, see the notes for amplification of statement H of the Class Definition.
- 95, see the notes for amplification of statement A in the Class Definition, see the notes under subclass of this class.

- 100, see the notes for amplification of statement B in the Class Definition.
- 194, see the notes for amplification of statement E of the Class Definition.
- 206, see the notes for amplification of statement C of the Class Definition.
- 240, see the notes for amplification of statement D of the Class Definition.
- 400, see the notes for amplification of statement F of the Class Definition.

#### SECTION IV - REFERENCES TO OTHER CLASSES

##### SEE OR SEARCH CLASS:

- 29, Metal Working, appropriate subclasses for processes having combined operations involving metal working, machining, metal fusion bonding, or casting class and treating not provided for in the metal working, machining, welding, or casting classes. Since Class 29 is a residual metal treating class and Class 148 is also a residual metal treating class, the relationship established makes Class 148 superior in all cases wherein significant heat treatment as defined in "A. Metal Casting, Metal Fusion Bonding, etc." above, first paragraph, is included. However, Class 29 is also a generic mechanical assembly class. See Notes to the Class Definition, (2) Note of the Class 29 definition, (7) Note under Class 29, subclass 592, and the Class 29, subclass 428, definition. Wherein Class 29 mechanical assembly is involved, placement in Class 148 as original is proper over Class 29, if significant heat treatment as described in "A. Metal Casting, Metal Fusion Bonding, etc." above is included. In all other situations, mechanical assembly operations remain in Class 29. The combination of reactive coating or chemical heat removing (e.g., flame-cutting, etc.) or burning (i.e., oxidizing) to remove a portion of a metal workpiece, with a Class 29 metal working, machining, fusion bonding, casting, or mechanical assembly operation goes as an original to Class 148. (See Lines With Other Classes and Within This Class, "Metal Casting, Metal Fusion Bonding, etc.," above.)
- 72, Metal Deforming, appropriate subclasses for processes of deforming metal by working that involve the use of heat. Class 148 is superior to Class 72, if significant heat treatment is present before, after, or during the deforming

- operation. Significant heat treatment is defined under the first paragraph of "A. Metal Casting, Metal Fusion Bonding, etc." above. See Lines With Other Classes and Within This Class, Relationship To Combination Classes, "With Heat Treatment", paragraph (c) of the Class 72 definition. (See Lines With Other Classes and Within This Class, "Metal Casting, Metal Fusion Bonding etc.," above.)
- 117, Single-Crystal, Oriented-Crystal, and Epitaxy Growth Processes; Non-Coating Apparatus Therefor, for processes and non-coating apparatus for growing therein-defined single-crystal of all types of materials, including metal, alloy, or intermetallic single-crystal (except those proper for the class of Metal Founding). Class 117 is proper for metal, alloy, or intermetallic single-crystal growing in any physical state, including solid phase recrystallization. Class 117 is proper for metal, alloy, or intermetallic single-crystal growing and such combined with perfecting operations for the growing step, except that Class 148 provides for single-crystal growing combined with a subsequent step of heat treatment (which herein includes controlled cooling) when the purpose of the heat treatment (or controlled cooling) is to modify the internal physical structure or chemical property of a metal, alloy, or intermetallic material. When the subsequent heat treatment (or controlled cooling) merely operates on the single-crystallinity, such as stress or strain annealing or to remove point defects, the combined process is proper for Class 117; when the subsequent heat treatment (or controlled cooling) operates to effect significant metal, alloy, or intermetallic material heat treatment (or controlled cooling) purposes, such as solutionizing, homogenizing, or precipitation hardening, then the combined process is proper for Class 148. Class 117 provides for simultaneous or prior perfecting operations combined with single-crystal growing. See Class 117 definition, section C, (4) Note, for discussion of perfecting operations. (See Lines With Other Classes and Within This Class, "Chemical Coating, Cleaning, Etching etc.," above.)
- 134, Cleaning and Liquid Contact With Solids, appropriate subclasses for process of metal cleaning and pickling, per se, Combinations with a Class 148 operation go as original to Class 148. (See Lines With Other Classes and Within This Class, "Chemical Coating, Cleaning, Etching, etc.," above.)

- 156, Adhesive Bonding and Miscellaneous Chemical Manufacture, for adhesive bonding and chemical etching. Combinations of adhesive bonding or chemical etching with treatment of metal to modify or maintain the internal physical structure or chemical properties of metal go as original in Class 148. (See Lines With Other Classes and Within This Class, "Chemical Coating, Cleaning, Etching, etc.," above.)
- 164, Metal Founding, appropriate subclasses for processes of casting molten metal. (See Lines With Other Classes and Within This Class, above.)
- 204, Chemistry: Electrical and Wave Energy, appropriate subclasses for processes of electrocoating or sputter-coating that result in a metal layer being formed or in metal being electrocoated by another material and combinations of electrocoating or sputter-coating with other chemical treating operations that (1) involve preparatory treatment of metal substrates including heat-treatment which if claimed alone would be proper for Class 148 and (2) post-treatment solely of the electrocoated or sputter-coated layer including heat-treatment which if claimed alone would be proper for Class 148. However, if the subsequent treatment modifies the original substrate or a combination of the original substrate and the electrocoated or sputter-coated layer, placement goes elsewhere.
- (a) Thus, Class 148 takes as original in combination with an electrocoating or sputter-coating step only processes of post-treating electrocoated or sputter-coated article or stock having an original substrate which is post-treated and having present therewith a nonelectrocoated or nonsputter coated solid or semi-solid metal portion or layer to modify the internal physical structure (i.e., microstructure) or chemical properties of metal. In combinations, including electrocoating or sputter-coating which have post-treatments, that also include metal casting, fusion bonding, machining, or working; it is necessary to have significant heat treatment as defined in Class 148, Lines With Other Classes and Within This Class, "A. Metal Casting, Metal Fusion Bonding, etc." above before placement as original in Class 148. Combinations that involve reactive coating as defined in Class 148, subclasses 240-287, and a Class 204 electrocoating or sputter-coating operation go to Class 204.
- (b) Carburizing or nitriding of metal operations as defined in Class 148, subclasses 206-238, if combined with a Class 204 operation go in Class 148 as original regardless of the order of the treatment and whether or not the coating or substrate is treated.
- (c) Since Class 148 is superior to Class 204, if claims are present which independently are classifiable in both classes, placement goes as original to Class 148.
- (1) Note. Interdiffusion of the electrocoated or sputter-coated layer occurring during the coating operation or during the post-treatment operation is proper for Class 204 if limited to the interfacial region between the coating and the substrate as a perfecting of the bond between the coating and substrate. If the electrocoated or sputter-coated layer is completely melted in the post-treatment operation to perfect the bonding of the coating, this is proper for Class 204. If multiple electrocoated or sputter-coated regions are interdiffused to the extent of completely alloying with loss of layer identity, this is proper for Class 204. However, if the coating is completely interdiffused into a metal substrate to completely alloy, leaving no identifying layer on the substrate, placement goes to Class 148. (See Lines With Other Classes and Within This Class, above.)
- 205, Electrolysis: Processes, Compositions Used Therein, and Methods of Preparing the Compositions, particularly subclasses for processes of electrocoating of metal. (See Lines With Other Classes and Within This Class, above.)
- 219, Electric Heating, appropriate subclasses for processes of electric heating of metal for metal fusion bonding, machining, or working of metal and for processes of heating metal, per se. If the Class 219 metal fusion bonding or working of metal is combined with significant heat treatment of metal as hereinabove defined, placement goes to Class 148. Lacking a step of metal fusion bonding, machining, or working of metal, an electric heating to perform an operation falling under the Class 148 definition will go to Class 148. Class 219 includes processes utilizing an arc, plasma, laser, or other electrically generated heat to cut metal. In gen-

- eral, the combination of electric heat cutting and chemical-heat removing or burning of metal will go to Class 148. However, an exception evolved in Class 219 wherein there is a simultaneous chemical-heat removing or burning and arc-cutting in which air or oxygen assisted the cutting (see Class 219, subclass 69.1, (1) Note. Surface melting of a solid or semi-solid metal workpiece for purposes other than metal fusion bonding, and consistent with the Class 148 definition, are provided for in Class 148, even if by electric heating. (See Lines With Other Classes and Within This Class, "Metal Casting, Metal Fusion Bonding, etc.," above.)
- 228, Metal Fusion Bonding, appropriate subclasses for processes of metal fusion bonding or welding of metal. A combination of metal fusion bonding with a separate step involving significant heat treatment as hereinabove defined will go to Class 148. Thus, a subsequent step of heat treating to perfect the solid fusion bond left by the fusion bonding step as, for example, by diffusion or by tempering goes to Class 148. However, nominal annealing with no mention of the annealing temperature remains with Class 228. Combinations of metal fusion bonding and a separate step of surface melting of metal which is distinct and nonpreparatory to the fusion bonding step go to Class 148. Combinations of reactive coating of metal or chemical-heat removing (i.e., flame-cutting) or burning of metal with metal fusion bonding go to Class 148. Combinations of high frequency vibration in a separate step for purposes of changing microstructure and metal fusion bonding go to Class 148. (See Lines With Other Classes and Within This Class, "Metal Casting, Metal Fusion Bonding, etc.," above.)
- 427, Coating Processes, for processes of coating, per se. (See Lines With Other Classes and Within This Class and Within This Class, above.)
- 428, Stock Material or Miscellaneous Articles, subclasses 692.1 and 693.1 for stock materials having a defined magnetic layer; and subclasses 800-848.9 for magnetic heads, and magnetic and magneto-optic storage medium, per se, with specific detail of composition or physical chemistry (e.g., materials, microstructure, surface property, etc.).
- 445, Electric Lamp or Space Discharge Component or Device Manufacturing, appropriate subclasses for processes of producing an assembled electric lamp or space discharge device wherein final manufacturing steps involve Class 148 heating or Class 148 coating treatment of solid metal electrodes or filaments within the completely assembled device, in which case a cross-reference is placed in Class 148. However, any Class 148 treatment of a metal electrode, per se, goes as an original in Class 148, regardless of intended use in an electric lamp or space discharge device. Thus, carburizing, decarburizing, or hardening of a metal electrode or metal filament, per se, goes in Class 148 as original. (See Lines With Other Classes and Within This Class, "Metal Casting, Metal Fusion Bonding, etc.," above.)
- 502, Catalyst, Solid Sorbent, or Support Therefor: Product or Process of Making, for processes of treating metal for purposes of enhancing its catalytic function or to make it more durable for catalytic operation even if a class 148 operation is involved. However, if heat treatment is involved to modify or maintain the microstructure or chemical properties of solid or semi-solid metal, a cross-reference to Class 148 is mandatory. (See Lines With Other Classes and Within This Class, "Chemical Coating, Cleaning, Etching, etc.," above.)
- 508, Solid Anti-Friction Devices, Materials Thereof, Lubricant or Separant Compositions for Moving Solid Surfaces and Miscellaneous Mineral Oil Compositions, subclasses 100 through 109 for inter alia materials used to make solid anti-friction devices or articles, which material contain a lubricant as a permanent part thereof, whether by permanent coating, impregnation into the interstices thereof, or by being part of the composition.

## SECTION V - GLOSSARY

### AGING OR AGEING

Also termed precipitation hardening or strengthening. A process whereby the hardness/strength of a metal alloy may be increased by subjecting a supersaturated solid solution to elevated temperature to precipitate out a secondary phase containing the solute. Aging may also be manifested as a spontaneous increase in hardness at room temperature. Aging for a longer time than that corresponding to maximum hardness at the particular temperature is termed overaging. Aging after or during straining is known as strain aging. Maraging steels are a specific group of high nickel (i.e., greater

than ten percent Nickel), low carbon martensitic steels which can be fabricated while in a comparatively ductile martensitic condition and later strengthened by aging treatment.

#### AMORPHOUS

A term signifying a lack of regular crystalline order, much like the absence of long-range crystalline order in glass.

#### ANNEALING

A single thermal heat treatment wherein the heating of a metal workpiece to a temperature results in improved formability.

#### AUSTEMPERING

A procedure that involves preliminary quenching of austenized metal to a temperature in the lower bainite range, usually in a molten salt bath, holding at this temperature until transformation is complete, and quenching or air cooling to room temperature. If desired, a lower hardness level may be produced by including an additional tempering step.

#### AUSTENIZING

A process of heating to an elevated temperature within the austenitic range.

#### BLUEING

A process of forming a protective oxide coating on ferrous metal.

#### CARBURIZING

A process wherein a metal substrate is treated with an externally supplied source of carbon resulting in the carburization of the metal by chemical reaction or diffusion.

#### CASE HARDENING

A term most often applied to carburizing or nitriding processes which result in a hardened surface on the workpiece.

#### MALLEABLEIZING

A process applied to cast irons whereby the combined carbon in the as-cast microstructure is graphitized to

form temper carbon. When combined with decarburization of the surface, the resulting product is termed white-heart malleable iron.

#### MARTEMPERING

A process which involves preliminary quenching of austenized metal to a temperature just above the Ms temperature and holding until the temperature is equalized throughout the metal, followed by air cooling through the martensite transformation range and subsequent reheating to produce tempered martensite of the desired strength level.

#### NITRIDING

A process wherein a metal substrate is treated with an externally supplied source of nitrogen resulting in an increased nitrogen content of the metal by chemical reaction or diffusion.

#### NORMALIZING

A process of heating the metal above its critical temperature range and cooling in air thereby establishing a fine uniform grain size and improving microstructural uniformity.

#### PATENTING

A continuous process consisting of heating the metal to a temperature well above the upper critical temperature, then rapidly cooling through the critical temperature at a comparatively rapid rate to a predetermined elevated temperature, the cooling step being commonly effected in a fused metallic bath.

#### PRECIPITATION HARDENING

See definition for ageing above.

#### RECRYSTALLIZATION

A thermal treatment of previously worked metal to effect an equiaxed microstructure through the nucleation of strain free grains and the gradual consumption of the worked matrix by the growth of these grains.

#### SOLUTION TREATING

A process whereby an alloy system possessing decreasing solute solubility with temperature is treated to dissolve said solute in the parent phase. Subsequent quenching results in solute supersaturation and thus places the



metal alloy in a condition for age hardening. Also applied to heating a multi-phase metal alloy to an elevated temperature to dissolve one or more phases.

#### STRESS RELIEVING OR STRESS RELIEF ANNEALING

The heating of metal to a comparatively low temperature to relieve microstructural strain induced by working.

#### TEMPERING

Involves the heating of previously quenched or normalized metal alloy to an elevated temperature, and then cooling under suitable conditions to obtain the desired mechanical properties.

#### SUBCLASSES

#### 22 COMPOSITIONS:

This subclass is indented under the class definition. Compositions employed in the treatment of solid metal and processes for preparing same when not otherwise classifiable.

- (1) Note. In this subclass are collected, for example, compositions specialized for use in masking areas of metal surface to protect said areas during the metal treatment, e.g., the use of protective paint on localized areas during carburizing or nitriding treatments.
- (2) Note. The rules for determining Class placement of the Original Reference (OR) for claimed chemical compositions are set forth in the Class Definition of Class 252 in the SECTION LINES WITH OTHER CLASSES AND WITHIN THIS CLASS, subsection COMPOSITION CLASS SUPERIORITY, which includes a hierarchical ORDER OF SUPERIORITY FOR COMPOSITION CLASSES.

#### SEE OR SEARCH CLASS:

- 106, Compositions: Coating or Plastic, for coating or plastic compositions in general.
- 427, Coating Processes, subclass 259 for a coating process including utilizing a masking coating.

- 510, Cleaning Compositions for Solid Surfaces, Auxiliary Compositions Therefor, or Processes of Preparing the Compositions, subclasses 245 through 274 for metal cleaning compositions, particularly subclasses 258+ and 269+ for pickling compositions.

#### 23 Fluxing:

Compositions which contain a substance which facilitates uniting by fusion in such processes as welding, soldering and coating.

- (1) Note. This subclass and indented subclasses 24 to 26, also take methods of fluxing using a particular composition, even when that method is designated as a method of soldering, brazing or welding.

#### SEE OR SEARCH CLASS:

- 75, Specialized Metallurgical Processes, Compositions for Use Therein, Consolidated Metal Powder Compositions, and Loose Metal Particulate Mixtures, appropriate subclasses for fluxing compositions specialized for use in metallurgical processes.
- 228, Metal Fusion Bonding, subclasses 214+ for methods of soldering, brazing or welding which include, but are not restricted to, the step of fluxing by the use of a particular composition.

#### 24 Metallic:

The composition as applied contains metal particles.

#### SEE OR SEARCH CLASS:

- 75, Specialized Metallurgical Processes, Compositions for Use Therein, Consolidated Metal Powder Compositions, and Loose Metal Particulate Mixtures, subclasses 252+ for a loose mixture of metal particles and non-metal particles which may be fluxing agents. Where such a mixture is claimed, and the mixture is disclosed of use only for fluxing of solid metal and only in combination with a vehicle, that is, a binder, slurring agent, etc., the patent is placed here and cross-referenced in Class 75, subclasses 252+.

- 106, Compositions: Coating or Plastic, subclass 1.05 for metal-depositing compositions which may contain metal particles, a flux and a vehicle.
- 228, Metal Fusion Bonding, subclass 56 for comparison with this subclass (24).
- 428, Stock Material or Miscellaneous Articles, subclasses 558 and 560+ for metallic stock material which often contains fluxing ingredients.
- 25 Oleaginous:**  
The composition contains an oil or fat.
- 26 Inorganic:**  
Composed wholly of inorganic substances when applied to the metal.
- 27 Heat treating:**  
Compositions for treating solid metal when in a heated condition.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
13.1+, for heat treatment processes utilizing special compositions.  
27+, for heat treating compositions applied to the surface of the metal work in the nature of a granular deposit or coating.
- SEE OR SEARCH CLASS:  
252, Compositions, for heat exchange and related compositions, per se. This and indented subclasses of Class 148 provide for patents directed to metal heat treating compositions where, in addition to the heat exchange function the composition, or any of its constituents, reacts chemically, with the metal or any of its alloy constituents to form coatings, metal compounds, etc., or to case harden the work.
- 28 Liquid:**  
The composition is in a liquid condition when brought into contact with the hot metal.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
18, and 20.6, for processes of heat treating while contacting the metal with a liquid.
- 29 Oleaginous:**  
The liquid composition contains an oil or fat.
- 30 Carbonaceous:**  
The composition contains available carbon, which it gives up to the heated metal.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
19, for processes of heat treating ferrous alloys for heat treating while contacting the metal with a carbonaceous solid.
- 33 BARRIER LAYER STOCK MATERIAL, P-N TYPE:**  
This subclass is indented under the class definition. Electrically semiconductive stock which is essentially homogeneous and has at least two contiguous layers differing in the number of unbound electrons and/or differing in energy gap levels, which exhibit a junction between the layers.
- (1) Note. A semiconductive material is an electronic conductor whose resistivity at room temperature is in the range  $10^{-2}$  to  $10^{-9}$  ohm-cm (which is between metals and insulators), in which the electric charge carrier concentration increases with increasing temperatures over some temperature range. Certain semiconductive material possess two types of carriers, namely negative electrons and positive holes. The essential difference between a semiconductor and a metal is that the number of free electrons in the former is very small, the energy band being either entirely full or entirely empty, except for a few electrons and holes created by thermal excitation (intrinsic semiconductor) or by the presence of impurities. By energy gap is meant the energy range between the bottom of the conduction band and the top of the valence band. The vacant energy levels in the valence band are defined as holes.

