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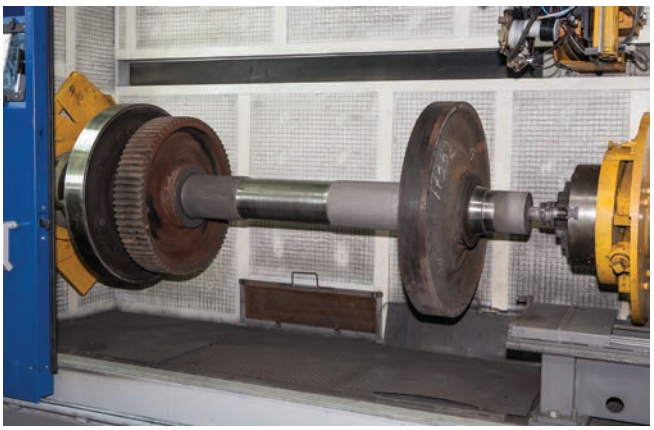
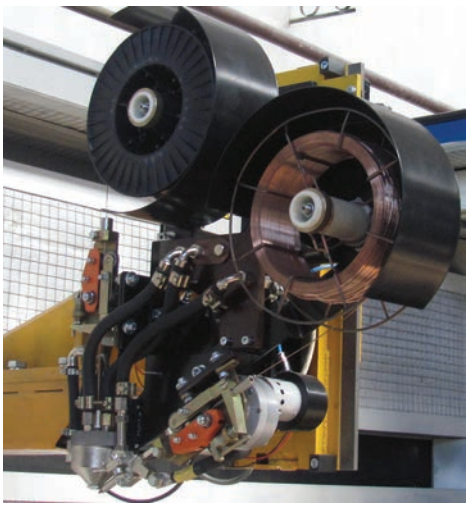
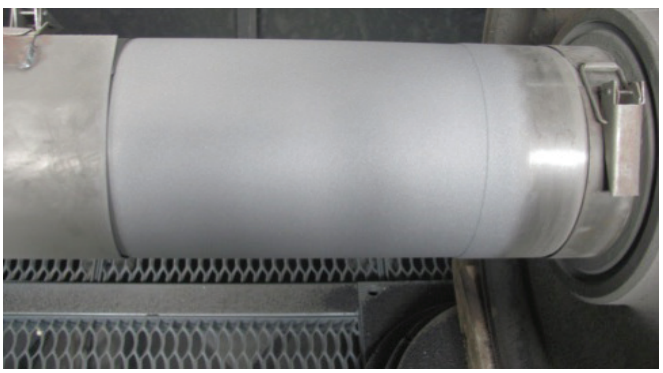
UNIT FOR HIGH-VELOCITY ELECTRIC ARC SPRAYING

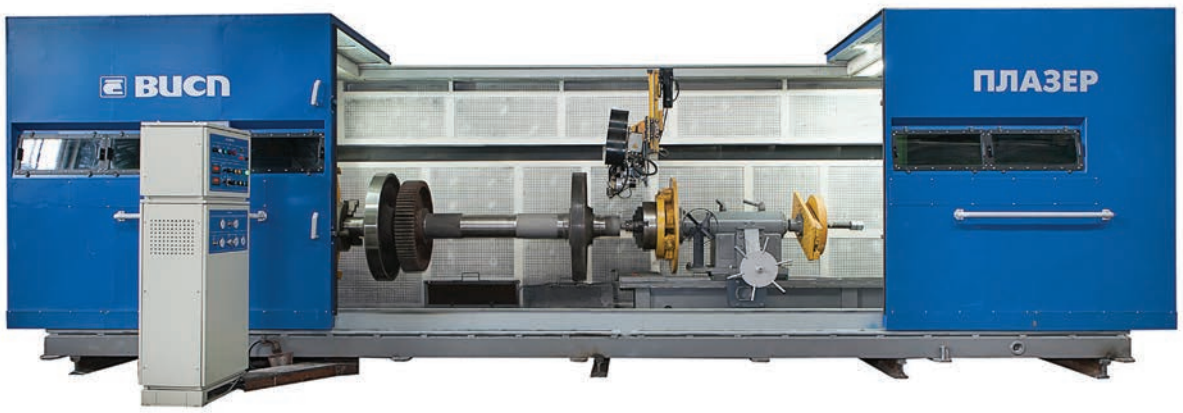
> The unit is designed for deposition of wear, corrosion resistant and special coatings, repair of worn machine parts by means of double-wire electric arc spraying in high-velocity flow of hot combustion products of hydrocarbon gas with air of current-conducting materials in form of wire (flux-cored wire) of 1.6–2.2 mm diameter. Joint development of PWI and «PLAZER» Company.





