

## CLASS 228, METAL FUSION BONDING

### SECTION I - CLASS DEFINITION

This is a residual class for metal fusion bonding as defined in this definition.

For placement of a patent in this class, its claimed disclosure should meet the minimum requirements of the class definition, and should not extend beyond the boundaries indicated in Scope of the Class, below, and discussed in Lines With Other Classes and Within This Class.

Terms followed by an asterisk (\*) in the definitions are defined in the Glossary, below.

This class provides for an apparatus for or a method of joining the meeting faces of juxtaposed or engaged metal work parts or of the same part originally in a form-sustaining state, by the direct application of heat and/or mechanical energy to either of: (a) such work parts, to such an extent as to effect a flowing or blending together of some of the metal in neighboring regions of said work parts into a continuous metallic zone interconnecting said work parts, or (b) such work parts and a metallic filler, to such an extent as to effect a flowing or blending together of the filler and some of the metal of said work portions into a continuous metallic zone interconnecting said work portions with filler and thus with each other.

Additionally, this class provides for methods of joining a metal work part to a juxtaposed or engaged nonmetal work part wherein bonding there between is effected by intermingling of the molecules of the metal part with the nonmetal part; and for methods of joining juxtaposed or engaged nonmetal work parts when utilizing metallic cement.

### SCOPE OF THE CLASS

Placement of an original patent into Class 228 may be made on the basis of a claim reciting means for or the step of applying to work portions energy in the form of: (1) heat; (2) pressure; and/or (3) vibratory energy, provided that there is a teaching that a metal fusion bonded product is produced by the applied energy.

Also see Class 420, Alloys or Metallic Compositions.

### SECTION II - LINES WITH OTHER CLASSES AND WITHIN THIS CLASS

Class 228 includes patents disclosing and claiming certain steps or instrumentalities useful for a proper operation of fusion bonding which are partially listed as follows: (1) a metallic heat applicator (subclasses 51+); (2) seam back-up means (subclass 50 and subclass 216); (3) specialized solder pot (subclass 56); (4) solder form (subclass 56)

A patent claiming closing of a minute opening in a single workpiece (e.g., tipping) is proper subject matter for Class 228, in that the periphery of a single work opening is considered to constitute meeting faces of a single work part as required by the definition of this class. Coating of a work part which may, incidentally, cover small openings in the part is not considered to be proper subject matter for this class.

### RELATIONSHIP TO CLASSES INVOLVING, PER SE, METAL FUSION BONDING

#### Classes Of Article Making

Generally a patent claiming making of a particular article will be found in the appropriate class directed to making of that article except that a patent claiming performing a single fusion bonding operation is placed in this class (228). Fusion bonding combined with additional operations which are considered to be ancillary to the bonding (e.g., preheating, positioning for bonding, or pretinning) will also be found in this class (228).

Examples of such classes providing for the manufacture of particular articles may be found in References to Other Classes, below.

Because of the technology in the making of semiconductor and related devices, certain art terms used to designate operations specially recognized in that discipline are listed below which, when combined with fusion bonding, will cause placement of a patent in Class 29, Metal Working, and Class 438, Semiconductor Device Manufacturing: Process, particularly subclasses 26+, 51, 55, 64+, and 106+ for methods of packaging a semiconductor device and subclasses 455+ for laminating or bonding plural semiconductor substrates; see the search notes thereunder.

(1) Diffusion (not diffusion bonding)

(2) Assembling two semiconductors for an electrical function (Note that each semiconductor may be, for example, a p layer, an n layer, a chain of p or n layers or a laminated article of p and n layers).

(3) Shaping a metal layer to form a conductor.

(4) Cutting

(5) Assembling other than to bond (i.e., other than juxtapose)

(6) Bonding to create a junction

(7) Doping

Also see References to Other Classes, below, for specific search notes to the following:

The Class Of Wireworking

The Class Of Metal Casting

The Class Of Electric Fusion Bonding

#### RELATIONSHIP TO COMBINATION CLASSES

A patent claiming a combination of metal fusion bonding with a different operation, whether manufacturing or nonmanufacturing, is proper subject matter for Class 228, except as specifically noted in the search notes in References to Other Classes, below, relating to the following combination classes:

The Class Of Package Making

The Classes Including Post-fusion Treatment

#### RELATIONSHIP TO OTHER CLASSES

The Heating Classes:

Placement of a patent claiming heating is in the appropriate heating class, even though the sole disclosed application of the heat is in the production of a metal fusion-bonded product of this class (228). In this connection, the term "heating" includes the usually accepted auxiliary means or step such as supporting or holding material to be heated, or causing or permitting relative movement between the material and the heating means.

But if, in addition to the above recited heating structure or step, a claim recites a means to further metal fusion bonding, placement is in this class (228). Examples of such claimed limitations are: (a) moving or guiding one work part relative to another work part, into a position for mutual fusion bonding; (b) forcing or urging one

work portion against another work portion at the immediate zone of fusion; or (c) moving or guiding flux or filler.

A claim to the combination of a Class 228 application (e.g., "soldering") with supplying of heat to such applicator is considered to define heating, proper for one of the heating classes (see paragraph 4, below), even though details of the applicator are also recited, such as: (a.) its alloy composition or its shape; or (b) adjusting such applicator relative to its support.

"Means for supplying heat" may be, for example, nothing more elaborate or detailed than a claimed pair of terminals for connection of the applicator to an electrical circuit. See References to Other Classes, below, for examples of classes providing for heating.

The Work Handling Or Product Handling Classes:

The placement of patents claiming handling work for, or product of, a metal fusion bonding operation, and also claiming fusion bonding is in this class (228) except where the fusion bonding is recited by name only, i.e., in terms that name but do not describe any characteristics of a metal fusion bonding operation. The so excepted patents are placed in appropriate classes related to material handling, per se. See References to Other Classes, below, for examples of classes providing for handling the work or product of a fusion bonding operation.

See References to Other Classes, below, for specific search notes to the following classes:

The Classes Of Coating

The Class Of Adhesive Bonding

The Class Of Static Structures

#### SECTION III - REFERENCES TO OTHER CLASSES

SEE OR SEARCH CLASS:

- 29, Metal Working, subclasses 1.1 through 25.42 , 91+, 592.1 through 623.5 and 825 through 899.1 (class of article making)
- 29, Metal Working, particularly subclass 33, includes the combination of metal fusion bonding apparatus with another type of manufacturing apparatus, if the other operation occurs subsequent to the metal fusion bonding, or if

- the disclosure is silent as to whether such other type of manufacturing operation occurs before or after the bonding operation generally. (Note that the combination of metal fusion bonding apparatus with another type of manufacturing apparatus is found in Class 228 if the bonding occurs subsequent to the other operation.) Class 29, particularly subclasses 592 through 559, includes a method of metal fusion bonding combined with another type of manufacturing operation, other than when it is clear that the metal fusion bonding occurs subsequent to the other operation. (Class Including Post-fusion Treatment)
- 52, Static Structures (e.g., Buildings), includes in situ construction of a static structure, even if claimed in combination with metal fusion bonding. (Class Of Static Structures)
- 53, Package Making, includes patents for the combination of fusion bonding to make or close a metal receptacle, with receptacle filling or contents material treating or for gas filling and/or evacuating, regardless of whether or not such additional operation occurs before, during or after the fusion bonding operation. (Class Of Package Making)
- 59, Chain, Staple, and Horseshoe Making (class of article making)
- 75, Specialized Metallurgical Processes, Compositions for Use Therein, Consolidated Metal Powder Compositions, and Loose Metal Particulate Mixtures (class providing for heating).
- 118, Coating Apparatus, includes patents to apparatus for coating metal upon a single, individual, form-sustaining metallic work part, or a plurality of discrete parts, even when the sole use of the coating lies in the subsequent fusion bonding of such individual work part(s) to another work part. (class of coating)
- 126, Stoves and Furnaces (class providing for heating).
- 140, Wireworking, subclasses 71+. (class of article making)
- 140, Wireworking, subclasses 111+, for placement of a patent claiming apparatus for joining metal wire by a fusion bonding operation, generally. Methods of bonding wire are to be found in this class (228) unless combined with another operation peculiar to the making of wire material. (Class Of Wireworking)
- 148, Metal Treatment, particularly subclass 127, includes metal treatment comprising changing of the crystalline structure of metal combined with metal fusion bonding. (Class Including Post-fusion Treatment)
- 156, Adhesive Bonding and Miscellaneous Chemical Manufacture, includes fusion bonding wherein: (a) nonmetallic work parts are bonded directly together; (b) metallic and/or nonmetallic work parts are bonded together by nonmetallic filler (adhesive); or (c) a metallic work part is bonded directly to nonmetallic work part by at least slightly melting the nonmetallic material (to effect a nonmetallurgical bond). This class (228) includes fusion bonding wherein: (a) metallic work parts are bonded directly together; (b) metallic and/or nonmetallic work parts are bonded together by metallic filler; or (c) a metallic work part is bonded directly to a nonmetallic work part where there is no melting of the nonmetal (and a metallurgical bond is effected). (class of adhesive bonding)
- 163, Needle and Pin Making. (class of article making)
- 164, Metal Founding, includes fusion bonding plural metallic work portions by metal casting involving the use of a "mold". In the apparatus portion of this class (228), in order to constitute a "mold" and thereby exclude a claim from this class, a device must confine molten metallic material in all directions against the force of gravity and at least a portion of such device must be readily removable from the product of the casting operation. On the other hand, in the process portion of this class (228) in order to constitute "molding" and exclude a patent from this class, significant shaping must be set forth. (Class of Metal Casting)
- 165, Heat Exchange (class providing for heating).
- 193, Conveyors, Chutes, Skids, Guides, and Ways (class providing for handling the work or product of a fusion bonding operation).
- 198, Conveyors: Power-Driven (class providing for handling the work or product of a fusion bonding operation).
- 209, Classifying, Separating, and Assorting Solids (class providing for handling the work or product of a fusion bonding operation).
- 219, Electric Heating, includes patents for joining metallic work parts provided that the work parts or the filler material constitute part of an electrical circuit that supplies the energy to produce the bond. For placement of a patent therein, there must be some indication in a claim that the fusion bonding apparatus is in fact an electrical apparatus or that the process

- includes electrical current through the work parts or the filler. Hence, placement of a patent will be in this class (228), if such claim recites only a “welding device”, “welding”, or “spot welding” regardless of the disclosure.
- 219, Electric Heating (class providing for heating).
- 242, Winding, Tensioning, or Guiding (class providing for handling the work or product of a fusion bonding operation).
- 226, Advancing Material of Indeterminate Length (class providing for handling the work or product of a fusion bonding operation).
- 266, Metallurgical Apparatus (class providing for heating).
- 271, Sheet Feeding or Delivering (class providing for handling the work or product of a fusion bonding operation).
- 294, Handling: Hand and Hoist-Line Implements (class providing for handling the work or product of a fusion bonding operation).
- 414, Material or Article Handling (class providing for handling the work or product of a fusion bonding operation).
- 427, Coating Processes, includes the step of coating metal upon a single, individual, form-sustaining metallic work part or a plurality of discrete work parts, even when the sole use of the coating lies in the subsequent fusion bonding of such individual work part(s) to another work part. (class of coating)
- 432, Heating (class providing for heating).
- 901, Robots (class providing for handling the work or product of a fusion bonding operation).
- or other harmful gases, (2) chemically remove oxides or other films, or (3) otherwise augment bonding.
- MEETING FACE**
- That portion of a work part\* intended to abut and be fusion bonded to another similar portion of the same or another work part.
- METAL**
- Material which may be subjected to an operation of the class type; an elemental metal or alloy of mixture of metals in self-shape-sustaining state (i.e., not molten, gaseous, or powdered).
- PRODUCT**
- Solid material or article after an operation of the class type has been performed thereon.
- (1) Note. The product of one operation may constitute work\* for a subsequent operation.
- ROLLER**
- A tangible instrumentality having a peripheral surface which is generated by a line revolving about an axis, said instrumentality being disclosed as revolving about said axis so that successive peripheral portions thereof cyclically move into and out of engagement with a generally planar surface of another member, with relative movement occurring between said axis and the planar surface along a direction parallel to the planar surface, thereby producing a relative rolling motion between the roller surface and the planar surface as contrasted with a sliding motion, (i.e., the surfaces move in the same direction at substantially the same linear speed so that there is no relative linear movement between the roller surface and the planar surface at point of engagement).
- (1) Note. The generating line of the peripheral surface of the roller may have any continuous profile (e.g., straight, curved, or irregular), and the line may have any desired inclination, other than at right angles, relative to the axis. Thus, to be considered a ROLLER, any and all cross-sections taken at right angles to the axis must show a circular material engaging periphery.
- ROLLER-LIKE MEMBER**

## SECTION IV - GLOSSARY

### APPLICATOR

A device by or through which heat, pressure, vibratory energy, flux\* and/or filler\* may be applied directly to the work\*.

### FILLER

A metallic material to be applied to the work in order to join meeting face\* together and become an integral part of the product\*.

### FLUX

A nonmetallic material to be applied to the work in order to: (1) shield the work from atmospheric oxygen

A tangible rotating instrumentality having a peripheral surface with some, but not all, of the characteristics of a roller\*.

- (1) Note. (a) In a first type of roller-like member the surface is generated by a line revolving about an axis (thus the member looks like a roller), but there is relative movement between the surface of the roller-like member and another member to produce sliding action therebetween; or; (b) In a second type of roller-like member the relative movement of the roller-like member and another member and another member produces rolling engagement between their respective surfaces (thus the roller-like member acts like a roller), but the surface is not generated by a revolving line (e.g., the roller-like member is rough, gear-like, or recessed).

#### WORK

Material which is intended to be subjected to a treatment of the class type.

#### WORK PART

An article to be subjected to the class type operation.

#### SUBCLASSES

##### 1.1 MEANS TO APPLY VIBRATORY SOLID-STATE BONDING ENERGY (E.G., ULTRASONIC, ETC.) TO WORK:

This subclass is indented under the class definition. Device for subjecting work to an oscillation having a cyclic frequency within or above that of audible sound, which oscillation is disclosed as effecting fusion-bonding by a scrubbing type action of two work parts in intimate contact thereby tending to disrupt any bond inhibiting substances therebetween.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 18, for means for causing vibratory motion in either the work or an applicator for the purpose of cleaning the work or applicator.
- 44.3, for means for applying continuous pressure to work parts without the application of ultrasonic energy.

56.2, for a solder pot or bath provided with means to apply ultrasonic energy to liquid flux or filler.

110.1+, for the process of metallurgically bonding by the effect of vibration.

SEE OR SEARCH CLASS:

72, Metal Deforming, subclass 56, for a method of or apparatus for, deforming metal by the application of kinetic energy of fluid or field.

148, Metal Treatment, particularly subclass 558 for a process of treating solid or semi-solid metal with high frequency vibration.

##### 2.1 INCLUDING MEANS TO PROVIDE HEAT BY FRICTION BETWEEN RELATIVELY MOVING SURFACES (I.E., FRICTION WELDER):

This subclass is indented under the class definition. Device having means for causing motion, one with respect to the other, of either (a) two mutually engaging work portions or (b) a work portion and a work-engaging, tangible instrumentality, which rubbing contact generates heat sufficient to produce a flow of the metal work portion(s) for subsequent fusion bonding.

SEE OR SEARCH THIS CLASS, SUBCLASS:

112.1+, for a method of fusion bonding using frictional heat.

##### 2.3 Means to rotate one surface relative to the other about a fixed axis:

This subclass is indented under subclass 2.1. Device wherein the relative movement comprises rotation of one of the surfaces about a line passing generally normally therethrough.

SEE OR SEARCH THIS CLASS, SUBCLASS:

114.5, for a method of fusion bonding including heating of the work by rotating one surface relative to another.

SEE OR SEARCH CLASS:

72, Metal Deforming, subclasses 67+ for a device for deforming work turning about an axis by causing relative rubbing motion between such work and a tool.

**2.5** This subclass is indented under the class definition. Device including means to release a high energy shock wave and cause the energy released to directly engage the meeting face of a work part and thereby cause that face to intimately engage and become united with the corresponding face of another work part.

SEE OR SEARCH THIS CLASS, SUBCLASS:

107, for the process of bonding by release of explosive energy.

