TECHNICAL INSIGHTS

ADVANCED MANUFACTURING

TECHNOLOGY ALERT

11th July 2014

1. NOVEL TOOL FOR CARRYING OUT VARIOUS MANUFACTURING PROCESSES

Manufacturing techniques such as cutting, milling, and drilling are carried out on a large scale by a wide range of industrial sectors during the manufacturing of their products. The drawback with these manufacturing techniques is that the tool used in these processes makes it difficult for manufacturing parts and products that are being produced for the industrial sector such as aerospace and automobile. Researchers from the Loughborough University in UK have developed an innovative tool that could be used for processes such as cutting, milling, and drilling with increased precision and ease.

The Loughborough University researchers have developed a tool that has the potential to transform the way cutting, drilling, and milling are carried out in manufacturing. The tool increases the ease with which the materials such as aerospace grade composites can be cut. It uses a technique called ultrasonically assisted manufacturing (UAM), which employs a specially designed piezoelectric transducer. This transducer works in tandem with conventional methods such as turning, drilling, or milling. The device creates ultrasonic vibrations ranging between 20 kHz and 39kHz, which allows the machining technique to soften the composite material, which results in using less force from the cutting tool. This reduced force from the cutting tool results in significantly less damage, waste, and better finish of the product that is being manufactured. According to the researchers, the combination of the ultrasonically assisted manufacturing and the novel tool has been able to address challenges such as material wastage and difficulty in cutting that are seen with carbon or epoxy composites. Based on various experiments, UAM coupled with the tool has shown significant improvements in drilling carbon or epoxy composites with reduced damage in the

machined composite. Currently, the researchers are working on developing this process to be used for materials such as nickel-alloys, which they believe would be adopted on a large scale by a wide range of industrial sectors. According to the researchers, the potential of thisl tool can be extended to biomedical applications.

The tool is easy to use, can be be used on a wide range of materials, and can increase the surface finish of the products being manufactured.

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2. NOVEL APPLICATION FOR 3D PRINTING TECHNOLOGY

Braille is a type of tactile writing system that is used by visually impaired people. There has been a significantly large number of developments in the Braille printers for further increasing the capabilities for visually impaired people. With the invention of 3D printing, a large of number of applications in various industrial sectors has been possible.

Researchers from the Korea Institute of Science and Technology, Korea, have now converged 3D printing technology with 3D thermal flow treatment for developing Braille books, Braille picture books, and Braille teaching materials. The researchers believe that the products made using the convergence of the above mentioned technologies would help in developing products with high flexibility in size, height, and color. This novel process has enabled the production of touchable products with detailed lines and curves. The research team is said to have used the thermal flow technique on the surface of the products in order to enhance the durability and adhesiveness. Among the various 3D printing technologies that are available, the researchers used fused deposition modelling, which is a layer technique that stacks one filament layer at a time based on the data of the 3D model. This 3D printing technology enables manufacturing of miniature models or prototypes of complex 3D objects using computer-aided drawing (CAD) at a significantly low cost and time. The shape and thickness of the finished product can also be controlled by varying the number of filament layers. Since the tactile objects are touched by people, it was essential to manufacture them in a way that is harmless to the human body and also durable. Hence, the researchers have used the used thermal reflow processing for surface treatment. If the surface of the produced object is treated with temperatures of

160 degrees C or higher, the solid filament melts to fill the tiniest crevices and gets absorbed into the object creating a surface with better adhesiveness. The surface treated objects, which are made from plastic, are seen to be more durable than objects made out of paper. Thermal flow treatment also helps in reducing surface roughness of the objects that are made using the 3D printing process. According to the researchers, the surface treatment process that they have used can be applied for other materials such as plastic, metal, ceramics, and so on for controlling the adhesiveness of the surface of the Braille products.

A major advantage of this innovation is that it can be used for developing tactile writing systems that are expected to help the visually impaired people significantly.

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3. ENHANCED ENERGY EFFICIENCY FOR ROBOTIC MOTOR CONTROL

The use of robots in industrial processes has been constantly increasing primarily because of their ability to perform repetitive or hazardous tasks reliably and precisely. The robots can perform the tasks better than humans because the degree of error for a robot is extremely low when compared to human error. Moreover, certain tasks, such as working with heavy objects or in presence of extreme environmental conditions, can be accomplished only using robots. A robot normally consists of various robotic arms. Motors are used to control the movement of the arms. Currently, digital controllers are used for driving these motors. Developing and programming the controllers in a way that they work efficiently is a challenge currently faced in the robotic industry.

To ensure that the joints can perform intended movements orders are constantly sent to the motors. The orders let the motor know, for example, at what angle its axis needs to be all the time. Currently, digital controllers can issue orders discretely, that is, orders are issued at specific moments. Each order is followed by a brief pause and then the subsequent order is transmitted. So before a new order is received by the controller, the existing order remains valid. This mode of operation is known as zero-order reconstruction and has been extensively used in robotics.