Block of high-velocity electric arc metallizer





Appearance of restored part and unit in the framework of semi-automatic line

Developed by PWI

INDUCTION HIGH-FREQUENCY UNIT
FOR REMELTING OF REFRACTORY POWDER MATERIALS

One of the perspective directions of HF-plasma application is remelting of powder materials. A source of HF-discharge is a high-frequency generator, which induces a powerful electromagnetic high-frequency field in the inductor. The inductor contains a plasmatron forming a set mode for plasma forming gas escape at 7000–10000 °C temperature.

One of the directions of HF-plasma application is remelting of powder materials with further deposition of molten particles on a substrate; the second one is remelting and balling of powder materials. High melting efficiency of oxide materials allows wide application of developed equipment in additive technologies.

> Technology of plasma treatment of powder materials using HF-plasma allows receiving the spherical particles independent on shape of raw material. Application of special design reactor allows treatment of powder of chemically active metals and alloys in plasma with their further usage for additive technologies.

Developed by PWI

LASER TECHNOLOGY AND EQUIPMENT FOR

MANUFACTURE OF MULTILAYER BELLOWS

PWI has developed the technology and equipment for laser welding of thin-wall pipes of stainless steel for manufacture of multilayer bellows, which carry and divide liquid and gaseous media, including aggressive ones.

Following the developed technology the bellow consists of several laser-welded thin-wall pipes (from 3 to 10 layers) of 0.15–0.20 mm thickness each. The bellow will keep working capacity in such a multi-layer bellow structure, even if one welded joint breaks in process of operation.

Development advantages:

- reduced amount of rejects from 50 % in argon-arc welding to 0.5 % in laser welding
- 4 times rise of productivity
- cyclic strength, corrosion resistance and other characteristics of laser-welded multilayer bellow 1.5–4 times exceed the characteristics of single layer bellow made by argon-arc welding (depending on number of layers and bellow sizes).

Developed by PWI

WELDING OF TITANIUM

AND ITS ALLOYS

A team of experts in the field of welding of titanium and alloys on its basis has been working at PWI for more that 30 years. For the first time in the world the unique technologies of non-consumable argon-arc welding of titanium with halogenide fluxes; narrow-gap argon-arc tungsten electrode welding with controlling magnetic field; press welding of titanium with copper and aluminum with steel were developed in course of these years.

The technologies for titanium and its alloys welding developed at the PWI have found wide application in aircraft- and rocket construction as well as at enterprises of chemical machine building of CIS countries. Currently, PWI fulfills contract-based complex works on development of technology and equipment for titanium welding and engineering maintenance at manufacture of specific products.

