

A Tale of Two US Patents **K. Sampath¹**

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Patents provide incentives to invent, invest in, and disclose new technology. By definition, an invention or discovery is something new and clearly distinguishable from prior art, but not a mere extension or a simple variation of prior art. Patents secure for limited times to inventors (or assignees) the exclusive right to their respective discoveries. This exclusive right primarily precludes others from using the invention without an appropriate licensing agreement. An anomalous situation has occurred when the U.S. Patent & Trademark Office (USPTO) awarded two US Patents (5,523,540 and 5,744,782) to two different assignees for essentially the same product: gas metal arc welding (GMAW) electrodes for joining certain high strength steels (such as HY-80, HY-100, HY-130, HSLA-80 and HSLA-100) used in naval hull construction of both surface and stealth vessels. These welding electrodes preclude a need for substantial preheating while also show a higher resistance to hydrogen assisted cracking (HAC) of high strength naval steels following arc welding. This paper examines the technological tale of the above two US patents from the following perspectives: are the cited inventions something new and clearly distinguishable from prior art; how do the respective patent disclosures enable anyone skilled in the art to verify numerous claims cited in the patents, contentious issues and scope for cross-licensing.

Background

Preheating of naval steels (with a specified minimum yield strength ranging from 80 to 130 ksi) while welding is often required to overcome susceptibility to HAC in the weld heat affected zone (HAZ). Prior art shows that this form of cracking occurs especially in high strength steels that have the potential to form high-carbon twinned martensite when the following conditions are simultaneously present: 1) a source of dissolved hydrogen; 2) a susceptible (martensitic) microstructure; 3) high residual tensile stress; 4) a temperature range that does not allow significant solid-state diffusion of hydrogen from the steel; and 5) a time delay following welding that allows hydrogen to accumulate at internal “flaws” in the steel. Preheating, interpass temperature control and post-soaking operations, individually or in combination, essentially reduce the dissolved hydrogen content by allowing the hydrogen to diffuse (“escape”) from the steel while also allowing transformation of the weld metal and more importantly the adjacent HAZ to a less susceptible microstructure that might reduce the peak residual tensile stress as well.

Nevertheless, preheat, interpass temperature control and post-soak temperature control during welding are quite expensive, add to welder discomfort while also reduce the overall welding productivity. It is estimated that elimination or substantial reduction in temperature control during welding could save about \$10M in the construction of an aircraft carrier, and \$15M in the construction of a submarine in material, labor and lost productivity.

In view of these potential cost savings, the U.S. Navy has been very proactive in funding and supporting the development and use of non-martensitic high strength plate steels such as HSLA-80 steels (with a specified minimum yield strength of 80 ksi) and HSLA-100 steels (with a specified minimum yield strength of 100 ksi), and advanced consumable electrodes that eliminate or require substantially less preheat. The HSLA-80 and HSLA-100 steels are characterized by a predominantly ferritic and bainitic microstructure, respectively. These microstructures offer high strength and good low-temperature impact toughness while showing particularly a minimum susceptibility to HAC in the weld HAZ. However, advanced welding consumables that match the good weldability of the HSLA-80 and HSLA-100 steels are not available commercially. Furthermore, when the currently available welding consumables were tested with HSLA-100 steels, the test weldments showed a greater susceptibility to cause cracking in the weld metal.

To this end, the U.S. Navy has identified that the candidate advanced GMA welding consumables for high strength steels should exhibit the following characteristics. Besides no or minimal susceptibility to HAC and a need to eliminate or substantially reduce preheat, the electrodes should show minimal variation in weld mechanical properties (especially yield strength) when they are used to produce weld deposits over a wide range of weld cooling rate representing a broad welding operational envelope in terms of plate thickness, welding position, weld energy input, preheat and interpass and post-soak temperature controls.

Currently, the chemical composition and mechanical property requirements for GMAW electrodes for joining high strength steels (in excess of 80 ksi yield strength) used in naval construction are specified in MIL-E-23765/2E (SH) Electrodes and Rods – Welding, Bare, Solid, or Alloy Cored; and Fluxes, Low Alloy Steel, Apr. 22, 1994. Traditionally welding electrodes for steels are classified on the basis of the minimum transverse tensile strength of the weld deposit, which in turn is dependent on both chemical compositions of the weld deposit and weld cooling rate. One of the unique requirements of high strength steel welding electrodes is the minimum required low-temperature impact toughness level of the weld metal increases with increasing minimum required room-temperature strength level of the weldment.