## SEE OR SEARCH CLASS:

- 117, Single-Crystal, Oriented-Crystal, and Epitaxy Growth Processes: Non-Coating Apparatus Therefor, particularly subclasses 22+ for liquid phase single crystallization techniques of the melt-pull type which produce adjoining crystals of different composition (i.e., junction formation), subclasses 56+ for liquid phase epitaxial growth techniques involving a change in a growth-influencing parameter (e.g., multilayer or junction or superlattice formation), subclasses 89+ for chemical vapor deposition techniques of forming a single crystal involving a change in a growth-influencing parameter (e.g., multilayer or junction or superlattice formation), and subclass 105 for vapor deposition techniques of forming a single crystal involving a change in a growth-influencing parameter (e.g., multilayer or junction or superlattice formation).
- 136, Batteries: Thermoelectric and Photoelectric, subclasses 236.1+ for thermoelectric compositions wherein at least two elements of a battery are claimed; particularly subclasses 238 and 239 for semiconductive materials.
- 252, Compositions, subclass 62.3 for compositions specialized and designed for use as one member of two whose interface exhibits barrier layer properties, e.g., either P-type or N-type.
- 257, Active Solid-State Devices (e.g., Transistors, Solid-State Diodes), appropriate subclasses for an active solid-state devices many of which include a barrier layer.
- 428, Stock Material or Miscellaneous Articles, subclasses 615+ for a metallic composite defined in terms of the composition of its components, especially subclass 620 for such composite having a semiconductor component, but no P-N junction.
- 438, Semiconductor Device Manufacturing: Process, for methods of making semiconductor structures possessing a barrier layer; see the search notes therein.
- 33.1 With contiguous layer doped to degeneracy:**  
This subclass is indented under subclass 33. Stock which has two contiguous layers of semiconductive material doped to degeneracy.
- (1) Note. The term “degenerate” indicates a sufficiently high concentration of carriers so that the material acts essentially like a conductor rather than a semiconductor.
- (2) Note. The contiguous degenerate doped layers exhibit a junction width on the order of 200 angstroms.
- 33.2 With recess, void, dislocation, grain boundaries or channel openings:**  
This subclass is indented under subclass 33. Stock in which at least one layer contains voids, dislocations, grain boundaries or channel openings.
- (1) Note. The structural characteristics referred to in this subclass may be present in the semiconductive material by design prior to formation of contiguous layers or subsequent to the formation thereof.
- 33.3 With non-semiconductive coating thereon:**  
This subclass is indented under subclass 33. Stock combined with a nonsemiconductive coating.
- 33.4 With contiguous layers of different semiconductive material:**  
This subclass is indented under subclass 33. Stock in which the material in at least two contiguous layers, which are considered the semiconductors, is of different compositions.
- 33.5 Having at least three contiguous layers of semiconductive material:**  
This subclass is indented under subclass 33. Stock comprising three or more contiguous layers of semiconductive material.
- 33.6 Including an alloy layer having named impurities:**  
This subclass is indented under subclass 33.5. Stock including at least one alloyed layer of semiconductive material having named impurities.

**95 PROCESS OF MODIFYING OR MAINTAINING INTERNAL PHYSICAL STRUCTURE (I.E., MICROSTRUCTURE) OR CHEMICAL PROPERTIES OF METAL, PROCESS OF REACTIVE COATING OF METAL AND PROCESS OF CHEMICAL-HEAT REMOVING (E.G., FLAME-CUTTING, ETC.) OR BURNING OF METAL:**

This subclass is indented under the class definition. Subject matter which relates to (1) a process of modifying or maintaining the internal physical structure (i.e., microstructure) or chemical properties of metal not elsewhere provided, (2) a process of reactive coating of metal, and (3) a process of chemical-heat removing (e.g., flame-cutting, etc.) or burning (i.e., oxidizing) of a portion of a metal workpiece.

- (1) Note. Most subject matter herein will relate to processes of treating solid or semisolid metal with heat without melting a substantial portion thereof and will also include the combination of significant heating and working not provided for in the other metal working classes. However, casting or casting and working of molten metal, if combined with heat treatment to change the microstructure of a solid metal resulting therefrom, is acceptable to this class.
- (2) Note. For purposes of distinguishing over the metal working classes, significant heat treatment occurs when the temperature or heating or cooling rate is provided for in a nonworking treating step or when microstructure description is utilized in the claim. Working at a specified temperature is not a significant heat treatment without mention of microstructure. The mere use of the term "ageing" or "tempering" will be considered significant heat treatment. Except for "work hardening", the use of the term "hardening" will be considered significant heat treatment. "Quenching" will be considered significant heat treatment lacking an indication that it means simply returning to a convenient working temperature. "Stress-relief-annealing" will remain in the metal working

classes. Working metal in the "superplastic" state or during "dynamic-recrystallization" remains in the working classes unless a temperature is provided. "Ion implantation" will be a sufficient indication of microstructural change to place classification in Class 148. When combined with working, "annealing", per se, will remain in the metal working classes. However, annealing at a specified temperature goes in Class 148. Merely, heating or cooling a metal to a working temperature is not significant heat treatment. However, the presence in any step of a significant heat treatment as hereinabove described is sufficient to place the classification in Class 148.

- (3) Note. The presence of carburizing, nitriding, or reactive coating is sufficient to place the classification in Class 148, even if a metal working step is present.

**96 Superconductive metal or alloy (i.e., superconductive T<sub>c</sub> at or below 30° K):**

This subclass is indented under subclass 95. Process wherein a metal or an alloy of metal that develops zero resistance to electrical current flowing therethrough at or below 30° Kelvin is the metal being treated.

**SEE OR SEARCH CLASS:**

- 29, Metal Working, subclass 599 for processes of producing superconductor without microstructural change or alloying (e.g., by diffusion) and having superconductive T<sub>c</sub> at or below 30° K.
- 505, Superconductor Technology: Apparatus, Material, Process, appropriate subclasses for a process of treating metal or metal alloy that becomes superconducting above 30° Kelvin and for cross-reference art collections relating to superconducting technology.

**97 Particle (e.g., ion, neutron, etc.) bombardment or electromagnetic wave energy (e.g., laser, etc.):**

This subclass is indented under subclass 96. Process wherein a superconducting precursor or superconducting metal is subjected (1) to

particle (e.g., ion, neutron, etc.) bombardment for purposes other than implantation or (2) to electromagnetic wave energy (e.g., laser, etc.).

**98 Producing or treating an A3B (e.g., Nb<sub>3</sub>Sn, V<sub>3</sub>Ga, Nb<sub>3</sub>Al, etc.) superconducting alloy:**

This subclass is indented under subclass 96. Process wherein an intermetallic superconducting alloy having three parts of metal A to one part of metal B present, often identified as an A3B (e.g., Nb<sub>3</sub>Sn, V<sub>3</sub>Ga, Nb<sub>3</sub>Al, etc.), and said to have an A-15 crystal structure is produced or treated.

(1) Note. This subclass accepts implantation of another metal or element into the A3B structure.

**99 Treating in extraterrestrial environment (e.g., space, moon, etc.) or zero gravity environment:**

This subclass is indented under subclass 95. Treating in extraterrestrial environment (e.g., space, moon, etc.) or zero gravity environment: Process wherein a metal or metal alloy is treated at any stage in an environment outside of the atmospheric mantle surrounding earth (e.g., space, moon, etc.) or in a zero gravity environment.

**100 Magnetic materials:**

This subclass is indented under subclass 95. Processes which include developing, improving, modifying, or preserving the magnetic properties of a free metal or alloy, occurring alone or mixed with one or more other components.

(1) Note. Most of the patents in subclasses 100 through 122 relate to the production of stock material such as billets, rods, dust cores, powder, etc., having magnetic properties which are different from those of the starting material.

(2) Note. Subclasses 100 through 122 take all types of processes of the type defined therein except those restricted to changing the magnetic properties of a metal, and wherein such change is effected by:

(a)electrolysis, provided for in Class 205, Electrolysis: Processes, Composi-

tions Used Therein and Methods of Preparing the Compositions.

(b)casting a metal and treatment of the metal before removal from a mold, provided for in Class 164, Metal Founding.

(c)Class 335, Electricity: Magnetically Operated Switches, Magnets, and Electromagnets, subclasses 209+ for magnets and electromagnets in general especially subclass 284 for patents relating to magnetizing or demagnetizing, also Class 336, Inductor Devices, appropriate subclasses.

(d)the formation of a coating on a metal base provided for in subclasses 240+ of this class or Class 427, Coating Processes, appropriate subclasses, respectively, depending on whether the coating is accomplished with or without a chemical reaction with the metal base.

(3) Note. The material being treated must contain a free metal or alloy component which is intentionally included therein. Treatment of such material, except as indicated in (2) Note, will result in classification in Class 148 unless there is a clear indication that such treatment has no effect upon the internal structure of the metal. This factor is of particular importance in connection with subclass 104.

(4) Note. Processes reciting some step in addition to heat treatment and/or working are classified in this subclass, rather than in one of subclasses 120, 121 or 122, e.g., combined processes reciting heat treatment and/or working combined with any of the steps of manipulation, pickling, impregnating, etching, winding, broad magnetizing, etc., are placed in this subclass and cross-referenced to the appropriate one of subclasses 120 to 122. However, some operations which amount to no more than that of "providing" the material, such as a broad casting of the metal or the mere alloying of specified metals making up the material whose magnetic properties are to be altered, are not suffi-

cient, by themselves, to place a combined process in this subclass. In such cases classification will be in the appropriate indented subclass.

- (5) Note. Processes of producing metal powder, of the type classifiable in Class 420, Alloys or Metallic Compositions, accompanied by broad treatment in a magnetic field, not carried out simultaneously with another operation, are classified in Class 148 subclass 100 and in indented subclass 108 when such treatment is significantly recited. Where the material has permanent magnet properties, such processes are classified in subclasses 101+.

**SEE OR SEARCH THIS CLASS, SUBCLASS:**

300+, for magnetic stock resulting from processes of subclasses 100 through 122, not recited in terms of significant external structure. A claim reciting a particular orientation of crystals relates to internal structure and belongs in subclasses 300+.

**SEE OR SEARCH CLASS:**

29, Metal Working, subclasses 602.1+, for (1) methods of manufacturing magnets or parts thereof, having metallic material as an active magnetic component which, in addition to the manufacturing steps, recite no procedure other than broad treatment in a magnetic field, for intentionally modifying the magnetic properties of the work, or (2) methods of manufacturing magnets from nonmetallic materials which recite some step in addition to one or more of the following: making the composition, molding, heat treatment, magnetizing. Processes restricted to any or all of the four named operations are classified in Class 252, Compositions, subclasses 62.51+, unless the molding is recited significantly in which case the process is classified in Class 264, Plastic and Nonmetallic Article Shaping or Treating: Processes, subclasses 427+.

- 75, Specialized Metallurgical Processes, Compositions for Use Therein, Consolidated Metal Powder Compositions, and Loose Metal Particulate Mixtures, subclasses 343+ for processes of preparing free metals or alloys, or mixtures thereof in powder form, where the process does not modify any inherent magnetic properties that may be present in the material or where the magnetic properties of the material produced are due entirely to the size and/or shape of the particles.
- 252, Compositions, subclasses 62.51+ for processes of preparing magnetic compositions and the compositions resulting therefrom as well as such processes combined with heat treating, magnetizing and broad molding, taken singly or in combination, except where a metallic component is intentionally present in the composition and the magnetic properties of such component are modified by some step of the process, in which case the process belongs in Class 148, Metal Treatment, subclasses 100+.
- 335, Electricity: Magnetically Operated Switches, Magnets, and Electromagnets, subclasses 296+ for magnets or electromagnets with significant structural details.
- 336, Inductor Devices, appropriate subclasses for inductor devices with significant structural details.
- 361, Electricity: Electrical Systems and Devices, subclass 267 for demagnetizing methods and apparatus.
- 420, Alloys or Metallic Compositions, appropriate subclasses for alloys designated as "magnetic" or "permanent magnet" where no more specific designation of their magnetic properties is set forth.
- 428, Stock Material or Miscellaneous Articles, subclass 611 for metallic stock material having magnetic properties coordinated with its shape.

**101 Permanent magnet:**

This subclass is indented under subclass 100. Processes carried out with material intended for use as a permanent magnet.

- (1) Note. Processes conforming to the above definition, including broad treatment in a magnetic field or broad magnetizing, not carried out simultaneously with another operation, are placed in this subclass. Such processes including a specific step of treatment in a magnetic field or of magnetizing, are placed in subclass 103 unless age hardening is included, in which case the patent is placed in subclass 102 and cross-referenced in subclass 103.
- (2) Note. This subclass and the indented subclasses 102 and 103 take processes of treating magnetic material under the definition thereof, wherein the material at some stage of the process is in comminuted form.

**SEE OR SEARCH THIS CLASS, SUBCLASS:**

300+, for permanent magnetic material resulting from processes classifiable in subclasses 101 to 103, not recited in terms of significant external structure.

**SEE OR SEARCH CLASS:**

29, Metal Working, subclasses 607 and 608 for processes of manufacturing permanent magnets not coming within the definitions of Class 148, subclasses 101 to 103, or Class 252, Compositions, subclasses 62.51+. The line involving these three classes is stated in (3) Note and in the search note to Class 29 under the definition of subclass 100 of Class 148.

252, Compositions, subclasses 62.51+ for processes as described in the search note to Class 252 under the definition of subclass 100 of Class 148, where the products are permanently magnetic.

**102 Age hardening:**

This subclass is indented under subclass 101. Processes which include age hardening.

**103 Treatment in a magnetic field:**

This subclass is indented under subclass 101. Processes, including a significant treatment in a magnetic field.

- (1) Note. The processes of this subclass include at least one step of magnetizing or other treatment in a magnetic field, e.g., making the material magnetically anisotropic.

**SEE OR SEARCH THIS CLASS, SUBCLASS:**

108, for methods of modifying the magnetic properties of a metal not capable of use as a permanent magnet, and not classifiable in subclasses 104 or 105, involving the significant application of a magnetic field to the work.

**SEE OR SEARCH CLASS:**

335, Electricity: Magnetically Operated Switches, Magnets, and Electromagnets, subclass 284 for devices for magnetizing or demagnetizing magnets or electromagnets.

361, Electricity: Electrical Systems and Devices, subclass 267 for demagnetizing methods and apparatus.

**104 Dust cores:**

This subclass is indented under subclass 100. Processes in which comminuted metallic material, the particles of which are usually separated from each other by electrically insulating material, is compacted into self-sustaining form, or in which a previously produced dust core is subjected to a treatment not classifiable elsewhere.

- (1) Note. For the line involving Classes 29, 148 and 252 relative to methods of producing magnetic material or stock, see (3) Note and the search notes following the definition of subclass 100 of this class.
- (2) Note. To be classified in this subclass, a process must recite a treatment in addition to that of compacting, which alters or preserves the magnetic properties of the material.

SEE OR SEARCH THIS CLASS, SUBCLASS:

513, for processes of heat treating particulate metal not involving altering the magnetic properties thereof.

SEE OR SEARCH CLASS:

252, Compositions, subclass 62.51 for processes of making magnetic compositions, including the steps of magnetizing and/or broad molding, even though a metallic component is intentionally included in the composition providing the composition is not subjected to a heat treatment which alters the internal structure of such component. See the search note to Class 252 under Class 148, subclass 100.

336, Inductor Devices, subclass 223 and 234 for dust cores recited in terms of significant structure.

#### 105 **Particulate material:**

This subclass is indented under subclass 100. Processes wherein the material is in particulate form at the time its magnetic properties are altered, as well as at the end of the process.

(1) Note. The products of processes of this subclass are in the form of powder, granules, flakes, lumps, etc.

SEE OR SEARCH THIS CLASS, SUBCLASS:

513, for processes of heat treating particulate metal not involving altering the magnetic properties thereof.

#### 108 **Treatment in a magnetic field:**

This subclass is indented under subclass 100. Processes including the significant application of a magnetic field to the work.

SEE OR SEARCH THIS CLASS, SUBCLASS:

100, for combined processes not classifiable in subclasses 101 through 105, reciting a broad step of magnetizing which is not performed simultaneously with another operation.

103, for processes involving the significant application of a magnetic field to permanent magnet material.

#### 110 **Silicon steel:**

This subclass is indented under subclass 100. Processes, restricted to the treatment of steel having at least 0.4% silicon.

(1) Note. A process reciting "silicon steel", and not specifying the silicon content, will be placed in this subclass if it comes within the definition of subclass 100.

(2) Note. The patents of this subclass embrace a larger combination of steps than those which are classified in indented subclasses 111 to 113, e.g., many of the patents of this subclass recite coating, pickling, or manipulation in addition to working and/or heat treatment. However, some operations which amount to no more than that of "providing" the material, such as a broad casting of the metal or the mere alloying of specified metals making up the material whose magnetic properties are to be altered, are not sufficient, by themselves, to place a combined process in this subclass. In such cases, classification will be in the appropriate indented subclass.

SEE OR SEARCH THIS CLASS, SUBCLASS:

120+, for processes not classifiable in subclasses 100 to 108 for altering the magnetic properties of metallic material other than silicon steel.

579+, for processes of treating silicon steels which do not alter the magnetic properties of the material.

#### 111 **Working:**

This subclass is indented under subclass 110. Processes restricted to working or working and heat treatment.

#### 112 **Heat treatment:**

This subclass is indented under subclass 110. Processes restricted to heating and/or cooling.



**113 With special compositions:**

This subclass is indented under subclass 112. Processes wherein the work is in contact with a special composition or atmosphere which does not form a reactive coating with the base, and wherein the work is not subjected to a mechanically applied force.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 110, for processes wherein silicon steel is subjected to a substantial force, as by clamping, while in contact with a special material or composition without effecting any change in shape or dimensions.
- 240+, for processes wherein the only treatment employed, to alter the magnetic properties of a metallic material, is a reactive coating of a metal base.
- 625+, for other heat treating of ferrous metal with special compositions.

**120 Working:**

This subclass is indented under subclass 100. Processes restricted to working, or working and heat treatment.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 111, for processes of the type defined above when the material being treated is a silicon steel.

**121 Heat treatment:**

This subclass is indented under subclass 100. Processes restricted to heating and/or cooling.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 112, for processes of the type defined above when the material being treated is a silicon steel.

**122 With special compositions:**

This subclass is indented under subclass 121. Processes wherein the work is in contact with a special composition or atmosphere which does not form a reactive coating with the base and wherein the work is not subjected to a mechanically applied force.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 100, for processes wherein the work is subjected to a substantial force, as by clamping, while in contact with a special material or composition.
- 240+, for processes wherein the only treatment employed, to alter the magnetic properties of a metallic material, is a reactive coating of a metal base.

**194 Chemical-heat removing (e.g., flame-cutting, etc.) or burning of metal:**

This subclass is indented under subclass 95. Process which is directed to utilizing chemically generated heat to remove or sever a portion from a solid or semisolid metal workpiece by localized burning (i.e., oxidization) or by localized melting (e.g., flame-cutting, etc.).

SEE OR SEARCH CLASS:

- 164, Metal Founding, particularly subclass 460, wherein there is flame-cutting of a cast product while a continuous portion of the cast product is still associated with the casting mold and see (2) Note thereunder.
- 166, Wells, particularly subclass 297 for a process of in situ chemical-heat cutting of metal structures in the earth.
- 219, Electric Heating, appropriate subclasses for the utilization of arc, plasma, laser or other electrically generated heat cutting and particularly subclass 69.1 for oxygen assisted arc cutting, per se.

- (1) Note. In general, heat cutting and chemical-heat removing or burning of metal will go to Class 148. A special line evolved in Class 219 wherein arc-cutting in air or with Oxygen assisted arc-cutting (see Class 219, subclass 69.1, (1) Note) remained in Class 219 regardless of the oxidation reaction involved.

**195 Control responsive to sensed condition of workpiece:**

This subclass is indented under subclass 194. Process including sensing or determining a variable condition of a metal workpiece and

- controlling the process in response to the sensed or determined condition.
- 196 Program or pattern control:**  
This subclass is indented under subclass 194. Process wherein a template or program generated function controls a cutting action by causing a chemical-heating means to move in response to the template or program.
- 197 Utilizing fluid contact other than flame:**  
This subclass is indented under subclass 194. Process wherein an auxiliary gas or liquid, utilized for purposes other than chemical generation of heat, is brought into contact with a workpiece for any reason; such as, for collecting or ensnaring solid refuse or waste material produced by the removing or burning process or for quenching or cooling operations.
- 198 With solid additive:**  
This subclass is indented under subclass 194. Process wherein a solid treating agent is utilized on a workpiece or within a flame to assist removing material from or burning of a workpiece.
- 199 Metal powder:**  
This subclass is indented under subclass 198. Process wherein a solid agent is in the form of free metal powder.
- 200 Of edge or corner (e.g., deburring, etc.):**  
This subclass is indented under subclass 194. Process wherein an edge or corner of a workpiece is subjected to chemical-heat removing or burning, per se, of all or a portion of an existing edge or corner of a workpiece.
- 201 Cylindrical workpiece:**  
This subclass is indented under subclass 194. Process wherein a workpiece is of circular cross-section (e.g., rod, roll, tube, etc.).
- 202 Scarfing (e.g., desurfacing, planing, gouging, etc.):**  
This subclass is indented under subclass 194. Process wherein a surface of a metal workpiece is subjected to chemical-heat to remove shards or small protuberances therefrom in a desurfacing, planing, or gouging operation.
- 203 Simultaneous removing or burning of multiple sides of workpiece:**  
This subclass is indented under subclass 202. Process wherein a removing or burning heat concurrently impinges plural faces of a workpiece.
- 204 Flame piercing:**  
This subclass is indented under subclass 194. Process wherein a metal workpiece is subjected to chemical-heat to form an aperture or opening by completely burning away a portion that initially resided at the location of an aperture or opening without actually providing plural pieces.
- 205 Plural nozzles or plural work-contacting jets:**  
This subclass is indented under subclass 194. Process wherein plural nozzles or plural gaseous jets contact a workpiece for purposes of chemical-heat cutting or other treatment thereof.
- (1) Note. This subclass excludes gaseous jets either as surrounding or combining gaseous streams which mix or combine in a single nozzle or which result in only one gaseous stream that contacts the workpiece.
- 206 Carburizing or nitriding using externally supplied carbon or nitrogen source:**  
This subclass is indented under subclass 95. Process wherein a metal substrate or workpiece is treated with an externally supplied source of carbon or nitrogen or both resulting in the carburization or nitriding of a metal by chemical reaction or diffusion.
- (1) Note. Carburizing or nitriding most often results in a chemical reaction forming a metal compound. However, if there is a positive indication of merely diffusion into the metal substrate without a chemical reaction (e.g., carbide or nitride formation, etc.) placement is proper hereinunder if from an external supply of carbon or nitrogen.
- (2) Note. Carburizing or nitriding combined with a step of melting a metal surface is proper hereinunder.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

278, for processes of reactive coating wherein a carbide coating is obtained by reaction of a noncarbon containing external reactive agent (e.g., metal, etc.) which deposits on a metal alloy base and carbon in the alloy base out-diffuses or reacts with the agent to form a metal carbide coating on said base.