Developed by PWI

MICROPLASMA SPRAYING
OF BIOCOMPATIBLE COATINGS ON IMPLANTS

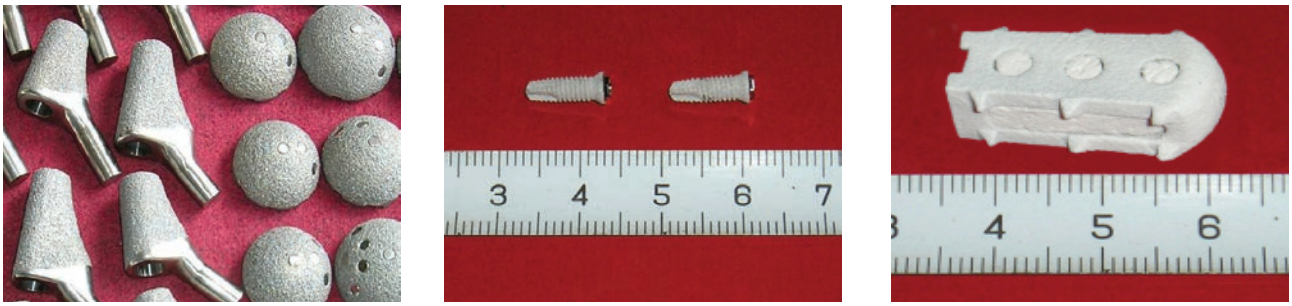
PWI has developed a technology and equipment of microplasma spraying of biocompatible coatings on the surface of different implants, including hip implants, dental implants, intervertebral cages etc.

Unit for microplasma spraying MPN-004 with powder batchbox

This technology allows depositing coatings from hydroxyapatite powder (HA), titanium cellular coatings as well as double-layer biocermet (titanium-hydroxyapatite) coatings. Spraying of biocompatible coatings is done on microplasma spraying unit MPN-004. PLASMATRON FOR SPRAYING OF COATINGS Pub. No.:WO/2004/010747, International Application No.: PCT/UA2003/000014, Publication date: 29.01.2004. (IRP4).

Spraying of Ti-layer with regulated porosity (5–30 %, pore size 50–300 μm) and minimum oxidation level is carried out by means of microplasma spraying of Ti-wire. Combination of cellular Ti-coating with external HA layer provides coating cohesion strength with implant surface satisfying ISO 137779-2 and high level of biocompatibility.

> Based on complete complex of mechanical and biomedical tests the implants with microplasma biomedical coatings are used in practice for hip replacement.



a *b* *c*

Products with biocompatible coatings made by microplasma spraying: *a* — parts of hip implant; *b* — cermet implant for interbody spinal fusion; *c* — dental implant

Developed by PWI

Calendar of July *

JULY 1, 2000 Entered into force Rules for classification and construction (Materials and Welding). These Rules apply to all welding work performed in the course of new construction, conversion or repairs carried out on ships and their machinery installations, including steam boilers, pressure vessels and pipelines, for which an application for classification has been submitted to Germanischer Lloyd.

JULY 2, 1929 American inventor and businessman Edward Budd (1870–1946) received a patent on the technology of welding in the automotive industry. Edward Budd was a pioneer in the mass production of all-metal car bodies and founded his own company «Edward Budd Manufacturing Company». Preferring the frame metal structures, Edward Budd proceeded not only from the fact that they are stronger than wood ones and also more manufacturable. Edward Budd was the first who applied spot welding in the automotive industry.

JULY 3, 1960 At the beginning of July 1960, T.M. Slutskaya (1907–1987), a representative of the Paton School, developed for the first time the self-shielding activated electrode materials for arc welding. She developed the basis of alloying wires with rare earth and rare metals, due to which nitrogen was bound into refractory nitrides.

JULY 4, 1981 The largest Soviet nuclear-powered submarine in the world, a heavy strategic-purpose missile cruiser submarine of the Project 941 «Akula» with a length of more than 170 m was put into tests. Its pressure hulls were welded from sections (shells) of cylindrical, conical and elliptical shape with a wall thickness of 75 mm. A similar submarine at the same time was created in the United States and, later on was named «Ohio».

JULY 5, 1931 Date of death of Oscar Chelberg (1870–1931), a Swedish inventor and industrialist, founder of the company ESAB in 1904. Oscar Chelberg invented the electrode coating used for manual arc welding by immersion of a bare steel wire into the mixture of carbonates and silicates. The purpose of the coating is to protect the molten metal from the effect of oxygen and nitrogen, present in the atmosphere. His pioneering developments laid the foundation for beginning the investigations on the development of reliable welding electrodes. Today, ESAB produces welding materials, equipment for welding and cutting of metal for practically all the branches of industry.