Commonly, design engineers select welding electrodes to provide weld deposits that typically exceed the tensile strength of the steels being welded. This practice is called overmatching, and is mainly used to “protect” the weld deposit from the presence of fabrication-related weld flaws. These flaws when present and subjected to occasional excessive service loads can potentially lead to catastrophic consequences. However, overmatching of high strength steels often requires the use of preheat, interpass temperature control and post-soak temperature control during welding, which is quite expensive. In these instances, undermatching of base metal strength with a lower strength weld metal is a viable option when the following two conditions are simultaneously met: 1) the undermatched weld metal offers very high toughness, particularly exceptional low-temperature impact toughness especially for US Navy applications; 2) undermatching allows the use of cost-effective fabrication practices.

To this end, the MIL-100S electrodes are commonly used to overmatch HSLA or HY steels with a 80 ksi minimum yield strength, or match/undermatch HSLA or HY steels with a 100 ksi minimum yield strength. Similarly, the MIL-120S electrodes are commonly used to overmatch HSLA or HY steels with a 100 ksi minimum yield strength, or match/undermatch HSLA or HY steels with a 130 ksi minimum yield strength.

US Patent 5,523,540

In June 1996, the USPTO awarded a US Patent 5,523,540, “Welding Electrodes For Producing Low Carbon Bainitic Ferrite Weld Deposits,” to inventors Coldren et al, and assigned the said patent to Alloy Rods Global, Inc. Hanover, Pa. This patent claims welding electrodes useful for GMAW of high-strength steels such as HSLA and HY steels used as hull materials for naval ships, aircraft carriers and submarines. The welding electrodes claimed in the said patent form weld deposits with a low carbon bainitic ferrite microstructure, and yield strength in excess of 80 ksi. Table 1 shows the experimental chemical composition range and the claimed chemical composition range of the Coldren patent, and also compares them with MIL-E-23765/2E chemical composition requirements for MIL-100S and MIL-120S electrodes. It is interesting to note (see Table 1) that the ranges for various elements claimed in US Patent 5,523,540 closely match with the ranges specified for respective elements in MIL-E-23765/2E, except for nickel content.

Table 1: Chemical Composition Ranges Claimed in US Patent 5,523,540

Element	MIL-E-23765/2E Range		US Patent 5,523,540		
			Experimental Range		Range Claimed
	MIL-100S	MIL-120S	Minimum	Maximum	
Carbon	<0.08	<0.1	0.012	0.035	0.01-0.05
Manganese	1.25-1.80	1.40-1.80	0.89	1.69	0.70 - 1.80
Phosphorus			0.008	0.012	
Sulfur			0.003	0.012	
Silicon	0.20-0.55	0.25-0.60	0.27	0.36	0.20 - 0.40
Chromium	<0.3	<0.6	0.01	0.6	<0.80
Nickel	1.40-2.10	2.0-2.80	2.46	5.92	2.0 - 9.0
Molybdenum	1.40-2.10	0.30-0.65	0.44	0.96	0.40 - 1.50
Vanadium			0.004	0.01	<0.01
Niobium			0	0	
Copper	<0.25	<0.25	0	0	<1.0
Titanium	<0.1	<0.1	0.003	0.045	<0.03
Aluminum	<0.1	<0.1	0.001	0.038	<0.035

