Superalloy Joining Patents

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TITLE	CITATION	ACCESS	ABSTRACT
Shielding Gas Mixture for Welding Superalloys	Hoback, Gregory L., Meyers, James L. United States. Patent 5,083,002 .Shielding Gas Mixture for Welding Superalloys . Kokomo, IN: Haynes International, Inc., January 21, 1992.	Read Patent	This invention discloses a novel shielding gas mixture for use in gas shielded arc welding processes. The shielding gas of this invention may be used in a wide variety of processes when welding various superalloy compositions. In the broad range, the composition contains, in percent by volume, 5 to 12 helium, 0.1 to 0.9 carbon dioxide and the balance argon. The typical composition contains about 10 helium, about 0.25 to 0.55 carbon dioxide and the balance argon plus impurities.
Welding Superalloy Articles	Foster, Michael, Updegrove, Kevin. United States. Patent 6,333,484. Welding Superalloy Articles. Hackensack, NJ: Chromalloy Gas Turbine Corporation, December 25, 2001.	Read Patent	A process is provided for welding a nickel or cobalt based superalloy article to minimize cracking by preheating the entire weld area to a maximum ductility temperature range, maintaining such temperature during welding and solidification of the weld, raising the temperature for stress relief of the superalloy, then cooling at a rate effective to minimize gamma prime precipitation.
Homogeneous Welding via Pre-Heating for High Strength Superalloy Joining and Material Deposition	Rabinovich, Albert, Shubert, Gary, and Ivory, Steven. United States. Application 20050274701.Homogeneous Welding via Pre-Heating for High Strength Superalloy Joining and Material Deposition. Hartford, CT: United Technologies Corporation, December 15, 2005 .	Read Patent	A method of homogeneously welding a superalloy which includes preheating the superalloy prior to welding and allowing it to cool prior to welding. The alloy is then welded, cooled to room temperature and then heated to stress relieve.
Process for Welding Nickel-Based Superalloys	Everett, Mark A. United States. Patent 4,804,815. Process for Welding Nickel-Based Superalloys. Edison, NJ: Quantum Laser Corporation, February 14, 1989.	Read Patent	A process for preventing crack formation in nickel alloy substrates having a gamma-prime phase includes providing a substrate comprised of a nickel alloy having a gamma-prime phase. A portion of the substrate is irradiated with a laser beam and thereby forms a molten pool of the alloy. A supply of coating particles are dispersed within the pool, the particles are comprised of a nickel alloy having gamma-prime forming constitutents. Rapid relative motion between the beam and the pool is effected so that the pool rapidly solidifies and thereby minimizes the formation of gamma-prime therein and adjacent thereto.

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Welding of Gamma'-Strengthened Superalloys	Abdo, Zafir. United States. Application 20060219758. Welding of Gamma'-Strengthened Superalloys. Siemens Westinghouse Power Corporation, March 29, 2005.	Read Patent	A method of welding .gamma.'-strengthened superalloys. The methods improve the weldability of these superalloys by creating areas having lower amounts of .gamma.'-forming elements, resulting in stronger welds. In one method, a vacuum heat treatment is used to create .gamma.'-depleted zones having reduced amounts of .gamma.'-forming elements. A post weld heat treatment may then be used. In another method, a .gamma.-stabilizing element, such as Cr or Ni, is deposited on the area to be welded. Again, a post weld heat treatment may then be used.
Weld Repair of Superalloy Castings	Lulofs, James B. United States. Patent 6,916,387. Weld Repair of Superalloy Castings. Howmet Corporation: Cleveland, OH, July 12, 2005.	Read Patent	A method of repairing a void on a nickel or cobalt base superalloy investment casting by vibrating the casting for a time before repairing the void, vibrating the casting while filling the void wherein the void is filled by repeatedly making incremental weld deposits of a superalloy filler material in the void using pulsed gas tungsten arc welding, and impinging each incremental deposit with a cooling gas after each incremental weld deposit is made and before the next incremental weld deposit is made, and vibrating the casting for a time after the void is filled.