**3.1** This subclass is indented under the class definition. Device having means for applying a mechanical force to the meeting faces\* of two work parts to produce a fusion bond at said area without the aid of any other force or energy (e.g., heat).

(1) Note. A patent disclosing the bonding of work heated to any degree above and beyond room temperature is excluded herefrom.

SEE OR SEARCH THIS CLASS, SUBCLASS:

44.3+, for a device for applying pressure to work which has been or is being heated.

115+, for a method of bonding by pressure alone.

SEE OR SEARCH CLASS:

72, Metal Deforming, subclasses 199+, for a roller or roller-like tool-element for deforming metal work; and see the search notes thereto.

81, Tools, subclasses 300+, for pliers of general utility.

100, Presses, for a press of general utility.

173, Tool Driving or Impacting, subclasses 90+, for an impacting device of general utility.

492, Roll or Roller, for a roll, per se, not elsewhere provided for, and see the notes thereunder.

**4.1** This subclass is indented under the class definition. Device, having means for causing relative movement between separate workpieces to position such workpieces in adjacency or engagement and means for fusion bonding one

of said workpieces to the other, forming more than one distinct bonded joint.

(1) Note. Multiple "spot" welds along a single pair of meeting faces are not considered to be distinct for this subclass.

SEE OR SEARCH THIS CLASS, SUBCLASS:

15+, and 49.1+, for a fusion bonding device having means for juxtaposing two portions of a single workpiece.

178+, for a process of forming plural metallurgical joints.

SEE OR SEARCH CLASS:

29, Metal Working, subclasses 33+, for the combination of apparatus for producing a fusion bonded product plus apparatus using such product as work in subsequent assembling operation; subclasses 700+, for apparatus for assembling, per se; subclasses 428+, for a corresponding method; and see Lines With Other Classes and Within This Class, The Classes Including Post-Fusion Treatment, in this class (228).

**4.5** This subclass is indented under subclass 4.1. Device including means to metallurgically unite a first part to an additional part(s) at first and second points on the first part to transmit electrical energy from the additional part(s) with respect thereto.

SEE OR SEARCH THIS CLASS, SUBCLASS:

179.1+, for a process of making an electrical device involving plural bonds.

**5.1** This subclass is indented under subclass 4.1. Device including an instrumentality capable of altering some property, characteristic, or condition of at least one workpiece before it has become a part of a fusion-bonded product\*.

(1) Note. The alteration, for example, may include cleaning, cutting, deforming, insulation stripping, etc., before bonding.

- 5.5** This subclass is indented under subclass 4.1. Device including a flexible member generally adapted to conform to the surface behind the meeting face of one of the parts and distribute energy from a power supply to that surface and cause the meeting faces to be united.

SEE OR SEARCH THIS CLASS, SUBCLASS:

106, for the process of bonding including use of a compliant cushioning medium.

- 5.7** This subclass is indented under subclass 4.1. Device particularly adapted to cut to shape and unite the rear longitudinal extent of a first web or work to the front longitudinal extent of a second web to form a product of the combined length of the webs.

**6.1 Plural discrete workpieces:**

This subclass is indented under subclass 4.1. Device which juxtaposes workpieces, all of whose dimensions are determinable.

- (1) Note. This subclass excludes means for bonding material of indeterminate length; e.g., forming bimetallic strip, by rolling laminae together, welding wire (from a reel) onto a workpiece, etc. Patents to means for bonding such workpieces are found in subclass 4.1.

**6.2 With electrical connection made at joint:**

This subclass is indented under subclass 6.1. Apparatus wherein the discrete workpieces are electrical devices such that the bonded joint provides and electrically conductive path therebetween.

SEE OR SEARCH THIS CLASS, SUBCLASS:

44.7, for apparatus for forcing work parts together one of which is an electrical device.

- 7** This subclass is indented under the class definition. Device provided with detection means for sensing a particular shape, dimension of property of (e.g., holes, indentations, marks, magnetic or optical characteristics, etc.) a tangible object temporarily presented to the device; and with mechanism, actuated by or

responsive to the detection means, for regulating an operation of the device.

- (1) Note. Placement into this subclass requires the disclosure that the temporarily presented tangible object be capable of being exchanged with a different object, or its form be capable of being changed, for the purpose of performing a different or modified operation. Therefore, an integral part of a machine (e.g., cam) is not included even though there is a disclosure that the part may be removed from the machine for purposes of replacement with a like part.

- (2) Note. The tangible object, may be a workpiece, provided that the controlled operation is performed upon another workpiece.

SEE OR SEARCH THIS CLASS, SUBCLASS:

10+, for a device controlled by the presence or absence of work.

SEE OR SEARCH CLASS:

- 83, Cutting, subclasses 76.1+, for a cutting means provided with similar control apparatus.  
 226, Advancing Material of Indeterminate Length, subclass 9, for material advancing means provided with similar control apparatus.  
 234, Selective Cutting (e.g., Punching), subclasses 59+, for a pattern-controlled selective cutting machine.  
 901, Robots, subcollection 2+, for the controlling of a robot arm, particularly subcollection 10, for the guiding of the arm by direct contact with the work, and subcollection 42, for an art collection of welding robots.

- 8** This subclass is indented under the class definition. Device including means for: (1) detecting any of the following characteristics: a state or property, a change in a state or property, or the occurrence of a predetermined event, in any of the following: the work, the product of a machine, the machine itself, any part of the machine, or the environment of the machine affecting the operation thereof; and (2) initiating (as a direct result of such detection) a force

or energy impulse other than that generated or transmitted by the detecting means; and (3) regulating or modifying (as a direct result of such initiation) the operation of said machine.

- (1) Note. This definition requires a patent to claim at least four instrumentalities for original placement herein. One of these must be a fusion-bonding machine or a device (e.g., work feeder, work-heater, product-handler) necessary to the proximate function of fusion-bonding. The other three are: (a) a senser (e.g., photocell system, trip-lever, pressure diaphragm) to detect a condition as stated in (a) of the definition. (b) an activator (e.g., an element to make or break an electric circuit, a clutch, a valve) to cause a release of energy more than, or different from, that accounted for by mere change in condition (e.g., position or movement) of the senser while it is functioning; and (c) a controller (e.g., a motor or driver for said machine or device) to change or cause the operation of said machine or device. Therefore, a cam follower (or senser) directly linked to a controller, whereby follower movement directly effects controller movement, is not proper subject matter for this subclass due to lack of an activator as defined. On the other hand, disclosure of a cam follower that makes and breaks an electrical circuit that energizes a motor, may be placed herein.
- (2) Note. A voluntary act of the person operating the machine is not proper subject matter for this subclass. For example, disclosure of an on-off switch manipulated by an operative to start and/or stop the machine (even though the switch initiates a release of energy) is not included herein, but is placed on the basis of claimed features of the machines.
- (3) Note. The machine that is regulated by the control means is not limited to a fusion-bonding machine of this class. It can be another machine associated with the fusion-bonding machine if the claim reciting the combination of the other machine and fusion-bonding machine is

acceptable for placement into this class (228).

- (4) Note. The control systems disclosed in the patents of this and indented subclasses are similar in concept to control systems of other classes (see the search notes below). The total operations and the claimed combinations are, of course, different, but the control systems, per se, found in the classes referenced in the search notes below are usually analogous to those herein, and may be applicable to the machines of this class (228).

SEE OR SEARCH CLASS:

- 72, Metal Deforming, subclasses 6+ and see (4) Note, above.
- 83, Cutting, appropriate subclasses and see (4) Note, above. The notes to Class 83, subclass 399 summarize all the subclasses in Class 83 pertaining to "control" subclasses therein.
- 226, Advancing Material of Indeterminate Length, subclasses 10+ and see (4) Note above.
- 227, Elongated-Member-Driving Apparatus, subclasses 2+, for elongated member driving means provided with control apparatus.

- 9** This subclass is indented under subclass 8. Device, whose detecting means is arranged to sense the presence, absence, size, temperature, or other property or condition of work associated with the device.
- 10** This subclass is indented under subclass 9. Device whose detecting means is arranged to sense the presence or absence of a workpiece in the device.
- 11** This subclass is indented under subclass 10. Device whose detecting means modifies or regulates the operation of means to move filler.
- 12** This subclass is indented under subclass 8. Device comprising a work-holding device which conveys the work to or past a fusion-bonding device, the detecting means being arranged to sense the presence or absence of such work-holding device at a given location.



**13** This subclass is indented under the class definition. Device including means for severing or dividing a portion of the work, filler, flux or product\* from a large body thereof, thus changing at least one of the dimensions of such body.

**14** This subclass is indented under subclass 13. Device including means for bringing work, and that portion of the filler or the flux which has been cut, into mutual engagement.

- (1) Note. Included in this subclass are patents disclosing melting of the cut filler or flux before application to the work.

**15.1** This subclass is indented under the class definition. Device including means for deforming (and defined below) the work, filler, or flux wherein the deformation occurs prior to the fusion bonding.

- (1) Note. The term "deformation" for this subclass and the indented subclasses requires a permanent change in the shape or size of a member without removal of material therefrom. See the Class Definition and Lines With Other Classes and Within This Class in Class 72 for a definition of metal deformation.
- (2) Note. A single, integral instrumentality (e.g., welding bell, may be used to deform and then fuse the work.
- (3) Note. Placement into this subclass or the indented subclasses requires only that there be some deformation of a work part prior to fusion of that work part; the additional occurrence of simultaneous deformation is immaterial. For example, a patent to a device for making helical tubing, wherein a leading portion of a blank is deformed into a convolution of a tube and then fused to a following portion of the blank prior to the deformation of that following portion, is included herein.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 19+, for apparatus for deforming applied filler material.

141.1+, for the method of bonding combined with shaping.

SEE OR SEARCH CLASS:

- 29, Metal Working, subclasses 33+, for the combination of apparatus for producing a fusion-bonded produce with apparatus using such product as work in a subsequent deforming operation.
- 72, Metal Deforming, for a metal deforming device, particularly subclasses 49+, for production of a helical seam by deformation; subclasses 51+, for production of a longitudinal seam by deformation; subclass 66, for formation of a helical coil by means of a work-guide member orbiting about the longitudinal centerline of the formed coil; subclasses 135+, for formation of a helical coil by deflection running-length work; and subclasses 176+, for production of a longitudinal seam by deflecting running-length work.
- 219, Electric Heating, subclass 128, 149+, 603+, 633, and 765 for apparatus for electric fusion bonding and deforming.

**16** This subclass is indented under subclass 15.1. Device having an open ended, tapered passage-way, through which the work is moved in the direction of decreasing taper.

- (1) Note. The inner periphery of the conduit is closed or substantially closed along at least a portion of its length.

SEE OR SEARCH CLASS:

- 72, Metal Deforming, subclasses 274+, for a similar device for deforming metal without fusion-bonding.

**17** This subclass is indented under subclass 15.1. Device wherein the deformation is directly caused by a roller\* or a roller-like\* member.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 19, for a roller for deforming applied filler material.
- 30, for a roller that accomplishes fusion-bonding itself, without producing any prior deformation.

## SEE OR SEARCH CLASS:

72, Metal Deforming, subclass 50, for formation of a helical seam by shaped deforming roll(s); and subclasses 199+, for a roller or roller-like tool-element for deforming work.

- 17.5** This subclass is indented under subclass 15.1. Device including means to shape or distort a single generally planar part to a cylindrical configuration and means to surface bond the meeting faces thereof.

## SEE OR SEARCH THIS CLASS, SUBCLASS:

144+, for the method of uniting the margins of a one-piece blank.

- 17.7** This subclass is indented under subclass 17.5. Device including means to shape or distort a long attenuated web into a tubular coil to juxtapose the faces of opposite side edges along a line running spirally axially along the tube so formed, and means for bonding the resulting seam.

## SEE OR SEARCH THIS CLASS, SUBCLASS:

145, for the method of forming a helically bonded tube.

- 18** This subclass is indented under the class definition. Device to which has been added a sub-combination or assembly which is recognized as the subject matter of some other class.

- (1) Note. The subject matter of the specific subclasses herein following (19-56.5) are considered so basic to the operation characterizing this class that they are dealt with as manifestations of that operation, rather than as combinations. Thus, fusion-bonding devices with means to handle or cool work or product, or provided with gauge, indicator or stop, are considered to be so common in the art that they do not merit the special characterization of "combined".
- (2) Note. See Lines With Other Classes and Within This Class, Relationship to Combination Classes, for a statement of the line between combinations of apparatus

proper for this class (228), and combinations appropriate to other classes.

- (3) Note. Many patents in this subclass are directed to apparatus for performing a metal fusion-bonding operation combined with apparatus for mechanically cleaning work or applicator. However, means for supplying an acid to the work is considered to be fluxing, even though a cleaning operation is also performed thereby. Patents claiming means for performing such an operation will be found in subclasses 33+.

## SEE OR SEARCH CLASS:

- 15, Brushing, Scrubbing, and General Cleaning, for a cleaning device, per se.
- 29, Metal Working, subclasses 33+, for the combination of metal fusion-bonding apparatus with apparatus for performing a subsequent manufacturing treatment other than fusion bonding; and see Lines With Other Classes and Within This Class, The Classes Including Post-Fusion Treatment, in this class (228).
- 72, Metal Deforming, subclasses 39+, for apparatus for cleaning plus deforming metallic work.

- 19** This subclass is indented under the class definition. Device having means for exerting a force on, or transmitting energy to flux or filler material after said material has been applied to the work for the purpose of changing either the quantity, density or configuration of such material.

- (1) Note. Placement of patent into this and the indented subclasses requires that the modifying means be a device independent of the fusion-bonding means. Therefore, seam modification accomplished by an applicator that applies flux or filler to the work will be found in the appropriate applicator subclasses, such as 25+, 33+, etc.
- (2) Note. Included in this subclass and the indented subclasses are patents claiming a desoldering device not elsewhere classified.

- (3) Note. Also included in this subclass (19) are patents directed to means for applying centrifugal force, or to a compressing roller, for modifying the applied material.

SEE OR SEARCH CLASS:

- 72, Metal Deforming, subclass 113, 199+, for deforming means, per se, which may be effective to roll a fusion-bonded seam.
- 75, Specialized Metallurgical Processes, Compositions for Use Therein, Consolidated Metal Powder Compositions, and Loose Metal Particulate Mixtures, subclasses 228+ for a composition having a continuous phase of free metal made by consolidating metal particles.
- 118, Coating Apparatus, subclass 63 and 100+ for apparatus for acting on an applied coating.

**20.1 By fluid blast or suction:**

This subclass is indented under subclass 19. Device whose force applying or energy transferring means comprises an instrumentality for directing a gas, liquid, or other fluid in a stream under pressure, or for directing a gas, liquid, or other fluid by subatmospheric pressure.

- (1) Note. Included in this subclass is a patent claiming the combination of fusion bonding means and means for removing fumes of acid flux during a fusion bonding operation.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 46, for a device for applying a fluid blast or suction to work or product for cooling purposes.

SEE OR SEARCH CLASS:

- 118, Coating Apparatus, subclass 63 for apparatus for applying a fluid blast to an applied coating.

**20.5 Hand tool:**

This subclass is indented under subclass 20.1. Device intended to be supported manually by an operative.

- 21** This subclass is indented under subclass 19. Device comprising means (e.g., a barrier or a tube) in addition to the force-exerting or energy transmitting means, for directing the material separated from the work.

- 22** This subclass is indented under subclass 19. Device where force applying means engages said material, with a relative rubbing or sliding motion, for effecting the change of quantity, density or configuration.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 35, for an applicator pad.

SEE OR SEARCH CLASS:

- 15, Brushing, Scrubbing, and General Cleaning, for a wiper, per se.

- 23** This subclass is indented under subclass 22. Device having a material engaging surface generally defining a closed loop and means to permit every portion of said surface to continuously travel in and along said loop during work engagement.

- (1) Note. Included in this subclass are patents disclosing a rotary brush wherein the ends of the bristles constitute a substantially continuous material engaging surface.

- (2) Note. A roller which only compresses a seam, and thus has no sliding engagement therewith is not considered to be a wiper, but will be found in subclass 19.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 19, for a roller for compressing a seam.

SEE OR SEARCH CLASS:

- 118, Coating Apparatus, subclass 110, for a rotary member acting on an applied coating.

- 24** This subclass is indented under the class definition. Device comprising an applicator and means to move said applicator to deliver a series of blows against the work, which series of blows contributes to the formation of a fusion-bonded seam.