Researchers at the University of the Basque Country, Spain, have found out that the energy consumed in controlling robot motors can be significantly reduced by using an alternative to the zero-order reconstruction mode. The researchers have used a polynomial function that is based on the two most recent orders to reconstruct the process. This reconstruction is known as fractional order reconstruction. Lab tests conducted with this mode of operation showed that the energy required for driving the motors is significantly reduced. In ideal cases the reduction is expected to be as high as 40% than the conventional zero order reconstruction mode. This mode of operation is particularly suited for flexible joints in robots such as those mimicking the elbow and wrist.

The researchers conducted tests on small-scale prototypes in the lab. As the lab environment replicates an ideal scenario the validity of the reconstruction mode in real time situations still need to be confirmed. The researchers are planning to carry on such tests on an industrial scale to check whether similar energy savings can be achieved. Even if the savings are not as much as in the laboratory environment it can lead to more efficient operation of robots.

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4. PATENT ANALYSIS OF WELDING ELECTRODES

Welding electrodes are commonly used in electric arc welding process as conductors for carrying the current from the source to the materials that are welded together. The current that is carried by the electrodes is converted to heat energy that is required for the welding process. In the arc welding process, the electrode is used as a filler material in addition to being used as a conductor. Electrodes that are used in the welding process usually have chemical properties similar to that of the material that is being welded. In the welding process, the nitrogen and oxygen molecules react with metal that is being welded, producing impurities in the welded joint thereby weakening the weld joint. In order to avoid the formation of impurities, the electrodes are usually coated with a substance, the commonly used coating substances are flux, inert gas, and substances that produce slag. These coating substances usually prevent formation of oxides and nitrides when the electrodes are melted during the welding process. Some of the

oxides that are left out on the welded joint are removed during the cooling period after the welding process is completed. Some of the commonly used electrode materials are vanadium, chromium, and nickel materials.

Some of the advantages of using electrodes in welding process are that they produce flux, which helps in preventing oxidation. They protect the molten metal from the reactions caused by oxygen and help in stabilizing the arc that is used in the welding process.

From the patents that have been exhibited, it can be seen that the research is being carried out for developing various welding electrode configurations and components, and for different applications such as oil storage cylinder brackets and arc welding.

Title	Publication Date/Publication Number	Assignee	Inventor	Abstract
Projection welding electrode clamping device for oil storage cylinder bracket	April 17, 2013/ CN 202877721 U	Nanyang Cijan Automotive Shock Absorber Co., Ltd.	Sun Feng, Wang Yi, Wen Tao, Deng Yu, Jin Qu	The utility model relates to a projection welding electrode clamping device for an oil storage cylinder bracket. The projection welding electrode clamping device is in a cylinder structure and composed of a fixed clamping part and a movable clamping part. The fixed clamping part and the movable clamping part are fixed through bolts, wherein the upper end face of the fixed clamping part is provided with an electrode clamping groove, and the lower end face of the movable clamping part is provided with a fixing groove which is matched with the electrode clamping groove. The projection welding electrode clamping device can be used for clamping and fixing different electrodes, and therefore the purpose of conducting projection welding on various oil storage cylinder brackets through one projection welding machine can be achieved, work efficiency can be improved effectively, industrialization production can be realized, and production cost of an enterprise can be lowered.
Systems and methods for welding electrodes	April 4, 2013/ US 20130270248 A1	Hobart Brothers Company	Steven Edward Barhorst, Mario Anthony Amata	The invention relates generally to welding and, more specifically, to welding wires for arc welding, such as Gas Metal Arc Welding (GMAW) or Flux Core Arc Welding (FCAW). In one embodiment, a tubular welding wire includes a sheath and a core. Further, the core includes a carbon source and an agglomerate having a Group I or Group II compound, silicon dioxide, and titanium dioxide. Additionally, the carbon source and the agglomerate together comprise less than 10% of the core by weight.
Manufacture of cored welding electrodes	November 05, 2012 / US 20130055565 A1	Lincoln Global, Inc.	Marie A. Quintana, Janet Morse, Jonathan Sterling Ogborn, Greg Gerth, Vaidyanath B. Rajan, Radhika R. Panday	The outer metal sheath of a cored welding electrode is made by twin roll casting without cold rolling.
Cutting tool for forming and re-forming welding electrodes with contoured faces	September 14, 2012/ US 20130008295 A1	Gm Global Technology Operations, Inc.	David R. Sigler, Michael J. Karagoulis	A cutting tool that can cut concentric ringed features (e.g. protruding ridges or intruding grooves) onto a weld face of an electrical resistance welding electrode is disclosed. The cutting tool includes a cutter blade that can be rotated about the electrode weld face. The cutter blade has at least one cutting surface configured to cut the concentric ringed features onto the weld face when the cutting surface is rotated relative to the weld face while engaged therewith.