Welding High-Strength Nickel Base Superalloys	Stueber,, Richard J., Milidantri, Thomas, and Tadayon, Moshen. United States. Patent 5,374,319. Welding High-Strength Nickel Base Superalloys. Orangeburg, NY: Chromalloy Gas Turbine Corporation, December 20, 1994.	Read Patent	A process is provided for welding a gamma-prime precipitation-strengthened nickel base superalloy by heating the weld area and adjacent region to a ductile temperature, welding while maintaining the entire weld area and adjacent region at the ductile temperature and holding the weldment, weld area and adjacent region at the ductile temperature until the entire weld has solidified. The ductile temperature is above the aging temperature but below the incipient melting temperature of the superalloy.
Multi-Laser Beam Welding High Strength Superalloys	Hu, Yiping, and Hehmann, William F. United States. Patent 6,972,390. Multi-Laser Beam Welding High Strength Superalloys. Honeywell International, Inc: Morristown, NJ, December 6, 2005 .	Read Patent	A method is provided for repairing degraded and/or eroded areas on gas turbine blades and vanes. The method is directed to turbine blades and vanes made of advanced superalloy materials with high elevated-temperature properties. The method uses multiple laser beams to perform steps of preheating the repair area, welding the repair area, and post-welding heating of the repaired area. The method uses an array of two or more lasers to perform the steps of heating, welding, and post-weld heat treatment in nearly simultaneous operation thereby dramatically reducing or eliminating the hot cracking associated with other welding methods used with superalloy materials. The method is further directed to cladding or material buildup of degraded turbine blades where the weld material is the same as the matrix or better superalloy materials.

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Interactive Laser Welding at Elevated Temperatures of Superalloy Articles	Goodwater, Frank, Huynh; Lang D., Kang, David S., Li; Hon, Lizotte, James M., and Doyle, Brian G. United States. Patent 5,554,837. Interactive Laser Welding at Elevated Temperatures of Superalloy Articles. San Antonio, TX: Chromalloy Gas Turbine Corporation, September 10, 1996.	Read Patent	A process and apparatus is provided for laser welding a nickel and/or cobalt based superalloy article comprising: preheating the entire weld area and adjacent region to a ductile temperature with an induction heat coil and maintaining such temperature during welding and solidification of the weld; and welding the preheated article utilizing a laser with a powder alloy feed with a control means controlling the laser, power feed and motion system on which the article is fixtured, wherein the control means includes a vision system which digitizes the weld area providing a path for the laser welding to follow.
Shimmed Laser Beam Welding Process for Joining Superalloys for Gas Turbine Applications	Nowak, Daniel Anthony, Feng, Ganjiang, and Spiegel, Lyle B. United States. Application 20070017906. Shimmed Laser Beam Welding Process for Joining Superalloys for Gas Turbine Applications. Schenectady, NY: General Electric Company, June 30, 2005.	Read Patent	A method of laser beam welding at least two adjacent superalloy components includes (a) aligning the components along a pair of faying surfaces but without a backing plate; (b) placing a superalloy shim between the faying surfaces; (c) welding the components together using a laser beam causing portions of the superalloy components along the faying surfaces to mix with the superalloy shim; and cooling the components to yield a butt weld between the components.
High Energy Beam Welding of Single-Crystal Superalloys and Assemblies Formed Thereby	Feng, Ganjiang, and Nowak, Daniel Anthony. United States. Patent 6,596,411. High Energy Beam Welding of Single-Crystal Superalloys and Assemblies Formed Thereby. Schenectady, NY: General Electric Company, July 22, 2003 .	Read Patent	A method of welding articles formed of single-crystal superalloys, particularly single-crystal nickel-base superalloys containing 10 weight percent or more of refractory metals, and welded assemblies formed thereby. A shim is positioned between the articles, and a backing strip is preferably positioned to contact both articles and bridge the gap between the articles. The articles are then welded together using a high energy beam with a low current pulse frequency and low travel speed.