- (1) Note. Any deformation of the work by such applicator is considered to occur simultaneously with the fusion-bonding thereof, not before fusion.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
15+, for fusion-bonding apparatus including means for deforming work before fusion.  
44.3+, for a device for delivering a single blow against the work.
- SEE OR SEARCH CLASS:  
173, Tool Driving or Impacting, subclasses 90+ for an impacting device of general utility.
- 25** This subclass is indented under the class definition. Device having means for moving or guiding an applicator while said applicator contributes to the formation of a fusion-bonded product\*.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
45, for means for moving an applicator before or after fusion-bonding.  
47.1+, for means for moving work past a stationary applicator during fusion-bonding.
- 26** This subclass is indented under subclass 25. Device whose applicator is moved or guided along a predetermined path, a length of which substantially coincides in location and direction with that of work moving through a zone of fusion-bonding.
- (1) Note. Included in this subclass are patents disclosing some relative movement between the applicator and work during fusion along part or all of the applicator path length.
- (2) Note. Excluded from this subclass are patents disclosing tangential contact between the applicator and work (e.g., roller applicator).
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
29+, for a device comprising a roller or roller-like applicator which makes tangential contact with work.
- SEE OR SEARCH CLASS:  
72, Metal Deforming, subclasses 184+, for a "flying tool" for deforming metal work and see the search class notes thereof.
- 27** This subclass is indented under subclass 25. Device, whose applicator is moved or guided along a zig-zag or looped path which follows the direction of a seam to be formed and generally defines the width of such seam.
- 28** This subclass is indented under subclass 25. Device, whose applicator is moved to and fro along a generally straight or curved path with fusion occurring during both a forward and return stroke of the applicator.
- (1) Note. Also included is a patent disclosing an applicator progressing along a seam to be formed by increments while in a continuous to-and-fro motion.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
32, for means to reciprocate an applicator with fusion occurring only during the forward or return stroke, but not both.
- 29** This subclass is indented under subclass 25. Device, whose applicator is moved or guided, during fusion either in a closed-loop path or along a portion of a planar, closed-loop path, which portion is curved through-out its length.
- (1) Note. Included in this and the indented subclasses are patents disclosing orbital applicator movement and mutual engagement of the applicator and work at a tangential point or line.
- (2) Note. The movements known as "rotating", "revolving", or "orbital" are all considered as having a "closed-loop path".

- 30** This subclass is indented under subclass 29. Device , wherein the moving applicator is a roller\* or a roller-like\* member.
- SEE OR SEARCH CLASS:  
 72, Metal Deforming, subclasses 199+, for a roller or roller-like tool-element for deforming metal work; and see the search notes thereto.  
 101, Printing, appropriate subclasses, for a roller or roller-like member employed in a printing operation.  
 118, Coating Apparatus, subclasses 244+ and 258+, for a roller for coating work.
- 31** This subclass is indented under subclass 30. Device , whose movable roller or roller-like applicator is submerged, at least partially, in a reservoir of liquid flux or filler material; or is supplied with liquid flux or filler by a roller (or roller-like member) which is so submerged; or is supplied with liquid flux or filler by a train of rollers (or roller-like members) at least one of which is so submerged.
- SEE OR SEARCH CLASS:  
 118, Coating Apparatus, subclasses 244+ and 258+, for a coating device having a rotary applicator associated with a bath of liquid coating material.
- 32** This subclass is indented under subclass 25. Device , including means to positively impart motion of the applicator.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
 45, for movement of an applicator other than during fusion.
- 33** This subclass is indented under the class definition. Device having means effective to bring work or applicator (on the one hand), and flux or filler (on the other), into mutual engagement.
- (1) Note. A hand-maneuvered applicator is excluded from this and indented subclasses.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
 52+, for means for applying or supplying flux or filler material, mounted on a hand-maneuvered applicator.
- SEE OR SEARCH CLASS:  
 118, Coating Apparatus, for similar apparatus for supplying material in a coating operation.
- 34** This subclass is indented under subclass 33. Device , comprising means for physically removing scum or oxide from a portion of an exposed surface of liquid flux or filler.
- SEE OR SEARCH CLASS:  
 118, Coating Apparatus, subclass 422, for coating apparatus including pool surface skimming or conditioning means.
- 35** This subclass is indented under subclass 33. Device , comprising either a filamentary member or a plurality thereof for transmitting, or a porous member for absorbing and transmitting flux or filler material in a liquid state to the work or applicator.
- SEE OR SEARCH CLASS:  
 118, Coating Apparatus, subclasses 264+, for a pad, or absorbent or porous applicator, for coating work.
- 36** This subclass is indented under subclass 33. Device , comprising means to move or guide at least part of such work or applicator into liquid flux or filler material contained in a reservoir.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
 25+, for a reservoir that moves during fusion,  
 31, for a bath associated with a roller operating to ultimately transmit flux or filler to work.  
 56.1+, for a solder pot having passive means for guiding work.
- SEE OR SEARCH CLASS:  
 118, Coating Apparatus, subclasses 400+, for immersion means for coating a single work portion.

- 37** This subclass is indented under subclass 36. Device including means to create or support a stream of flux or filler, or to disturb the surface of a pool of flux or filler, with which stream or pool the work is brought into contact.
- (1) Note. As disclosed by a number of the patents in this subclass, the work may be partially immersed in the stream or pool only to the extent necessary to establish a substantial surface-to-surface contact of the work and liquid.
- 38** This subclass is indented under subclass 36. Device , wherein the immersion means functions either to:
- (1) simultaneously translate and turn the work over and over, or
- (2) move the work in a closed-loop path.
- SEE OR SEARCH CLASS:  
118, Coating Apparatus, subclass 416, for apparatus for rotating work during coating.
- 39** This subclass is indented under subclass 36. Device , including means for: (a) placing a barrier member or layer into engagement with an area of the work for effectively separating such area from the liquid, or (b) physically limiting movement of the work into the liquid.
- SEE OR SEARCH CLASS:  
118, Coating Apparatus, subclass 406, for similar masking means associated with coating apparatus.
- 40** This subclass is indented under subclass 36. Device , which functions to move or guide only the work, rather than an applicator.
- 41** This subclass is indented under subclass 33. Device whose applying or supplying means is designed and intended to bring the flux or filler into engagement with the work or applicator which at least a portion of such flux or filler is in a form-sustaining state.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
245+, for a corresponding method.
- SEE OR SEARCH CLASS:  
118, Coating Apparatus, subclasses 76+, for coating apparatus including means to transfer solid coating material to work.  
401, Coating Implements With Material Supply, subclasses 49+, for a hand-manipulable implement including a piece of solid coating material for coating a work surface by sliding frictional contact therewith.
- 42** This subclass is indented under subclass 33. Device whose applying or supplying means is designed and intended to bring the flux into engagement with the work or applicator while the flux is in a gaseous state.
- 43** This subclass is indented under subclass 33. Device including means to impart motion to, or to guide, the work.
- 44.3** **INCLUDING MEANS TO FORCE OR CLAMP WORK PORTIONS TOGETHER DURING BONDING:**  
This subclass is indented under the class definition. Device having means to apply, either directly or indirectly, a continuous pressure to work parts being bonded, such pressure urging or holding the portions against one another and being effective at the immediate zone of fusion.
- (1) Note. No attempt has been made to distinguish between various degrees of pressure. Therefore, patents in this subclass will include those directed to devices having opposed work engaging surfaces whose disclosed use is only to hold the work during fusion (where some pressure will inherently be present at the area of fusion), as well as those whose disclosure teaches the use of pressure to complete or produce the fusion bond.
- (2) Note. Included in this subclass are patents claiming the combination of a pair of opposed dies acting upon juxtaposed work portions, even though there may inherently be some further applicator movement after engagement with the work.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 3, for a device for producing a fusion bond by pressure only.
- 15+, for a device for applying pressure for deforming work before fusion bonding.
- 24, for means to apply a series of blows which produce a fusion bond.

SEE OR SEARCH CLASS:

- 100, Presses, for a press of general utility.
- 269, Work Holders, for means to grip, hold or clamp a work part, per se.

**44.5** This subclass is indented under subclass 44.1. Device wherein the pressure applying means includes particular provision to coaxially position a pair of hollow cylindrical members for subsequent metallurgical bonding.

**44.7 Work portion comprises electrical component:**  
This subclass is indented under subclass 44.3. Device particularly adapted to a work part intended to be used in the transmission or regulation of electrical energy.

**45** This subclass is indented under the class definition. Device having means to positively impart motion to, or to direct the motion of, an applicator other than for the direct purpose of accomplishing fusion-bonding.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 24, for means to impart repetitive movements of a pressure applicator toward and against work, to accomplish bonding of the work by successive impacts.
- 25+, for means to move or guide an applicator while such applicator is taking part in a bonding operation.
- 36, for means to move or guide an applicator into a bath of liquid flux or filler.

**46** This subclass is indented under the class definition. Device having means for bringing work or product\*, and a heat absorbent medium, into mutual engagement.

- (1) Note. A device for presenting the work or product to, or transporting it through, ambient atmosphere is not considered to be means to cool. However, apparatus (e.g., a fan) for circulating air over or around work or product is considered to constitute such cooling means.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 20.1, for a device for removing flux or filler by means of a fluid blast or suction.
- 50, for a seam backup which inherently, or by disclosure, acts to chill hot metal in contact therewith.

**47.1 WITH MEANS TO HANDLE WORK OR PRODUCT:**

This subclass is indented under the class definition. Device having means for moving, guiding, or affecting the motion of work or product\*, relative to a fusion bonding apparatus.

SEE OR SEARCH CLASS:

- 219, Electric Heating, for electric means to heat combined with means to move or guide work before, during, or after the heating operation; and see section VII, A of this definition.
- 432, Heating, subclass 230 for a residual heating device including means for moving or guiding work relative to a heat emitter during heating.

**48** This subclass is indented under subclass 47.1. Device, wherein said means to move or guide causes work, circular in cross-section, to turn about a single, stationary internal axis.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 38, for means for rotating work in a bath of liquid flux or filler.

**49.1 Including means to orient work or position work portion relative to another work portion:**

This subclass is indented under subclass 47.1. Device wherein said means for moving or guiding either: (a) causes, or facilitates, motion of the work in a path other than rectilinear, (b) causes relative movement between portions of the same work to be bonded, or (c)

maintains a desired spatial relationship between portions of work being bonded.

**49.2 Means to rotate work and to position work about a different axis:**

This subclass is indented under subclass 49.1. Apparatus wherein the means is provided for moving the work or product about a rotary axis and further wherein the means is provided for moving the work of product in a path other than the rotary axis.

**49.3 Pipe joint aligner:**

This subclass is indented under subclass 49.1. Apparatus wherein the means is provided for juxtaposing meeting faces of a pair of hollow cylindrical bodies.

**49.4 Sheet aligner:**

This subclass is indented under subclass 49.1. Apparatus wherein the means is provided for juxtaposing meeting faces of the thickness dimension of a pair of bodies each having one dimension much smaller than its other two.

**49.5 Work portion comprises electrical component:**

This subclass is indented under subclass 47.1. Apparatus wherein the device is particularly adapted to a work part intended to be used in the transmission or regulation of electrical energy.

**49.6 Work portion comprises can body:**

This subclass is indented under subclass 47.1. Device wherein the device is particularly adapted to work on a work part to be used as a contents holding vessel.

**50** This subclass is indented under the class definition. Device comprising a tangible instrumentality having a surface portion designed and intended to engage directly the surface area of the work or material being fused, on the side of the work opposite to the side which receives energy for fusion-bonding, for the purpose of reacting against such energy.

SEE OR SEARCH THIS CLASS, SUBCLASS:

46, for a similar instrumentality (a "chill") provided with means to bring it into engagement with work or product.

SEE OR SEARCH CLASS:

219, Electric Heating, subclass 160, for back-up means for an electric welder.  
285, Pipe Joints or Couplings, for a backup member that constitutes part of, or remains with, the joint as a coupling.

**51** This subclass is indented under the class definition. Device comprising a tangible instrumentality having a surface of metal, designed and intended to engage work and/or flux or filler material for transferring heat energy thereto so that a fused bond may be produced.

(1) Note. A "soldering iron" under this subclass is a handtool (i.e., one which is entirely held and fully manipulated by hand), and may have attachments that move relatively during treatment, such as an iron combined with means to feed flux or filler. However, a hand tool comprising the combination of an iron and an additional work engaging member that moves relative to the iron during bonding (e.g., "capping iron", which is a soldering iron and a work engaging tool guide) is not considered to be a "soldering iron", per se, but will be found in subclasses 25+.

SEE OR SEARCH THIS CLASS, SUBCLASS:

25+, for a hand operated applicator movable with respect to a work engaging tool guide.

SEE OR SEARCH CLASS:

126, Stoves and Furnaces, subclasses 236+, for a heater for a "soldering iron", subclasses 413+, for a "soldering iron" having an integral liquid or gaseous fuel burner; and see Lines With Other Classes and Within This Class, Relationship to Other Classes, The Heating Classes, in Class 228.

219, Electric Heating, for the combination of a "soldering iron" and electrical heating means, and see Lines With Other Classes and Within This Class, Relationship to Other Classes, The Heating Classes, in Class 228.



- 52** This subclass is indented under subclass 51. Device , including means for moving or guiding the flux or filler material relative to the surface of the instrumentality or the work.

**SEE OR SEARCH CLASS:**

226, Advancing Material or Indeterminate Length, for means for moving solid flux or filler of indeterminate length either, per se, or to a “soldering iron” which is recited by name only.

- 53** This subclass is indented under subclass 52. Device , including means to raise the temperature of the instrumentality.

**SEE OR SEARCH CLASS:**

126, Stoves and Furnaces, subclasses 236+ , for the combination of a “soldering iron” and a heater, and see Lines With Other Classes and Within This Class, Relationship to Other Classes, The Heating Classes, in Class 228.

219, Electric Heating, for the combination of a “soldering iron” and electrical heating means, and see Lines With Other Classes and Within This Class, Relationship to Other Classes, The Heating Classes, in Class 228.

- 54** This subclass is indented under subclass 51. Device , wherein the material of said instrumentality, at or adjacent to the surface, is composed of a mixture of concatenation of two or more different metals\*.

- 55** This subclass is indented under subclass 51. Device , including means for (a) changing, or facilitating a change in, the relative position of the instrumentality and a supporting member (e.g., handle), or: (b) releasing, or facilitating a release of, the instrumentality from a supporting member (e.g., handle).

(1) Note. Included in this subclass are patents disclosing means for permitting the relative position to be changed for purposes of storage or tip heating, as well as for the purpose of permitting the head or tip to occupy different positions.

**56.1 SPECIALIZED POT:**

This subclass is indented under the class definition. Device comprising a receptacle for containing liquid flux or filler and having passive means for directing work into, or holding work within the receptacle, or having means to treat the flux or filler by means other than heating.

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

31, for a bath associated with a roller operating to ultimately transmit flux or filler to work.

36+, for a “solder pot” combined with means for bringing work into the liquid material.

**SEE OR SEARCH CLASS:**

126, Stoves and Furnaces, subclass 240, for the combination of a “solder pot” and a heater.

**56.2 Having means to treat flux or filler:**

This subclass is indented under subclass 56.1. Device comprising a receptacle for containing liquid flux or filler provided with means to subject the flux or filler to an action which produces a change in the flux or filler.

**56.3 SOLDER FORM:**

This subclass is indented under the class definition. Device comprising an article (i.e., a discrete three-dimensional body substantially in its ultimate use form) adapted to be applied to work as filler material.

**SEE OR SEARCH CLASS:**

126, Stoves and Furnaces, and subclasses 263.01+ for an exothermic article, per se.

148, Metal Treatment, subclasses 23 through 26 , for a fluxing composition, per se.

420, Alloys or Metallic Compositions, subclasses 122+, for a solder alloy, per se.

428, Stock Material or Miscellaneous Articles, for a stock material product in the form of a rod, bar or single or plural layer web or sheet with structure (e.g., shape or size) not provided for elsewhere.

**56.5** This subclass is indented under the class definition. Device having means for either:

- (1) visually or audibly communicating or making known the physical state or location of, or
- (2) establishing, by abutment therewith, the location of work, filler, flux, product\* or machine part.