SEE OR SEARCH CLASS:

75, Specialized Metallurgical Processes, Compositions for Use Therein, Consolidated Metal Powder Compositions, and Loose Metal Particulate Mixtures, appropriate subclasses for processes of reacting a carbon or nitrogen source with a molten mass of metal to increase the carbon or nitrogen content of the metal.

423, Chemistry of Inorganic Compounds, appropriate subclasses for processes of producing a metal carbide or metal nitride (i.e., not a coated metal), per se, by reacting a metal with a source of carbon or nitrogen.

427, Coating Processes, appropriate subclasses for processes, per se, of depositing a carbide or nitride on a metal or metal alloy base wherein the base does not supply the source of the carbon or nitrogen or the metal which forms the carbide or nitride (e.g., chemical vapor deposition of a metal carbide on a metal base).

- (1) Note. A metal layer on a metal oxide layer if completely reacted with an external source of carbon to provide a metal carbide layer on the metal oxide layer goes as original to Class 427 since no metal layer remains adjacent the metal carbide layer and there was no metal substrate directly carburized. To simplify the line remember that, if coating is involved, the carburized or nitridized reaction product must remain adjacent or contiguous with a metal substrate for the process to remain in Class

148. This will apply whether or not the metal substrate remaining after reaction was the source of the metal in the reacted layer. Also, if no metal substrate remains with the product, placement goes to Class 427 even if the reaction product was produced from a metal substrate.

**207 Carburizing or nitriding uniformly throughout the entire mass (i.e., internal carburizing):**

This subclass is indented under subclass 206. Process in which carburizing or nitriding is not limited to the surface of a metal or metal alloy and which occurs throughout the entire metal substrate.

- (1) Note. This is not to be confused with carburizing or nitriding which produces a case or layer of increased carbon or nitrogen content on the external surface of a metal or metal alloy substrate.

**208 With decarburizing or denitriding:**

This subclass is indented under subclass 206. Process which includes at some stage in the process a procedure for elimination or reduction of the carbon content or the nitrogen content of a metal substrate by chemical or physical-chemical procedures and does not include mechanical procedures (e.g., grinding) for removal of the carbon or nitrogen containing metal.

**209 Utilizing particulate fluid bed:**

This subclass is indented under subclass 206. Process in which a particulate fluid bed is utilized at any stage in a process of treating a metal or metal alloy for purposes of heat transfer or carburization or nitridization or both.

**210 Of selected surface area (e.g., zone, top only, etc.):**

This subclass is indented under subclass 206. Process wherein only a partial area (e.g., zone, etc.) or portion (e.g., top only, etc.) of a work-piece surface is subjected to carburization or nitridization.

- (1) Note. During carburizing or nitriding, penetration of carbon or nitrogen into the metal substrate or reaction therewith cre-

ates what is often referred to as a gradient referring to variation in composition with depth. This should not be confused with the zone or portion of the surface referred to in this subclass.

- 211 With working, machining, or cutting:**  
This subclass is indented under subclass 210. Process which includes a step of deforming a solid metal or mechanically cutting or grinding away of portions of a solid metal to produce a desired shape or form.
- 212 Nitriding:**  
This subclass is indented under subclass 210. Process which involves exposing a metal substrate or workpiece to an external reactive agent containing nitrogen that causes formation of a nitrogen enriched layer by reacting with the metal substrate or workpiece at any stage in the process.
- 213 Utilizing attached protective shield, mask or coating:**  
This subclass is indented under subclass 210. Process wherein a portion of a workpiece is covered with a temporary protective shield, mask or coating that prohibits the carburizing or nitriding action in an area to which it is attached and which is not intended to remain a part of the final product and acts in transitory manner to achieve the carburizing or nitriding of a selective surface area.
- 214 With noncarburizing or non-nitriding coating:**  
This subclass is indented under subclass 213. Process which includes a coating step other than carburizing or nitriding.
- 215 Measuring, sensing, or testing:**  
This subclass is indented under subclass 206. Process which includes a recited step of measuring, sensing, or testing at any stage in the process.
- 216 Of gas composition (e.g., carbon content, etc.):**  
This subclass is indented under subclass 215. Process which includes a step of measuring, sensing, or testing of the composition of a gaseous environment or of input or exhaust gases of the process.
- 217 With noncarburizing or non-nitriding reactive coating (e.g., oxidizing, siliconizing, boronizing, etc.):**  
This subclass is indented under subclass 206. Process which includes a distinct and separate operation involving coating of a metal or metal alloy substrate with a material that reacts with the metal to provide a coating thereon containing the reaction product of the metal with an externally supplied reactant other than a carburizing or nitriding reactant.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
240, through 297, for processes of reactive coating of metal not involving carburizing or nitriding.
- 218 Combined carburizing and nitriding (e.g., carbonitriding, nitrocarburizing, etc.):**  
This subclass is indented under subclass 206. Process wherein a carburizing and a nitriding reaction occurs in the same process.
- 219 With working, machining, cutting, or post-carburizing and post-nitriding heating or quenching:**  
This subclass is indented under subclass 218. Process which includes either (1) a step of deforming solid metal or mechanically cutting or grinding away of portions of solid metal to produce a desired shape or form, or (2) a post-carburizing or post-nitriding heating or sudden cooling (i.e., quenching) operation.
- 220 With producing or treating of workpiece having plural noncarburized or non-nitrided layers or mechanically engaged article or stock:**  
This subclass is indented under subclass 206. Process which includes producing or treating of (1) a workpiece having plural noncarburized or non-nitrided layers, or (2) mechanically engaged article or mechanically engaged stock.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
516, for noncarburizing or non-nitriding processes of producing or treating of layered, bonded, welded, or mechanically engaged stock or article.

- 221 With casting or solidifying from melt:**  
This subclass is indented under subclass 206. Process wherein a metal or metal alloy is cast or a total mass (i.e., not just a portion or coating) of metal is solidified from a melted state.
- (1) Note. Coating from a melt is excluded from this subclass even though the coating is solidified.
- 222 Utilizing ionized gas (e.g., plasma, etc.) or electron arc or beam:**  
This subclass is indented under subclass 206. Process which uses at any process stage an ionized gas (e.g., plasma, etc.) or an electron arc or beam.
- 223 Including use of vacuum:**  
This subclass is indented under subclass 206. Process which includes use of a vacuum at any stage in the process.
- 224 Utilizing wave energy (e.g., laser, etc.) or electric heating with work as conductor:**  
Process under 206 which uses wave energy (e.g., laser, etc.) or electric heating with a metal workpiece as a conductor by passing a current of electricity through the workpiece to cause heating thereof at any stage in the process.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
222, for a process which uses ionized gas (e.g., plasma, etc.) or an electron arc or beam.
- 225 Iron (Fe) or iron base alloy:**  
This subclass is indented under subclass 206. Process wherein a metal workpiece undergoing carburizing or nitriding is iron or an iron alloy containing greater than 50 percent iron.
- 226 With working, machining, or cutting:**  
This subclass is indented under subclass 225. Process which includes a step of deforming the solid metal or mechanically cutting or grinding away of portions of the solid metal to produce a desired shape or form.
- 227 Utilizing fused agent or media:**  
This subclass is indented under subclass 225. Process wherein an agent or media in the melted or molten state is utilized at any stage in the process for any purpose.
- 228 Nitriding:**  
This subclass is indented under subclass 227. Process which involves exposing a metal substrate or workpiece to an external reactive agent containing nitrogen that causes formation of a nitrogen enriched layer by reacting with the metal substrate or workpiece at any stage in the process.
- 229 With post-carburizing quenching:**  
This subclass is indented under subclass 227. Process which includes a post-carburizing sudden cooling (i.e., quenching) operation.
- 230 Nitriding:**  
Process under 225 which involves exposing a metal substrate or workpiece to an external reactive agent containing nitrogen that causes formation of a nitrogen enriched layer by reacting with the metal substrate or workpiece.
- 231 Utilizing nitrogen containing agent other than ammonia or elemental nitrogen:**  
This subclass is indented under subclass 230. Process wherein a nitrogen containing agent other than ammonia or elemental nitrogen is utilized.
- 232 With post-nitriding heating or quenching:**  
This subclass is indented under subclass 230. Process which includes a post-nitriding heating or sudden cooling (i.e., quenching) operation.
- 233 With post carburizing heating or quenching:**  
This subclass is indented under subclass 225. Process which includes a post-carburizing heating or sudden cooling (i.e., quenching) operation.
- 234 Utilizing agent containing cyano (CN) radical or halogen (X) radical or metal carbonate:**  
This subclass is indented under subclass 225. Process which utilizes at any stage an agent containing a cyano (CN) radical or halogen

(X=Fluorine, Chlorine, Bromine or Iodine) radical or a metal carbonate.

**235 Utilizing hydrocarbon, oil or oxygenated hydrocarbon (e.g., alcohol, furan, carbohydrate, etc.):**

This subclass is indented under subclass 225. Process wherein hydrocarbon, oil or oxygenated hydrocarbon (e.g., alcohol, furan, carbohydrate, etc.) is utilized at any stage in the process.

**236 Utilizing solid carbonaceous material containing free carbon, coal, peat, or coke:**

This subclass is indented under subclass 225. Process wherein a solid carbonaceous material containing free carbon, coal, peat, or coke is utilized at any stage in the process.

**237 Refractory metal (i.e., Ti, V, Cr, Zr, Nb, Mo, Hf, Ta, W) or refractory base alloy:**

Process under 206 wherein a metal workpiece undergoing carburizing or nitridizing is a refractory metal (i.e., Ti, V, Cr, Zr, Nb, Mo, Hf, Ta, W) or alloy thereof containing greater than 50 percent of any one of the refractory metals.

**238 Nitriding:**

This subclass is indented under subclass 206. Process which involves exposing a metal substrate or workpiece to an external reactive agent containing nitrogen that causes formation of a nitrogen enriched layer by reacting with the metal substrate or workpiece at any stage in the process.

**239 With ion implantation:**

This subclass is indented under subclass 95. Process wherein an ionic species is directed at a substrate with sufficient energy to be deposited within the microstructure or interstitial spaces of a metal substrate.

SEE OR SEARCH THIS CLASS, SUBCLASS:

206+, for ion implantation of carbon or nitrogen which combines with the metal or metal substrate to form a coating thereon or to affect a composition change throughout.

SEE OR SEARCH CLASS:

204, Chemistry: Electrical and Wave Energy, appropriate subclasses for processes of coating a substrate utilizing ionic bombardment and sputtering from a target wherein the sputtered material becomes deposited on a metal substrate to form a coating thereon.

(1) Note. There is no intent to take sputter coating in this particular subclass of Class 148.

250, Radiant Energy, subclass 492.3 for processes of, per se, ion or electron beam irradiation.

427, Coating Processes, appropriate subclasses for processes of ion implanting, per se, or ion plating of the near surface region of substrates in general to provide a coating thereon.

(1) Note. There is no intent to take ion plating in this subclass of Class 148.

(2) Note. Class 427 will take simultaneous ion implantation and diffusion as proper for Class 427 if coating is present. However, inclusion of a separate step which by itself would be classifiable in Class 148 is enough to place the combination in Class 148. Moreover, a combination of a metal working step proper for one of the metal working classes and ion implantation for coating purposes will be proper for this subclass. Ion implantation throughout a metal substrate is not merely coating for Class 427 and since microstructural change is involved, placement will be considered proper for Class 148.

438, Semiconductor Device Manufacturing: Process, appropriate subclasses for ion implantation of a semiconductor substrate (e.g., for gettering, amorphousizing, or doping of semiconductor material to alter electrical characteristics, etc.).

**240 Processes of coating utilizing a reactive composition which reacts with metal substrate or composition therefore:**

This subclass is indented under subclass 95. Processes involving forming a layer of a coating on an elemental or alloyed metal substrate by applying thereto a material which reacts with the metal substrate to form a layer in whole or part thereon distinct from the metal, per se, to a composition which reacts with a metal substrate to form a coating thereon and to processes of preparing said reactive coating compositions.

- (1) Note. This subclass also includes compositions and processes of preparing same and methods of use which are not specifically provided elsewhere and which perfect the reactive coating processes. The perfecting of the reactive coating process may be either prior or subsequent to the coating process. Included herein are subcombinations where the reactive coating step is not claimed, per se, or wherein the composition or treatment involves a prior reacted metal substrate. In all instances there must be disclosure consistent with a coating process proper for this subclass.
- (2) Note. Coating for purposes of this subclass is consistent with the definition of coating as elaborated in Class 427, Coating Processes.
- (3) Note. Each of the subclasses under subclass 240 also provides for compositions. In those instances where the process of coating is not claimed or wherein a composition is claimed which is not coextensive with the coating process it is incumbent for proper placement to analyze the claim from the perspective of the step which allows the claim to be proper in subclass 240.
- (4) Note. Unless specifically noted as, for instance, that the material is reactive (subclasses 252, 254, and 256) or nonreactive (subclass 248) the material in the coating composition may or may not be reactive with the metal substrate. There must be, however, at least one material

in the composition which reacts with the base. For instance, a composition containing a nonreactive dicarboxylic acid and a reactive inorganic phosphorus material is classified in subclasses 253+.

- (5) Note. Included herein are processes of coating a nonmetallic material with a metal or alloy coating and subsequently forming a base supplied reacted coating thereon.
- (6) Note. This and the indented subclasses do not include case hardening, i.e., carburizing or nitriding processes and compositions therefore.

**SEE OR SEARCH THIS CLASS, SUBCLASS:**

206, through 238, for carburizing, nitriding, or both (e.g., carbonitriding) using an externally supplied source of carbon or nitrogen.

**SEE OR SEARCH CLASS:**

- 106, Compositions: Coating or Plastic, appropriate subclass for a coating composition which does not react with a metal substrate to form a coating thereon and wherein the metal substrate does not supply an ingredient of the formed coating.
- 134, Cleaning and Liquid Contact With Solids, appropriate subclass for processes of cleaning a metal surface.
- 204, Chemistry: Electrical and Wave Energy, subclasses 471+ for electrophoretic or electro-osmotic coating and subclasses 192.12+ for glow discharge sputter deposition. Plural coating processes wherein a Class 148 process precedes or is subsequent to a Class 204 process are proper in Class 204. A process involving electrophoresis, electro-osmosis, or cathode sputtering and wherein a chemical reaction between a metal substrate and a reactive coating material is involved is proper in Class 204.
- 205, Electrolysis: Processes, Compositions Used Therein, and Methods of Preparing the Compositions, subclasses 67+ for electroforming and subclasses 80+ for electrolytic coat-

- ing. Plural coating processes wherein a Class 148 process precedes or is subsequent to a Class 205 process are proper in Class 205. A process involving electrolysis and wherein a chemical reaction between a metal substrate and a reactive coating material is involved is proper in Class 205.
- 252, Compositions, subclasses 79.1+ for compositions for treating a metal substrate and wherein the disclosure is silent as to a subsequent chemical reaction with a reactive coating composition and which may react with a metal surface and subclasses 387+ for anticorrosion compositions which may react with a metal surface and which are added to a metal surface indirectly as through a circulating system rather than directly surface treating the metal with a composition.
- 427, Coating Processes, appropriate subclass for plural coating, processes wherein none of the steps involves a reaction of a metal or metal substrate with an exteriorly applied chemically reactive coating material. All combinations of plural coating methods, one of which is applied by a Class 148 method, are provided for in Class 148. Metals merely applied to a metal base unless otherwise stated are not considered to result in a reaction and are thus proper for Class 427. Nonmetals, e.g., C, B, Si, P, etc., applied to a metal substrate are considered to result in a chemical reaction unless otherwise stated are proper for Class 148.
- 428, Stock Material or Miscellaneous Articles, appropriate subclass for a coated metal product formed by a process of this subclass, and in particular, subclasses 472.1, 472.2 and 473.3.
- 445, Electrical Lamp or Space Discharge Component or Device Manufacturing, subclasses 9+ for creating a deposition layer within a space discharge device by reaction with a gaseous material or aerosol and subclass 14 for coating on a particular base material part or place.
- 510, Cleaning Compositions for Solid Surfaces, Auxiliary Compositions Therefor, or Processes of Preparing the Compositions, appropriate subclasses, particularly subclasses 245+ for compositions for cleaning a metal substrate and wherein the disclosure is silent as to a subsequent chemical reaction with a reactive coating composition and which may react with a metal surface.
- 520, Synthetic Resins or Natural Rubbers, appropriate subclass for a coating composition containing a synthetic resin or natural rubber and which composition does not react with a metal substrate to form a coating thereon and wherein the metal substrate does not supply an ingredient of the formed coating.
- 241 Testing or electrical or wave energy utilized:**  
This subclass is indented under subclass 240. Subject matter wherein a test, or electrical or wave energy is involved.
- (1) Note. For purposes of this subclass the test or the use of electrical or wave energy need not be part of the actual coating process. It is sufficient if any part of the claim involves a test, or involves electrical or wave energy.
- 242 Molten bath or molten surface utilized during reaction:**  
This subclass is indented under subclass 240. Subject matter wherein the coating material is a solid at ambient temperature but is in a partially or fully melted state or wherein the normally solid metal substrate is in a partially melted condition.
- 243 Liquid reactive coating composition utilized:**  
This subclass is indented under subclass 240. Subject matter wherein a material which is in liquid form contacts a metal substrate and reacts at the surface therewith to form a layer on the substrate which is distinct from the substrate.
- (1) Note. The material need not be liquid at ambient conditions, it must, however, be liquid under the conditions of use, e.g., molten, etc.



- (2) Note. A liquid for purposes of the subclass can contain solid materials, e.g., suspensions, slurries, dispersions, etc. The material must, however, have a continuous phase that allows it to flow readily and assume the form of its container.
- (3) Note. A solid reactant material which is to be dissolved in a liquid dispersant is proper for this subclass, additionally, a concentrate of a material which is to be applied to a metal substrate upon further dilution or which must be dissolved in a liquid for application is proper herein.

SEE OR SEARCH THIS CLASS, SUBCLASS:

242, wherein a reactive solid material in molten form is applied to a substrate.

**244 Dye or organic pigment containing:**

This subclass is indented under subclass 243. Subject matter wherein the reactive liquid coating composition contains an organic colorant, e.g., organic, dye, etc.

- (1) Note. The organic colorant can be applied simultaneously with the reactive coating material or can be the reactive material.

SEE OR SEARCH CLASS:

8, Bleaching and Dyeing; Fluid Treatment and Chemical Modification of Textiles and Fibers, in particular subclasses 506+, for processes of dyeing nontextile materials, and for processes of dyeing previously modified metal surfaces wherein the surface has been modified so as to be no longer in a free metal or alloyed state, and no claim exists as to the metal modification step.

**245 Electrically insulating coating formed which is more than mere oxide formation:**

This subclass is indented under subclass 243. Subject matter wherein the reaction product of the metal substrate and the reactive material is claimed or disclosed as being electrically insulating and is more than the formation of an oxide, per se.

- (1) Note. Processes wherein a material reacts with a metal substrate to provide a nonoxide coating are proper for this subclass.

SEE OR SEARCH THIS CLASS, SUBCLASS:

284+, for the formation of an oxide disclosed or claimed as being electrically insulating.

**246 Contains lubricant or oil or overcoat thereof:**

This subclass is indented under subclass 243. Subject matter wherein the coating composition contains an oil, or a material disclosed or claimed as a lubricant wherein the reacted product's surface is overcoated with an oil or a material disclosed or claimed as a lubricant.

- (1) Note. In a reactive coating composition containing an oil or lubricant material it is possible for the oil or lubricant to be reactive with the metal substrate.