JULY 6, 1935 The construction of the German heavy cruiser «Admiral Hipper» was started. After signing the Treaty of Versailles, Germany was restricted in the construction of large-capacity ships. In order to officially comply with the restrictions to weight, several radical innovations were included in the design of this type of a ship. Designers were the first to use welding in large military ships instead of riveting. Because of their heavy armament of eight 203 mm guns and small sizes, the British began referring to such vessels as «pocket battleships». The hull of the ship was built of transverse steel frames; more than 90 % of the structure was joined using welding, which reduced the total mass of the hull by 15 %.

JULY 7, 1962 The absolute speed record of 2681 km/h was set in the experimental all-weather interceptor E-166 of the Design Bureau «MiG». This flight was performed by the test pilot G.K. Mosolov. Unlike the Americans, who chose a titanium alloy as the basic material of their reconnaissance aircraft, the «Experimental Design Bureau named after A.I. Mikoyan» chose different grades of steels. Its application allowed refusing from riveted structures in favour of welded ones. This, in turn, required the creation of new technological cycles, taking into account the use of different welding methods during a large-panel assembly. The experimental operation of the E-166 aircraft allowed gaining an important flight experience at high supersonic speeds.

JULY 8, 1761 Date of birth of V.V. Petrov (1761–1834), a Russian physicist- experimenter, self-taught electrical engineer, academician of the St. Petersburg Academy of Sciences. One of the outstanding achievements of the scientist was the discovery of the phenomenon of an electric arc in 1802 and evidence of the possibility of its practical application for the purpose of melting, welding metals and their reduction from ores and for lighting. In 1802, he designed a large galvanic battery consisting of 2100 copper-zinc cells with an electromotive force of about 1700 V.

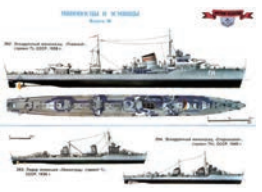
*The material was prepared by the Steel Work Company (Krivoy Rog, Ukraine) with the participation of the editorial board of the Journal.

JULY 9, 2014 The first launch of the rocket-carrier of «Angara» family from the «Plesetsk» Cosmodrome was performed. The rocket is capable of delivering 35 tons of cargo into orbit. The requirements of strength and tightness of welds of the fuel tanks were the most fully satisfied by argon-arc welding. During the construction of the «Angara» rocket -carrier, it is supposed to gradually introduce friction stir welding for application. The «Angara» rocket-carrier replaces the outdated model «Proton-M».

JULY 10, 1905 During dispersal of the workers meeting, L.I. Borchaninov (1837–1905) was killed. He was a worker at the Motovilikh plants, one of the first welders in Russia. He was working under the supervision of N.G. Slavyanov, an inventor of arc welding of metals. Together with the worker P. Aspidov, he accompanied Slavyanov to the Fourth Electrical Exhibition in St. Petersburg, where they equipped a temporary workshop and demonstrated the process of restoring metallic parts using electric welding. He participated in the building of the largest in Russia and Europe tugboat «Kasogs Prince Rededya», where welding was used instead of riveting for the first time in the history of shipbuilding.

JULY 11, 1979 «Skylab», the first and only American space station, leaved the orbit, completing its work. During the flight, experiments were carried out on evaluation of the effect of zero gravity on the quality of welded joints produced by electron beam welding. The «Skylab» station was equipped with a complex which included multi-purpose electric furnaces and an electron beam installation. The experiments were conducted on the investigation of molten metal, photographing the behaviour of calcined materials in zero gravity, studying the crystal growth, treatment of immiscible alloys and brazing of stainless steel.

JULY 12, 1929 The first in the history of aviation the flight of the German giant flying boat «Dornier Do-X» took place. The aircraft was designed for service at the long-distance passenger airlines. On October 20, 1929, during a 40-minute demonstration flight, this plane took off from the Lake Constance with 169 passengers on board. This record remained unsurpassed in the first half of the XX century. Due to the low flight characteristics, the aircraft did not come to the series production but only made several demonstration flights to Africa, North and South America in 1930–1932. In order to reduce weight, welding was applied for joining aluminum parts.