**SEE OR SEARCH CLASS:**

72, Metal Deforming, subclasses 31.01+ for, metal deforming apparatus having means for indicating the condition or position of work, product or machine element.

**57** This subclass is indented under the class definition. Device which does not meet the definition of any prior subclass in this schedule.

**58** Device for bonding together a plurality of assembled and juxtaposed galvanic cells.

**SEE OR SEARCH CLASS:**

429, Chemistry: Electrical Current Producing Apparatus, Product and Process, subclasses 158+, 160 and 161 for plural galvanic cells having means to bind the cells together.

**59** Means for directing the transmission of heat while a fusion-bonding operation is being performed.

**SEE OR SEARCH CLASS:**

432, Heating, subclass 226 for a residual heating device having a mask, baffle or conductor concentrating heat on or protecting a section of an article being heated.

**60** A bonding device for deforming, and completely joining by bonding, material at one end of a tube.

**101** This subclass is indented under the class definition. Process including the securing discrete juxtaposed meeting faces of work parts or spaced juxtaposed meeting faces of a single work part by adherence or coherence at the interface of the juxtaposed areas.

(1) Note. This is the generic locus for the process of bonding work faces together. In this and the subclasses indented hereunder, for example, is a process of securing metal parts together by welding, brazing or soldering, a process of bonding a metal and a nonmetal surface together, as well as a process of joining two nonmetal parts when using a metallic filler.

(2) Note. The process of coating or casting a layer of material on a base in which the casting or coating joins as by bonding to the base is not considered to be surface bonding for this subclass; however, if solidification of the cast or coated layer is followed by a treatment, e.g., rolling or forging, to effect or improve the bond between the base and the layer, such process, if it is otherwise eligible, is classified in this and the indented subclasses.

(3) Note. Where the process claimed includes coating either the meeting face of a metal work part or a nonmetal work part with a layer of metallic or nonmetallic material and then uniting the two such faces together by use of nonmetallic cement or adhesive or by making of a nonmetallic part plastic and pressing the parts together so that their meeting faces adhere to each other, the process will be classified with the art which provides for the method of making the joint, the coating operation being only a step in preparation for the uniting operation. See Lines With Other Classes and Within This Class, Relationship to Other Classes, The Class of Adhesive Bonding, in Class 228.

(4) Note. Faces of parts are considered to be "meeting" for this and the indented subclasses if they are bonded together, even if it is through an intermediate filler material and even if the faces are oppositely bevelled for the reception of filler material.

**SEE OR SEARCH CLASS:**

29, Metal Working, subclasses 527.2+, for a process of casting and/or coating

- a layer on a base followed by subsequent treatment of the layer and base, in which the initial casting or coating step effects the bond between the layer and base and the subsequent treatment is for purposes other than to effect or perfect such bond, and see (2) Note above.
- 65, Glass Manufacturing, subclasses 59.2+ for a process of bonding glass to metal wherein a uniting operation involves a glassworking operation, e.g., fusing or softening of the glass; see the "Search Notes" thereunder.
- 156, Adhesive Bonding and Miscellaneous Chemical Manufacture, subclasses 60+ for a process for joining parts utilizing a nonmetallic cement or by making a nonmetallic part tacky or adhesive by means of an activating agent and causing it to adhere to another part.
- 164, Metal Founding, subclasses 91+ for a uniting process involving metal casting.
- 205, Electrolysis: Processes, Compositions Used Therein, and Methods of Preparing the Compositions, subclass 114 for a process of bonding parts together by electro-deposition.
- 264, Plastic and Nonmetallic Article Shaping or Treating: Processes, for a miscellaneous process of molding and at the same time uniting two or more substances.
- 403, Joints and Connections, subclasses 265+ for a joint between two members which joint comprises a fusion bond between the members.
- 413, Sheet Metal Container Making, subclasses 24+ for a process of making receptacles and containers including the closures therefor from sheet metal, which process may include joining the parts together by a soldering operation.
- 419, Powder Metallurgy Processes, subclasses 5+ for a process of applying one or more layers of particulate metal to a metal base and heating the assembly so as to sinter the particulate metal and concurrently bond that layer or layers to the base.
- 428, Stock Material or Miscellaneous Articles, subclass 939 for a metallic stock material made by a process of this subclass.
- 102** This subclass is indented under subclass 101. Process including a step of using means for: (a) detecting any of the following characteristics: a state or property, or the occurrence of a pre-determined event, in any of the following: the work, the product of the machine, the environment of the machine affecting the operation thereof, an external preplanned information supply, or a time period limiting means; and (b) initiating (as a direct result of such detection) a force or impulse other than that generated or transmitted by the detecting means; and (c) regulating or modifying (as a direct result of such initiation) the operation.
- SEE OR SEARCH CLASS:  
901, Robots, subcollection 2+ for the controlling of a robot arm, particularly subcollection 10, for the guiding of the arm by direct contact with the work, and subcollection 42 for an art collection of welding robots.
- 103** This subclass is indented under subclass 101. Process especially to enable an operative to (1) determine the occurrence or extent of a variation in an operating condition or (2) observe or determine the location or condition of an element or material by direct observation.
- SEE OR SEARCH CLASS:  
73, Measuring and Testing, for structure similar to that of this subclass, but lacking the step of surface bonding.  
374, Thermal Measuring and Testing, subclasses 5+ for flaw determination by thermal testing, absent a step of surface bonding.
- 104** This subclass is indented under subclass 103. Process including determining a condition of the product, while making no change therein, if the product is determined to be good.
- (1) Note. A faulty product may be damaged by a test of this subclass.

**105** This subclass is indented under subclass 103. Process including observing by use of means which modifies the path of light rays from that observed to the eye of the observer.

**106** This subclass is indented under subclass 101. Process including the use of a flexible member generally adapted to conform to the surface behind the meeting face of one of the parts and distribute energy from a power supply to that surface and cause the meeting faces to be bonded.

**107** This subclass is indented under subclass 101. Process including release of a high energy shock wave and causing the energy released to directly engage the meeting face of one of the work parts and thereby cause that face to intimately engage and become united with the corresponding face of the other work part.

(1) Note. Energy that reaches the part via a gaseous or liquid medium is considered to directly engage the part as required by this subclass; however, energy that reaches the part via a solid element, e.g., an explosively driven ram, is not considered to directly engage the part.

(2) Note. Included herein is deformation by chemical or electrical explosion.

SEE OR SEARCH THIS CLASS, SUBCLASS:

2.5, for apparatus utilized in explosive bonding.

SEE OR SEARCH CLASS:

428, Stock Material or Miscellaneous Articles, subclass 940 for metallic stock material made by a process of this subclass.

**108** This subclass is indented under subclass 107. Process wherein the explosion progresses at a numerically prescribed, claimed velocity.

**109** This subclass is indented under subclass 107. Process wherein the distance that the parts are spaced or their angular relation prior to the explosion is numerically recited in the claim.

**110.1 Using high frequency vibratory energy (e.g., ultrasonic):**

This subclass is indented under subclass 101. Process including subjecting work in the vicinity of the juxtaposed meeting faces to oscillating force having a cycle frequency within or above that of audible sound, which oscillation is for effecting the fusion bonding.

SEE OR SEARCH THIS CLASS, SUBCLASS:

1.1, for apparatus for welding by use of means for producing high frequency vibratory energy.

18, for means causing vibratory motion in either the work or the applicator for the purpose of cleaning the work or the applicator.

27, and 28, for a device for causing vibratory motion in an applicator for the purpose of agitating a melt.

262, for the process of utilizing vibration to distribute fused filler material in fusion bonding.

SEE OR SEARCH CLASS:

428, Stock Material or Miscellaneous Articles, subclass 940 for metallic stock material made by a process of this subclass.

**111** This subclass is indented under subclass 110.1. Process including subjecting of the work part(s) or of the filler material to action which brings about a change in the part or material, either before or after the bonding operation.

(1) Note. Positional change or thermal change is not considered to be a treatment for this subclass.

**111.5 Soldering or liquid phase bonding:**

Process under 110.1 comprising fusion bonding by use of filler material that (a) is made liquid by use of heat which is insufficient to make the material being bonded liquid or (b) is liquid before being subjected to vibratory energy.

**112.1 Using dynamic frictional energy (i.e., friction welding):**

This subclass is indented under subclass 101. Process in which the bond is effected at least in part by means of heat generated (a) by the rapid relative motion of the meeting faces of the parts to be joined, or (b) by the rapid motion of a separate part contacting and moving relative to one or more of the work parts to be joined.

SEE OR SEARCH THIS CLASS, SUBCLASS:

2.1+, for apparatus for welding by frictional heat.

234.1+, for a process of joining parts involving a particular manner of applying welding heat.

SEE OR SEARCH CLASS:

156, Adhesive Bonding and Miscellaneous Chemical Manufacture, subclass 73.1 for the process of friction welding nonmetallic elements.

428, Stock Material or Miscellaneous Articles, subclass 940 for metallic stock material made by a process of this subclass.

**113** This subclass is indented under subclass 112.1. Process wherein energy for effecting bonding is stored in the moving mass of the work and/or the work-holding portion of the machine.

(1) Note. Ordinarily weights are clearly shown and claimed to provide bonding energy.

(2) Note. Motor power means may be disconnected or may continue to function during bonding.

**114** This subclass is indented under subclass 112.1. Process including subjecting of the work part(s) or of the filler material to action which brings about a change in the part or material, either before or after the bonding operation.

(1) Note. Positional change or thermal change is not considered to be a treatment for this subclass.

**114.5 By rotating one work surface relative to another about an axis:**

This subclass is indented under subclass 112.1. Process wherein the relative movement comprises rotation of one of the surfaces about a line passing generally normally therethrough.

SEE OR SEARCH THIS CLASS, SUBCLASS:

2.1, for a device for fusion bonding including means for heating the work by rotating one surface relative to another.

**115** This subclass is indented under subclass 101. Process in which bonding is effected between the meeting faces of juxtaposed metal parts solely by forcing one meeting face to contact and bear upon the other without the application of adhesive, interface solvent or other extraneous agent, and without the application of external heat or heat generating material, or the utilization of residual heat from a previous heating step.

(1) Note. The essence of this subclass is bonding by the application of pressure in the absence of heat. Patents recite this phenomenon variously as "cold welding", or "solid phase bonding" and are classified here if they otherwise come within the terms of the definition. Further note that these terms are confused in the art and that the simple naming in disclosure will not necessarily cause placement in this subclass.

SEE OR SEARCH THIS CLASS, SUBCLASS:

233.1, for a process of metal fusion bonding at a specific rate of varying pressure or schedule of distinct pressures.

SEE OR SEARCH CLASS:

428, Stock Material or Miscellaneous Articles, subclass 940 for metallic stock material made by a process of this subclass.

**116** This subclass is indented under subclass 115. Process including prior to bonding, subjecting the work part(s) to action which brings about a change in the part.

- (1) Note. Positional change or thermal change is not considered to be a treatment for this subclass.
- 117** This subclass is indented under subclass 115. Process wherein the forcing action is effected by the action of a roller\* moving relatively to the work part.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
- 233.1, for a process of roll bonding at a specific rate of varying pressure or schedule of varying pressures.
- 233.3, for a process of roll bonding at a specific rate of varying temperature or schedule of varying temperatures.
- 235.1+, for a process of bonding by a specific mode of applying pressure, particularly subclasses 235.2+ for roll bonding.
- 118** This subclass is indented under subclass 101. Process which include, prior to the bonding operation, (1) treating portions of the work parts so as to prevent bonding, where so treated; (2) juxtaposing a series of parts, portions of which are of materials that will not bond; or (3) treating tools to be used in the bonding operation to prevent adherence of bonding material thereto.
- (1) Note. The bond preventing of this subclass is intended to prevent uniting of certain areas of the parts at the temperatures and pressure of the welding operation. Also, the "materials that will not bond" include those materials previously treated in the manner of phrase (1).
- (2) Note. The bond inhibiting material of this subclass is of insignificant thickness.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
- 189, for fusion bonding of plural joints with use of spacing means for holding bonded parts a significant distance apart.
- 215+, for fusion bonding with use of means which prevents bonding material from flowing to those portions of the parts where bonding is not desired.
- SEE OR SEARCH CLASS:
- 156, Adhesive Bonding and Miscellaneous Chemical Manufacture, subclass 289 for a laminating process utilizing a bond inhibiting parting material.
- 164, Metal Founding, subclasses 72+, for a process of coating a mold surface with an agent to prevent adherence of cast metal to the mold.
- 119** This subclass is indented under subclass 101. Process including operation on a previously constructed but damaged work part(s) to renew, mend, fix or otherwise treat the part so as to put it into better or usable condition or to the state of newness as originally manufactured.
- SEE OR SEARCH CLASS:
- 29, Metal Working, subclasses 402.01+ especially 402.18, for a process of reclaiming, renewing or repairing articles for reuse by operations other than surface bonding; see the search notes thereunder.
- 120** This subclass is indented under subclass 101. Process in which one of the parts being secured by fusion bonding is non-metallic, and which includes securing a metal intermediate member to the nonmetal work part by means of a non-bonded interlock, the sole function of the metal part being to facilitate the joiner of two work parts, and then bonding an exposed surface of the metal intermediate member to the second metallic part.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
- 135+, for mechanically joining two metallic parts in addition to bonding of those parts.
- 121** This subclass is indented under subclass 101. Process including securing two or more non-metal parts together by means of a liquified metallic intermediate bonding material.
- (1) Note. This subclass includes, for example, forming a coating of metallic material on the parts and then soldering,

brazing or deposit welding the coated parts together.

SEE OR SEARCH THIS CLASS, SUBCLASS:

120, for a process of mechanically attaching a metallic bonding layer of lamina to each of two nonmetallic parts, and then effecting a bond between the metallic laminae with a molten metallic cement.

SEE OR SEARCH CLASS:

156, Adhesive Bonding and Miscellaneous Chemical Manufacture, for bonding metal parts by nonmetallic cement (filler).

427, Coating Processes, for a process of coating metallic objects with nonmetallic coatings and for coating nonmetallic articles with metallic coatings.

#### 122.1 Metal to nonmetal with separate metallic filler:

This subclass is indented under subclass 101. Process including securing a metallic work part to a nonmetallic work part by means of a liquified metallic intermediate bonding material.

- (1) Note. This subclass includes a process of forming a surface layer of metallic material on the nonmetallic part and then bonding that surface to the metallic part if (a) during bonding the surface layer flows to fill the space between bonded parts, or (b) additional filler material is supplied to fill the space between the bonded parts.
- (2) Note. For this class, a metal/nonmetal mixture is considered to be a metal.
- (3) Note. Silicon (Si) is considered to be a nonmetal and germanium (Ge) is considered to be a metal in the manufacture of a semiconductor. Broadly, a "semiconductor material" is considered to be a nonmetal.

SEE OR SEARCH THIS CLASS, SUBCLASS:

179.1, for the manufacture of a semiconductor including metal-to-metal bonding at plural joints. Also, that subclass

serves as a collecting place for cross-reference of patents to the manufacture of semiconductors not meeting the requirements of this subclass.

188, for a method of metallic fusion bonding of plural joints without use of an intermediate metallic filler.

194, for a method of coating and subsequently diffusion bonding a workpiece (which may be nonmetallic) to another, if there is no use of filler material.

262.2+, for a method of joining a nonmetal workpiece to another workpiece without use of a metallic filler.

903, for an art digest of bonding a metal to a nonmetal.

#### 123.1 Semiconductor-type nonmetallic material:

This subclass is indented under subclass 122.1. Process wherein the nonmetal part exhibits asymmetrical voltage-current conduction characteristics due to either: (a) the presence, in the crystal lattice of constituent material, of mobile electrons or electron vacancies (i.e., holes) in the valance shells of atoms of the material; or (b) the presence of a layer of interface in mutual contact with two adjacent conductors.

SEE OR SEARCH THIS CLASS, SUBCLASS:

179.1+, for a process of metal fusion bonding including uniting multiple terminals to a semiconductor device.

SEE OR SEARCH CLASS:

438, Semiconductor Device Manufacturing: Process, particularly subclasses 26+, 51, 55, 64+, and 106+ for methods of packaging a semiconductor device; see the search notes thereunder.

#### 124.1 With treating:

This subclass is indented under subclass 122.1. Process including subjecting of the work part(s) or of the filler material to an action which brings about a change in the part or material.