**247 Contains an atom of hafnium, titanium or zirconium (excludes activating composition):**

This subclass is indented under subclass 243. Subject matter wherein the reactive liquid coating composition contains at least one atom of hafnium, titanium or zirconium in either elemental or compound form and wherein said materials are not activators.

- (1) Note. The hafnium, titanium or zirconium materials need not be reactive with the substrate to be proper for placement in this subclass.

**248 Contains nonreactive organic liquid at ambient temperature (e.g., solvent, etc.):**

This subclass is indented under subclass 243. Subject matter wherein the liquid reactive coating composition contains a nonreactive organic material which is normally liquid at ambient temperature (e.g., solvents, etc.).

SEE OR SEARCH THIS CLASS, SUBCLASS:

259, for a liquid organic material at ambient temperature which is disclosed as being a reactant with the metal sub-

strate, and for solid organic materials at ambient temperature which may or may not react with the metal substrate.

**249 Nonreactive halogenated hydrocarbon:**

This subclass is indented under subclass 248. Subject matter wherein the nonreactive liquid contains only atoms of carbon, hydrogen and halogen or atoms of halogen and carbon.

- (1) Note. Halogen for purposes of this subclass is limited to fluorine, chlorine, bromine, iodine and astatine.

**250 Contains organic phosphorus or organic chromium compound:**

This subclass is indented under subclass 243. Subject matter wherein the liquid reactive coating composition contains at least one atom of phosphorus or chromium as part of an organic compound and which organic compound may or may not be chemically reactive with the metal substrate.

SEE OR SEARCH THIS CLASS, SUBCLASS:

258+, for a liquid reactive coating composition containing elemental chromium or an inorganic chromium compound.

**251 Contains solid synthetic polymer:**

This subclass is indented under subclass 243. Subject matter wherein the liquid reactive coating composition contains a solid synthetic polymer which may or may not be chemically reactive with the metal substrate.

- (1) Note. See Class 520 for a definition of the term "solid synthetic polymer".

**252 Contains dicarboxylic acid or salt thereof which reacts with metal substrate:**

This subclass is indented under subclass 243. Subject matter wherein the liquid reactive coating composition contains a dicarboxylic acid compound or salt thereof which must be chemically reactive with the metal substrate.

- (1) Note. A dicarboxylic acid compound for purposes of this subclass requires the presence of two carboxylic acid groups.

A. A carboxylic acid denotes:

(A1) The C-C-OH structure wherein n is one or greater and the C- atom is not double bonded to oxygen, sulfur, selenium, or tellurium, or is not triple bonded to nitrogen.

(A2) The -C-C-OH structure wherein n is an integer, e.g., oxalic acid when  $n=1$

B. The salt of a carboxylic acid denotes the structure:

(B1) C-C-O-X wherein n is one or more and the (C-C-O-) group and the X component are held together primarily by ionic forces; the carbon atom bonded to the -C- group is not double bonded to oxygen, sulfur, or tellurium, or triple bonded to nitrogen.

(B2) The structure Z-C-C-O-X wherein n is an integer, Z is -C-OH or a derivative as defined in the (1) Note of this subclass and wherein the X component and the (Z-C-O-) component are held together primarily by ionic forces.

**253 Contains phosphorus:**

This subclass is indented under subclass 243. Subject matter wherein the liquid reactive coating composition containing elemental phosphorus or an inorganic phosphorus compound is applied to a metal substrate and reacts therewith.

- (1) Note. In most instances the phosphorus material reacts with the metal substrate. This is not a necessary criteria for classification in this area. It is possible that a composition containing a phosphorus atom will react with the metal wherein the phosphorus atom itself does not react. In subclasses 254, 256 and 257 the phosphorus must react.

**254 Liquid composition applied prior to reaction of metal substrate with phosphorus (e.g., cleaning, activating, etc.):**

This subclass is indented under subclass 253. Subject matter wherein a liquid composition is applied to the metal substrate prior to the appli-

cation of the liquid reactive composition containing a phosphorus atom in either an elemental or compound form which is reactive with the metal substrate.

- (1) Note. This subclass takes liquid preparatory treatments of the metal substrate prior to reaction with the metal substrate. In certain instances, however, the step prior to reaction with phosphorus can involve an additional reaction with the substrate.
- (2) Note. This subclass provides for processes and compositions wherein the preliminary step of applying a material to the substrate prior to reaction is claimed and no claim provides for the subsequent reaction with phosphorus.

**255 With additional coating composition containing an atom of chromium, phosphorus or sulfur:**

This subclass is indented under subclass 253. Subject matter wherein the process involves two or more coating steps, at least one step involves a coating composition containing a phosphorus atom, and at least one of the two or more coating steps requires a composition containing chromium or sulfur or an additional phosphorus atom.

- (1) Note. The requirement for this subclass is met as long as one of the coating steps involves a liquid coating composition containing phosphorus.
- (2) Note. This subclass provides for processes and compositions wherein the step of utilizing a coating composition containing phosphorus, chromium, or sulfur is claimed and no claim specifically provides for a preliminary coating process of using a coating composition containing at least one phosphorus atom. (It must be disclosed as a preliminary treatment of the substrate.)

**256 Specified liquid or gaseous coating composition applied after reaction with phosphorus:**

This subclass is indented under subclass 253. Subject matter wherein a specified liquid or gaseous coating composition is applied subsequent to the process of coating the metal sub-

strate with a liquid coating composition containing a reactive phosphorus atom in either elemental or compound form.

- (1) Note. Specified for purpose of this subclass requires that at least one chemical atom of the coating material be identified in the claims. The term "organic" is not sufficient to be considered as being specified.
- (2) Note. This subclass provides for processes and compositions wherein the actual step of chemically modifying a base substrate with a phosphorus containing reactant is not claimed and the claim itself is to the treating of a base which has already been reacted with a phosphorus material.

**257 Specified coating composition contains organic material:**

This subclass is indented under subclass 256. Subject matter wherein at least one of the atoms in the liquid or gaseous coating composition is part of an organic compound.

**258 Contains an atom of chromium:**

This subclass is indented under subclass 253. Subject matter wherein the liquid reactive coating composition contains at least one atom of phosphorus and at least one atom of chromium.

**259 Contains organic additive other than for pH control:**

This subclass is indented under subclass 253. Subject matter wherein the liquid reactive coating composition contains at least one phosphorus atom and at least one organic compound and which organic compound is more than merely an agent for controlling the acidity or basicity of the coating composition.

- (1) Note. The organic compound may or may not be a reactant with the metal substrate.

**260 Nitrogen-containing organic compound:**

This subclass is indented under subclass 259. Subject matter wherein the organic compound contains at least one nitrogen atom.

- 261 Contains an atom of arsenic, boron or metal atom other than alkali metal:**  
This subclass is indented under subclass 253. Subject matter wherein the liquid reactive coating composition contains at least one phosphorus atom and at least one atom of arsenic, boron or of a metal atom other than alkali metal.
- (1) Note. Excluded herefrom as alkali metals are lithium, sodium, potassium, rubidium, cesium and francium.
- 262 Contains an atom of iron or manganese or a group II metal atom (Be, Ca, Sr, Ba, Zn, Cd, Hg):**  
This subclass is indented under subclass 261. Subject matter wherein the metal atom is iron or manganese or a group II metal atom (i.e., Be, Mg, Ca, Sr, Ba, Ra, Zn, Cd, Hg).
- 263 Contains an atom of calcium:**  
This subclass is indented under subclass 262. Subject matter wherein the group II metal atom is calcium.
- 264 Contains an atom of chromium:**  
This subclass is indented under subclass 243. Subject matter wherein a reactive liquid composition containing elemental chromium or inorganic chromium compound is applied to a metal substrate.
- (1) Note. The chromium in elemental form or as part of an inorganic compound may or may not be reactive with the metal substrate.
- 265 Post chromium treatment with specified material (other than mere air drying):**  
This subclass is indented under subclass 264. Subject matter wherein the process includes a treatment with a specified composition subsequent to the treatment with the chromium containing composition and wherein said specified composition involves more than air, per se.
- (1) Note. Specified, for purposes of this subclass, requires at least one chemical atom of the material to be identified in the claims. The term "organic" is not sufficient to be considered as "specified".
- (2) Note. This subclass provides for processes and compositions wherein the actual step of chemically modifying the substrate with a chromium containing composition is not claimed and the claim is to the treating of a base which has already been reacted with a composition containing chromium.
- 266 Contains an atom of sulfur, selenium or tellurium:**  
This subclass is indented under subclass 264. Subject matter wherein the liquid reactive coating composition contains at least one atom of chromium and at least one atom of sulfur, selenium or tellurium.
- 267 Contains trivalent chromium ion or reducing agent or an organic additive:**  
This subclass is indented under subclass 264. Subject matter wherein the liquid reactive coating composition contains at least one atom of chromium in trivalent form or contains a material disclosed or claimed as a reducing agent or contains an organic additive.
- 268 Contains an atom of boron, silicon or metal atom other than alkali metal:**  
This subclass is indented under subclass 264. Subject matter wherein the liquid reactive coating composition contains at least one atom of chromium and at least one atom of boron, silicon or of a metal atom other than an alkali metal atom.
- (1) Note. Excluded herefrom as being alkali metals are Li, Na, K, Ru, Cs and Fr.
- 269 Metal substrate contains elemental Ti, Zr, Hf, Cu, Ta, or Th or alloy thereof:**  
This subclass is indented under subclass 243. Subject matter wherein a liquid composition is applied to a metal substrate containing at least one elemental or alloyed form of Ti, Zr, Hf, Cu, Ta or Th and reacts therewith.
- (1) Note. This subclass provides for a metal substrate containing any of the above elements regardless of the amounts of those elements therein.
- (2) Note. The particular elements enumerated above need not be involved in the

reaction process. It is sufficient for purposes of the subclass if the particular element is present in the substrate.

**270 Contains an atom of sulfur, selenium or tellurium:**

This subclass is indented under subclass 243. Subject matter wherein a reactive liquid composition containing an atom of sulfur, selenium or tellurium is applied to a metal substrate.

- (1) Note. The sulfur, selenium or tellurium, required for this subclass may or may not be reactive with the metal substrate.

**271 Contains organic sulfur compound:**

This subclass is indented under subclass 270. Subject matter wherein sulfur is in the form of an organic compound.

**272 Coating or treating a metal oxide with a specified composition:**

This subclass is indented under subclass 243. Subject matter wherein the process includes a subsequent treatment of a disclosed or claimed metal oxide layer with a specified composition.

- (1) Note. Specified for purposes of this subclass requires that at least one chemical atom of the composition be identified in the claims.
- (2) Note. This subclass provides for processes and composition wherein the actual step of producing the metal oxide is not claimed and the claim itself is to treating the metal oxide disclosed as formed by a process proper under subclass 243 with a "specified" composition.

**273 Contains an atom of arsenic or metal atom other than alkali metal:**

This subclass is indented under subclass 243. Subject matter wherein a reactive liquid composition containing an atom of arsenic or a metal atom other than an alkali metal is applied to a metal substrate and reacts therewith.

- (1) Note. The arsenic or metal atom other than alkali metal required for this subclass may or may not be reactive with the metal substrate.

- (2) Note. Excluded herefrom as being alkali metals are Li, Na, K, Ru, Cs, and Fr.

**274 Contains organic material:**

This subclass is indented under subclass 243. Subject matter wherein a reactive liquid composition containing an organic compound is applied to a metal substrate.

- (1) Note. The organic compound required for this subclass may or may not be reactive with the metal substrate.

**275 Metal substrate contains elemental aluminum or magnesium or alloy thereof:**

This subclass is indented under subclass 243. Subject matter wherein a reactive liquid composition is applied to a metal substrate containing at least one elemental or alloyed form of aluminum or magnesium.

- (1) Note. This subclass provides for a metal substrate containing any of the above elements regardless of the amounts of those elements therein.
- (2) Note. The particular elements enumerated above need not be involved in the reaction process. It is sufficient for purposes of this subclass if the particular element is present in the metal substrate.

**276 Coating during or after metal oxide formation:**

This subclass is indented under subclass 240. Subject matter wherein a reactive composition is applied to a metal substrate and reacts at the surface to form an oxide layer and wherein concurrent with or subsequent to said oxide formation an additional coating process is involved.

- (1) Note. This subclass provides for processes and compositions wherein the initial step of forming the metal oxide is not claimed (it must be disclosed as formed by a process proper under subclass 240) and the claim itself is to the other coating steps required for this subclass and compositions therefore.

- 277 Metal oxide formed after applied coating:**  
This subclass is indented under subclass 240. Subject matter wherein a reactive material is applied to the surface of a modified substrate and a reaction is caused thereby to convert the previously formed surface into an oxide layer.
- (1) Note. This subclass provides for processes and compositions wherein the initial step of treating the elemental metal or alloy containing substrate with a chemical reactant is not claimed (it must be disclosed as a process proper for subclass 240 and the claim is to the treating step of forming the metal oxide and to compositions therefore.
- 278 Carbide formation, decarburization or carbonizing:**  
This subclass is indented under subclass 240. Subject matter wherein a carbide is formed, decarburizing occurs, or a carburizing reaction is involved.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
206, through 238, for carburizing, nitriding, or both (e.g., carbonitriding) using an external source of carbon or nitrogen.
- (1) Note. Thus, for this subclass the carbide formation or carbonizing requires an external noncarbon or nonnitrogen containing external reactant and the source of the carbon is the substrate. Metallization of high carbon content alloy substrate by vapor deposition of a metal without diffusion of carbon to form a carbide containing coating thereon is an example of the type reactive coating provided in this subclass.
- 279 Contains an atom of boron or silicon that reacts with metal substrate:**  
This subclass is indented under subclass 240. Subject matter wherein a reactive material containing at least one atom of boron or silicon is applied to the metal substrate and a silicon or boron atom is disclosed or claimed.
- 280 Reactive material applied nonuniformly or reacted selectively:**  
This subclass is indented under subclass 240. Subject matter wherein the reaction with the metal substrate is of a nonuniform nature.
- (1) Note. Included herein, but not limited thereto, are metal treatments utilizing a mask to shield a portion of the metal surface and to expose a portion of the surface to be treated or chemical treatments involving a single side of a sheet material.
- 281 Metal substrate contains elemental Ti, Zr, Nb, Ag, Ta or W or alloy thereof:**  
This subclass is indented under subclass 240. Subject matter wherein the metal substrate contains elemental or an alloyed form of titanium, zirconium, niobium, silver, tantalum or tungsten.
- (1) Note. This subclass provides for a metal substrate containing any of the above elements regardless of the amount of those elements therein.
- (2) Note. The particular elements enumerated above need not be involved in the reaction process. It is sufficient for purposes of this subclass if the particular element is present in the substrate.
- 282 Metal substrate contains elemental copper or alloy thereof:**  
This subclass is indented under subclass 240. Subject matter wherein the metal substrate contains elemental copper or an alloy thereof.
- (1) Note. This subclass provides for a copper containing substrate regardless of the amount of copper.
- (2) Note. The copper need not be involved in the reaction process. It is sufficient if copper is merely present in the metal substrate.
- 283 Contains an atom of halogen, organic material or gaseous sulfur:**  
This subclass is indented under subclass 240. Subject matter wherein the material which reacts with the metal surface contains at least

- one halogen atom (F, Cl, Br, I, At) or is an organic material, or is gaseous sulfur.
- (1) Note. See Class 260, Chemistry of Carbon Compounds for a definition of the term "organic".
- 284 Coating composition applied forms oxide coating:**  
This subclass is indented under subclass 240. Subject matter wherein an oxide of a metal is formed on a metal containing substrate.
- 285 Oxide of aluminum, beryllium or magnesium formed:**  
This subclass is indented under subclass 284. Subject matter wherein an oxide layer of aluminum, beryllium or magnesium is formed on an aluminum, beryllium or magnesium containing substrate.
- (1) Note. This subclass provides for oxide formation, regardless of the degree of oxide formation or the amount of aluminum, beryllium, or magnesium in the metal containing substrate.
- 286 Oxide of cobalt, chromium or nickel formed:**  
This subclass is indented under subclass 284. Subject matter wherein an oxide layer of chromium, cobalt, or nickel is formed on a chromium, cobalt or nickel containing substrate.
- (1) Note. This subclass provides for oxide formation, regardless of the degree of oxide formation, or the amount of chromium, cobalt, or nickel in the metal containing substrate.
- 287 Oxide of iron formed:**  
This subclass is indented under subclass 284. Subject matter wherein an oxide layer of iron is formed on an iron containing substrate.
- (1) Note. This subclass provides for iron oxide formation regardless of the degree of oxide formation or the amount of iron in the metal containing substrate.
- 300 Magnetic:**  
This subclass is indented under subclass 400. Stock material for magnetic material which is claimed as resulting from a Class 148 treatment, as having an internal structure which resulted from a Class 148 treatment, which is claimed in terms of a specified magnetic property, e.g., coercive force, etc., or for coated magnetic material wherein the coating is followed by a Class 148 treatment.
- SEE OR SEARCH THIS CLASS, SUBCLASS:**
- 100+, for processes of developing, improving, modifying or preserving the magnetic properties of metallic material by a Class 148 process.
- SEE OR SEARCH CLASS:**
- 252, Compositions, subclasses 62.51+ for magnetic compositions which do not contain a continuous phase of metal. The recitation that metallic particles are present in a nonmetallic (e.g., resinous) vehicle, matrix or binder will be taken as meaning that no continuous phase of metal is present.
- 420, Alloys or Metallic Compositions, appropriate subclasses for alloys or metallic compositions defined only as "magnetic", "magnetized" or "permanent magnet", material even though disclosed as resulting from a Class 148 treatment as well as alloys or metallic compositions claimed, per se, which are inherently magnetic.
- 427, Coating Processes, subclasses 127+ for coating processes, per se, wherein the base or coating are magnetic and wherein there is no separate step of modifying or maintaining the internal physical structure (i.e., microstructure) or chemical properties of the metal.
- 428, Stock Material or Miscellaneous Articles, subclasses 692.1 and 693.1 for stock materials having a defined magnetic layer and subclasses 800-848.9 for magnetic recording component or stock.
- 301 Rare earth and transition metal containing:**  
This subclass is indented under subclass 300. Stock material which contains both a rare earth metal and a transition metal, e.g., Co<sub>5</sub> Sm etc.

- 302 Boron containing:**  
This subclass is indented under subclass 301. Stock material which additionally contains boron.
- 303 Copper containing:**  
This subclass is indented under subclass 301. Stock material which additional contains copper.
- 304 Amorphous:**  
This subclass is indented under subclass 30. Stock material which has no regular crystal structure but rather has a series of noncrystalline areas much like a glass.
- (1) Note. The recitation that a material is “glassy” will be taken as an indication of amorphous structure.
- (2) Note. Amorphous Structure is usually created by cooling certain alloys at extremely high rates of speed such that the alloy can be cooled before having a chance to crystallize.
- 305 With inclusion:**  
This subclass is indented under subclass 304. Amorphous stock material which internal structure interspersed within an amorphous matrix.
- (1) Note. These inclusions may be formed within the amorphous matrix or caused to form by later treatment, e.g., precipitate, etc.
- 306 Iron base (i.e., ferrous):**  
This subclass is indented under subclass 306. Stock material which contains over 50 percent iron.
- 307 Silicon containing:**  
This subclass is indented under subclass 306. Stock material which additionally contains silicon.
- 308 Specific crystallographic orientations:**  
This subclass is indented under subclass 307. Stock material wherein the material is defined as having its crystals oriented in a particular manner, e.g., by Miller indices, “cube on edge” etc.
- (1) Note. A specification of random orientation is excluded and placed in subclasses 307 or 309.
- 309 Containing over 1 percent aluminum:**  
This subclass is indented under subclass 307. Stock material which additionally contains more than 1 percent aluminum.
- 310 Nickel containing:**  
This subclass is indented under subclass 306. Stock material which additionally contains nickel.
- 311 Cobalt containing:**  
This subclass is indented under subclass 306. Stock material which additionally contains cobalt.
- 312 Nickel base:**  
This subclass is indented under subclass 300. Stock material which contains over 50 percent nickel.
- 313 Cobalt base:**  
This subclass is indented under subclass 300. Stock material which contains over 50 percent cobalt.
- 314 Manganese base:**  
This subclass is indented under subclass 300. Stock material which contains over 50 percent manganese.
- 315 No single metal over 500 percent:**  
This subclass is indented under subclass 300. Stock material which contains 50 percent or less of any single metal, i.e., no base metal.
- 316 Carburized or nitrided:**  
This subclass is indented under subclass 400. Stock material wherein the surface of the material contains additional carbon or nitrogen diffused therein.
- (1) Note. So called “case hardened” material is presumed to have carbon only diffused into the surface unless indicated to the contrary.



**317 Nitrided:**

This subclass is indented under subclass 316. Stock material wherein the surface of the material contains additional nitrogen diffused therein.