Critical Examination

Coldren et al based their patent claims on their experiments that evaluated 22 solid wire electrodes and 9 metal-cored wire electrodes and produced as many as 45 weldments. These 45 weldments differed from one another on welding electrode type (solid or metal-

cored), welding electrode composition, weld heat input or weld cooling rate. The electrode chemical composition principally varied carbon, manganese, nickel, chromium, molybdenum, titanium and aluminum. No vanadium was added in the compositions of the welding electrodes thereby indicating that Coldren et al did not conceive vanadium content as an intentional variable. The amounts of silicon, phosphorus and zirconium in the welding electrodes were maintained at some nominal levels. All of the welding experiments were performed on HY-100 plate. The patent does not disclose other welding conditions such as plate size, joint design, or weld shielding gas although the patent disclosures reveal that the weld cooling rates were varied by changing the heat input, plate thickness, preheat temperature and interpass temperature. The patent reports the chemical composition of the resulting weld deposits although it is unclear whether these refer to the undiluted weld metal. The patent also reports that the yield strengths of weld deposits ranged from 88 to 138 ksi. It is unclear whether the reported yield strengths were obtained from either all-weld-metal or transverse-weld tensile testing. In general, because of base metal dilution effects, the 0.2% yield strengths obtained from all-weld-metal tensile specimens are commonly lower compared to 0.2% yield strengths obtained from transverse-weld tensile testing.

Interestingly, several claims (# 1, 19, 32, 33 and 37) in this patent refer to welding electrode comprising "(carbon,) molybdenum and nickel in proportions effective to produce a weld deposit with a low carbon bainitic ferrite microstructure." However, the patent does not disclose this proportion, or mention the need to control this proportion in the abstract, field of invention, description of the invention background, summary of the invention, detailed description of the invention or examples sections of the said patent. A detailed analysis of the reported chemical compositions of either the electrodes or weld deposits did not reveal any such proportion among carbon, nickel and molybdenum. Further, from the information disclosed in the patent, the desirable proportions that resulted in weld deposits with a low carbon bainitic ferrite microstructure, or the undesirable proportions that did not produce weld deposits with a low carbon bainitic ferrite microstructure could not be ascertained. It appears that the inventors perhaps added this requirement in the above claims either as an after-thought or to circumvent prior art in obtaining this patent. If Coldren et al did not conceive this proportion, then their patent claims are not based on novel or innovative idea, and this can be a basis for invalidating this patent or deleting (or substantially reducing the scope of) many of the claims contained therein.

Over-Reach

Further, the USPTO has awarded several claims in this patent that allow a much wider range for nickel and molybdenum contents of the welding electrodes than the experimental range investigated. The basis for such an award could not be ascertained either. The patent also adds copper (up to about 1.0 wt.%) to its set of claims although the experiments do not mention using electrodes containing copper, either as an alloy addition or as an electrode coating. Furthermore, while no vanadium was added in the compositions of the welding electrodes thereby confirming that Coldren et al did not design their experiment to evaluate the effect of vanadium content, it is also unclear why the USPTO allowed claims that restricted the vanadium content of the welding electrodes

between 0 to 0.01 wt.%. The claim limiting the vanadium content up to 0.01 wt.% also appears to “over-reach” in imposing undue restrictions on future innovations as the prior art clearly indicates the ill-effects of vanadium in excess of 0.01 wt.% on the properties of very high strength steels.

Prior Art

The US Patent 5,523,540 offers several general statements but does not invariably reference relevant prior art. For example, the Coldren patent states that “the percentage of martensite formed, and thus the weld metal strength level is very dependent upon the weld metal cooling rate. Faster cooling rates promote martensite formation. Consequently weld metal cooling rates must be carefully controlled so that the amount of martensite formed is fairly constant, because variations in the amount of martensite will result in variations in the strength of the weld metal.” *Inter alia*, this group of statements provides a rational basis for repudiating the US Navy requirement that the electrodes based on martensitic weld metal microstructures could not show minimal variation in weld mechanical properties (especially yield strength) when they are used to produce weld deposits over a wide range of weld cooling rate representing a broad welding operational envelope in terms of plate thickness, welding position, weld energy input, preheat and interpass and post-soak temperature controls. Had the patent disclosures made appropriate references to austenite transformation, critical cooling rate, martensite-start (M_S) and martensite-finish (M_f) temperatures and preheat temperature, such references based on prior art would have provided a context to the many sources that potentially cause variations in the amount of martensite and the resultant variations in mechanical properties. Alternatively, the references to prior art would have also provided a rational context how the disclosures cited in the patent (welding electrodes for producing low carbon bainitic ferrite weld deposits) successfully overcome the limitations of the prior art. It appears that the inventors did not choose such a course as they perhaps felt the citation of the relevant prior art could be counter-productive to their interests.