- (1) Note. Positional change or thermal change is not considered to be a treatment for this subclass.

**124.5 Active or reactive filler component:**

This subclass is indented under subclass 122.1. Process comprising use of material intended to effect bonding, which material serves to (a) chemically engage the molecular structure of the member being bonded to another member or (b) be chemically engaged by the molecular structure of another member.

**124.6 Forming hermetic seal (e.g., welding lid to container):**

This subclass is indented under subclass 122.1. Process intended to completely join two surfaces (i.e., to make an airtight joint).

**124.7 Forming joint of rotary shaft:**

This subclass is indented under subclass 122.1. Process intended to connect the ends of two rodlike members to produce a member which is to be used to transmit rotary energy.

**125** This subclass is indented under subclass 101. Process with modifying the shape or position of material at the interface of the bonded juxtaposed meeting faces wherein such material is the result of flow created by the bonding operation.

**126** This subclass is indented under subclass 101. Process including enclosing an inner cylindrical part with a separate co-extensive hollow outer cylindrical part and bonding the parts to each other along substantially their entire contacting faces.

(1) Note. The inner cylindrical part may be tubular.

SEE OR SEARCH THIS CLASS, SUBCLASS:

143, for a process of coiling a web upon itself to form a tube having two or more thicknesses.

154, for a process of shaping a portion of either or both of a telescoping tube and an inner rod-like member prior to bonding of those parts, wherein only a location such as the end of the tube is joined to the inner member; the sleeve and the core piece are not co-extensive.

SEE OR SEARCH CLASS:

29, Metal Working, subclass 422, for a process of encasing an article in a container and deforming the end of the container to confine the article therein. Subclass 455.1, for a process of encasing a tube or rod with a sheath radially spaced therefrom. Subclasses 515+, particularly subclasses 517+, for a process of enclosing a tube or rod with a separate coextensive tubular member and joining them by a deforming operation.

**127** This subclass is indented under subclass 126. Process including heating and/or cooling one or more of the parts being joined to effect relative radial expansion and/or contraction of the parts and force the parts into close contact with each other to effect bonding at contacting area.

SEE OR SEARCH CLASS:

29, Metal Working, subclass 447, for a process of distorting one part by heating or cooling to change a dimension of that part, and then joining it to another part while so distorted, e.g., shrink fitting.

**128** This subclass is indented under subclass 126. Process which in addition to bonding include providing the parts with mating structural features which restrict relative movement of the parts.

SEE OR SEARCH THIS CLASS, SUBCLASS:

135+, for fusion bonding in general combined with mechanical joining.

SEE OR SEARCH CLASS:

29, Metal Working, subclass 521, for a process of joining parts by interlocking mating projections and recesses carried by opposed faces of the parts.

**129** This subclass is indented under subclass 126. Process including juxtaposing a substantially flat sheet or ribbon external part and the inner cylindrical part by folding the sheet or ribbon part around or otherwise causing it to be cylindrical and conform to the inner part and encase the same.



**130** This subclass is indented under subclass 129. Process in which the folding or conforming of the sheet or ribbon part progresses from one end to the other of that part.

**131** This subclass is indented under subclass 126. Process including inserting the inner cylindrical part into the outer cylindrical part and bonding the assembled parts.

SEE OR SEARCH CLASS:

29, Metal Working, subclasses 517+, for a process of joining a core part to a sheath part by deforming the walls of the sheath inwardly to grip the core without fusion bonding of the parts. Subclass 523, for a process of joining parts by expanding an internal tubular part radially outwardly to grip a surrounding part without fusion bonding of the parts.

**132** This subclass is indented under subclass 131. Process in which bonding is effected by means of an intermediate bonding material, i.e., a filler\*.

(1) Note. In the patents of this subclass, the intermediate bonding material has no structural or functional characteristics other than those necessary to the bonding operation.

**133** This subclass is indented under subclass 132. Process including assembling a preformed cylinder of bonding material between the inner and outer cylindrical work parts.

(1) Note. Included herein is placement of a coating of filler material on the part(s) which solidifies prior to bonding.

SEE OR SEARCH THIS CLASS, SUBCLASS:

249, for a miscellaneous process of joining parts by means of a separate solid preplaced filler interposed between the parts.

**134** This subclass is indented under subclass 132. Process including pouring or distributing fused metallic bonding material into the space between the assembled inner and outer cylindrical parts from a receptacle above the assembled parts.

drical parts from a receptacle above the assembled parts.

SEE OR SEARCH THIS CLASS, SUBCLASS:

256+, for a miscellaneous process of applying or distributing fused filler metal in a joint.

**135** This subclass is indented under subclass 101. Process which in addition to securing by fusion bonding includes use of structural means to restrict movement of the parts, wherein the structural means remains a part of the product.

(1) Note. The use of structural means of this subclass may include the interfitting of the work parts or the use of a separate fastening member.

SEE OR SEARCH THIS CLASS, SUBCLASS:

127, for cladding a cylindrical member with interfitting of the work parts.

175, for bonding by fusion bonding combined with additionally bonding by use of adhesive or another fusion operation.

212, for bonding using clamping means which is not intended to remain as a part of the product.

**136** This subclass is indented under subclass 135. Process wherein the structural securing comprises stressing the work part(s) beyond the elastic limit thereof.

**137** This subclass is indented under subclass 136. Process in which the use of structural means includes the interfolding of two or more sheet material edges followed by a pressing or flattening of the folds so as to mechanically prevent dislodgement of the edges.

(1) Note. The "interfolding" of the edges of the material is intended to be such as to prevent all movement of the edges except axial of the fold(s).

SEE OR SEARCH THIS CLASS, SUBCLASS:

5, and 15+, for apparatus for joining work portions first by deforming and then by fusion bonding.

- 150, for forming a one-piece blank into a tube and bonding the seam.
- SEE OR SEARCH CLASS:  
220, Receptacles, subclasses 610+ and 677+ for seam structures of metallic receptacles.  
413, Sheet Metal Container Making, particularly subclasses 27+ for seaming.
- 138** This subclass is indented under subclass 135. Process in which the additional structural means includes a member straddling the surface bonded joint at the location of said joint, which member is attached to each of the sheet material parts being bonded together.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
189, for use of a bridging member that is fusion bonded to the sheets in addition to fusion bonding of the sheets together.  
212, for a process in which a member is attached to the parts being bonded to hold them relatively positioned during the bonding operation, which member is not intended to remain as a part of the bonded assembly.  
216, for a process employing a back-up member that spans the space between the parts to be bonded and retains the molten filler metal therein but is removed after solidification of the filler metal.
- 139** This subclass is indented under subclass 135. Process wherein the structural means used includes a part distinct from the part(s) being bonded together, wherein the distinct part remains as a component of the assembled product.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
213, for clamping means adapted to be removed from the bonded product.
- 140** This subclass is indented under subclass 139. Process wherein the distinct structural part includes a helically ribbed portion adapted to interfit with either one of the parts being fastened together or with another cooperatively
- grooved member to hold together the parts being bonded.
- 141.1 With shaping:**  
This subclass is indented under subclass 101. Process including in addition to fusion bonding, physically shaping the parts bonded either before, during, or after the bonding operation.
- (1) Note. "Shaping" of the subclass is intended to describe the physical act of permanently altering the form, configuration, dimensions, proportions, or contour of a part either with or without the removal of material.
- (2) Note. Effecting a bonded joint utilizing pressure that shapes the work parts in the vicinity of the bond is not considered shaping for this subclass. For example, roll bonding in which there is substantial reduction of the parts is not included in this and the indented subclasses unless there is shaping remote from the bonding operation.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
235.2+, for roll bonding in which there is significant shaping of the parts in the vicinity of the bond, but no remote shaping claimed.
- SEE OR SEARCH CLASS:  
59, Chain, Staple, and Horseshoe Making, subclass 35 for a process of soldering, brazing, or welding combined with the bending particular to the formation of a chain link.  
156, Adhesive Bonding and Miscellaneous Chemical Manufacture, subclasses 196+ for a process of permanently bending or reshaping or embossing of self-sustaining lamina combined with lamination by nonmetallurgical bonding.  
219, Electric Heating, subclasses 149+ and 602+ for electrical heating of metal combined with the shaping thereof.  
413, Sheet Metal Container Making subclasses 1+ for a process of soldering, brazing or welding combined with shaping of sheet metal parts at other than the areas to be joined for making

particular products, e.g., automobile radiator making and can making.

- 142** This subclass is indented under subclass 141.1. Process wherein each of the meeting faces of the separate parts or portions of the same part are shaped so that the parts are matched and united upon a line joining the apexes of the angle of junction of the parts.

- (1) Note. Included herein is the making a picture frame wherein the corners (meeting faces) are beveled at 45 degrees and then joined. The making of a picture frame where the corners are formed by parts cut normal to the frame part are not included herein.

SEE OR SEARCH CLASS:

- 428, Stock Material or Miscellaneous Articles, subclass 599 for metallic stock material having a defined corner configuration.

- 143** This subclass is indented under subclass 141.1. Process including shaping or distorting a sheet to coil upon itself at least two convolutions to produce a tube having a wall of at least two thicknesses of said sheet, and then bonding one or more extending edge(s) of the sheet to that part of the body of the sheet juxtaposed thereto.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 130, for a process of progressively forming a sheath around a core, and bonding the sheath to the core.  
144+, for a process of forming a tube of single thickness by bending a web into tubular form and joining the meeting edges of the web.

- 144** This subclass is indented under subclass 141.1. Process including shaping or distorting a single part to juxtapose marginal portions thereof and surface bonding the meeting faces thereof.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 5, and 15+, for bonding apparatus combined with shaping means.  
192, for a process of soldering, brazing or welding the joints of chain links.

SEE OR SEARCH CLASS:

- 59, Chain, Staple, and Horseshoe Making, for apparatus for making chain links which may include bending the link into a circular shape and securing the juxtaposed ends to form a link.  
72, Metal Deforming, subclasses 48+, for metal tube seaming by deformation.  
493, Manufacturing Container or Tube From Paper; or Other Manufacturing From a Sheet or Web, subclass 269 for making a tube from a sheet or web.

- 145** This subclass is indented under subclass 144. Process including bending a long attenuated web into a tubular coil to juxtapose the faces of opposite side edges along a line running spirally axially along the tube so formed, and bonding the resulting seam.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 15.7, from apparatus for forming and edge bonding to form a helically seamed tube.

SEE OR SEARCH CLASS:

- 72, Metal Deforming, subclasses 49+, for metal tube seaming by deformation.  
140, Wireworking, subclass 76 for a process of making ferrules by winding wire into a helix and soldering the adjacent convolutions together.  
493, Manufacturing Container or Tube From Paper; or Other Manufacturing From a Sheet of Web, subclasses 299+ for making a helical tube from a sheet or web.

- 146** This subclass is indented under subclass 144. Process in which the shaping of the marginal portions of the part are juxtaposed progressively from one end of the part to the other end.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 15+, for apparatus for progressively forming and bonding a one-piece blank to form a tube.  
130, for a process of progressively bending a web around a core and joining the web to the core.

- 143, for a process of forming a web into a multilayer tube and joining the resultant seam.
- 147** This subclass is indented under subclass 146. Process wherein a tubular article is produced that has no defined trailing end.
- 148** This subclass is indented under subclass 147. Process wherein the tubular article is formed about a member to permanently encase that member.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
130, for a process of forming a sheath member about a coextensive core with bonding of the sheath to the core.
- 149** This subclass is indented under subclass 144. Process in which the single part is of constant thickness throughout and that thickness is relatively thin compared to the lateral dimension of the part.
- 150** This subclass is indented under subclass 149. Process wherein the part is formed into an elongated tubular member and the margins being bonded extend in a plane common to the axis thereof.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
15.5+, for apparatus for forming a seamed tube.
- 151** This subclass is indented under subclass 150. Process wherein the meeting faces to be bonded extend along the axis of the formed part and extend from the radially inner surface to the radially outer surface thereof.
- (1) Note. Faces of parts are considered to be “meeting” for this subclass if they are bonded together even if it is through an intermediate filler material and even if the faces are oppositely bevelled for the reception of filler material.
- 152** This subclass is indented under subclass 144. Process wherein the single part is of varying thickness dimension and is relatively thick when compared to the lateral dimension thereof.
- 153** This subclass is indented under subclass 141.1. Process including shaping a first part to match a meeting face of a second part which is other than flat, so that the first part overlaps the second part followed by joining the meeting faces of the parts.
- 154** This subclass is indented under subclass 153. Process in which the lapped portion is annular in shape and is caused to surround at least a portion of the part to which it is joined.
- 155** This subclass is indented under subclass 141.1. Process in which the securing together of the meeting faces of work part(s) is followed by shaping of the part(s).
- 156** This subclass is indented under subclass 155. Process wherein the shaping is brought about by pulling a work part along its axial extent through an orifice to apply tensile force to the part and elongate that part.
- SEE OR SEARCH CLASS:  
72, Metal Deforming, subclasses 274+ for the process of shaping a metal part by drawing the part through a closed die without surface bonding.
- 157** This subclass is indented under subclass 155. Process including bonding a first work part to a second work part at a first point or line, bonding the first work part at a second point or line to the second work part or to a third work part, followed by stretching of the first work part.
- (1) Note. In this subclass there is deliberate elongation of a portion of the work part remote from the bonded faces with no corresponding significant change in the parts at the bonded faces.
- SEE OR SEARCH CLASS:  
29, Metal Working, subclasses 6.1+ for cutting of a single work part at spaced, offset lines and deforming the severed portions apart from each other.
- 158** This subclass is indented under subclass 155. Process wherein the shaping is brought about by the action of a roller\*.

- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
235.2+, for roll bonding wherein the roller not only serves to force the meeting faces of the work parts together to effect surface bonding but also may deform the work in the vicinity of the bond.
- SEE OR SEARCH CLASS:  
72, Metal Deforming, subclasses 199+ for rolling to form metal work in the absence of surface bonding.
- 159** This subclass is indented under subclass 155. Process in which the shaping operation includes separating some of the substances of the joined parts therefrom.
- SEE OR SEARCH CLASS:  
29, Metal Deforming, subclasses 557+ for a process of reshaping a one-piece blank by removing material therefrom.  
156, Adhesive Bonding and Miscellaneous Chemical Manufacture, subclasses 2+ for etching shape a work-piece in the absence of metal fusion bonding.
- 160** This subclass is indented under subclass 155. Process wherein the shaping includes the use of a sharp cutting edge to pierce and sever one portion of the work part(s) from another.
- (1) Note. The severed portion of the part may be scrap or may be a usable product.
- SEE OR SEARCH CLASS:  
83, Cutting, and see the search notes of that class for cutting of general utility.
- 161** This subclass is indented under subclass 159. Process wherein the shaping operation produces a void or recession in the work part(s) such that a cross-section can be taken there across which will show the void to be completely encircled by material of the part(s).
- (1) Note. The void in the work part(s) may extend all the way from one side to the other or may extend only part way there-through.
- 162** This subclass is indented under subclass 159. Process wherein the shaping is done by the action of a crystalline cutting tooth.
- (1) Note. The crystalline cutting tooth may be a naturally formed element or may be artificially formed to be similar to a naturally formed element.
- SEE OR SEARCH CLASS:  
451, Abrading, for shaping by a crystalline tool in the absence of fusion bonding.
- 163** This subclass is indented under subclass 159. Process wherein shaping and removal of material is done by heating the work part(s) beyond the melting point and removing the flowable material.
- (1) Note. Included herein is cutting by use of oxyacetylene torch.
- 164** This subclass is indented under subclass 141.1. Process in which one or more of the parts to be joined is subjected to a shaping operation prior to the joining operation.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
135+, for a process of surface of fusion bonding combined with shaping of the parts to effect supplementary physical joining.
- 165** This subclass is indented under subclass 164. Process wherein the shaping includes the formation of an elongated recess in the meeting face of at least one of the parts, which recess is specifically intended for receipt of metallic intermediate bonding material.
- (1) Note. The groove, channel or trough is frequently of V- or U-shape, and is formed in one of the parts rather than in the juncture of the parts.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
137, for a process involving supplementary lock seaming which may result in formation of a groove.