JULY 13, 1936 The destroyer of the project 7 «Gnevny» was launched. It was the main ship of the so-called Stalinist series, built for the Soviet Navy in the second half of the 1930s, one of the most popular types of destroyers in the history of the Soviet fleet. The thickness of the hull lining was 5–9 mm, the deck flooring was 3–10 mm, and the watertight bulkheads were only 3–4 mm. The structures were mainly riveted, but the electric welding was used for the assembly of bulkheads, platforms under the lower deck and a number of other elements.

JULY 14, 1969 An inhabited underwater apparatus designed to study the middle depths of the Gulf Stream (up to 1000 m), the Ben Franklin mesoscaphe, was submerged into the water. It was designed by Jacques Picard. A special attention was paid to welds. Numerous tests and examinations were carried out before it was allowed to use the apparatus. For welding, electrodes, alloyed with manganese and molybdenum, were used.

JULY 15, 2010 In the summer of 2010, the book «Paton School» was prepared for publication. It presents information about the world-famous Paton's scientific and engineering school in the field of welding and related technologies, which was organized by academician E.O. Paton, an outstanding scientist, and further developed by academician B.E. Paton, a worthy successor of his activities. In the book the formation and development of this school is highlighted and information about its famous representatives is given.

JULY 16, 1961 By decree of the Presidium of the Supreme Soviet of the USSR for great successes in the development of the rocket industry, science and technology, successful performance of the first flight of a Soviet man in space in the «Vostok» spacecraft-satellite, M.K. Yangel was re-awarded the title Hero of Socialist Labour.

JULY 17, 1964 By resolution of the Council of Ministers of the Ukr.SSR of 12.06.1964 No. 59.5 and resolution of the Presidium of the Academy of Sciences of the Ukr.SSR of July 17, 1964 No. 188 the E.O. Paton Prize of the National Academy of Sciences of Ukraine was established for outstanding scientific works in the field of developing the new metallic materials and methods for their treatment. This is one of the few examples where the award is named after a welder-scientist.

JULY 18, 1955 At Disneyland an amusement facility: a model of a space rocket called Moonliner, was opened. Since 1955 to 1962 Moonliner was located in the first futuristic exhibition. It was also an example of a new approach to modern advertising media. In order to build a 27-meter aluminum rocket the welding in inert gases was used. It is interesting that with the development of rocket construction, the same welding methods were used in the production of real space rockets. The construction of such a facility caused a wide resonance with the public already before the launch of the first satellite of Earth.

JULY 19, 1900 The opening of the Paris Metro took place. The opening was dated for the beginning of the 1900 World's Fair. The Paris Metro is one of the oldest metros in Europe (the fourth after the London, Budapest and Metro in Glasgow). The unsurpassed capabilities of thermit welding at that time were demonstrated visually during laying the tracks of the Paris Metro.

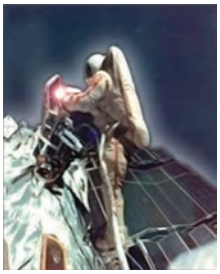
JULY 20, 1966 The crew commander Neil Armstrong and the pilot Edwin Aldrin of the American spacecraft «Apollo-11» landed a lunar module on the Moon. The accomplishment of this project could not be achieved without the use of modern welding technologies.

JULY 21, 2007 The skyscraper «Burj Khalifa» of 829.8 m height was officially recognized as the tallest building in the world during construction. The solemn opening ceremony took place on January 4, 2010 in Dubai, the largest city of the United Arab Emirates. During its construction the welding technologies were especially in demand. They were applied starting from the foundation and ending at the highest point, where everything was fastened either with bolts or electric arc welding. It is one of the records and demonstrates how large structures can be created by welding. The spire of «Burj Khalifa» is a complex steel structure with many columns and welded beams.

JULY 22, 1872 Date of birth of V.F. Mitkevich (1872–1951), an outstanding Russian and Soviet electrical engineer, academician of the Academy of Sciences of the USSR. In 1901, he proposed circuits of a single-phase full-wave rectifier (full-wave with two windings) for converting an alternating current into a direct current and a three-phase one-half-wave rectifier (half-wave with zero output). V.F. Mitkevich was the first in the world to propose a three-phase arc for welding metals.