Elevated-Temperature, Plasma-Transferred Arc Welding of Nickel-Base Superalloy Articles	Flowers, Gilbert E., Kelly, Jr., Earl L., Grossklaus, Jr., Warren D., Barber, James D., Grubbsm, Gray W., and Williams, Levi . United States. Patent 6,084,196. Elevated-Temperature, Plasma-Transferred Arc Welding of Nickel-Base Superalloy Articles. Cincinnati, OH: General Electric Company , July 4, 2000 .	Read Patent	A nickel-base superalloy article which is susceptible to strain-age cracking and has a directionally oriented, single crystal, or equiaxed grain structure is repaired with minimal welding heat input into the article. The article is first heated to a welding temperature of from about 1650.degree. F. to about 2000.degree. F. in an inert atmosphere. A damaged area of the article is weld repaired using a plasma-transferred arc welder which vaporizes a filler metal in a plasma arc and deposited the vaporized metal onto the article to form a weld overlay. Minimal additional heat is added to the article during welding, as the weldment metal is vaporized remotely from the article.

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Method of Bonding Cast Superalloys	Burke, Michael A., Freyer, Paula D., Hebbar, Mohan A., Seth, Brij B., Swartzbeck, Gary W., and Zagar, Thomas Walter . United States. Patent 6,325,871. Method of Bonding Cast Superalloys. Orlando, FL: Siemens Westinghouse Power Corporation, December 4, 2001 .	Read Patent	A method of bonding cast superalloys is disclosed. The method includes the steps of casting separate superalloy component parts, machining the mating surfaces of the separate parts in a controlled manner to avoid recrystallization of the material and to ensure a tight fit between the parts, bonding the parts together, and thermally treating the bonded component. In a preferred embodiment, the component is a turbine blade for a land-based gas turbine
Method of Diffusion Bonding Superalloy Components	Stueber, Richard J., and Blanche, Brenton L.. United States. Patent 6,464,129. Method of Diffusion Bonding Superalloy Components. Wayne, PA: Triumph Group, Inc., October 15, 2002 .	Read Patent	A method of joining superalloy substrates together comprises diffusion bonding the superalloy substrates by depositing an activator directly on the surface of the joint to be bonded and thereafter subjecting the joint to heat and pressure. The heat and pressure causes the surface of the superalloy, in the presence of the activator, to diffusion bond without the use of a brazing alloy. By eliminating the brazing alloy, a high strength, high temperature bond is achieved, yet there is no molten brazing alloy to be drawn through capillary action into any fine features surrounding the joint being bonded, and there is no residue left at the interface that would diminish the mechanical properties of the joint.
Nickel Base Superalloy Preweld Heat Treatment	Vogt, Russell G., Launsbach, Michael G., and Corrigan, John. United States. Patent 6,120,624. Nickel Base Superalloy Preweld Heat Treatment. Whitehall, MI: Howmet Research Corporation, September 19, 2000.	Read Patent	A preweld heat treatment for precipitation hardenable IN939 nickel base superalloy having a gamma matrix and gamma prime strengthening phase dispersed in the matrix comprises heating the nickel base superalloy at about 2120 degrees F. for a time to solution gamma prime phase followed by slow cooling to below about 1450 degrees F. at a rate of about 1 degree F./minute or less, and cooling to room temperature. The preweld heat treatment eliminates strain age cracking at base metal weld heat-affected zone upon subsequent heat treatment to develop alloy mechanical properties.
Surface Treatment of Oxidizing Materials	Shirzadi, Amir A., and Wallach, Eric R. United States Patent 6,669,534. Surface Treatment of Oxidizing Materials. December 30, 2003.	Read Patent	A method for treating the surface of a material to remove an oxide layer formed thereon. The method comprising the step of grinding the surface of the material with a grinding or polishing device having a metal with a melting point of 300.degree. C. or lower impregnated therein.