Title	Publication Date/Publication Number	Assignee	Inventor	Abstract
Movable heat preservation device of welding rod	July 19, 2012/ CN 202754298 U	Tianjin permanent Welding Material Co., Ltd.	Luoyong Bin, Shyh-Liang Chen, Liu Yang, Cui Zhiqiang	The utility model aims to provide a movable heat preservation device of a welding rod. The technical scheme includes that the movable heat preservation device of the welding rod comprises a box body and a box cover. The box body is provided with a box body heat preservation layer. The box cover is provided with a box cover heat preservation layer. A welding rod storage space is arranged in the box body heat preservation layer. The movable heat preservation device of the welding rod is characterized in that a connection block is fixed in the box body and contacted tightly with the box body heat preservation layer, and a handle is arranged on the side face of the box body; wheels are arranged at the bottom end of the box body, a piston communicated with the box cover is arranged on the box cover, a piston fixing piece is arranged on the surface of the box cover, and the piston is connected with the piston fixing piece through a piston fixing belt. The movable heat preservation device of the welding rod has the advantages of being easy to carry and move and reducing labor intensity for workers; the welding rod can be stored and taken out through the piston arranged on the box cover without opening the box cover, and therefore heat losses are reduced, and the welding rods are prevented from being affected by damp.
Nut projection welding electrode with metal insulator positioning pin	May 25, 2012/ CN 202741916 U	Yingcheng Chun evapotranspiration Welding Equipment Co., Ltd.	Zhao Jianwei, Xu Mingxiang, Liu Xueming, Li Meiqing	The utility model relates to a welding electrode, in particular to a nut projection welding electrode with a metal insulator positioning pin. The nut projection welding electrode with the metal insulator positioning pin includes a nut projection welding electrode, and is characterized in that the positioning surface of the positioning pin of the nut projection welding electrode is a cylindrical surface, and the positioning pin of the nut projection welding electrode is a two-section insulated assembly with the cylindrical surface. The positioning surface of the positioning pin of the nut projection welding electrode adopts the cylindrical surface for positioning, so as to avoid positioning vacuum and ensure the coaxiality; the positioning pin of the nut projection welding electrode is the insulated assembly, so as to avoid damaging threads; and an assembly insulation sleeve of the positioning pin of the nut projection welding electrode does not move during welding, so as to achieve a long service life.
Systems and methods for welding electrodes	March 12, 2012/ US 20130233839 A1	Hobart Brothers Company	Steven Barhorst, Mario Amata	The invention relates generally to welding and, more specifically, to electrodes for arc welding, such as Gas Metal Arc Welding (GMAW) or Flux Core Arc Welding (FCAW). In one embodiment, a tubular welding wire includes a sheath and a core. The core includes a carbon source and a potassium source that together comprise less than 10% of the core by weight. Furthermore, the carbon source is selected from the group: carbon black, lamp black, carbon nanotubes, and diamond.

Title	Publication Date/Publication Number	Assignee	Inventor	Abstract
Application of surface relief to spot welding electrodes	October 26, 2009/ US 8350179 B2	GM Global Technology Operations LLC	James G. Schroth, David R. Sigler	The workpiece-contacting surface of the spot welding electrode may be suitably modified to incorporate a desired shape or form, generally comprising a depressed region outlining a recognizable shape, to form aesthetically-pleasing or functional features in the surface of a workpiece during resistance spot welding. Methods for creating the desired form in the spot welding electrode including abrasion, upsetting, and electrical discharge machining are disclosed. Preferably the electrode face is shaped and subsequently redressed during welding operations at the welding station.
A milling cutter for dressing resistance welding electrodes	June 27, 2008/ WO 2009004546 A1	Sinterleghe S R L, Eugenio Tedeschi, Anselmo Grilli	Eugenio Tedeschi, Anselmo Grilli	The milling cutter (10) comprises three blades (11) each having a cutting edge (12) and a rear face (14). The cutting edges extend radially outwards from a longitudinal axis (x) so as to create, during the rotation of the milling cutter, one or two concave surfaces (13) for receiving the ends of one or two electrodes (E). The rear face (14) has a concave profile in a section plane perpendicular to the cutting edge (12).
Apparatus to process welding electrodes comprises a grinding wheel in a housing having a through-hole for guiding a welding electrode in a defined position to the wheel	March 7, 2000/ DE 10010520 A1	Rolf Tamm	Rolf Tamm	Apparatus to process welding electrodes comprises a grinding wheel in a housing (14). A through-hole (50) is provided in the housing for guiding a welding electrode (52) in a defined position to the wheel. Preferred Features: The housing has a first part for receiving the grinding wheel and a second part fixed to the first part and having a through-hole. The plane of the grinding wheel falls with its parting plane between the two parts of the housing. The housing has a number of different through-holes for the different types of welding electrodes.

Exhibit 1 depicts patents related to welding electrodes.

Picture Credit: Frost & Sullivan

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