- (1) Note. This and the indented subclass contain patents to so called “carbonitrided” material wherein both carbon and nitrogen have been diffused into the surface.

**318 Ferrous (i.e., iron base):**

This subclass is indented under subclass 317. Stock material which contains over 50 percent iron.

**319 Ferrous (i.e., iron base):**

This subclass is indented under subclass 316. Stock material which contains over 50 percent iron.

**320 Ferrous (i.e., iron base):**

This subclass is indented under subclass 400. Stock material which contains over 50 percent iron.

**321 1.7 Percent or more carbon containing (e.g., cast iron):**

This subclass is indented under subclass 320. Stock material which additionally contains 1.7 percent or more carbon.

- (1) Note. Most so called “cast iron” contains over 1.7 percent carbon. A patent claiming “cast iron” will be placed in this or indented subclasses in the absence of a specific disclosure that the carbon content is less than 1.7 percent.

**322 Malleabilized:**

This subclass is indented under subclass 321. Stock material which is chill cast iron (see subclass 323 for definition) which has been subsequently heat treated to allow the combined carbon of the white chill cast iron to substantially precipitate as fine globules of graphite in a matrix of iron of much lower carbon content (usually in the range of .4 to .6 percent).

- (1) Note. The terms “malleabilized” or “malleable iron” will be taken as meaning a patent is proper for this subclass in

the absence of disclosure that the carbon content is less than 1.7 percent or the disclosure that the heat treatment of white cast iron is not intended.

**323 Chill cast:**

This subclass is indented under subclass 321. Stock material which has been cast in such a manner that substantially all the carbon in the iron is combined with the iron rather than allowed to precipitate out as inclusions of free graphite carbon.

- (1) Note. The presence of combined carbon and absence of free graphite causes the chill cast iron to have a white rather than a grey appearance when fractured. The recitation that a cast iron is “white” will be taken to mean that it has been chill cast. So called “mottled iron” which contains areas of white iron mixed with grey iron will also be classified hereunder.

**324 Six percent or more group IV, V or IV transition metal containing:**

This subclass is indented under subclass 321. Stock material which additionally contains one or more of the elements titanium, zirconium, hafnium, vanadium, niobium, tantalum, chromium, molybdenum or tungsten in a total amount of 6 percent or more.

**325 Nine percent or more chromium containing:**

This subclass is indented under subclass 320. Stock material which additionally contains 9 percent or more chromium.

- (1) Note. This subclass contains most so called stainless steels. The recitation that a stock material is “stainless steel” will cause it to be placed in this or indented subclasses unless it is clear that the material does not contain 9 percent or more chromium.

**326 Age or precipitation hardened or strengthened:**

This subclass is indented under subclass 325. Stock material which has been first heated to a relatively high temperature to cause ingredients thereof to dissolve to form a solid solution and then aged, or heated to a lower temperature for an extended period of time whereby phases are

- precipitated which increase the hardness, or strength of the material.
- (1) Note. Often after the first high temperature heating “solution treatment” the material is quenched to room temperature before being heated to age or precipitate.
- (2) Note. The aging, or precipitation may take place at room temperature for some material, but there must be a positive recitation of “aging”, or “precipitation”, or words to that effect in the claims to place a material here.
- (3) Note. “Solution” treated material which has not been positively claimed as given an aging, or precipitation treatment is excluded herefrom and placed in subclasses 325 or 327 as appropriate.
- 327 Eight percent for more total content of nickel and/or manganese:**  
This subclass is indented under subclass 325. Stock material which additionally contains a combined total of 8 percent or more.
- (1) Note. The stock material need not contain any nickel or manganese at all if the content of the other element is 8 percent or more.
- 328 Age or precipitation hardened or strengthened:**  
This subclass is indented under subclass 320. Stock material which has been first heated to a relatively high temperature to cause ingredients thereof to dissolve to form a solid solution and then aged, or heated to a lower temperature for an extended period of time whereby phases are precipitated which increase the hardness, or strength of the material.
- (1) Note. Often after the first high temperature heating “solution treatment” the material is quenched room temperature before being heated to age, or precipitate.
- (2) Note. The aging, or precipitation may take place at room temperature for some material, but there must be a positive recitation of “aging”, or “precipitation”, or words to that effect in the claims to place a material here.
- (3) Note. “Solution” treated material which has not been positively claimed as given an aging, or precipitation treatment is excluded herefrom and placed in appropriate subclasses below.
- 329 Eight percent or more manganese containing:**  
This subclass is indented under subclass 320. Stock material which additionally contains 8 percent or more manganese.
- 330 Beryllium or boron containing:**  
This subclass is indented under subclass 320. Stock material which additionally contains beryllium or boron.
- 331 Rare earth metal containing:**  
This subclass is indented under subclass 320. Stock material which additionally contains scandium, yttrium or a lanthanide metal.
- 332 Copper containing:**  
This subclass is indented under subclass 320. Stock material which additionally contains copper.
- 333 Chromium containing, but less than 9 percent:**  
This subclass is indented under subclass 320. Stock material which additionally contains chromium in an amount of less than 9 percent.
- 334 Molybdenum containing:**  
This subclass is indented under subclass 333. Stock material which additionally contains molybdenum.
- 335 Nickel containing:**  
This subclass is indented under subclass 334. Stock material which additionally contains nickel.
- 336 Nickel containing:**  
This subclass is indented under subclass 320. Stock material which additionally contains nickel.

**337 Three percent or more manganese containing or containing other transition metal in any amount:**

This subclass is indented under subclass 320. Stock material which additionally contains at least one of 3 percent or more manganese or any amount of one or more other transition metals not provided for above.

- (1) Note. Transition metals are those elements with atomic numbers 21 through 30, 39 through 48 and 57 through 80.

**400 STOCK:**

Elemental metal, alloys or metallic compositions which (a) are the product of a process or this class (148) e.g., heat treated, age hardened etc., (b) are claimed in terms of specific magnetic properties, (c) are amorphous, (d) possess the property of shape memory, (e) are the product of significant Class 164, Metal Founding, step, e.g., chill cast, directionally solidified etc., or (f) are the product of the dispersion of particulate matter in molten metal which particulate matter retains its identity in the final product, e.g., dispersion strengthened.

- (1) Note. An alloy or metallic composition defined solely in terms of its elemental constituents is classified in Class 420, Alloys or Metallic Compositions, whether or not such a claim includes a recitation of physical or chemical properties such as noncorrosiveness, hardness or ductility which are inherent in the alloy or metallic composition.
- (2) Note. As to (a) of this subclass definition the recitation of chemical or physical properties which are the result of a Class 148 process of treatment is proper for this or indented subclasses. As to (e) of this subclass definition a significant Class 164 step is one in which there is a particular Class 164 manipulation intended to control the internal structure of the product. The recitations "chill cast" and "directionally solidified" are considered to be significant Class 164 manipulations. As to (f) of this subclass definition there must be a clear disclosure that the particles remain as such in the product for placement hereunder.

Cases of doubt will be resolved by placement in Class 420.

- (3) Note. The order of superiority among various alloy, metallic composition and metal stock areas and methods of manufacture involving them is as follows:

1. Class 419, Powder Metallurgy Processes.

2. Class 75, Specialized Metallurgical Processes, Compositions for Use Therein, Consolidated Metal Powder Compositions, and Loose Metal Particulate Mixtures, subclasses 228+, consolidated metal powder composition.

3. Class 420, Alloys or Metallic Compositions, claimed as products.

4. Class 148, Metal Treatment, subclasses 2 through 30 in class schedule order, providing for methods of treatment of solid metal.

5. Class 148, Metal Treatment, subclasses 400+, stock.

6. Class 420, Alloys or Metallic Compositions, processes of making including melting.

7. Class 164, Metal Founding.

This list is not complete but may be added to as the proper relationship of other areas is determined. For a more comprehensive discussion of other metallurgical areas and the relationship among them see the definition, of Class 420, Alloys or Metallic Compositions.

- (4) Note. In general, no cross-references have been placed in this, or indented subclasses based on disclosure from Class 420, Alloys or Metallic Compositions. Thus a search for unclaimed disclosure of stock for this and indented subclasses should be made in the appropriate subclasses of Class 420 based on the composition of the material. The only exception of this rule is subclasses 402 to 404 of this class which serve as

digests for their subject matter disclosed in Class 420 original patents. Also, in general no cross-references have been placed in Class 420 from this and indented subclasses based on disclosure of the composition of the stock in this and indented subclasses. The only exception to this rule is the cross-reference are collections of Class 420, subclasses 901 to 903 which also serve as a collection point for pertinent disclosure from this and indented subclasses.

- (5) Note. The rules for determining Class placement of the Original Reference (OR) for claimed chemical compositions are set forth in the Class Definition of Class 252 in the section LINES WITH OTHER CLASSES AND WITHIN THIS CLASS, subsection COMPOSITION CLASS SUPERIORITY, which includes a hierarchical ORDER OF SUPERIORITY FOR COMPOSITION CLASSES.

**SEE OR SEARCH CLASS:**

428, Stock Material or Miscellaneous Articles, subclasses 411.1+ and 615+ for nonmetallic and metallic composites, respectively, defined in terms of the composition of their components, and the main Class Definition of the class (428), sections VI, B, VI, C4 and VI, C6, for the distinction between stock materials for that class (428) and a “stock” classified herein.

**401 Radioactive:**

This subclass is indented under subclass 400. Stock material which is claimed as being radioactive, containing an isotope of an element which is radioactive, or containing an element of which all the known isotopes are radioactive.

- (1) Note. The elements of which all known isotopes are radioactive are technetium, promethium, and all the elements of atomic number 84 and higher.

**402 Mechanical memory:**

This subclass is indented under subclass 400. Stock material which when shaped at a first temperature, and reshaped at a different tem-

perature resumes its first shape when returned to the first temperature, or at some intermediate temperature.

- (1) Note. This subclass is placed in this class since this “memory” of the first shape is believed to occur due to changes of crystal form at different temperatures. However, all metallic stock possessing mechanical memory is placed hereunder no matter what the disclosed theory may be.

**403 Amorphous, i.e., glassy:**

This subclass is indented under subclass 400. Stock material which has no regular crystal structure, but rather has a series of noncrystalline areas much like a glass.

- (1) Note. This structure usually is created by cooling certain alloys at extremely high rates of speed, such that the alloy can be solidified and cooled before having a chance to crystallize.

**404 Directionally solidified:**

This subclass is indented under subclass 400. Stock material in which solidification of the alloy, or metallic composition has been carried out along one plane only, usually resulting in a “columnar” crystalline structure.

**SEE OR SEARCH CLASS:**

428, Stock Material or Miscellaneous Articles, subclass 611 for metallic stock material with preformed fibers which have an orientation coordinate with the shape of the body.

**405 Age or precipitation hardened or strengthened:**

This subclass is indented under subclass 400. Stock material which has been first heated to a relatively high temperature to cause ingredients thereof to dissolve to form a solid solution and then aged, or heated to a lower temperature for an extended period of time whereby phases are precipitated which increase the hardness, or strength, of the material.

- (1) Note. Often after the first high temperature heating “solution treatment” the material is quenched to room tempera-

- ture before being heated to age, or precipitate.
- (2) Note. The aging, or precipitation may take place at room temperature for some material, but there must be a positive recitation of “aging”, or “precipitation”, or words to that effect in the claims to place a material here.
- (3) Note. “Solution” treated material which has not been positively claimed as given an aging, or precipitation treatment is excluded herefrom and placed in appropriate subclasses below.
- 406 Magnesium base:**  
This subclass is indented under subclass 405. Stock material which contains over 50 percent magnesium.
- 407 Refractory metal base:**  
This subclass is indented under subclass 405. Stock material which contains over 50 percent by weight of a single metal selected from titanium, vanadium, chromium, zirconium, niobium, molybdenum, hafnium, tantalum, or tungsten.
- 408 Cobalt base:**  
This subclass is indented under subclass 405. Stock material which contains over 50 percent of cobalt by weight.
- 409 Nickel base:**  
This subclass is indented under subclass 405. Stock material which contains over 50 percent of nickel by weight.
- 410 Chromium containing:**  
This subclass is indented under subclass 409. Stock material which additionally contains chromium.
- 411 Copper base:**  
This subclass is indented under subclass 405. Stock material which contains over 50 percent of copper by weight.
- 412 Tin containing:**  
This subclass is indented under subclass 411. Stock material which additionally contains tin.
- 413 Zinc containing:**  
This subclass is indented under subclass 411. Stock material which additionally contains zinc.
- 414 Nickel containing:**  
This subclass is indented under subclass 411. Stock material which additionally contains nickel.
- 415 Aluminum base:**  
This subclass is indented under subclass 405. Stock material which contains over 50 percent of aluminum.
- 416 Copper containing:**  
This subclass is indented under subclass 415. Stock material which additionally contains copper.
- 417 Magnesium containing:**  
This subclass is indented under subclass 416. Stock material which additionally contains magnesium.
- 418 Vanadium, niobium or tantalum containing:**  
This subclass is indented under subclass 417. Stock material which additionally contains at least one of the metals vanadium, niobium, or tantalum.
- 419 Containing over 50 percent metal, but no base metal:**  
This subclass is indented under subclass 405. Stock material which contains over 50 percent of total metal by weight, but wherein no single metal is present in an amount over 50 percent by weight.
- 420 Magnesium base:**  
This subclass is indented under subclass 400. Stock material which contains over 50 percent of magnesium.
- 421 Titanium, zirconium or hafnium base:**  
This subclass is indented under subclass 400. Stock material which contains over 50 percent of titanium, over 50 percent, zirconium or over 50 percent hafnium by weight.

- 422 Vanadium, niobium or tantalum base:**  
This subclass is indented under subclass 400. Stock material which contains over 50 percent vanadium, over 50 percent niobium, or over 50 percent tantalum by weight.
- 423 Chromium, molybdenum or tungsten base:**  
This subclass is indented under subclass 400. Stock material which contains over 50 percent of chromium, over 50 percent of molybdenum, or over 50 percent of tungsten by weight.
- 424 Manganese base:**  
This subclass is indented under subclass 400. Stock material which contains over 50 percent of manganese by weight.
- 425 Cobalt base:**  
This subclass is indented under subclass 400. Stock material which contains over 50 percent of cobalt by weight.
- 426 Nickel base:**  
This subclass is indented under subclass 400. Stock material which contains over 50 percent of nickel by weight.
- 427 Chromium containing:**  
This subclass is indented under subclass 426. Stock material which additionally contains chromium.
- 428 Aluminum containing:**  
This subclass is indented under subclass 427. Stock material which additionally contains aluminum.
- 429 Aluminum containing:**  
This subclass is indented under subclass 426. Stock material which additionally contains aluminum.
- 430 Noble metal base:**  
This subclass is indented under subclass 400. Stock material which contains over 50 percent by weight of a single metal selected from ruthenium, rhodium, palladium, osmium, iridium, platinum, gold, or silver.
- 431 Silver base containing in situ formed oxides:**  
This subclass is indented under subclass 430. Stock material which contains over 50 percent of silver by weight and additionally contains metal oxides formed in the silver containing the material by chemical reaction.
- (1) Note. The oxide may be formed, e.g., by reaction of a metal oxide with another to produce a different metal oxide, e.g.,  $\text{AgO} + \text{Cd} \rightarrow \text{CdO} + \text{Ag}$ , or by reaction of silver base alloy with elemental oxygen to oxidize part of the alloy, etc.
- 432 Copper base:**  
This subclass is indented under subclass 400. Stock material which contains over 50 percent of copper by weight.
- 433 Tin containing:**  
This subclass is indented under subclass 432. Stock material which additionally contains tin.
- 434 Zinc:**  
This subclass is indented under subclass 432. Stock material which additionally contains zinc.
- 435 Nickel containing:**  
This subclass is indented under subclass 432. Stock material which additionally contains nickel.
- 436 Aluminum containing:**  
This subclass is indented under subclass 432. Stock material which additionally contains aluminum.
- 437 Aluminum base:**  
This subclass is indented under subclass 400. Stock material which contains over 50 percent of aluminum by weight.
- 438 Copper containing:**  
This subclass is indented under subclass 437. Stock material which additionally contains copper.
- 439 Magnesium containing:**  
This subclass is indented under subclass 438. Stock material which additionally contains magnesium.
- 440 Magnesium containing:**  
This subclass is indented under subclass 437. Stock material which additionally contains magnesium.

- 441 Zinc base:**  
This subclass is indented under subclass 400. Stock material which contains over 50 percent of zinc by weight.
- 442 Containing over 50 percent metal, but no base metal:**  
This subclass is indented under subclass 400. Stock material which contains over 50 percent of total metal by weight, but wherein no single metal is present in an amount of over 50 percent by weight.
- 500 Utilizing disclosed mathematical formula or relationship:**  
This subclass is indented under subclass 95. Process wherein a mathematical formula or relationship containing variables is disclosed and utilized in the claimed process.
- (1) Note. The mere use of constants or percentages, per se, does not meet the criteria for this subclass.
- 501 Nonferrous metal, nonferrous alloy or non-base alloy:**  
This subclass is indented under subclass 500. Process wherein the metal is a nonferrous metal, an alloy having greater than 50 percent of one of the nonferrous metals or an alloy having no one metal present in an amount greater than 50 percent.
- 502 Aluminum (Al) or aluminum base alloy:**  
This subclass is indented under subclass 501. Process wherein aluminum or an alloy containing greater than 50 percent aluminum is the nonferrous based metal.
- 503 Utilizing therein symbol for temperature:**  
This subclass is indented under subclass 500. Process which utilizes, in a mathematical formula or relationship therein, a symbol to represent temperature other than abbreviations representing the temperature scale (e.g., C for centigrade, etc.).
- (1) Note. Utilization of a temperature or temperature range, per se, is not proper hereinunder unless the temperature or temperature range is part of the mathematical formula or relationship.
- 504 With working step:**  
This subclass is indented under subclass 503. Process which includes a working step.
- 505 Utilizing therein factors or percentages related to metal or metal alloy composition (i.e., including carbon content):**  
This subclass is indented under subclass 500. Process wherein a mathematical formula or relationship utilizes factors or percentages related to a metal or alloy composition including all materials whether metal or not (e.g., carbon content).
- (1) Note. For this subclass, the mere use of percentages or moles utilized to define a metal or metal alloy composition is not sufficient by itself for placement herein. An actual mathematical formula or relationship must be present which includes as a part thereof factors or percentages related to the composition.
- 506 With chromium (Cr) in the mathematical relationship:**  
This subclass is indented under subclass 505. Process wherein a factor or percentage related to chromium (Cr) content is utilized in a mathematical formula or relationship.
- 507 With titanium (Ti) in the mathematical relationship:**  
This subclass is indented under subclass 505. Process wherein a factor or percentage related to titanium (Ti) content is utilized in a formula or mathematical relationship.
- 508 With measuring, testing, or sensing:**  
This subclass is indented under subclass 95. Process which includes a step involving measuring, testing, or sensing of a reaction condition.
- (1) Note. The adjustment of a condition to a specified level (e.g., temperature) is not proper hereinunder unless there is an actual recitation in the claim of measuring, testing or sensing.
- SEE OR SEARCH CLASS:  
73, Measuring and Testing, appropriate subclasses for processes of measuring or testing, per se.