- 170, for cutting of a bevel on each of a pair of mating parts which may be recited as "grooving".
- 166** This subclass is indented under subclass 165. Process wherein the parts are joined along their greater generally straight margins.
- 167** This subclass is indented under subclass 165. Process wherein generally flat work parts are angularly joined to form the walls of an elongated chamber.
- 168** This subclass is indented under subclass 165. Process wherein the meeting faces of the parts engage along a circular line, as in the bonding of tubular members.
- 169** This subclass is indented under subclass 158. Process including forming in at least one of the meeting faces a channel for the reception of filler material, and subsequent fusion bonding of the meeting faces.
- 170** This subclass is indented under subclass 164. Process wherein the shaping includes the use of a sharp cutting edge to pierce and sever one portion of the part(s) from another.
- (1) Note. The severed portion of the part may be scrap or may be a usable product.
- SEE OR SEARCH CLASS:  
83, Cutting, for severing by a sharp cutting edge without fusion bonding.
- 171** This subclass is indented under subclass 170. Process wherein the shaping serves to cause the meeting faces of the parts to correspondingly meet and fit against each other.
- 172** This subclass is indented under subclass 170. Process wherein the shaping operation is done by the action of a crystalline cutting tooth.
- (1) Note. The crystalline cutting tooth may be a naturally formed element or may be artificially formed to be similar to a naturally formed element.
- SEE OR SEARCH CLASS:  
451, Abrading, for shaping by a crystalline tool in the absence of fusion bonding.
- 173.1 By deforming:**  
This subclass is indented under subclass 164. Process wherein the shaping is done by stressing a part beyond its elastic limit.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
265, for a process of simultaneously shaping and bonding metal working parts.
- SEE OR SEARCH CLASS:  
72, Metal Deforming, for deforming of metallic parts in the absence of fusion bonding.
- 173.2 Pressing first work part against second work part:**  
This subclass is indented under subclass 173.1. Process wherein a first work part is physically urged against a second work part with sufficient force to cause their mating surfaces to complement one another by deformation.
- 173.3 Preforming work faying surface:**  
This subclass is indented under subclass 173.1. Process wherein a faying surface, i.e., a meeting face of a work part designed to mate with a meeting face of a second work part, is altered in shape by deformation thereof to facilitate a bonding operation.
- 173.4 Tube or frame member:**  
This subclass is indented under subclass 173.1. Process wherein a work part being deformed is a hollow elongated body whose longitudinal dimension is much greater than its lateral cross-sectional dimension, i.e., a tube, or therein a work part being deformed is an elongated element specially configured to be used as a structural load bearing member, i.e., a frame member.
- SEE OR SEARCH CLASS:  
29, Metal Working, subclasses 897+, for method of making structural members proper in that class (29). See Lines With Other Classes and Within This Class, The Classes Including Post-Fusion Treatment, in this class (228) for the classification line between Class 29 and Class 228.

**173.5 Rod, bar, or wirelike object:**

This subclass is indented under subclass 173.1. Process wherein a work part being deformed is an elongated body whose longitudinal dimension is much greater than its lateral dimension.

**173.6 Sheet material:**

This subclass is indented under subclass 173.1. Process wherein a work part being deformed is a metallic body having one dimension much smaller than its other two.

**173.7 Continuously feeding sheet material:**

This subclass is indented under subclass 173.6. Process wherein the metallic body is fed continuously to means performing the shaping operation.

**174** This subclass is indented under subclass 164. Process wherein the shaping includes the formation of an elongated recession in at least one of the work parts.

SEE OR SEARCH THIS CLASS, SUBCLASS:

165, for a similar operation wherein the elongated recession is for the express purpose of receiving filler material.

**175** This subclass is indented under subclass 101. Process including a bonding operation as provided for under that definition and including another distinct bonding operation of a different type.

(1) Note. The two bonding operations of this subclass may both be provided for in this class, e.g., welding plus brazing or tack welding followed by diffusion welding. Also, the two bonding operations may include a first bonding operation of this class type and a second operation of another class type, e.g., welding and adhesive bonding.

SEE OR SEARCH THIS CLASS, SUBCLASS:

135, for fusion bonding combined with mechanical securing.

187, for a first bonding operation between a first pair of meeting faces and a second bonding operation between a second pair of meeting faces wherein

both operations are of the same basic type but include the use of fillers that fuse at different temperatures.

230, for a first bonding operation between a pair of meeting faces and a second bonding operation between that pair of meeting faces wherein both operations are of the same basic type.

**176** This subclass is indented under subclass 101. Process in combination with either (1) an operation to perfect the basic operation of this class or (2) an operation for treating or working the work part(s) or the filler prior to during bonding wherein the additional operation is other than that within this class definition.

(1) Note. Not included in this subclass is fusion bonding combined with another operation so intimately associated with the bonding operation as to be generally considered in the art to be part of the bonding operation when recited in combination therewith and specifically provided for under subclass 101 and below this subclass. Specifically, application of a coating of flux, filler or bond facilitating metal, cleaning, heating, handling or the application of a special environment, combined with bonding is provided for below and is excluded from this subclass.

SEE OR SEARCH THIS CLASS, SUBCLASS:

18, for fusion bonding apparatus combined with apparatus for performing other operations.

103+, for fusion bonding combined with measuring or testing.

135+, for fusion bonding combined with mechanical joining.

141.1+, for fusion bonding combined with shaping.

175, for fusion bonding combined with other securing.

199+, for fusion bonding followed by product treatment, e.g., cooling and cleaning.

203+, for treating of work parts or filler material prior to fusion bonding, e.g., cleaning, application of a preliminary bond facilitating coating or other chemical treatment.

214+, for bonding and protecting the work part(s) or filler, e.g., by a getter, protective vapor, vacuum or by application of flux.

SEE OR SEARCH CLASS:

29, Metal Deforming, subclasses 1.1 through 25.42, 91+, 592.1 through 623.5 and 825 through 899.1 (subclasses for making "special articles") for an operation involving fusion bonding and an additional step peculiar to manufacture of an article, as provided for therein, subclasses 592+ for combined operations involving metal fusion bonding and subsequent, unrelated, additional work treatment, and subclasses 428+, for fusion bonding combined with bringing work parts together and orienting the parts prior to bonding.

**177** This subclass is indented under subclass 101. Process wherein fusion bonding is set forth in a claim as any of multiple forms thereof, e.g., "welding", "brazing", "sweating", "soldering", or "diffusion bonding".

**178** This subclass is indented under subclass 101. Process which includes securing together a plurality of distinct pairs of meeting faces.

(1) Note. Bonding at several locations between a single pair of meeting faces (e.g., spot welding along a pair of overlapped margins or bonding a corrugated panel to a planar panel in face-to-face relation) is not considered to meet the requirements of this and the indented subclasses.

**179.1 Of electrical device (e.g., semiconductor):**  
This subclass is indented under subclass 178. Process for the manufacture of product members intended to be used in the transmission or regulation of electrical energy.

(1) Note. This subclass serves as a collecting place for cross-references of patents directed to the manufacture of a semiconductor device even though only a single joint is formed, except when bonding a metal to a nonmetal with a metallic filler.

SEE OR SEARCH THIS CLASS, SUBCLASS:

4.5, for means for bonding a terminal(s) to an electrical device.

123.1, for bonding of a semiconductor device involving uniting a metal to a nonmetal utilizing a metallic filler.

SEE OR SEARCH CLASS:

29, Metal Working, subclasses 592.1+ for the manufacture of an electrical device wherein fusion bonding is combined with an additional operation not incidental to the bonding operation.

438, Semiconductor Device Manufacturing: Process, particularly subclasses 26+, 51, 55, 64+, and 106+ for methods of packaging a semiconductor device; see the search notes thereunder.

**180.1 Simultaneous bonding of multiple joints (e.g., dip soldering of printed circuit boards):**

This subclass is indented under subclass 179.1. Process wherein plural distinct meeting faces are caused to be secured at the same time.

**180.21 Component terminal to substrate surface (i.e., nonpenetrating terminal):**

This subclass is indented under subclass 180.1. Process wherein electrical terminals of a component are bonded to contact on a face of a substrate wherein the terminals do not extend into or through the substrate.

**180.22 Lead-less (or "bumped") device:**

This subclass is indented under subclass 180.21. Process wherein the terminal extends above the surface of the substrate.

**180.5 Wire bonding:**

This subclass is indented under subclass 179.1. Process of fusion bonding a small strand member to another member.

**181** This subclass is indented under subclass 178. Process including securing of parallel coextensive generally cylindrical cells to an intersecting plate.



- (1) Note. Securing of multiple cells to a single plate is included herein even though the multiple joints may run together.
- 182** This subclass is indented under subclass 178. Process for the manufacture of individual distinct definite dimension products\*.
- SEE OR SEARCH CLASS:  
29, Metal Working, subclasses 1.1 through 25.42, 91+, 592.1 through 623.5, and 825 through 899.1 inclusive for the manufacture of a specified article wherein welding is combined with another operation that is peculiar to the manufacture of that article and is not ancillary to the welding operation.
- 183** This subclass is indented under subclass 182. Process used in the manufacture of articles intended to contain a first fluent material separate from a second fluent material and transmit thermal energy from one fluent material to the other.
- 184** This subclass is indented under subclass 182. Process used in the manufacture of enclosed chambers to be used for the storage of fluent material.
- 185** This subclass is indented under subclass 178. Process which includes the bonding of a plurality of similar work parts to a common base work part in a symmetrical or orderly arrangement.
- 186** This subclass is indented under subclass 178. Process in which there are first and second fusion bonding operations, the first bonding operation serving to seal the environment about the meeting faces of the second bonding operation.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
175, for bonding of the class type preceded by another bonding operation.
- 187** This subclass is indented under subclass 178. Process in which the forming of the plural joints includes the utilization of different degrees of heat.
- (1) Note. The operation of this subclass normally uses filler materials of differing melting temperatures whereby the initially formed joints are not disturbed by successive joining steps which occur at temperatures below the preceding fusion temperatures.
- 188** This subclass is indented under subclass 178. Process in which one of the work parts is a material other than metal.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
120, for a process of mechanically attaching a metallic bonding lamina to a nonmetal base, and then bonding that metallic bonding lamina to another work part.  
122.1, for bonding a nonmetal to a metal, using a metallic filler.  
903, for an art collection of bonding of a metal part to a nonmetal part.
- 189** This subclass is indented under subclass 178. Process which includes placing an independent part (1) to overlap the meeting faces of the work part(s) being secured then bonding said independent part to each of the two work parts or (2) to separate the parts during bonding, wherein the independent part is intended to remain as a part of the secured assembly.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
138, for a process of using a mechanically secured bridge member.  
213, for a process of using a securing member to hold work parts, which securing member is intended to be removed from the bonded assembly.
- 190** This subclass is indented under subclass 178. Process which includes assembling a plurality of generally coextensive laminae, one upon another, and the simultaneous bonding of the adjacent interfaces thereof.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
118, for the process of fusion bonding using bond inhibiting separating material of insignificant thickness.

- 191** This subclass is indented under subclass 101. Process including securing by fusion bonding the meeting faces and subsequent separating of the faces.
- specific reference to the time period of exposure of the meeting faces to heat and pressure; e.g., the parts will be subjected to heat and pressure for approximately half hour.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
264, for the process of disassembling a fusion bonded joint in the absence of the step of fusion bonding.
- 192** This subclass is indented under subclass 101. Process for securing by soldering, brazing or welding the meeting faces of an element making up one of the parts of a chain.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
144+, for forming and uniting the meeting faces of a one-piece blank other than a chain link.
- SEE OR SEARCH CLASS:  
59, Chain, Staple, and Horseshoe Making, subclass 35 for a process of soldering, brazing or welding chain links combined with an additional chain making operation such as, for example bending or forming the links.  
219, Electric Heating, subclass 52 for heating and/or welding in the manufacture of chain having significant electric heating, as in utilizing the work part(s) as a part of the electric circuit.
- 193** This subclass is indented under subclass 101. Process wherein the meeting faces are heated to a prescribed temperature below the melting point and are subjected to intimate engagement such that the molecules of one face intermix with those of the other face.
- (1) Note. A solid filler material may or may not be used in the process of this subclass; however, the filler is heated up to but below its melting point and/or any molten filler produced during the process must be substantially absorbed by the work parts to fall within the scope of this subclass.
- (2) Note. Most of the patents including a claim proper for this subclass include
- 194** This subclass is indented under subclass 193. Process including use of filler material or other material which either unites with one or both of the meeting faces or influences the faces to help bring about bonding therebetween.
- 195** This subclass is indented under subclass 193. Process wherein the temperature of the parts is such that there is some slight melting and flowing at the points of highest pressure but wherein the melting point has not been reached and wherein the bonding is of the type relying on the intermix of the surface molecules of the faces.
- 196** This subclass is indented under subclass 101. Process in which one self-sustaining work part is joined to another at their meeting faces by locally heating at least a portion of the meeting faces to the fusion point of at least one of the work parts, the fused material joining the parts being derived solely from the parts.
- (1) Note. The joining of two or more parts by use of a filler material of the same constituency as the work parts is sometimes designated as an "autogenous" joint but is not so considered for this subclass.
- (2) Note. Only minor melting of the work parts is found in this subclass so that the work parts substantially retain their original configuration. Formation of a substantial pool of liquid at the meeting faces of the work parts will be found elsewhere.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
254, for joining of "pre-tinned" or filler coated parts either with or without the application of additional filler material.
- SEE OR SEARCH CLASS:  
219, Electric Heating, subclasses 117+ for a process of bonding with pressure by

- the use of electrically generated heat, and subclasses 137 and 148 for a similar process not utilizing pressure.
- 197** This subclass is indented under subclass 196. Process utilizing the phenomenon of molecular intermixing of engaged meeting faces to augment bonding.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
193+, for bonding by molecular intermixing without melting (other than incipient melting) of the parts.
- 198** This subclass is indented under subclass 101. Process wherein filler material is delivered to the meeting faces in a different chemical form from that to be used as the final bonding filler and wherein a reaction is utilized to release the filler for the desired function.
- 199** This subclass is indented under subclass 101. Process including, after the bonding operation, subjecting the work part(s) or of the filler material to action which brings about a change in the part or material.
- (1) Note. Positional change or thermal change is not considered to be a treatment for this subclass.
- (2) Note. The treatment of this subclass is limited to treatment related to a welding process.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
176, for metallic fusion bonding combined with other operations taking place before or during bonding.
- SEE OR SEARCH CLASS:  
29, Metal Working, subclasses 592+ for combined operations involving metal fusion bonding and subsequent unrelated additional work treatment.
- 200** This subclass is indented under subclass 199. Process wherein the change brought about is a reduction in the thermal level of the product of the bonding operation and wherein the change is brought about in a prescribed order or rate or manner.
- 201** This subclass is indented under subclass 199. Process wherein the change brought about is removal of the foreign material from the product.
- 202** This subclass is indented under subclass 201. Process wherein the foreign material is removed at least in part by a molecular change in the product or the foreign material.
- 203** This subclass is indented under subclass 101. Process including, before the bonding operation, subjecting the work part(s) or the filler material to action which brings about a change in the part or material.
- (1) Note. Positional change or thermal change is not considered to be treatment for this subclass.
- SEE OR SEARCH CLASS:  
29, Metal Working, subclasses 81.01+ for a process of removing scale from metal.
- 204** This subclass is indented under subclass 203. Process in which a material which inherently acts to facilitate the movement of molten filler by capillarity is placed on one or more of the work parts or in the space between the meeting faces of the work parts so as to direct filler material to the joint.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
256, for general application of filler to the work parts.
- 205** This subclass is indented under subclass 203. Process wherein the change brought about is removal of the foreign material from the work parts or from the filler.
- 206** This subclass is indented under subclass 205. Process wherein the foreign material is removed at least in part by a molecular change in the parts, filler or foreign material.
- 207** This subclass is indented under subclass 206. Process wherein the cleaning includes the application to the meeting faces of material which assists in the bonding operation by pro-

- tecting the parts during bonding or by being involved directly in the bonding operation.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
223, for the application of flux in a bonding operation wherein no change in the work parts or the filler is made prior to bonding.
- 208** This subclass is indented under subclass 203. Process including, prior to securing, coating one or more of the meeting faces of the work parts with a metal of such nature as to cooperate with the filler material to facilitate securing, wherein the coating metal does not melt during bonding.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
122.1+, for a process which includes coating a nonmetallic part with metal and then soldering, brazing, or welding the coated part to either a metal or a metal coated nonmetal part.  
254, for a process of soldering, brazing or welding in which the fusible filler material is supplied from a "pre-tinned" layer or coating on at least one of the parts to be joined.
- SEE OR SEARCH CLASS:  
428, Stock Material or Miscellaneous Articles, subclasses 615+ for a metallic composite defined in terms of the composition of its components.
- 209** This subclass is indented under subclass 208. Process wherein the coating is applied to the meeting face of the work part(s) by molecular transfer between the coating and the part.
- 210** This subclass is indented under subclass 208. Process wherein the coating is attached to the meeting face of the work part(s) by physically interlocking the part therewith.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
135+, for bonding workpiece with mechanical interlocking therebetween.
- 211** This subclass is indented under subclass 203. Process wherein the change in the work part(s) or the filler includes a molecular change.
- 212** This subclass is indented under subclass 101. Process including use of means temporarily establishing the position of the work parts for securing by fusion bonding.
- (1) Note. Included herein is use of work holders as well as clamping means carried by the work but securing one work part relatively to another and moldable material such as plaster which holds the work temporarily.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
139, for the process of securing work parts which includes attaching the parts together by a separate fastening means which is intended to remain as a part of the bonded product.
- 213** This subclass is indented under subclass 212. Process including specific recitation of removing clamping means from the product after fusion bonding of the parts together.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
212, for holding work parts during bonding by use of plaster and subsequent removal of the plaster.
- 214** This subclass is indented under subclass 101. Process (a) including shielding of the filler, a metal part (or component thereof) or both against detrimental effects prior to, during, or subsequent to joining or (b) including application of a substance to the meeting faces or the filler to promote union of the meeting faces.
- (1) Note. A process of protecting metal parts where not combined with fusion bonding is classified elsewhere in accordance with the operation performed.
- (2) Note. During the bonding operation the flux substance of clause (b) may protect the work from oxidation, may clean, or may catalytically enter into the reaction between the materials being united.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 199, for fusion bonding combined with subsequent treatment of the bonded joint.
- 203, for fusion bonding combined with treatment of work or filler prior to bonding.