For example, it is well known in prior art that martensite forms only from austenite. The austenite transforms to martensite between the M_S and M_f temperatures. Both the M_S and M_f temperatures of a steel are dependent on its chemical composition, but not on cooling rate. If one is interested in producing a fairly constant amount of martensite in the weld metal, then one must preclude or control the transformation of austenite to other non-martensitic transformation products such as ferrite, pearlite or bainite. Instead one should control the cooling rate to allow a fairly constant amount of austenite to reach the M_S temperature, and subsequently allow it to transform to martensite between the M_S and M_f temperatures.

As is well-known in prior art, certain alloy additions and use of faster cooling rates (higher than a critical cooling rate) enable one to retain the austenite up to the M_S temperature, and thereby allows the beginning of the austenite to martensite transformation. While austenite continues to transform to martensite between the M_S and M_f temperatures, at the M_f temperature, all the remaining austenite is transformed into martensite. As the austenite-to-martensite transformation is athermal, at any temperature

between the M_S and the M_f temperatures, the percentage of austenite that has transformed to martensite is related to the ratio of the temperature difference between the M_S temperature and the actual temperature and the temperature difference between the M_S and M_f temperatures. If the M_f temperature is below ambient (or preheat) temperature, then at the ambient (or preheat) temperature the remaining (residual) austenite will transform to a microstructure other than martensite, and thereby affect the weld metal strength.

It is conceivable that based on the chemical composition of the weld deposit and actual welding conditions (such as the use of high heat input and high preheat/interpass temperature controls during welding,) one may obtain a somewhat slower weld cooling rate than desirable. This may not allow the untransformed (residual) austenite in the weld deposit to reach the M_f temperature, and instead allow the transformation of the remaining austenite to a microstructure other than martensite. For this reason, weld preheat is always limited to above the ambient temperature but below the M_f temperature of the steel or the weld deposit, whichever is lower. Furthermore, preheating is an effective remedy in driving away hydrogen only when the preheat temperature is maintained below the M_f temperature of the steel or the weld deposit, as (residual) austenite has both a higher solubility and a lower diffusivity for hydrogen.

Based on the above reported prior art and lack of specific new information on the relationships among carbon, molybdenum and nickel that provide the proportions effective to produce a weld deposit with a low carbon bainitic ferrite microstructure, it may be summarized that Coldren et al have disclosed an invention or discovery that is not something new and clearly distinguishable from prior art, but is a merely an extension or a simple variation of prior art. The wide ranges claimed for nickel, molybdenum, copper and vanadium perhaps serve to circumvent limitations arising from prior patents while also placing “undue hardship” on future innovations, thereby undermining the very objectives of patent awards.

US Patent 5,744,782

Almost 2 years later, in April 1998, the USPTO awarded a US Patent 5,744,782, “Advanced Consumable Electrodes For Gas Metal Arc (GMA) Welding of High Strength Low Alloy (HSLA) Steels,” to inventors Sampath et al, and assigned the said patent to Concurrent Technologies Corporation, Johnstown, Pa. The U.S. Government has a paid-up license in this invention as the underlying work was performed for the U.S. Navy Manufacturing Technology program. This patent relates to the invention of solid, bare, consumable wire electrodes for GMA welding of HSLA steels used as hull materials for naval ships, aircraft carriers and submarines.

Coincidentally, like the Coldren patent, the purpose of Sampath patent is also to produce low-carbon bainitic ferrite weld deposits that are insensitive to HAC and show minimal variations in weld mechanical properties (especially yield strength) to wide variations in the welding operational envelope. The welding electrodes provided in the said patent eliminate or reduce the need for preheat controls while meeting the mechanical property requirements of the existing MIL-100S and MIL-120S GMA welding electrodes, when

welded over a broad range of weld energy inputs and weld cooling rates. Table 2 compares the MIL-E-23765/2E chemical composition requirements for MIL-100S and MIL-120S electrodes with the experimental chemical composition range and claimed chemical composition range of the Sampath patent. It is interesting to note (see Table 2) that the ranges for various elements claimed in US Patent 5,744,782 closely match with the ranges for respective elements evaluated in the supporting experiment, and the ranges specified for respective elements in MIL-E-23765/2E, with additional restrictions on oxygen, nitrogen and hydrogen contents.