- 324, Electricity: Measuring and Testing, appropriate subclasses for processes of determining electrical properties by electrical means, per se, even though nonelectrical values are derived from the electrical values determined.
- 356, Optics: Measuring and Testing, appropriate subclasses for processes which utilize visible light to measure optical properties, per se, or for processes of testing visible light for optical properties and which utilize visible light to test for nonoptical properties, per se, when not elsewhere provided.
- 374, Thermal Measuring and Testing, appropriate subclasses for thermal testing, per se, or the combination of thermal testing and nonthermal testing, per se.
- 509 Magnetic or electrical property:**  
This subclass is indented under subclass 508. Process wherein a magnetic or electrical property is measured, tested, or sensed.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
100+, for processes which include the intent of developing, modifying or preserving the magnetic properties, per se, of a free metal or alloy.
- (1) Note. In many cases of metal treatment, magnetic properties are inherently changed. The mere use of magnetic property changes to determine other microstructural changes or to follow the course of the process is proper hereinunder unless the emphasis and intent is consistent with subclasses 100+. If there is any doubt as to intent, hierarchy prevails and a cross-reference to other parts of this class is advisable.
- 510 Change in dimension (e.g., expansion, elongation, distortion, etc.):**  
This subclass is indented under subclass 508. Process wherein a change in dimension (e.g., expansion, elongation, distortion, etc.) of a treated metal or alloy is measured, tested or sensed.
- 511 Temperature:**  
This subclass is indented under subclass 508. Process wherein there is an actual step of measuring, sensing, or testing of temperature.
- 512 Surface melting (e.g., melt alloying etc.):**  
This subclass is indented under subclass 95. Process wherein only a surface of the solid or semisolid metal is melted during the process.
- (1) Note. Alloying a melted metal surface by application of nonreactive alloying ingredients (e.g., other free metals, etc.) which diffuse into the melted metal to form an alloyed (i.e., not chemically reactive coating) surface composition including the ingredients of the melted metal surface and the infused ingredients is one of the species acceptable hereinunder.
- (2) Note. Some other species of surface melting involve purposes of hardening or relieving stress.
- (3) Note. Surface melting, per se, utilizing a heat source for purposes of sealing or reflowing the metal to close pores or remove cracks goes to the appropriate heating class. If homogenizing, alloying, or other modifying of metal microstructure (e.g., rehardening, diffusing, etc.) is present, this subclass is proper.
- (4) Note. There is no intent to take casting or melt coating, per se, into this subclass which relates only to melting of a solid metal substrate surface.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
206+, for processes of carburizing or nitriding a metal substrate from an external source of carbon or nitrogen.  
240+, for processes of reactive coating a metal substrate an externally supplied reactive ingredient as defined thereunder.
- SEE OR SEARCH CLASS:  
75, Specialized Metallurgical Processes, Compositions for Use Therein, Consolidated Metal Powder Composi-



- tions, and Loose Metal Particulate Mixtures, particularly subclass 10.11 for processes of zone melting or fractional crystallization wherein solid metal is traversed by a melt zone causing migration of the impurities within the metal resulting in purification of the metal or for processes of refining (e.g., smelting) molten metal zones by selective crystallization and separation of the crystallization phase from the melt to effect purification (i.e., fractional crystallization) thereof.
- 228, Metal Fusion Bonding, appropriate subclasses for processes of welding or joining of metal preforms by fusion bonding wherein there may be surface melting.
- (1) Note. The combination of metal fusion bonding, as in Class 228 with processes acceptable under the Class 148 definition, is proper for Class 148. However, this subclass specifically is excluding metal fusion bonding of the type found in Class 228. See particularly subclasses 516+ hereinunder for the combination of metal fusion bonding with processes acceptable under the Class 148 definition.
- 427, Coating Processes, appropriate subclasses for processes including applying a melted metal coating, per se, to a solid metal substrate.
- (1) Note. The distinction for Class 427 is that the total composition of the applied coating comes from an external source as opposed to any portion thereof, except for the interface therewith, coming from the metal substrate to which the coating is applied. Also, in Class 148 coating, the metal substrate is not in a molten condition when the coating is applied. However, if a melted metal substrate has a non-reactive coating or alloying material applied to it, placement is proper in this subclass if the resultant coating includes ingredients of the melted substrate and infused alloying ingredient. Moreover, if coating of a solid substrate by a Class 427 operation is involved in a combined process, melting of the metal coating surface occurring during a melting step separate from the coating operation must also include melting of the substrate to be proper in this subclass of Class 148.
- 513 Treating loose metal powder, particle or flake:**
- This subclass is indented under subclass 95. Process wherein (1) loose metal or metal alloy powder, particle or flake in a solid or semisolid state is cooled or heat treated to modify or maintain the internal physical structure (i.e., microstructure) or chemical properties and not elsewhere provided or (2) solid or semisolid metal or metal alloy is cooled or heat treated to modify or maintain the internal physical structure (i.e., microstructure) or chemical properties and loose metal powder, particle or flake is produced therefrom (e.g., comminuting).
- SEE OR SEARCH CLASS:
- 75, Specialized Metallurgical Processes, Compositions for Use Therein, Consolidated Metal Powder Compositions, and Loose Metal Particulate Mixtures, appropriate subclasses for processes of producing or purifying loose metal or metal alloy powder or for loose metal powder compositions.
- (1) Note. Class 75 takes purification of metal powder compositions that involve washing or cleaning operations and includes utilization of a vacuum, per se, therefor. However, Class 148 takes heat-treatment of solid or semi-solid metal powder involving chemical or physio-chemical operations to alter the metal composition (e.g., decarburizing, dehydrogenating, denitridizing, etc.).
- 502, Catalyst, Solid Sorbent, or Support Therefor: Product or Process of Making, particularly subclasses 300+ for process of making metal catalysts.

The line to other classes are expressed in Class 502.

**514 Treating consolidated metal powder, per se (i.e., no sintering or compacting step present):**

This subclass is indented under subclass 95. Process wherein a metal or metal alloy powder in a preconsolidated state is treated and there is no sintering or no consolidating step present.

**SEE OR SEARCH CLASS:**

- 75, Specialized Metallurgical Processes, Compositions for Use Therein, Consolidated Metal Powder Compositions, and Loose Metal Particulate Mixtures, subclasses 228+ for consolidated metal powder compositions.
- 419, Powder Metallurgy Processes, appropriate subclasses for processes of consolidating metal powder compositions having a sintering or compacting step therein and which may additionally have post-consolidating treatment therein.

- (1) Note. If a sintering or compacting step is present, placement goes to Class 419 even if there is a subsequent treatment controlling the microstructure or chemical properties. However, if in the recited process the starting material is preconsolidated and no further sintering or consolidating is included, Class 148 will control.

**515 With explosive or exothermic agent:**

This subclass is indented under subclass 95. Process wherein an explosive or exothermic chemical agent is utilized to treat a metal article or stock.

- (1) Note. Since the use of an explosive agent may be considered to involve working, the metal working classes provide for the use of an explosive agent. It is emphasized here that the line between Class 148 and the metal working classes requires that there be a separate step from the explosion in which there is a change in the internal physical structure (i.e., microstructure) or chemical properties or that the explosive force changes

the microstructure without deforming of the metal to be placed in this subclass.

- (2) Note. The use of the exothermic agent must be to produce heat for modifying or maintaining the internal physical structure or chemical properties of the metal which is in a separate step from the step of bonding by fusing or welding which is provided for in the mechanical treating classes.

**SEE OR SEARCH CLASS:**

- 29, Metal Working, subclass 421.2 for a process using an explosive agent to shape metal.

**516 Producing or treating layered, bonded, welded, or mechanically engaged article or stock as a final product:**

This subclass is indented under subclass 95. Process wherein a layered, bonded, welded, or mechanically engaged (e.g., inserts, etc.) article or stock having at least one layer or integral portion thereof made of metal or metal alloy is the product of a process consistent with the class definition.

- (1) Note. To remain in this subclass, it makes no difference whether layered, bonded, welded, or mechanically engaged article or mechanically engaged stock is the starting material of the process. It is however essential that the final product of the process be layered, bonded, welded, or mechanically engaged.

**SEE OR SEARCH THIS CLASS, SUBCLASS:**

- 538+, particularly subclasses 582, 591, 596, 606, 615, 625, 703, or 708, if the layer is a treating agent (e.g., protective annealing shield such as CaO, CaCO<sub>3</sub>, etc.) which is intended as a temporary layer but not part of the final product.

**517 Subambient temperature:**

This subclass is indented under subclass 516. Process wherein any metal portion of the article or stock undergoing treatment is actually cooled to a temperature identified as either below ambient temperature or below 20°C to

control the internal physical structure (i.e., microstructure) or chemical properties thereof.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

577, for processes of treating nonlayered metal or metal alloy at subambient temperature.

**518 With electrocoating (e.g., electroplating, anodizing, sputtering, etc.):**

This subclass is indented under subclass 516. Process which includes a step of electrocoating (e.g., electroplating, anodizing, etc.) by application of an externally supplied electrical current or by sputtering.

- (1) Note. If during a post-treatment operation the substrate becomes subjected to a Class 148 treatment that goes beyond the mere interdiffusion at the interface to perfect the coating, placement goes in this subclass whether or not the coating layer is involved. However, an electrocoating step must be present for this subclass.

SEE OR SEARCH CLASS:

205, Electrolysis: Processes, Compositions Used Therein, and Methods of Preparing the Compositions, appropriate subclasses for processes involving electrocoating of metal substrates and which include Class 148 operations as herein defined which are preparatory to the electrocoating or are posttreatment operations limited to the coating layer or involving diffusion affecting only the interface. Electrorefining is not considered to be electrocoating in Class 205 or for this subclass in Class 148.

**519 Pipe or tube:**

This subclass is indented under subclass 516. Process wherein a pipe or tube is produced or treated.

**520 With induction heating:**

This subclass is indented under subclass 519. Process which includes a step of heating the metal workpiece by utilizing a magnetic field to induce a flow of electrons in the workpiece that results in production of heat.

SEE OR SEARCH CLASS:

219, Electric Heating, appropriate subclasses for induction heating, per se, of a metal or for working and induction heating of metal which does not meet the criteria for significant heating as described under the notes in subclass 95 of Class 148.

**521 With metal fusion bonding:**

This subclass is indented under subclass 519. Process which includes a step of metal fusion bonding of metal.

SEE OR SEARCH CLASS:

219, Electric Heating, appropriate subclasses for processes of fusion bonding of metal, per se, by electric heating without a separate step involving significant heat treatment as defined in the notes under subclass 95 of Class 148.

228, Metal Fusion Bonding, appropriate subclasses for processes of welding metal, per se, without a separate step involving significant heat treatment as defined in the notes under subclass 95 of Class 148.

**522 With casting or solidifying from melt:**

This subclass is indented under subclass 516. Process wherein a metal or metal alloy, article or stock is subjected to a casting operation or a total metal mass (i.e., not just a portion or coating) is solidified from a melted state.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

538, for casting or solidifying from a melted state nonlayered, bonded, welded or mechanically engaged stock or article. See the notes thereunder for locations of related classes.

**523 Of aluminum (Al) or aluminum alloy:**

This subclass is indented under subclass 522. Process wherein a metal or metal alloy being cast or solidified is aluminum or an alloy containing greater than 50 percent aluminum.

- 524 With metal fusion bonding step utilizing electron arc or beam:**  
This subclass is indented under subclass 516. Process which utilizes an electron arc or beam for fusion bonding metal to metal.
- SEE OR SEARCH CLASS:  
219, Electric Heating, appropriate subclasses for processes of metal fusion bonding which use an electron arc or beam, per se, without a separate significant heating step as defined in the notes of subclass 95 of Class 148.
- 525 Utilizing wave energy (e.g., laser, electromagnetic wave energy, etc.) plasma or electron arc or beam:**  
This subclass is indented under subclass 516. Process which utilizes wave energy (e.g., laser, electromagnetic wave energy, etc.), plasma or an electron arc or beam for (1) modifying or maintaining the internal physical structure (i.e., microstructure) or chemical properties of metal or a metal alloy or (2) in a combined process that includes a step of modifying or maintaining the internal physical structure or chemical properties of metal or a metal alloy, the use of electromagnetic wave energy, plasma, electron arc or beam for any purpose.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
565, for processes of treating nonlayered metal with electromagnetic wave energy or electron arc or beam.
- 526 Electric heating with work as electrical conductor (e.g., alternating current, induction, etc.):**  
This subclass is indented under subclass 516. Process wherein an electrical current passes through the workpiece or is made to flow in a workpiece or through induction to cause the heating thereof.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
566+, for processes of electric heating with nonlayered metal as an electrical conductor.
- 527 With metal next to or bonded to metal:**  
This subclass is indented under subclass 516. Process wherein the article or stock being produced or treated has a metal layer or part next to or bonded to an adjacent metal layer or part.
- 528 With brazing or soldering:**  
This subclass is indented under subclass 527. Process wherein a step of brazing or soldering is present or wherein brazed or soldered article or stock is being treated.
- 529 Iron (Fe) or iron base alloy present:**  
This subclass is indented under subclass 527. Process wherein at least one of the layers or parts is iron (Fe) or an iron alloy containing greater than 50 percent iron.
- 530 Next to nonferrous metal or nonferrous base alloy:**  
This subclass is indented under subclass 529. Process wherein the iron or iron base alloy is next to a second layer or part which is identifiable as a nonferrous metal or nonferrous base metal alloy containing greater than 50 percent of any one of the nonferrous metals.
- 531 Aluminum (Al) or aluminum base alloy:**  
This subclass is indented under subclass 530. Process wherein the nonferrous metal is aluminum(Al) or the nonferrous base alloy has greater than 50 percent aluminum.
- 532 Copper (Cu) or copper base alloy:**  
This subclass is indented under subclass 530. Process wherein the nonferrous metal is copper (Cu) or the nonferrous base alloy contains greater than 50 percent copper.
- 533 Zinc (Zn), zinc base alloy or unspecified galvanizing:**  
This subclass is indented under subclass 530. Process in which the nonferrous metal is zinc (Zn) or the nonferrous base alloy contains greater than 50 percent zinc or in which there is a galvanizing step that does not specify the coating metal.
- 534 With working:**  
This subclass is indented under subclass 529. Process in which there is a metal deforming step.

**535 Aluminum (Al) or aluminum base alloy present:**

This subclass is indented under subclass 527. Process wherein at least one of the layers or parts is aluminum(Al) or an aluminum alloy containing greater than 50 percent aluminum.

**536 Copper (Cu) or copper base alloy present:**

This subclass is indented under subclass 527. Process wherein at least one of the layers or parts is copper or copper alloy containing greater than 50 percent copper.

**537 With coating step:**

This subclass is indented under subclass 516. Process which includes a coating step.

**538 With casting or solidifying from melt:**

This subclass is indented under subclass 95. Process which includes a step of casting metal or solidifying a total metal mass (i.e., not just a portion or coating) from a melted condition.

- (1) Note. Class 148 will take all processes of casting and significant heating with working or casting and heating wherein a change in microstructure occurs during a post-casting operation. In Class 148, both electrical and nonelectrical heating is acceptable. See the notes under the Class 148 definition to determine what constitutes significant heating for distinguishing over the other metal working and heating classes.
- (2) Note. Treating of a cast or solidified metal starting material without an actual recitation of the casting or solidifying step is improper for this subclass and the subclasses indented hereinunder.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 221, for processes of casting combined with carburizing or nitriding.  
 512, for processes of treating metal by melting only the surface thereof.  
 522+, for processes of producing or treating layered, bonded, welded or mechanically engaged article or stock as a final product when combined with a casting operation.

SEE OR SEARCH CLASS:

- 29, Metal Working, appropriate subclasses for a process combining casting and working of metal.  
 164, Metal Founding, appropriate subclasses for a process of casting, per se, of metal.  
 219, Electric Heating, appropriate subclasses for processes of casting, per se, or casting and working involving nonsignificant heat treating using electrical heating.

**539 Centrifugal casting:**

This subclass is indented under subclass 538. Process wherein melted metal is cast from a rotating means by centrifugal force (e.g., spin casting).

**540 Iron (Fe) or iron base alloy:**

This subclass is indented under subclass 538. Process wherein the metal being cast is iron (Fe) or an iron alloy containing greater than 50 percent iron.

**541 Continuous casting:**

This subclass is indented under subclass 540. Process wherein the metal being cast is continuously cast in an endless manner without interruption from the casting apparatus.

**542 Containing at least nine percent chromium (Cr) (e.g., stainless steel, etc.):**

Process under 540 wherein the iron alloy contains at least nine percent chromium (Cr) (e.g., stainless steel, etc.).

**543 Containing at least 1.5 percent carbon:**

This subclass is indented under subclass 540. Process wherein the iron alloy contains at least 1.5 percent carbon.

**544 With working:**

This subclass is indented under subclass 543. Process which involves a metal deforming step.

**545 With tempering, ageing, solution treating (i.e., for hardening), precipitation hardening or strengthening, or quenching:**

This subclass is indented under subclass 543. Process which includes a step of tempering, ageing, solution treating (i.e., for hardening),

- precipitation hardening or precipitation strengthening, or quenching as a literally expressed operation.
- 546 With working:**  
This subclass is indented under subclass 540. Process which includes a metal deforming step.
- 547 With tempering, ageing, solution treating (i.e., for hardening), precipitation hardening or strengthening, or quenching:**  
This subclass is indented under subclass 546. Process which involves a step of tempering, ageing, solution treating, precipitation hardening or precipitation strengthening, or quenching as a literally expressed operation.
- 548 With tempering, ageing, solution treating (i.e., for hardening), precipitation hardening or strengthening, or quenching:**  
This subclass is indented under subclass 540. Process which involves a step of tempering, ageing, solution treating (i.e., for hardening), precipitation hardening or precipitation strengthening, or quenching as a literally expressed operation.
- 549 Aluminum (Al) or aluminum base alloy:**  
This subclass is indented under subclass 538. Process wherein the metal being cast is aluminum(Al) or an aluminum alloy containing greater than 50 percent aluminum.
- 550 With extruding or drawing:**  
This subclass is indented under subclass 549. Process wherein there is a step of extruding or drawing of the aluminum or aluminum alloy.
- 551 Continuous casting:**  
This subclass is indented under subclass 549. Process wherein the metal being cast is continuously cast from the casting apparatus in an endless manner without interruption.
- 552 With working:**  
This subclass is indented under subclass 549. Process which involves a metal deforming step.
- 553 Copper (Cu) or copper base alloy:**  
This subclass is indented under subclass 538. Process wherein the metal being cast is copper (Cu) or a copper alloy containing greater than 50 percent copper.
- 554 With working:**  
This subclass is indented under subclass 553. Process which involves a metal deforming step.
- 555 Nickel(Ni) or nickel base alloy:**  
This subclass is indented under subclass 538. Process wherein the metal being cast is nickel(Ni) or a nickel alloy containing greater than 50 percent nickel.
- 556 With working:**  
This subclass is indented under subclass 555. Process which involves a metal deforming step.
- 557 With working:**  
This subclass is indented under subclass 538. Process which involves a metal deforming step.
- 558 With vibration (e.g., mechanical, sound, etc.):**  
This subclass is indented under subclass 95. Process which involves the use of mechanical vibration (e.g., high frequency sound, etc.) to modify the microstructure of the metal without deformation of the metal in the vibrating operation.
- 559 Heating or cooling of solid metal:**  
This subclass is indented under subclass 95. Process wherein metal remaining in the solid or semisolid state (i.e., unmelted) throughout the entire process is subjected to a heating or cooling operation.
- 560 Actinide or trans-actinide metal or alloy having greater than 50 percent actinide or trans-actinide metals:**  
This subclass is indented under subclass 559. Process wherein the metal undergoing treatment is a metal or metal alloy having greater than 50 percent of actinide or a trans-actinide metal or greater than 50 percent of a combination of different actinide and/or trans-actinide metals in the alloy.
- (1) Note. The actinide or trans-actinide metals include: actinium (Ac); thorium (Th); protactinium (Pa); uranium (U); neptunium (Np); plutonium (Pu); americium (Am); curium (Cm); berkelium

(Bk); californium (Cf); einsteinium (Es); fermium (Fm); mendelevium (Md); nobelium (No); and lawrencium (Lr).

**561 Passing through an amorphous state or treating or producing an amorphous metal or alloy:**

This subclass is indented under subclass 559. Process wherein a metal or metal alloy having no regular crystalline structure or periodicity (i.e., amorphous) in any amount is produced or treated by a process under the class definition or wherein a metal or metal alloy passes through a physical state having no regular crystalline structure or periodicity during the treatment of the metal or metal alloy.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 100, for a process of developing, improving, modifying, or preserving the magnetic properties of an amorphous metal or metal alloy.
- 403, for stock material which is in an amorphous state.

**562 Treating single crystal:**

This subclass is indented under subclass 559. Process wherein a single crystal metal or metal alloy is the material being treated.

SEE OR SEARCH CLASS:

- 117, Single-Crystal, Oriented-Crystal, and Epitaxy Growth Processes; Non-Coating Apparatus Therefor, for processes and non-coating apparatus for growing therein-defined single-crystal of all types of materials, including metal, alloy, or intermetallic single-crystal (except those proper for Class 164, subclass 122.2). Class 117 is proper for metal, alloy, or intermetallic single-crystal growing in any physical state, including solid phase recrystallization. Class 117 is proper for metal, alloy, or intermetallic single-crystal growing and such combined with perfecting operations for the growing step, except that Class 148 provides for single-crystal growing combined with a subsequent step of heat treatment (which herein includes controlled cooling) when the purpose of the heat treatment (or con-

trolled cooling) is to modify the internal physical structure or chemical property of a metal, alloy, or intermetallic material. When the subsequent heat treatment (or controlled cooling) merely operates on the single-crystallinity, such as stress or strain annealing or to remove point defects, the combined process is proper for Class 117; when the subsequent heat treatment (or controlled cooling) operates to effect significant metal, alloy, or intermetallic material heat treatment (or controlled cooling) purposes, such as solutionizing, homogenizing, or precipitation hardening, then the combined process is proper for Class 148. Class 117 provides for simultaneous or prior perfecting operations combined with single-crystal growing. See Class 117 definition, section C, (4) Note, for discussion of perfecting operations.