SEE OR SEARCH CLASS:

- 29, Metal Working, subclasses 81.01+ for a process of removing scale from metal.
- 134, Cleaning and Liquid Contact With Solids, subclasses 1 through 42 for article cleaning including the application of a liquid.
- 428, Stock Material or Miscellaneous Articles, subclass 588 and 560+ for stock material having as a component metal particles mixed with a flux.
- 451, Abrading, subclasses 32+ for a process of abrading including tumbling and subclasses 36+ for a process of abrading utilizing a fluent abradant.

- 215** This subclass is indented under subclass 214. Process which includes provision of means other than the shape of the work parts being joined for confining the flow of fluent filler material to the vicinity of the bonded joint.

SEE OR SEARCH CLASS:

- 427, Coating Processes, subclass 5.5 for a process in which a base is protected during a coating operation by a protective coating, and see the search notes therein.

- 216** This subclass is indented under subclass 215. Process in which the confining means comprises either (1) a body of sufficiently high melting point or heat conductivity to establish, with respect to the fused filler contacting it, a cooled zone, or (2) a body which acts to retain the fused filler within the space between the meeting faces of the work part(s).

SEE OR SEARCH CLASS:

- 164, Metal Founding, subclass 127 for a process of casting employing a "chill". Note that Class 164 takes molding apparatus and a process of

molding where the mold acts to contain and shape cast metal for producing a casting, whereas the body, or "chill", of this subclass acts to simply retain the filler within the joint; i.e., for all practical purposes the retainer of this subclass acts only as a back-up, the joining surfaces providing the other retaining surfaces.

- 217** This subclass is indented under subclass 214. Process wherein for bonding the work is isolated within a chamber within which a solid material having an affinity for undesirable gas(es) is placed to rid the environment of the bond of such gas(es).

- (1) Note. The gas most commonly gettered is oxygen.

- 218** This subclass is indented under subclass 214. Process wherein normal atmosphere is restricted from the environment of the bonding operation (1) by replacement with a different gaseous atmosphere, (2) by placing the work within a chamber and removing a portion or all gas from that chamber; or, (3) by engulfing the area about the bond operation with a flame that serves to consume that portion of the atmosphere considered undesirable.

SEE OR SEARCH CLASS:

- 75, Specialized Metallurgical Processes, Compositions for Use Therein, Consolidated Metal Powder Compositions, and Loose Metal Particulate Mixtures, subclass 709 for processes of covering the surface of molten metal to prevent contact with the ambient atmosphere.

- 148, Metal Treatment, for a process of significant heat treatment of metal to modify or maintain the internal physical structure (i.e., microstructure) or chemical property of metal and, also, for using a reactive or protective atmosphere. See the Class Definition, Metal casting, metal fusion bonding, machining, working classes, in Class 148 to determine what constitutes significant heat treatment. Also, see Class 148 for processes of chemical heat removing (e.g., flame cutting etc.) or burning (i.e., oxidizing) of

metal that use a reactive or protective atmosphere.

**219** This subclass is indented under subclass 218. Process as set forth under clause (1) of that definition.

- (1) Note. The atmosphere utilized to replace the normal atmosphere may be held in the area of the bond by an enclosing vessel or by the action of a directed blast which serves to expel the normal atmosphere.

**220** This subclass is indented under subclass 219. Process wherein the atmosphere replacing the normal atmosphere reacts with any available oxygen to eliminate that gas as an available material from the environment, thereby preventing oxidation of the work or filler.

**221** This subclass is indented under subclass 218. Process as set forth under clause (2) of that definition.

**222** This subclass is indented under subclass 214. Process wherein the work or filler is shielded against excessive heat by means which absorbs thermal energy therefrom.

- (1) Note. Included herein is the use of a heat shield or heat sink to protect the work remote from the meeting faces as well as the use of means to protect the meeting faces from being brought to a damaging temperature.

SEE OR SEARCH THIS CLASS, SUBCLASS:

199, for cooling of the work after the fusion bonding has been completed.

**223** This subclass is indented under subclass 214. Process including application of a substance to the meeting faces of the work or the filler to promote union of the meeting faces.

- (1) Note. The flux substance of this subclass may protect the work from oxidation, may clean, or may catalytically enter into the reaction between the materials being united, during the bonding operation.

SEE OR SEARCH THIS CLASS, SUBCLASS:

207, for bonding with the application of flux wherein the flux is active prior to the bonding operation to modify a condition of the work or filler. By comparison, the process of this subclass serves to modify a condition of the work or filler during or after the bonding operation.

218, for the application of fluxing material in the form of a gas or vapor, which establishes a protective or reactive atmosphere about the vicinity of the bond.

SEE OR SEARCH CLASS:

148, Metal Treatment, subclasses 23+ for a fluxing composition or method of fluxing using a particular fluxing composition, even when that method is designated to be a method of soldering, brazing, welding, or fusion bonding.

**224** This subclass is indented under subclass 223. Process in which the fluxing substance is incorporated with a filler prior to application of the filler for their concurrent application to the meeting faces.

- (1) Note. The flux of this subclass may be incorporated with the filler either as a core or as a coating on a filler wire or rod.

SEE OR SEARCH THIS CLASS, SUBCLASS:

56.1+, for a single or plural layer metal article which is useful as filler material in a metal fusion bonding operation and which includes metal united or combined with a flux.

223, for a process involving passing the meeting faces through a supernatant layer of flux on a bath of molten filler.

SEE OR SEARCH CLASS:

219, Electric Heating, subclass 145.22, 145.23+ and 146.1+ for weld rods for gas flame (Class 228) or electric arc (Class 219) use having a flux incorporated therein, and consult the search

- notes in that subclass and those indented thereunder for related art.
- 428, Stock Material or Miscellaneous Articles, for a stock material product in the form of a rod, bar or layer, with structure (i.e., shape), or in the form of plural layers not including a metal-next-to-metal laminate.
- 225** This subclass is indented under subclass 101. Process including a first application of filler and a subsequent application of filler to the same meeting faces for bonding.
- (1) Note. Included herein is the application of successive strata of filler one upon the other, as well as successive depositions on opposite sides or spaced areas of the joint.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
- 175, for plural bonding operations wherein different bonding techniques are used.
- 178, for plural bonding operations at different meeting faces.
- 226** This subclass is indented under subclass 225. Process wherein the filler material of the first application is chemically different from that of the second application.
- 227** This subclass is indented under subclass 101. Process including a first application of thermal energy to the work or to the filler and a second application of thermal energy to the work or filler to raise the temperature thereof and thereby effect or influence the bonding of a single joint.
- (1) Note. Included herein is the distinct application of heat to opposite sides of a single workpiece.
- SEE OR SEARCH CLASS:
- 148, Metal Treatment, particularly subclass 516 for combined processes of metal fusion bonding and significant heat treatment of metal to modify or maintain the internal physical structure (i.e., microstructure) or chemical property of the metal. See the Class Definition, Metal casting, metal fusion bonding, machining, working classes, in Class 148 to determine what constitutes significant heat treatment.
- 219, Electric Heating, for the application of electrical energy passing through the bonded joint to effect heating thereof.
- 228** This subclass is indented under subclass 227. Process including in addition to the plural applications of thermal energy, the application of force to cause the meeting faces to bond together.
- 229** This subclass is indented under subclass 227. Process wherein the first application of thermal energy is applied to the work and the second independent application of thermal energy is applied to the filler.
- 230** This subclass is indented under subclass 227. Process including different types of application of thermal energy.
- (1) Note. Included herein, for example, is the application of heat from an electrical resistance element combined with heating by a torch.
- (2) Note. Heating to a first temperature and subsequently heating to a different temperature is not considered to be "diverse" for this subclass. Similarly, heating at a first rate and then at a second rate is not considered to be diverse.
- 231** This subclass is indented under subclass 227. Process wherein at least one application of thermal energy is made after bonding has occurred.
- 232** This subclass is indented under subclass 227. Process wherein at least one application of thermal energy is made before bonding has occurred.
- 233.1** **Specific rate of varying pressure or schedule of distinct pressures:**  
This subclass is indented under subclass 101. Process (a) including applying changing force between the meeting faces to effect bonding, expressed in a claim in precise, numerical language with regard to the rate of change; or (b) including applying a first force between the

meeting faces expressed in a claim in precise, numerical language and subsequently applying a second, different force thereto, also expressed in a claim in precise, numerical language.

**233.2 Specific rate of varying temperature or schedule of distinct temperatures:**

This subclass is indented under subclass 101. Process (a) including applying thermal energy to the meeting faces or to the filler, to raise the thermal level (i.e., temperature) thereof, expressed in a claim in precise, numerical language with regard to the rate of change of the temperature or expressed as the rate of applying thermal energy to the work; or (b) including establishing a first temperature to the meeting faces or to the filler expressed in a claim in precise, numerical language and subsequently establishing a second, different temperature thereto, also expressed in a claim in precise, numerical language.

SEE OR SEARCH THIS CLASS, SUBCLASS:

234.1+, for bonding by use of critical temperature or heating when metal fusion bonding; particularly subclasses 235.1+ when combined with application of critical pressure between the meeting faces.

**234.1 Specific mode of heating or applying pressure:**

This subclass is indented under subclass 101. Process wherein a procedure of or an implement for applying thermal energy or force to the meeting faces of the work is set forth in a claim.

- (1) Note. Cooling is considered to be "applying temperature."
- (2) Note. Heating ancillary to welding in a furnace which may be disclosed, but NOT claimed, as electrically heated is included herein.
- (3) Note. Heating by engulfing a work in a liquid or by a "wave" of liquid over a portion of work is included herein.

SEE OR SEARCH CLASS:

219, Electric Heating, for welding using an electrical heating means, particularly subclasses 56+ for wire, rod, or bar bonding; subclasses 76.1+ for deposition welding; subclasses 78.01+ for resistance welding; subclasses 121.13+ for welding using an electron beam; subclasses 121.45+ for plasma welding; subclass 121.63 for welding with a laser; subclass 129 for brazing or soldering using an arc; and subclasses 136+ for welding using an arc.

**234.2 Vapor phase heating:**

This subclass is indented under subclass 234.1. Process including utilizing the latent heat of vaporization of a heat exchange medium to heat the work or filler material.

- (1) Note. Commonly, work to be bonded is placed with filler in a chamber filled with a normally liquid heat exchange medium, some of which is in the gaseous state, to transfer heat to the work and filler material (and liquify some of the medium) without heating the work above the temperature of vaporization of the medium.

SEE OR SEARCH THIS CLASS, SUBCLASS:

234.1, for a similar operation including transfer of heat from a liquid medium to filler.

**234.3 Exothermic reaction heating:**

This subclass is indented under subclass 234.1. Process including utilization of material placed on or about the vicinity of the meeting faces, which material is adapted to burn to supply sufficient heat to effect securing by fusion bonding.

- (1) Note. Included herein is applying pressure by use of a vacuum, by use of a magnet, isostatically, etc.

**235.1 Mode of applying pressure:**

This subclass is indented under subclass 234.1. Process wherein the procedure of or implement for applying force between the meeting faces to effect bonding is expressed in a claim.



- (1) Note. Included herein is applying pressure by vacuum, by magnetic attraction, isostatically, etc.

**235.2 Roll bonding:**

This subclass is indented under subclass 235.1. Process including applying bonding pressure by the action of a roller\*.

- (1) Note. In this subclass as well as elsewhere in this class, deforming a work part by a bonding tool simultaneously with bonding is considered to be incidental to the bonding and is accordingly classified therewith. Therefore, included herein is bonding by use of a roller with simultaneous deforming of the work part(s).

SEE OR SEARCH THIS CLASS, SUBCLASS:

141.1+, particularly subclass 158 indented thereunder for bonding combined with independent rolling to deform a workpiece.

**235.3 At specific temperature level:**

This subclass is indented under subclass 235.2. Process including claimed numerical thermal level.

**244** This subclass is indented under subclass 101. Process in which unfused filler is caused to melt at an area of contact with the meeting faces of the work part(s) and is then progressively advanced toward said meeting faces simultaneously with the fusion of additional quantities of filler.

- (1) Note. The unfused filler usually is in the form of a rod or wire.

SEE OR SEARCH THIS CLASS, SUBCLASS:

56.1+, for preformed solder for fusion bonding.

SEE OR SEARCH CLASS:

75, Specialized Metallurgical Processes, Compositions for Use Therein, Consolidated Metal Powder Composi-

tions, and Loose Metal Particulate Mixtures, subclasses 303+ and subclasses 252+ for a composition of loose metal particles mixed with particles of a nonmetal, which may be a flux.

219, Electric Heating, subclasses 145.1+ and 146.1+ for weld rods, per se, used in either an electric or a nonelectric welding process.

428, Stock Material or Miscellaneous Articles, subclass 588 and 560+ for stock material having as a component metal particles mixed with a flux.

**245** This subclass is indented under subclass 101. Process which includes locating a quantity of unfused filler on or adjacent the meeting faces prior to applying fusing heat to the filler so located.

- (1) Note. The placement of filler may occur either before or after juxtaposing the parts to be joined.

- (2) Note. The solid filler as preplaced frequently is pre-shaped or in the form of a powder to facilitate placement.

- (3) Note. The filler of this subclass may be liquid when located but will solidify prior to bonding.

SEE OR SEARCH CLASS:

403, Joints and Connections, subclasses 265+ for a fastener or connector having a supply of fusible material incorporated therein.

**246** This subclass is indented under subclass 245. Process wherein the filler is a solid, preformed article shaped to fit prescribed work.

**247** This subclass is indented under subclass 246. Process wherein the preformed filler is not limited in length by a trailing end.

**248.1 Applied in powdered or particulate form:**

This subclass is indented under subclass 245. Process wherein the filler is in the form of relatively small metal particles such that the particles can flow into position on the work similarly to a liquid.