JULY 23, 1995 Date of death of N.A. Langer (1910–1995), a chemical scientist-analyst, representative of the Paton school. He made a significant contribution to the development of methods for protection of welded joints against corrosion. He proposed original electrochemical methods for studying the corrosion resistance of welded joints. They allow predicting the stability of joints during operation in the environments with a high corrosion activity. Langer investigated the conditions for the occurrence of particularly threatening corrosion of welded joints, the so-called crevice corrosion, and also identified methods for its elimination. The results of a number of works have found application in industry.

JULY 24, 1967 In St. Louis the Arch was opened, also known as a Gateway to the West. It is a memorial, which is the hallmark of St. Louis. Its height is 192 m at the highest point and the width of its base is also 192 m. The arch is the highest monument at the territory of the United States. Builders, together with the company «Lincoln Electric», successfully manufactured and joined 142 parts of one of the most complex building structures in the US history. During its construction the manual arc welding, semi-automatic gas-shielded welding and submerged-arc welding were used.



JULY 25, 1984 In open space outside the board of the orbital station «Salyut-7», experiments in electron beam welding were carried out using a welding device URI (a versatile hand tool) designed at the E.O. Paton Electric Welding Institute. This device allowed welding, cutting, brazing metal and depositing coatings. The cosmonauts V. Dzhanibekov and S. Savitskaya went into outer space to perform welding technological works. For three and a half hours, the cosmonauts conducted the entire complex of planned experiments.

JULY 26, 1845 The ship «United Kingdom» with an all-metal hull started its first voyage across the Atlantic. The vessel was distinguished by its enormous sizes: its length was almost 100 m. In the «United Kingdom» for the first time, a screw propeller was used instead of paddle-wheels. That was a real event in shipbuilding. When creating a huge crankshaft for the ship, a new modernized «welding hammer» was used, invented by Joseph Stenster.

JULY 27, 1942 The American interceptor «Mustang NA-73X» took the first air battle. The need in accelerated production of military machinery forced the use of welding even wider. It was estimated that during the transition to welding in an aircraft weighing 4 tons, where it was usually necessary to apply up to 100,000 rivets of 112.5 mg each, a weight reduction of about 10 % is achieved. At the same time, aerodynamics, tightness and corrosion resistance are improved, and the time for manufacturing the whole structure is shortened by 60 %.

JULY 28, 1883 Date of birth of V.P. Vologdin (1883–1950), a Soviet scientist and engineer, a pioneer in the use of electric welding in ship building. He designed and built the first all-welded ship in the USSR. A tugboat of the series «ZhS» (iron welded) was built. It turned out that a hull of the ship became lighter, the labour intensiveness of the ship building was reduced by a third.

JULY 29, 1993 A certificate on registration of the Society of Welders of Ukraine was issued. It was founded in November 1992 by the initiative of the E.O. Paton Electric Welding Institute (Kiev). The organization unites all scientists, teachers, specialists, craftsmen and workers in the field of welding and related processes in Ukraine. The main task of the Society is informational, consulting, legal support of all workers employed in the welding industry of Ukraine.

JULY 30, 1904 The longest battle of the Russian-Japanese War, the defence of Port Arthur (July 30–December 23, 1904) began. The sailors of the Russian fleet and the workers of the Baltic Ship Repair Plant, located in the besieged city, successfully used arc welding by a coal electrode to repair the ship hulls.

JULY 31, 1962 Date of death of Nils Miller (1899–1962). He left after him a large company «Miller Electric». In the 1920s almost all electric arc welding was carried out using a bulky and expensive three-phase generator. In 1929, Nils Miller realized the need in designing a small and inexpensive welding machine, operating from the power mains. In 1935, the company «Miller Electric» was founded. Next year, El Mulder, the chief engineer of the «Miller Electric», invented the first in the world high-frequency industrial welding device at alternating current. This invention significantly improved the quality of welding and allowed using welding at alternating current.

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