**563 Mechanical memory (e.g., shape, heat-recoverable, etc.):**

This subclass is indented under subclass 559. Process wherein a metal or metal alloy having the ability when originally shaped at a first temperature and reshaped at a second temperature to undergo a reversible thermoelastic transition and resume its original shape when returned to the first temperature or an intermediate temperature is produced or treated in a process under the Class 148 definition.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 402, for stock material exhibiting a mechanical memory effect.

**564 Superplastic (e.g., dynamic recrystallization, etc.):**

This subclass is indented under subclass 559. Process wherein a metal or metal alloy possessing the characteristic of not rupturing or "necking down" when extensively deformed is produced or treated by a process under the class definition and wherein, if metal working is part of the process, a working temperature is provided as an indication of significant heating.

(1) Note. The term “superplastic” or “dynamic recrystallization hot working” is indicative of microstructural change. However, if a metal working step is present, placement goes to the metal working classes, unless the operation provides a working temperature which in combination with said terms will be sufficient criteria for placement in Class 148. Moreover, a combination of (1) the metal class working of “superplastic” metal or metal alloy at a nonspecified temperature and (2) a Class 148 operation goes in Class 148.

(2) Note. Superplastic deformation (1) is often induced by heating and working a metal or metal alloy, possessing a very fine grain structure, resulting in deformation exceeding 100 percent (i.e., based on elongation) and (2) is associated with phase change or allotropic transformation during the deformation.

SEE OR SEARCH CLASS:

72, Metal Deforming, appropriate subclasses for a process of working a metal undergoing dynamic-recrystallization or plastic deformation, if no temperature is provided.

420, Alloys or Metallic Compositions, subclass 902 for metal alloys exhibiting superplastic behavior.

**565 Utilizing wave energy (e.g., laser, electromagnetic, etc.), plasma or electron arc or beam:**

This subclass is indented under subclass 559. Process which utilizes wave energy (e.g., laser, electromagnetic, etc.), plasma or electron arc or beam for (1) modifying or maintaining the internal physical structure (i.e., microstructure) or chemical properties of metal or metal alloy or (2) in a combined process including a step of modifying or maintaining the internal physical structure or chemical properties of a metal or metal alloy, the use of wave energy, plasma, electron arc, or beam for any purpose.

SEE OR SEARCH THIS CLASS, SUBCLASS:

512, for process of using wave energy wherein the surface of the metal is

melted as defined for the purposes thereunder.

525, for processes of utilizing electromagnetic wave energy or electron arc or beam to treat layered metal workpieces or articles.

SEE OR SEARCH CLASS:

219, Electric Heating, appropriate subclasses for process of heating metal, per se, or for process of working metal that utilizes nonsignificant heating of the metal as set forth hereinabove in the line to the metal working classes.

**566 Electric heating with work as conductor (e.g., alternating current, induction, etc.):**

This subclass is indented under subclass 559. Process wherein an electric current from an external source is passed through a metal or metal alloy workpiece or is made to flow in a metal or metal alloy workpiece through induction to cause heating thereof.

SEE OR SEARCH THIS CLASS, SUBCLASS:

526, for processes of electric heating wherein an electric current is passed through a layered metal or metal alloy workpiece or article.

**567 Induction:**

This subclass is indented under subclass 566. Process wherein electricity is caused to pass through the workpiece by inducing current flow through influence of an external electrical field

SEE OR SEARCH THIS CLASS, SUBCLASS:

509, for processes of measuring or testing of electrical or magnetic properties utilizing induction therefor or coincident with the heating of a metal workpiece for Class 148 purposes.

526, for processes of inductively heating a layered metal or metal alloy workpiece or article.



- 568 Wire or filament:**  
This subclass is indented under subclass 567. Process wherein the metal or metal alloy workpiece undergoing treatment is a wire or filament.
- 569 Railway stock (e.g., rails, wheels, axles, etc.):**  
This subclass is indented under subclass 567. Process wherein the metal or metal alloy workpiece being treated is stock including rails, wheels, axles, or other metal parts utilized with a railway system.
- 570 Of hollow bodies (e.g., pipe, sphere, etc.):**  
This subclass is indented under subclass 567. Process wherein the metal or metal alloy workpiece being treated is hollow.
- 571 Inside only:**  
This subclass is indented under subclass 570. Process wherein the hollow workpiece being treated is heated by induction applied only from the inside thereof.
- 572 Rod, axle, shaft, or roller:**  
This subclass is indented under subclass 567. Process wherein the metal or metal alloy workpiece undergoing treatment is a rod, axle, shaft, or roller.
- 573 Gear, threaded article, drill or serrated work surface (e.g., saw blade, etc.):**  
This subclass is indented under subclass 567. Process wherein the metal or metal alloy workpiece undergoing treatment is a gear, threaded article, drill or serrated work surface (e.g., saw blade, etc.).
- 574 And cooling with fluid contact:**  
This subclass is indented under subclass 567. Process which includes a step of cooling the metal or metal alloy by contacting the same with a fluid cooling agent or medium.
- 575 Iron (Fe) or iron base alloy:**  
This subclass is indented under subclass 574. Process wherein the metal or metal alloy workpiece undergoing treatment is iron (Fe) or an iron alloy containing greater than 50 percent iron.
- 576 Wire or filament:**  
This subclass is indented under subclass 566. Process wherein the metal or metal alloy workpiece undergoing treatment is a wire or filament.
- 577 Chilling to subambient temperature:**  
This subclass is indented under subclass 559. Process wherein the metal is subjected to treatment at below ambient temperature (i.e., below 20°C).  
  
SEE OR SEARCH THIS CLASS, SUBCLASS:  
517, for processes using subambient temperature to treat a layered workpiece or article.
- 578 Iron (Fe) or iron base alloy:**  
This subclass is indented under subclass 577. Process wherein the metal undergoing treatment is iron (Fe) or an iron alloy containing greater than 50 percent iron.
- 579 Iron (Fe) or iron base alloy:**  
This subclass is indented under subclass 559. Process wherein the metal being treated is iron (Fe) or an iron alloy containing greater than 50 percent iron.
- 580 Spring or spring material:**  
This subclass is indented under subclass 579. Process wherein the metal being treated is described as a spring or spring material (e.g., coils, leaf, etc.).
- 581 Railway stock (e.g., rails, wheels, axles, etc.):**  
This subclass is indented under subclass 579. Process wherein the metal being treated is indicated to be stock including rails, wheels, axles, or other metal parts utilized with a railway system.
- 582 Treating with specified agent (e.g., heat exchange agent, protective agent, decarburizing agent, denitrating agent, etc.) or vacuum:**  
Process under 581 wherein a vacuum or a treating agent (e.g., heat exchange agent, protective agent, decarburizing agent, denitrating agent, etc.) specified as an element, compound or composition other than air or water is utilized to treat the iron or iron alloy.

- 583 Wheel:**  
This subclass is indented under subclass 581. Process wherein the metal being treated is a wheel.
- 584 With working:**  
This subclass is indented under subclass 581. Process which includes a step of deforming the metal.
- 585 With work handling:**  
This subclass is indented under subclass 581. Process wherein a metal workpiece is manipulated for positioning or moving about during any stage of the process.
- 586 Gear:**  
This subclass is indented under subclass 579. Process wherein the metal undergoing treatment is a part, which is usually toothed or spiraled and referred to as a gear, by which motion is transmitted from one portion of machinery to another.
- 587 Threaded article (e.g., screws, drill bits, etc.):**  
This subclass is indented under subclass 579. Process wherein the metal being treated contains a threaded portion (e.g., screws, drill bits, etc.).
- 588 Serrated work surface (e.g., saw blades, etc.):**  
This subclass is indented under subclass 579. Process wherein there is a serrated surface portion on the metal (e.g., saw blades, etc.) being treated.
- 589 Ring:**  
This subclass is indented under subclass 579. Process wherein the metal undergoing treatment is in the shape of an annular band of limited length (i.e., ring).
- 590 Pipe or tube:**  
This subclass is indented under subclass 579. Process wherein a hollow elongated cylinder (i.e., pipe or tube) is the metal undergoing treatment.
- 591 Treating with specified agent (e.g., heat exchange agent, protective agent, decarburizing agent, denitrifying agent, etc.) or vacuum:**  
This subclass is indented under subclass 590. Process wherein a vacuum or treating agent (e.g., heat exchange agent, protective agent, decarburizing agent, denitrifying agent, etc.) specified as an element, compound or composition other than air or water is utilized to treat the iron or iron alloy.
- 592 Nine percent or more chromium (Cr) (e.g., stainless steel, etc.):**  
This subclass is indented under subclass 590. Process wherein the pipe or tube is an iron alloy containing nine percent or more chromium (Cr) (e.g., stainless steel, etc.).
- 593 With working:**  
This subclass is indented under subclass 590. Process which includes metal deforming.
- 594 With work handling:**  
This subclass is indented under subclass 590. Process wherein a metal workpiece is manipulated for positioning or moving about during any stage of the process.
- 595 Wire, rod, or filament:**  
This subclass is indented under subclass 579. Process wherein the workpiece undergoing treatment is a wire, rod, or filament.
- (1) Note. The diameter of the rod makes no difference to this subclass.
- 596 Treating with specified agent (e.g., heat exchange agent, protective agent, decarburizing agent, denitrifying agent, etc.) or vacuum:**  
This subclass is indented under subclass 595. Process wherein a vacuum or a treating agent (e.g., heat exchange agent, protective agent, decarburizing agent, denitrifying agent, etc.) specified as an element, compound, or composition other than air or water is utilized to treat the wire, rod, or filament.
- 597 Nine percent or more chromium (Cr) (e.g., stainless steel, etc.):**  
This subclass is indented under subclass 595. Process wherein the wire, rod, or filament is an iron alloy containing nine percent or more chromium (Cr) (e.g., stainless steel, etc.).

- 598 With working:**  
This subclass is indented under subclass 595. Process which includes metal deforming.
- 599 With working at or below 120°C or unspecified cold working:**  
This subclass is indented under subclass 598. Process wherein there is a metal deforming operation that occurs from below 120°C down to 20°C or reciting a cold working at an unspecified temperature.
- 600 With work handling:**  
This subclass is indented under subclass 595. Process wherein the wire, rod, or filament is manipulated for positioning or moving about at any stage of the process.
- 601 With coiling or treating of coiled strip:**  
This subclass is indented under subclass 579. Process which includes a coiling step or treating of a coiled strip.
- 602 With working:**  
This subclass is indented under subclass 601. Process which includes a metal deforming step in addition to the coiling step.
- 603 With working at or below 120°C or unspecified cold working:**  
This subclass is indented under subclass 602. Process wherein there is a metal deforming operation that occurs from or below 120°C down to 20°C or reciting cold working at an unspecified temperature.
- 604 Of stacked plural workpieces:**  
This subclass is indented under subclass 579. Process wherein plural workpieces are vertically stacked, one above the other.
- (1) Note. Side-by-side or other arrangements for treating plural workpieces are not provided in this subclass.
- (2) Note. The presence of inserts or spacers between the plural workpieces for facilitating the treatment is acceptable for this subclass.
- 605 Nine percent or more chromium (Cr) (e.g., stainless steel, etc.):**  
This subclass is indented under subclass 579. Process wherein the Iron alloy undergoing treatment contains nine percent or more chromium (Cr) (e.g., stainless steel, etc.).
- 606 Treating with specified agent (e.g., heat exchange agent, protective agent, decarburizing agent, denitrating agent, etc.) or vacuum:**  
This subclass is indented under subclass 605. Process wherein a vacuum or treating agent (e.g., heat exchange agent, protective agent, decarburizing agent, denitrating agent, etc.) specified as an element, compound, or composition other than air or water is utilized to treat the iron or iron alloy.
- 607 Ageing, solution treating (i.e., for hardening), precipitation strengthening or precipitation hardening:**  
This subclass is indented under subclass 605. Process which includes operations designated as ageing, solution treating (i.e., for hardening), precipitation strengthening or precipitation hardening.
- (1) Note. See the main lines for Class 148 to determine placement herein, over the metal working classes, if metal working is present. Specifically, the presence of the terms ageing, solution treating, or precipitation strengthening or precipitation hardening are sufficient for placement in Class 148, over the metal working classes.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
545, 547, 548, or 622 for other Class 148 processes treating iron alloys by ageing, solution treating, precipitation strengthening or precipitation hardening.
- 608 With working:**  
This subclass is indented under subclass 607. Process which includes a metal deforming step.
- 609 With working:**  
This subclass is indented under subclass 605. Process which includes metal deforming.

- 610 With working at or below 120°C or unspecified cold working:**  
This subclass is indented under subclass 609. Process wherein there is a metal deforming operation that occurs from below 120°C down to 20°C or cold working at an unspecified temperature.
- 611 Austenitic phase structure:**  
This subclass is indented under subclass 605. Process wherein there is an Austenitic phase structure identified as present in the iron alloy.
- 612 Starting material contains 1.7 percent or more carbon (e.g., cast iron, etc.):**  
This subclass is indented under subclass 579. Process wherein the iron alloy contains 1.7 percent or more carbon (e.g., cast iron, etc.).
- 613 Decarburizing:**  
This subclass is indented under subclass 612. Process which includes a treatment that reduces the carbon content present in the work-piece.
- 614 Starting material is spherulitic (i.e., spheroidal) or vermicular (i.e., wormlike):**  
This subclass is indented under subclass 612. Process wherein there is a spherulitic (i.e., spheroidal) or vermicular (i.e., wormlike) carbon state present in the starting iron alloy undergoing treatment.
- 615 Treating with specified agent (e.g., heat exchange agent, protective agent, decarburizing agent, denitriding agent, etc.) or vacuum:**  
This subclass is indented under subclass 612. Process wherein a vacuum or treating agent (e.g., heat exchange agent, protective agent, decarburizing agent, nitridizing agent, etc.) is specified as an element, compound, or composition other than air or water is utilized to treat the iron or iron alloy.
- 616 Treating or producing white or malleable cast iron:**  
This subclass is indented under subclass 612. Process wherein the iron alloy undergoing treatment is white or malleable cast iron or wherein the product of the process is white or malleable cast iron.
- 617 Producing malleable cast iron:**  
This subclass is indented under subclass 616. Process wherein the product of the process is a malleable cast iron.
- 618 With spheroidal graphite production:**  
This subclass is indented under subclass 617. Process for producing a malleable cast iron product, also includes the production of spheroidal graphite.
- 619 Containing 10 percent or more manganese(Mn) (e.g., Hadfield steel, etc.):**  
This subclass is indented under subclass 579. Process wherein the iron alloy undergoing treatment contains 10 percent or more manganese(Mn) (e.g., Hadfield steel, etc.).
- 620 With working:**  
This subclass is indented under subclass 619. Process which includes metal deforming.
- 621 Highly alloyed (i.e., greater than 10 percent alloying elements):**  
This subclass is indented under subclass 579. Process wherein the iron based alloy contains greater than a total of 10 percent alloying elements.
- (1) Note. Steels of the types referred to as high speed tool alloys, maraging alloys, and iron-based super alloys are assumed to be highly alloyed for this subclass lacking an indication to the contrary.
- 622 Ageing, solution treating (i.e., for hardening), precipitation strengthening or precipitation hardening:**  
This subclass is indented under subclass 579. Process which includes operations designated as ageing, solution treating (i.e., for hardening), precipitation strengthening or precipitation hardening.
- (1) Note. See the main Class 148 lines to determine placement herein over the metal working classes if metal working is present. Specifically, the presence of the terms ageing, solution treating, or precipitation strengthening or precipitation hardening are sufficient for placement in Class 148 over the metal working classes.

- SEE OR SEARCH THIS CLASS, SUBCLASS:  
545, 547, 548, or 607 for other Class 148 processes or treating iron alloys by aging, solution treating, or precipitation strengthening or precipitation hardening as a literal expression.
- 623 Overageing:**  
This subclass is indented under subclass 622. Process which defines the aging operation as “overageing”.
- 624 With working:**  
This subclass is indented under subclass 622. Process which includes metal deforming.
- 625 Treating with specified agent (e.g., heat exchange agent, protective agent, decarburizing agent, denitrifying agent, etc.) or vacuum:**  
This subclass is indented under subclass 579. Process wherein a vacuum or a treating agent (e.g., heat exchange agent, protective agent, decarburizing agent, denitrifying agent, etc.) specified as an element, compound, or composition other than air or water, per se, to treat the iron or iron alloy.
- 626 With preserving, recovering, separately treating or handling of the specified treating agent:**  
This subclass is indented under subclass 625. Process which includes preserving, recovering, separately treating or manipulating for positioning or moving about of the specified treating agent.
- 627 With localized or zone heating or cooling:**  
This subclass is indented under subclass 625. Process wherein a heating or cooling operation is applied to a discontinuous area of the metal workpiece to provide treatment limited to one or several local areas or zones and not to other adjacent areas.
- 628 Using vacuum:**  
This subclass is indented under subclass 625. Process which involves the use of a vacuum at any stage of the process.
- 629 Decarburizing or denitrifying:**  
This subclass is indented under subclass 625. Process which includes a step decarburizing or denitrifying.
- 630 Utilizing particulate fluid bed:**  
This subclass is indented under subclass 625. Process which involves the use of a bed of particulate material in gaseous suspension serving as the treating agent.
- 631 Fused treating agent:**  
This subclass is indented under subclass 625. Process wherein the treating agent is fused.
- 632 With working:**  
This subclass is indented under subclass 631. Process which includes metal deforming.
- 633 Gaseous agent:**  
This subclass is indented under subclass 625. Process which includes the use of a specified gaseous agent other than air or water.
- 634 Hydrogen:**  
This subclass is indented under subclass 633. Process wherein the gaseous treating agent contains molecular hydrogen gas and excluding air.
- (1) Note. While water is excluded as a treating agent for this subclass, the presence of molecular hydrogen, as may be found in equilibrium in steam, is acceptable if the specification discloses the use thereof for molecular hydrogen content.
- (2) Note. Although there is molecular hydrogen present in air, the mere use of air is not intended as proper for this subclass.
- 635 With working:**  
This subclass is indented under subclass 633. Process which includes metal deforming.
- 636 Liquid agent:**  
This subclass is indented under subclass 625. Process wherein the specified treating agent is a liquid other than liquid air, per se, or water, per se.

- 637 And cooling or quenching:**  
This subclass is indented under subclass 636. Process which includes a cooling or quenching operation.
- 638 Treating composition contains water:**  
Process under 637 wherein the treating agent composition includes water, but is not water, per se.
- 639 Localized or zone heating or cooling:**  
This subclass is indented under subclass 579. Process wherein a heating or cooling operation is applied to a discontinuous area of the metal workpiece to provide treatment limited to one or several local areas or zones and not to another adjacent area.
- 640 Utilizing protective or insulating shielding from heat:**  
This subclass is indented under subclass 639. Process wherein a mechanical barrier or shield is utilized to protect or insulate the local area or zone of metal from heat.
- 641 Simultaneous heating and cooling treatment:**  
This subclass is indented under subclass 639. Process which includes a step of simultaneous heating and cooling.
- 642 Heating with flame treatment:**  
This subclass is indented under subclass 639. Process which involves use of a flame to heat a metal workpiece.  
  
SEE OR SEARCH THIS CLASS, SUB-CLASS:  
194+, for a process of flame cutting or burning of a metal workpiece.
- 643 With working:**  
This subclass is indented under subclass 639. Process which involves metal deforming.
- 644 Cooling**  
This subclass is indented under subclass 639. Process which includes cooling of metal.
- 645 With flattening, straightening or tensioning by external force:**  
This subclass is indented under subclass 579. Process wherein the metal workpiece is subjected to a flattening, straightening, or tensioning operation which utilizes an external force.  
  
(1) Note. The tensioning applies external pulling force in diverse directions to the metal workpiece without any actual bending or plastic deformation of the workpiece during the tensioning step.
- 646 With restraining of metal from expanding or contracting during heating or cooling:**  
This subclass is indented under subclass 579. Process wherein the expansion or contraction of the metal workpiece creates a force which is opposed by a holding or confining means to restrain the metal workpiece from expanding or contracting.
- 647 Die quenching:**  
This subclass is indented under subclass 646. Process wherein the workpiece is restrained in a die while undergoing a rapid cooling (i.e., quenching) operation.
- 648 With working:**  
This subclass is indented under subclass 579. Process which includes metal deforming.
- 649 Forging:**  
This subclass is indented under subclass 648. Process which includes a metal deforming operation by heating and hammering (i.e., forging).
- 650 With working at or below 120°C or unspecified cold working:**  
This subclass is indented under subclass 648. Process wherein there is a metal deforming operation that occurs at a temperature from below 120°C down to 20°C or cold working at an unspecified temperature.  
  
SEE OR SEARCH THIS CLASS, SUB-CLASS:  
577, for processes of treating a metal or metal alloy at temperatures below 20°C.