Table 2: Chemical Composition Ranges Claimed in US Patent 5,744,782

Element	MIL-E-23765/2E Range		US Patent 5,744,782		
			Experimental Range		Range Claimed
	MIL 100S	MIL 120S	Minimum	Maximum	
Carbon	<0.08	<0.1	0.026	0.030	<0.06
Manganese	1.25-1.80	1.40-1.80	1.49	1.82	1-2
Phosphorus			0.001	0.001	<0.01
Sulfur			0.0018	0.023	<0.01
Silicon	0.20-0.55	0.25-0.60	0.33	0.37	0.2-0.5
Chromium	<0.3	<0.6	0.01	0.02	
Nickel	1.40-2.10	2.0-2.80	2.38	3.78	2-4
Molybdenum	1.40-2.10	0.30-0.65	0.51	0.99	0.3-1
Vanadium			0.001	0.003	
Niobium			0	0	
Copper	<0.25	<0.25	0.001	0.20	<0.5
Titanium	<0.1	<0.1	0.0025	0.0033	<0.05
Aluminum	<0.1	<0.1			
Boron			0.0003	0.0057	<0.01
Oxygen			47	82	300 ppm
Nitrogen			4	10	50 ppm
Hydrogen			1.15	2.35	5 mL/100gm

Innovation

The US Patent 5,744,782 provides novel and innovative welding products based on a metallurgical model that integrates the U.S. Navy requirements with several constitutive equations related to carbon equivalent number (CEN), 50% bainite (B_{50}) transformation temperature and M_S and M_f temperatures. The metallurgical model itself underscores the relationships among chemical composition, processing, microstructure and mechanical properties. The invention uses the following metallurgical criteria for the weld metal to formulate the chemical composition range of the solid wire electrodes:

- 1) a calculated CEN ranging from 0.28 to 0.41;
- 2) a calculated B_{50} temperature ranging from about 400°C to 500°C;
- 3) a calculated M_S temperature less than the calculated B_{50} temperature; and

- 4) a combined oxygen and nitrogen content preferably below 550 ppm.

Although the above constitutive equations are well known in prior art, their concurrent use in designing electrode chemical compositions that meet or exceed U.S. Navy weld metal performance requirements is quite innovative. The metallurgical model initially consolidated the existing knowledge on high strength steel welding electrodes. This knowledge came from prior art performed at several U.S. Navy laboratories, national laboratories, commercial enterprises including shipyards and universities. Following this, the metallurgical model explained the various shortcomings of the prior art, and provided a rational basis that allowed anyone skilled in the art to reach beyond existing knowledge in specifying the chemical composition range of new high performance welding electrodes.

Full Disclosure

The electrode chemical composition claimed in the US Patent 5,744,782 is comprised of iron, and specific amounts (in percent by weight) of carbon, manganese, nickel, chromium, molybdenum, silicon, copper, vanadium, niobium, and boron that concurrently satisfy the following three equations:

$$B_{50} (\text{°C}) = 770 - (270 \times C) - (90 \times \text{Mn}) - (37 \times \text{Ni}) - (70 \times \text{Cr}) - (83 \times \text{Mo}) \dots\dots\dots (1)$$

where the calculated value of B_{50} is 400°C to 500°C

$$M_s (\text{°C}) = 561 - (474 \times C) - (33 \times \text{Mn}) - (17 \times \text{Ni}) - (17 \times \text{Cr}) - (21 \times \text{Mo}) \dots\dots\dots (2)$$

where the calculated value of M_s is 400°C to 450°C;

$$\text{CEN} = C + A(C) \times \{ \text{Si}/24 + \text{Mn}/6 + \text{Cu}/15 + \text{Ni}/20 + (\text{Cr} + \text{Mo} + \text{V} + \text{Nb})/5 + 5\text{B} \} \dots\dots\dots (3)$$

where $A(C) = 0.75 + 0.25 \tanh [20 \times (C - 0.12)]$,

where the calculated value of CEN is 0.28 to 0.41.