- (1) Note. The filler particles of this subclass may be suspended in a paste or liquid.
- SEE OR SEARCH CLASS:  
75, Specialized Metallurgical Processes, Compositions for Use Therein, Consolidated Metal Powder Compositions, and Loose Metal Particulate Mixtures, subclasses 255+ for a composition of loose metal particles.
- 248.5 Nonhomogeneous metal filler particles:**  
This subclass is indented under subclass 248.1. Process wherein the metal particles of the filler are of distinct, different size, shape, or material.
- 249** This subclass is indented under subclass 245. Process wherein the filler is placed in position to be between the meeting faces for securing by fusion bonding.
- 250** This subclass is indented under subclass 249. Process wherein the work parts are generally sheet-like and wherein the meeting faces to be secured by fusion bonding comprise directly abutting marginal edge faces.
- (1) Note. Included herein is the bonding of adjacent plates oppositely bevelled for reception of filler material.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
151, for butt joining the edges of a one-piece blank.
- 251** This subclass is indented under subclass 249. Process wherein the work parts are generally sheet-like and are secured to each other at their margins such that their meeting faces overlap.
- (1) Note. This subclass includes securing the edges of work if there is only slight overlap (e.g., as occurs when the edges of adjacent plates or sheets are bevelled in the same direction), just so a portion of one sheet when considered in cross-section extends beyond a portion of the other sheet.
- 252** This subclass is indented under subclass 249. Process wherein the work parts comprise a pair of superposed sheet-like members of generally the same surface area which are secured together by fusion bonding, one directly on top of the other and wherein the meeting faces comprise virtually all of the upper surface of the first sheet and virtually all of the lower surface of the second sheet.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
190, for a similar operation wherein at least three superposed sheets are simultaneously secured by fusion bonding.
- 253** This subclass is indented under subclass 249. Process including securing filler to at least one of the meeting faces prior to securing by fusion bonding.
- 254** This subclass is indented under subclass 253. Process wherein filler is secured to a meeting face by metallurgical (fusion) bonding or by adhesive bonding.
- 255** This subclass is indented under subclass 253. Process wherein the filler is secured to a meeting face by the structural shape of the work part, the filler part or by separate fastening means.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
135+, for structurally securing work parts together.
- 256** This subclass is indented under subclass 101. Process which includes contacting the meeting faces with molten filler or distributing molten filler to the meeting faces.
- (1) Note. Included herein is soldering, brazing or welding in which contact of fused filler with the meeting faces of the metal parts is effected by scraping, scratching, brushing or other surface exposure with some instrumentality while the surfaces are in contact with the fused filler. Aluminum is soldered or brazed by this process.

- (2) Note. This subclass includes joining parts together while subjecting molten filler to vibration to distribute the filler.
- (3) Note. Included herein is a process in which the meeting faces are moved relatively to one another while there is molten filler between them so to better distribute the filler throughout the joint.
- (4) Note. This subclass includes immersing the assembled meeting faces in a bath of molten filler to effect fusion bonding as well as immersing a single meeting face in a bath of molten filler followed by bringing that face with its still liquid coating of filler to a corresponding meeting face to effect securing by fusion bonding.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
204, for a process using porous or capillary feed material on or between the meeting faces to facilitate distribution of the filler throughout the joint.  
212, for application of a resilient clamping pressure to urge the parts together which, as an incident thereto, causes flow of filler from between the meeting faces as the filler metal fuses.
- SEE OR SEARCH CLASS:  
118, Coating Apparatus, subclasses 100+ for coating means having a solid self-sustaining member physically in contact with the previously applied coating, which member works or otherwise modifies or distributes the coating on the work.  
427, Coating Processes, subclasses 431+ for the process of coating articles by immersion in a molten metal bath.
- 257** This subclass is indented under subclass 256. Process wherein the molten filler is caused to flow by the action of the earth's gravity field thereon.
- 258** This subclass is indented under subclass 256. Process wherein the molten filler is drawn by surface tension through the narrow space between the meeting faces of the work parts.
- 259** This subclass is indented under subclass 256. Process wherein molten filler is distributed to the meeting faces by either (1) plunging the previously assembled faces beneath a generally nonflowing bath of filler or (2) plunging one of the meeting faces beneath such a pool and then assembling that face to the corresponding meeting face prior to solidification of the molten filler coating the first face.
- (1) Note. "Dip soldering", is included in this subclass.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
180.1+, for dip soldering plural joints.
- 260** This subclass is indented under subclass 256. Process wherein the filler is moved by the action of a pump into engagement with the meeting faces of the work part(s) as a solid current either passing unconfined through space or passing along a confined passage.
- (1) Note. "Wave soldering", is included in this subclass.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
180.1+, for simultaneously wave soldering plural joints.
- 261** This subclass is indented under subclass 256. Process wherein the molten filler is pressurized and forced through an orifice to form moving droplets which travel through space and engage the meeting face(s) of the work.
- 262** This subclass is indented under subclass 256. Process wherein travel of the molten filler is promoted by imparting high frequency, short duration, to-and-fro motion thereto.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
110.1, for fusion bonding wherein high frequency energy causes adherence of the meeting faces of work parts to each other or mutually to filler material to effect bonding of the parts.

**262.1 Critical work component, temperature, or pressure:**

This subclass is indented under subclass 101. Process including (a) use of specifically claimed work material, (b) applying force between the meeting faces to effect bonding, claimed expressly in precise, numerical language, or (c) applying thermal energy to the meeting faces or to the filler, claimed expressly in precise, numerical language with regard to the thermal level (temperature) or the rate of applying thermal energy.

- (1) Note. Lead (Pb), zinc (Zn), tin (Sn), chromium (Cr), germanium (Ge), manganese (Mn), as well as material claimed as "metal," are materials included in this and the indented subclasses, in addition to those specifically named in those titles or definitions.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 233.1, for a process of metal fusion bonding including a specific rate of applying pressure or schedule of distinct pressures.
- 233.2, for a process of metal fusion bonding including a specific rate of applying temperature or schedule of distinct temperatures.
- 234.1, for a process of metal fusion bonding including a specific mode of applying temperature or pressure.

**262.2 Nonmetal work component without metallic filler:**

This subclass is indented under subclass 262.1. Process of bonding either a nonmetallic material to another material or a nonmetallic material having a thin metallic coating to another material.

**262.21 Solid state bonding:**

This subclass is indented under subclass 262.2. Process wherein, during the bonding process, the filler material never goes into the vapor or liquid state.

**262.3 Nickel or cobalt member:**

This subclass is indented under subclass 262.1. Process of bonding a work article, the greatest percentage of which is nickel (Ni) or cobalt (Co), to another or like material.

- (1) Note. The work article of this subclass may be considered to be nickel or cobalt "based."
- (2) Note. "Inconel," "Kovar," or "Monel" is considered to be nickel based.

**262.31 Brazing or soldering:**

This subclass is indented under subclass 262.3. Process of bonding with liquid filler material at temperature less than the solidus of the material being bonded by either "brazing" or "soldering."

- (1) Note. If the liquidus of the filler material is less than 840° F (450° C), the operation is "soldering." If the liquidus of the filler material is 840° F (450° C) or more, the operation is "brazing." Actually, in some areas the terms have become somewhat interchangeable.
- (2) Note. An operation described as "brazing" or "soldering" is included in this subclass without limitation to the specific temperature range. An operation described as "welding" is included in this subclass only if the disclosure clearly is within the limits of the subclass definition.

**262.4 Ferrous metal member:**

This subclass is indented under subclass 262.1. Process for bonding a work article, the greatest composition percentage of which is iron (Fe), to another article.

- (1) Note. The work article of this subclass may be considered to be ferrous "based."
- (2) Note. The second article may or may not be ferrous.

**262.41 Steel member:**

This subclass is indented under subclass 262.4. Process wherein composition of the iron (Fe) work article comprises an alloy containing carbon (C), but not more than 1.7% carbon.

- (1) Note. Steel may be comprised of iron and carbon alloyed with any of many other materials.

**262.42 Brazing or soldering:**

This subclass is indented under subclass 262.41. Process of bonding with liquid filler material at temperature less than the solidus of the material being bonded by either “brazing” or “soldering.”

- (1) Note. If the liquidus of the filler material is less than 840° F (450° C), the operation is “soldering.” If the liquidus of the filler material is 840° F (450° C) or more, the operation is “brazing.” Actually, in some areas the terms have become somewhat interchangeable.
- (2) Note. An operation described as “brazing” or “soldering” is included in this subclass without limitation to the specific temperature range. An operation described as “welding” is included in this subclass only if the disclosure clearly is within the limits of the subclass definition.

**262.43 And nonferrous metal member:**

This subclass is indented under subclass 262.42. Process wherein the composition of the other work article is less than half iron (Fe).

**262.44 And nonferrous metal member:**

This subclass is indented under subclass 262.41. Process wherein the composition of the other work article is less than half iron (Fe).

**262.45 Brazing or soldering:**

This subclass is indented under subclass 262.4. Process of bonding with liquid filler material at temperature less than the solidus of the material being bonded by either “brazing” or “soldering.”

- (1) Note. If the liquidus of the filler material is less than 840° F (450° C), the opera-

tion is “soldering.” If the liquidus of the filler material is 840° F (450° C) or more, the operation is “brazing.” Actually, in some areas the terms have become somewhat interchangeable.

- (2) Note. An operation described as “brazing” or “soldering” is included in this subclass without limitation to the specific temperature range. An operation described as “welding” is included in this subclass only if the disclosure clearly is within the limits of the subclass definition.

**262.5 Aluminum or magnesium member:**

This subclass is indented under subclass 262.1. Process of bonding a work article, the greatest percentage of which is aluminum (Al) or magnesium (Mg), to another or like material.

- (1) Note. The work article of this subclass may be considered to be aluminum or magnesium “based.”

**262.51 Brazing or soldering:**

This subclass is indented under subclass 262.5. Process of bonding with liquid filler material at temperature less than the solidus of the material being bonded by either “brazing” or “soldering.”

- (1) Note. If the liquidus of the filler material is less than 840° F (450° C) the operation is “soldering.” If the liquidus of the filler material is 840° F (450° C) or more, the operation is “brazing.” Actually, in some areas the terms have become somewhat interchangeable.
- (2) Note. An operation described as “brazing” or “soldering” is included in this subclass without limitation to the specific temperature range. An operation described as “welding” is included in this subclass only if the disclosure clearly is within the limits of the subclass definition.

**262.6 Copper or noble metal member:**

This subclass is indented under subclass 262.1. Process of bonding a work article, the greatest percentage of which is copper (Cu) or a noble

metal (i.e., a material resistant to oxidation), to another or like material.

- (1) Note. The work article of this subclass may be considered to be copper or noble metal “based.”
- (2) Note. In this art, the term “doping” usually describes diffusion of dopant in a work article. Therefore, in the absence of specific disclosure otherwise, such disclosure will not be considered to be “brazing” or “soldering.”
- (3) Note. Noble metals (precious metals) are considered inactive or stable, and are usually found in elemental form in nature. Gold (Au), silver (Ag), and platinum group metals (i.e., platinum (Pt), ruthenium (Ru), rhodium (Rh), palladium (Pd), osmium (Os), and iridium (Ir)) are considered to be “noble” metals.

#### **262.61 Brazing or soldering:**

This subclass is indented under subclass 262.6. Process of bonding with liquid filler material at temperature less than the solidus of the material being bonded by either “brazing” or “soldering.”

- (1) Note. If the liquidus of the filler material is less than 840° F (450° C), the operation is “soldering.” If the liquidus of the filler material is 840° F (450° C) or more, the operation is “brazing.” Actually, in some areas the terms have become somewhat interchangeable.
- (2) Note. An operation described as “brazing” or “soldering” is included in this subclass without limitation to the specific temperature range. An operation described as “welding” is included in this subclass only if the disclosure clearly is within the limits of the subclass definition.

#### **262.7 Refractory metal member:**

This subclass is indented under subclass 262.1. Process for bonding a work article, the greatest percentage of which is a relatively hard-to-fuse metal, to another or like material.

- (1) Note. The work article of this subclass may be considered to be refractory metal “based.”
- (2) Note. Refractory metals have the highest melting points and the lowest vapor pressures of all metals. Hafnium (Hf), molybdenum (Mo), niobium (Nb) (also known as columbium (Cb)), rhenium (Re), tantalum (Ta), titanium (Ti), tungsten (W), zirconium (Zr), vanadium (V), and base alloys of such are considered to be refractory metals. Other materials may be refractory metals in certain uses.

SEE OR SEARCH THIS CLASS, SUBCLASS:

262.5+, for fusion bonding of aluminum (Al) (which in some ways is similar to a refractory metal); or for fusion bonding of any of a group of (refractory) metals including aluminum.

#### **262.71 Titanium or zirconium member:**

This subclass is indented under subclass 262.7. Process wherein the hard-to-fuse metal is titanium (Ti), zirconium (Zr), or an alloy thereof.

#### **262.72 Brazing or soldering:**

This subclass is indented under subclass 262.71. Process of bonding with liquid filler material at temperature less than the solidus of the material being bonded by either “brazing” or “soldering.”

- (1) Note. If the liquidus of the filler material is less than 840° F (450° C), the operation is “soldering.” If the liquidus of the filler material is 840° F (450° C) or more, the operation is “brazing.” Actually, in some areas the terms have become somewhat interchangeable.
- (2) Note. An operation described as “brazing” or “soldering” is included in this subclass without limitation to the specific temperature range. An operation described as “welding” is included in this subclass only if the disclosure clearly is within the limits of the subclass definition.

**262.8 Brazing or soldering:**

This subclass is indented under subclass 262.7. Process of bonding with liquid filler material at temperature less than the solidus of the material being bonded by either "brazing" or "soldering."

- (1) Note. If the liquidus of the filler material is less than 840° F (450° C), the operation is "soldering." If the liquidus of the filler material is 840° F (450° C) or more, the operation is "brazing." Actually, in some areas the terms have become somewhat interchangeable.
- (2) Note. An operation described as "brazing" or "soldering" is included in this subclass without limitation to the specific temperature range. An operation described as "welding" is included in this subclass only if the disclosure clearly is within the limits of the subclass definition.

**262.9 Brazing or soldering:**

This subclass is indented under subclass 262.1. Process of bonding with liquid filler material at temperature less than the solidus of the material being bonded by either "brazing" or "soldering."

- (1) Note. If the liquidus of the filler material is less than 840° F (450° C), the operation is "soldering." If the liquidus of the filler material is 840° F (450° C) or more, the operation is "brazing." Actually, in some areas the terms have become somewhat interchangeable.
- (2) Note. An operation described as "brazing" or "soldering" is included in this subclass without limitation to the specific temperature range. An operation described as "welding" is included in this subclass only if the disclosure clearly is within the limits of the subclass definition.

**264** This subclass is indented under the class definition. Process for separation of meeting faces of work part(s) which faces were previously bonded together by used metallic filler or were

previously metallurgically bonded directly together.

SEE OR SEARCH THIS CLASS, SUBCLASS:

191, for similar separation of meeting faces combined with metallurgical bonding therebetween.

**265 With concurrent bonding:**

This subclass is indented under subclass 141.1. Process wherein the work is simultaneously metallurgically fused and physically shaped.

## CROSS-REFERENCE ART COLLECTIONS

**901** Art collection of the process for bonding together a plurality of assembled and juxtaposed galvanic cells.

**902** Art collection of the process for bonding by use of flame in direct contact with the work or filler.

SEE OR SEARCH THIS CLASS, SUBCLASS:

218, for protection of work parts or filler by use of a reactive flame.

**903** Art collection of the process for uniting a metal part to a nonmetal work part.

SEE OR SEARCH THIS CLASS, SUBCLASS:

122.1, for bonding a metal and nonmetal by use of metallic intermediate filler.

188, for making of plural metallurgically bonded joints including a nonmetallic base.

SEE OR SEARCH CLASS:

156, Adhesive Bonding and Miscellaneous Chemical Manufacture, for a process of joining utilizing a nonmetallic cement and see the search notes in the definition to subclass 101 of this class.

205, Electrolysis: Processes, Compositions Used Therein, and Methods of Preparing the Compositions, subclass 114 for process of uniting metal parts to nonmetallic parts by means of electro-deposition.

- 419, Powder Metallurgy Processes, subclasses 10+ for process of producing articles in a solid or compact state from particulate material in which some of the particulate material is metal and some is nonmetal.
- 438, Semiconductor Device Manufacturing: Process, particularly subclasses 26+, 51, 55, 64+, and 106+ for methods of packaging a semiconductor device; see the search notes thereunder.
- 445, Electric Lamp or Space Discharge Component or Device Manufacturing, subclasses 24+ for a method of making a display or gas panel, subclass 26 for a method of making a fluorescent lamp, and subclass 27 for a method of making an incandescent lamp.
- 904** Art collection of the process peculiar to the uniting of small, elongated strands.

END