- 651 Heating step follows cold working:**  
This subclass is indented under subclass 650. Process wherein at least one heating operation follows a cold working operation.
- 652 Separate cooling step follows cold working step:**  
This subclass is indented under subclass 651. Process wherein there is a separate cooling operation performed subsequent to the cold working step.
- 653 With additional nonworking heating step:**  
This subclass is indented under subclass 648. Process wherein in addition to the step in which metal working occurs, there is a separate step of heating for modifying the microstructure of a metal workpiece.
- 654 Including cooling (e.g., quenching, etc.):**  
This subclass is indented under subclass 648. Process which includes, in addition to the metal working step, a separate cooling operation (e.g., quenching, etc.).
- 655 With separate handling or treating of the air, water, or unspecified fluid treating media:**  
This subclass is indented under subclass 579. Process wherein air, water, or an unspecified fluid treating media is subjected to a separate step of manipulation or treating outside of the metal treating operation.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
625, for process of treating the metal workpiece with a specified treating agent.
- 656 Work handling:**  
This subclass is indented under subclass 579. Process wherein a metal workpiece is manipulated for positioning or moving about at any stage in the process.
- 657 Continuous strip or sheet:**  
This subclass is indented under subclass 656. Process wherein the workpiece is in the form of a continuous strip or sheet of metal.
- 658 During cooling step:**  
This subclass is indented under subclass 656. Process wherein the handling of the workpiece takes place during a cooling step.
- 659 Including spheroidizing:**  
This subclass is indented under subclass 579. Process which involves production of spheroidal microstructural components.
- 660 Including cooling (e.g., quenching, etc.):**  
This subclass is indented under subclass 579. Process which includes a cooling step (e.g., quenching, etc.).
- 661 Strip, sheet, or plate:**  
This subclass is indented under subclass 660. Process wherein the metal workpiece is in the form of a strip, sheet, or plate.
- 662 Heating step follows cooling step:**  
This subclass is indented under subclass 660. Process in which a heating step follows a cooling step.
- 663 Tempering:**  
This subclass is indented under subclass 662. Process which includes a tempering heat treatment at any stage whereby a crystal structure such as martensite is transformed to carbides residing in austenite.
- 664 Multiple cooling steps:**  
This subclass is indented under subclass 660. Process wherein there are multiple cooling steps.
- 665 Beryllium (Be) or beryllium base alloy:**  
This subclass is indented under subclass 559. Process wherein the metal being treated is beryllium(Be) or a beryllium alloy containing greater than 50 percent beryllium.
- 666 Magnesium (Mg) or magnesium base alloy:**  
This subclass is indented under subclass 559. Process wherein the metal being treated is magnesium (Mg) or a magnesium alloy containing greater than 50 percent magnesium.
- 667 With working:**  
This subclass is indented under subclass 666. Process wherein there is a step of metal deforming.

- 668 Refractory metal (i.e., titanium (Ti), zirconium (Zr), hafnium (Hf), vanadium (V), niobium (Nb), columbium (Cb), tantalum (Ta), chromium (Cr), molybdenum (Mo), tungsten (W)), or alloy base thereof:**  
This subclass is indented under subclass 559. Process wherein the metal being treated is titanium (Ti), zirconium (Zr), hafnium (Hf), vanadium (V), niobium (Nb), columbium (Cb), tantalum (Ta), chromium (Cr), molybdenum (Mo), tungsten (W), or an alloy thereof containing greater than 50 percent of one of said metals.
- 669 Titanium (Ti) or titanium base alloy:**  
This subclass is indented under subclass 668. Process wherein the metal being treated is titanium (Ti) or titanium alloy containing greater than 50 percent titanium.
- 670 With working:**  
This subclass is indented under subclass 669. Process which includes a step of metal deforming.
- 671 With ageing, solution treating (i.e., for hardening), precipitation hardening or strengthening:**  
This subclass is indented under subclass 670. Process which includes a step of ageing, solution treating (i.e., for hardening), precipitation hardening or precipitation strengthening as a literally expressed condition.
- (1) Note. See the main definition for this class (148), Lines With Other Classes and Within This Class, "A. Metal Casting, Metal Fusion Bonding, etc.," to determine placement over the metal working classes, if metal working is present. Specifically, the presence of the terms aging, solution treating, for precipitation strengthening or precipitation hardening are sufficient for placement in Class 148 over the metal working classes.
- 672 Zirconium (Zr) or zirconium base alloy:**  
This subclass is indented under subclass 668. Process wherein the metal being treated is zirconium (Zr) or a zirconium alloy containing greater than 50 percent zirconium.
- 673 Tungsten (W) or tungsten base alloy:**  
This subclass is indented under subclass 668. Process wherein the metal being treated is tungsten (W) or a tungsten alloy containing greater than 50 percent tungsten.
- 674 Cobalt (Co) or cobalt base alloy:**  
This subclass is indented under subclass 559. Process wherein the metal being treated is cobalt(Co) or a cobalt alloy containing greater 50 percent cobalt.
- 675 Nickel (Ni) or nickel base alloy:**  
This subclass is indented under subclass 559. Process wherein the metal being treated is nickel(Ni) or a nickel alloy containing greater than 50 percent nickel.
- 676 With working:**  
This subclass is indented under subclass 675. Process which includes a metal deforming step.
- 677 With ageing, solution treating (i.e., for hardening), or precipitation hardening or strengthening:**  
This subclass is indented under subclass 676. Process which includes a step of ageing, solution treating (i.e., for hardening), or precipitation hardening or precipitation strengthening as a literal expression.
- (1) Note. See the main definition for this class (148), Lines With Other Classes and Within This Class, "A. Metal Casting, Metal Fusion Bonding, etc.," to determine placement over the metal working classes, if metal working is present. Specifically, the presence of the terms ageing, solution treating, or precipitation strengthening or precipitation hardening are sufficient for placement in Class 148 over the metal working classes.
- 678 Noble metal (i.e., silver (Ag), gold (Au), osmium (Os), iridium (Ir), platinum (Pt), ruthenium (Ru), rhodium (Rh), palladium (Pd)) or alloy base thereof:**  
Process under 559 wherein the metal being treated is silver(Ag), gold(Au), osmium(Os), iridium(Ir), platinum(Pt), ruthenium(Ru), rhodium(Rh), palladium(Pd), or an alloy base



- thereof containing greater than 50 percent of any one of said metals.
- 679 Copper (Cu) or copper base alloy:**  
This subclass is indented under subclass 559. Process wherein the metal being treated is copper (Cu) or a copper alloy containing greater than 50 percent copper.
- 680 With working above 400°C or nonspecified hot working:**  
This subclass is indented under subclass 679. Process wherein there is a metal deforming step that takes place at a temperature above 400°C or there is nonspecified hot working.
- (1) Note. See the main definition for this class (148), Lines With Other Classes and Within This Class, "A. Metal Casting, Metal Fusion Bonding, etc.," to determine placement over the metal working classes, if metal working is present.
- 681 Multiple working steps:**  
This subclass is indented under subclass 680. Process which includes plural metal deforming steps and wherein at least one of said metal deforming steps is performed above 400°C or is a nonspecified hot working.
- 682 With ageing, solution treating (i.e., for hardening), precipitation hardening or strengthening:**  
This subclass is indented under subclass 681. Process which includes a step of ageing, solution treating (i.e., for hardening), or precipitation hardening or precipitation strengthening as a literally expressed expression.
- (1) Note. See the main definition for this class (148), Lines With Other Classes and Within This Class, "A. Metal Casting, Metal Fusion Bonding, etc.," to determine placement over the metal working classes, if metal working is present. Specifically, the presence of the terms ageing, solution treating, or precipitation strengthening or precipitation hardening are sufficient for placement in Class 148 over the metal working classes.
- 683 With ageing, solution treating (i.e., for hardening), precipitation hardening or strengthening:**  
This subclass is indented under subclass 680. Process which includes a step of ageing, solution treating (i.e., for hardening), or precipitation hardening or precipitation strengthening as a literally expressed expression.
- (1) Note. See the main definition for this class (148), Lines With Other Classes and Within This Class, "A. Metal Casting, Metal Fusion Bonding, etc.," to determine placement over the metal working classes, if metal working is present. Specifically, the presence of the terms ageing, solution treating, precipitation strengthening or precipitation hardening are sufficient for placement in Class 148 over the metal working classes.
- 684 With working:**  
This subclass is indented under subclass 679. Process which includes a metal deforming step at from 400°C down to 20°C or cold working at an unspecified temperature.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
577, for processes treating solid or semi-solid metal at temperatures below 20°C.
- 685 With ageing, solution treating (i.e., for hardening), precipitation hardening or strengthening:**  
This subclass is indented under subclass 684. Process which includes a step of ageing, solution treating (i.e., for hardening), or precipitation hardening or precipitation strengthening as a literally expressed condition.
- (1) Note. See the main definition for this class (148), Lines With Other Classes and Within This Class, "A. Metal Casting, Metal Fusion Bonding, etc.," to determine placement herein over the metal working classes if metal working is present. Specifically, the presence of the terms ageing, solution treating, or precipitation strengthening or precipitation hardening are sufficient for place-

ment in Class 148 over the metal working classes.

**686 With ageing, solution treating (i.e., for hardening), precipitation hardening or strengthening:**

This subclass is indented under subclass 679. Process which includes a step of ageing, solution treating (i.e., for hardening), or precipitation hardening or precipitation strengthening as a literally expressed condition.

- (1) Note. See the main definition for this class (148), Lines With Other Classes and Within This Class, "A. Metal Casting, Metal Fusion Bonding, etc.," to determine placement over the metal working classes, if metal working is present. Specifically, the presence of the terms aging, solution treating, or precipitation strengthening or precipitation hardening are sufficient for placement in Class 148 over the metal working classes.

**687 Treating with specified agent (e.g., heat exchange agent, protective agent, decarburizing agent, denitrating agent, etc.) or vacuum:**

Process under 679 wherein a vacuum or a treating agent (e.g., heat exchange agent, protective agent, decarburizing agent, denitrating agent, etc.) specified as an element, compound, or composition other than air or water is utilized to treat the copper or copper alloy.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 206, for carburizing or nitriding of metal using an externally supplied source.  
240, for processes of coating metal utilizing a reactive agent that reacts with the metal substrate.

**688 Aluminum (Al) or aluminum base alloy:**

This subclass is indented under subclass 559. Process wherein the metal being treated is aluminum(Al) or an aluminum alloy containing greater than 50 percent aluminum.

**689 With extruding or drawing:**

This subclass is indented under subclass 688. Process wherein the metal is extruded or drawn through a shaping orifice for purpose of shaping the metal.

**690 And ageing, solution treating (i.e., for hardening), precipitation hardening or strengthening:**

This subclass is indented under subclass 689. Process which includes a step of ageing, solution treating (i.e., for hardening), precipitation hardening or precipitation strengthening as a literally expressed condition.

- (1) Note. See the main definition for this class (148), Lines With Other Classes and Within This Class, "A. Metal Casting, Metal Fusion Bonding, etc.," to determine placement over the metal working classes, if metal working is present. Specifically, the presence of the terms ageing, solution treating, or precipitation strengthening or precipitation hardening are sufficient for placement in Class 148 over the metal working classes.

**691 With working above 400°C or nonspecified hot working:**

This subclass is indented under subclass 688. Process wherein there is a metal deforming step that takes place at a temperature above 400°C or there is nonspecified hot working.

**692 Multiple working steps:**

This subclass is indented under subclass 691. Process which includes plural metal deforming steps and wherein at least one of said metal deforming steps is performed above 400°C or at an unspecified hot working temperature.

**693 With ageing, solution treating (i.e., for hardening), precipitation hardening or strengthening:**

This subclass is indented under subclass 692. Process which includes a step of ageing, solution treating (i.e., for hardening), or precipitation hardening or precipitation strengthening as a literally expressed condition.

- (1) Note. See the main definition for this class (148), Lines With Other Classes

and Within This Class, “A. Metal Casting, Metal Fusion Bonding, etc.,” to determine placement over the metal working classes, if metal working is present. Specifically, the presence of the terms ageing, solution treating, or precipitation strengthening or precipitation hardening are sufficient for placement in Class 148 over the metal working classes.

**694 With ageing, solution treating (i.e., for hardening), precipitation hardening or strengthening:**

This subclass is indented under subclass 691. Process which includes a step of ageing, solution treating (i.e., for hardening), or precipitation hardening or precipitation strengthening as a literally expressed condition.

- (1) Note. See the main definition for this class (148), Lines With Other Classes and Within This Class, “A. Metal Casting, Metal Fusion Bonding, etc.,” to determine placement over the metal working classes, if metal working is present. Specifically, the presence of the terms ageing, solution treating, or precipitation strengthening or precipitation hardening are sufficient for placement in Class 148 over the metal working classes.

**695 With working:**

This subclass is indented under subclass 688. Process which includes a metal deforming step at 400°C down to 20°C.

SEE OR SEARCH THIS CLASS, SUBCLASS:

577, for processes treating solid or semi-solid metal at temperatures below 20°C.

**696 Multiple working steps:**

This subclass is indented under subclass 695. Process which includes plural metal deforming steps and wherein each of said metal deforming steps are performed at from 400°C down to 20°C.

SEE OR SEARCH THIS CLASS, SUBCLASS:

577, for processes treating solid or semi-solid metal at temperatures below 20°C.

**697 With ageing, solution treating (i.e., for hardening), precipitation hardening or strengthening:**

This subclass is indented under subclass 696. Process which includes a step of ageing, solution treating (i.e., for hardening), precipitation hardening or precipitation strengthening as a literally expressed condition.

- (1) Note. See the main definition for this class (148), Lines With Other Classes and Within This Class, “A. Metal Casting, Metal Fusion Bonding, etc.,” to determine placement over the metal working classes, if metal working is present. Specifically, the presence of the terms ageing, solution treating, or precipitation strengthening or precipitation hardening are sufficient for placement in Class 148 over the metal working classes.

**698 With ageing, solution treating (i.e., for hardening), precipitation hardening or strengthening:**

This subclass is indented under subclass 688. Process which includes a step of ageing, solution treating (i.e., for hardening), or precipitation hardening or precipitation strengthening as a literally expressed condition.

- (1) Note. See the main definition for this class (148), Lines With Other Classes and Within This Class, “A. Metal Casting, Metal Fusion Bonding, etc.,” to determine placement over the metal working classes, if metal working is present. Specifically, the presence of the terms ageing, solution treating, or precipitation strengthening or precipitation hardening are sufficient for placement in Class 148 over the metal working classes.

- 699 Copper (Cu) containing:**  
This subclass is indented under subclass 698. Process wherein the aluminum alloy contains copper (Cu) in any amount.
- 700 Magnesium (Mg) containing:**  
This subclass is indented under subclass 699. Process wherein the aluminum alloy contains copper (Cu) and magnesium (Mg) in any amount.
- 701 Zinc (Zn) containing:**  
This subclass is indented under subclass 700. Process wherein the Aluminum alloy contains copper (Cu), magnesium (Mg), and zinc (Zn) in any amount.
- 702 Magnesium (Mg) containing:**  
This subclass is indented under subclass 698. Process wherein the aluminum alloy contains magnesium (Mg) in any amount.
- 703 Treating with specified agent (e.g., heat exchange agent, protective agent, decarburizing agent, denitrating agent, etc.) or vacuum:**  
This subclass is indented under subclass 688. Process wherein a vacuum or a treating agent (e.g., heat exchange agent, protective agent, decarburizing agent, denitrating agent, etc.) specified as an element, compound, or composition other than air or water is utilized to treat aluminum or aluminum alloy.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
206, for carburizing or nitriding of metal using an externally supplied source.  
240, for processes of coating metal utilizing a reactive agent that reacts with the metal.
- 704 In fused state:**  
This subclass is indented under subclass 703. Process wherein the specified agent is in a fused or melted state.
- 705 Zinc (Zn) or zinc base alloy:**  
This subclass is indented under subclass 559. Process wherein the metal being treated is zinc (Zn) or zinc alloy containing greater than 50 percent zinc.
- 706 Lead (Pb) or lead base alloy:**  
This subclass is indented under subclass 559. Process wherein the metal being treated is lead (Pb) or a lead alloy containing greater than 50 percent lead.
- 707 Over 50 percent metal, but no base:**  
This subclass is indented under subclass 559. Process wherein the metal alloy being treated contains over 50 percent metal and in which there is no one metal present over 50 percent.
- 708 Treating with specified agent (e.g., heat exchange agent, protective agent, decarburizing agent, denitrating agent, etc.) or vacuum:**  
This subclass is indented under subclass 559. Process wherein a vacuum or treating agent (e.g., specified heat exchange agent, protective agent, decarburizing agent, denitrating agent, etc.) is specified as an element, compound, or composition other than air or water.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
206, for carburizing or nitriding of metal using an externally supplied source.  
240, for processes of coating metal utilizing a reactive agent that reacts with the metal.
- 709 With preserving, recovering, or separately handling or treating of the agent:**  
This subclass is indented under subclass 708. Process wherein the specified treating agent or composition is itself treated (e.g., preserving, recovering, regenerating) in an operation distinct from the metal treating operation.
- 710 Utilizing particulate form in fluid bed:**  
This subclass is indented under subclass 708. Process wherein the specified agent is utilized in particulate form in a fluid bed to treat the metal or metal alloy.
- (1) Note. Utilizing a particulate material for heat exchange purposes is acceptable for this subclass, if a fluid bed is involved.

**711 In fused state:**  
This subclass is indented under subclass 708. Process wherein the specified agent is utilized in a fused or melted state to treat the metal or metal alloy.

**712 In gaseous state:**  
This subclass is indented under subclass 708. Process wherein the specified agent is utilized to treat the metal or metal alloy is in the gaseous state during the treatment operation.

**713 In liquid state:**  
This subclass is indented under subclass 708. Process wherein the specified agent is in the liquid state during the treatment of the metal or metal alloy.

**714 Localized or zone heating or cooling treatment:**  
This subclass is indented under subclass 559. Process wherein a portion or several portions but less than the total of a metal workpiece is subjected to a heating or cooling treatment that limits the change in microstructure to localized areas or zones as opposed to the entire workpiece.

#### CROSS-REFERENCE ART COLLECTIONS

These Cross-Reference Art Collections pertain to subclasses 400+ stock.

**900 Ion implanted:**  
Art collection pertaining to subclasses 400+ wherein the metal is treated by being bombarded by high velocity ions to drive them into the surface of the metal stock.

- (1) Note. This subclass is most closely related to subclasses 316+ since it is possible to use ion implantation rather than thermal diffusion to increase the carbon or nitrogen content of a metal surface.

**901 Surface depleted in an alloy component (e.g., decarburized):**  
Art collection pertaining to subclasses 400+ wherein the surface of the metallic stock has been intentionally depleted in an alloy component, e.g., decarburized.

**902 Having portions of different metallurgical properties or characteristics:**  
Art collection pertaining to subclasses 400+ wherein different parts of the metal stock have different metallurgical characteristics, usually as the result of differing Class 148 treatments.

- (1) Note. The stock material generally has the same composition throughout as differentiated from stock for Class 428, Stock Material or Miscellaneous Articles which has plural identifiable components, usually of different composition.

**903 Directly treated with high energy electromagnetic waves or particles (e.g., laser, electron beam):**  
This subclass is indented under subclass 902. Art collection for stock material which has been treated with high energy electromagnetic waves or particles. This usually causes the surface of the stock to be suddenly heated, the mass of the stock then quickly cools the surface giving the effect of a quench resulting in a hardened surface.

**904 Crankshaft:**  
This subclass is indented under subclass 902. Art collection wherein the stock material is a crankshaft.

**905 Cutting tool:**  
This subclass is indented under subclass 902. Art collection wherein the stock material is a cutting tool.

#### SEE OR SEARCH CLASS:

30, Cutlery, subclass 350 for blades wherein the cutting edge is treated in different manner than the rest of the blade.

**906 Roller bearing element:**  
This subclass is indented under subclass 902. Art collection wherein the stock material is a roller bearing element e.g., race, ball, roller, etc.

**907 Threaded or headed fastener:**  
This subclass is indented under subclass 902. Art collection wherein the stock material is a threaded or headed fastener, e.g., bolt, nut, nail etc.

- 908 Spring:**  
This subclass is indented under subclass 902.  
Art collection wherein the stock material is a spring, e.g., coil, leaf, etc.
- 909 Tube:**  
This subclass is indented under subclass 902.  
Art collection wherein the stock material is tubular.
- (1) Note. This subclass is not limited to tubular conduits, e.g., steam pipe, but also includes hollow tubular articles, e.g., internal combustion engine wrist pins, etc.
- 910 In pattern discontinuous in two dimensions (e.g., checkerboard pattern):**  
Stock material which the portions of differing metallurgical properties vary in two different directions, e.g., checkerboard pattern.

END