The first equation relates the chemical composition to the B_{50} temperature, i.e., the temperature at which 50% bainite transformation occurs. The second equation relates the chemical composition to the M_s temperature, i.e., the temperature at which martensite transformation starts. Based on mechanical property requirements, the desired ranges for B_{50} and M_s temperatures are approximately 400°C to 500°C, and 400°C to 450°C respectively. The third equation relates the chemical composition to CEN, which is often used to distinguish various high strength structural steel grades that may require preheating during weld fabrication. The desired value for CEN of structural steels ranges from 0.28 to 0.41. This range is considered useful for eliminating or substantially reducing the need for preheat and interpass temperature controls.

The above metallurgical criteria for weld metal chemical composition are met through a judicious selection of the chemical composition of the solid wire electrodes, while the gas

content of the deposited weld metal is controlled initially through producing wire electrodes from vacuum arc melted heats and subsequently through the application of suitable welding conditions.

The above metallurgical characteristics and their numerical ranges, in turn, were used to identify carbon, manganese, nickel and molybdenum as critical elements for achieving compositional control, and to specify appropriate compositional ranges for these individual alloy elements. Furthermore, the use of the metallurgical model implies that within the numerical ranges suggested for manganese, nickel and molybdenum, these elements could substitute one another to varying extent. This feature offers a strategic intent to assess the global availability of raw materials and to achieve cost control.

Enablement

Sampath et al based the patent claims on their experiments that evaluated 10 solid wire electrodes and produced as many as 30 weldments. These 30 weldments differed from one another on welding electrode composition, weld heat input or weld cooling rate. The electrode chemical composition principally varied manganese, nickel, molybdenum, copper, and boron while maintaining other alloy additions such as carbon, titanium, aluminum, vanadium, silicon, sulfur and phosphorus at some nominal levels.

All of the welding experiments were performed on 1-inch thick HSLA-100 plate. The patent has disclosed all relevant welding conditions including joint design, shielding gas type and gas flow rate, voltage, current, travel speed, wire feed rate, energy input, preheat and interpass temperatures and the measured weld cooling rates. The patent has also reported the chemical composition of the resulting undiluted weld metal and the tensile properties of all-weld-metal and Charpy V-notch (CVN) impact toughness as required by the MIL-E-23765/2E specification. This type of full disclosure basically enables a person skilled in the art to perform these experiments, and thus verify the patented claims. Furthermore, the chemical composition ranges awarded in the patented claims closely envelope the experimental ranges reported for both the welding electrodes and the weld deposits obtained therefrom.

A Business Dilemma

A close comparison of the Coldren and Sampath Patents indicates that both these patents pertain to the same end market: U.S. Navy construction of ships, aircraft carriers and submarines which use HY-80, HY-100, HSLA-80, HSLA-100 and HY-130 steels. Furthermore, as shown in Table 3, there is extensive overlap in the allowed chemical composition ranges of various claims in these two patents. In such a case, why did the USPTO award the Patent 5,744,782 especially when it has already awarded the Patent 5,523,540? Further, how does the issue of these two patents by the USPTO foster innovation and competition in the marketplace? Furthermore, does the US Patent 5,523,540 carry an inherent advantage as it was issued prior to the US Patent 5,744,782? Does the USPTO have a re-course to rescind either one or both of these two US Patents? Under these circumstances, how does a business potentially interested in this end market decide to use either one of these two patents for the manufacturing and marketing of

these advanced welding electrodes? Also, how does one resolve the business dilemma related to the technological tale of these two patents?

Table 3: A Comparison of Allowed Chemical Composition Ranges in US Patent 5,523,540 and US Patent 5,744,782

Element	MIL-E-23765/2E Range		US Patent 5,523,540 Range Claimed	US Patent 5, 744,782 Range Claimed
	MIL-100S	MIL-120S		
Carbon	<0.08	<0.1	0.01-0.05	<0.06
Manganese	1.25-1.80	1.40-1.80	0.70 - 1.80	1-2
Silicon	0.20-0.55	0.25-0.60	0.20 - 0.40	0.2-0.5
Chromium	<0.3	<0.6	<0.80	
Nickel	1.40-2.10	2.0-2.80	2.0 - 9.0	2-4
Molybdenum	1.40-2.10	0.30-0.65	0.40 - 1.50	0.3-1
Vanadium			<0.01	
Copper	<0.25	<0.25	<1.0	<0.5
Titanium	<0.1	<0.1	<0.03	<0.05

Four Alternatives

Because of the extensive overlap in the allowed chemical composition ranges of various claims in the two patents, the question of infringement mostly doesn't arise, and therefore "cease and desist" is not an option to enforce the rights of one patent on the other.

Clearly, as the U.S. Government has a paid-up license in the US Patent 5,744,782 with the end market clearly focused on U.S. Navy construction, it is conceivable that there would not be much of an incentive for an electrode manufacturer potentially interested in commercializing the Patent 5,744,782 to use it following appropriate licensing. This could be surmised from the fact that Concurrent Technologies Corporation, Johnstown, Pa, the assignee to the Sampath patent has offered to license its technology since May 1998, but till to date has not received any substantial interest. It is likely that based on their experience to date, Concurrent Technologies Corporation may decide not to maintain the Sampath patent beyond October 2005. Such a decision may indirectly assist Alloy Rods Global, Inc. Hanover, Pa, the assignee to the Coldren patent, even though they are yet to offer commercial products based on the Coldren patent awarded in June 1996.

It appears that four alternatives are potentially available to resolve the business dilemma arising from the award of two US Patents to two different assignees for essentially the same product. Firstly, either of the two patent assignees (for that matter anyone interested in pursuing) could approach the USPTO through registered patent attorneys, and request a re-examination of either one or both of these two patents. The USPTO recognizes only certain grounds for re-examination that include either prior art or enablement. Based on reasons cited earlier, it is conceivable that the Coldren patent may

be held invalid, or many of the claims contained therein may be disallowed or their scope severely limited.

Secondly, either of the two patent assignees could approach the US court system, cite interference and request to establish precedence. Essentially, precedence is established based on the timeline of the invention with specific emphasis on the new and clearly distinguishable from prior art themes of the invention. Besides being an intensive, time-consuming and expensive route, this could also raise several additional technical issues. For example, the Coldren patent used only HY-100 steel in its evaluation perhaps as the HY-100 steel was more readily available than the HSLA-100 steel used for evaluation in the Sampath patent. In the case of Sampath patent, the logistics of procuring the HSLA-100 steel plate and performing the experiments to verify that the U.S. Navy performance requirements are met led to extending the time for patent application. The Sampath patent assignee might also argue that although the currently available MIL-100S and MIL-120S electrodes do very well with the HY-100 steel, but the U.S. Navy primarily funded this development as the currently available MIL-100S and MIL-120S electrodes did not do well with the HSLA-100 steel. As the Coldren patent disclosures did not show that their electrodes provide the same performance characteristics with HSLA-100 steel as well as with HY-100 steel, the appropriate US Court could potentially decide to limit the application of the Coldren patent to just HY type steels. Such a decision, although might appear ill-conceived, could certainly affect electrode marketing if not electrode manufacturing. In fact, an artificial limitation of the economies of scale issues related to the manufacturing of these electrodes to independently cater to either of these two steel types could also emerge as a factor against such a possible decision.

Thirdly, the competitive market forces could be allowed to prevail if there is sufficient interest among electrode manufacturers to risk their business prospects with either patent. This route, may be a non-starter as it requires that the above two alternatives are at least temporarily abandoned.

Fourth and last, the two assignees could perhaps agree to work together and cross-license each other's invention in the interests of the U.S. Navy and the nation at large!

Summary

The USPTO has issued two different patents to two different assignees for essentially the same product - GMAW electrodes for joining high strength steels used in naval hull construction. This paper examines the technological tale of these two US Patents from the following perspectives: are the cited inventions something new and clearly distinguishable from prior art but not a mere extension or a simple variation of prior art; how do the disclosures enable anyone skilled in the art to verify numerous claims cited in the patents, contentious issues and scope for cross-licensing.