

TECHNICAL INSIGHTS

ADVANCED MANUFACTURING

TECHNOLOGY ALERT



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- 1. NOVEL 3D PRINTER FOR COMMERCIAL PURPOSES**
- 2. INSPECTION SYSTEM FOR MANUFACTURING INDUSTRIES**
- 3. MANUFACTURING PROCESS FOR SELF-ASSEMBLING ROBOTS**
- 4. PATENT ANALYSIS OF COLD PRESSURE WELDING PROCESS**

1. NOVEL 3D PRINTER FOR COMMERCIAL PURPOSES

In the consumer/commercial segment, 3D printing has been gaining wide adoption, as consumers and hobbyists buy lower-cost 3D printers to create their own products at home. There is an ongoing need for consumer/commercial 3D printers that are easier to operate and do not require a great deal of technical expertise on the part of the operator.

Blacksmith Group, a startup company from the Nanyang Technological University, Singapore, has developed a compact 3D printer that is capable of scanning products into digitized models. This 3D printer called Blacksmith Genesis allows users, who do not have much knowledge about 3D software, to scan any product of their choice and edit the digitized model, which can then be printed out using the 3D printer. The developers of the novel 3D printer have obtained funding through crowd funding. The 3D printer consists of a black aluminum casing containing all the components of the printer and is said to weigh approximately 6 kilograms. Blacksmith Genesis has a 2-inch LCD display, a Wi-Fi and in an integrated SD card reader in addition to a USB connection to facilitate instant printing for the users. The developers have also said that the 3D printer consists of an innovative platform for printing and scanning purposes, which is not available in the commercial 3D printers currently available in the market. Another noteworthy feature of this 3D printer is that the revolving platform used in the 3D printer enables 360 degrees scanning and can also print products having maximum size of 6650 cm³. Blacksmith Genesis has a fine resolution of 50 micrometers, thus detailing of the products manufactured using this novel printer is twice that of other compact printers. This novel printer houses a 5-mega pixel camera, which allows scanning to be carried out in 6 minutes. This is another key feature of this novel printer. The other features of the printer include live monitoring and automatic error detection, allowing users to monitor and control the printing process on their smartphones from anywhere in the world through the Internet. Some of the advantages of this 3D printer are ease of use

for consumers, the wide range of products that can be produced, and also the level of precision that can be achieved.

With the novel rotary platform in the Blacksmith Genesis 3D printer, the developers have created a 3D printer that could be used by general consumers, such as hobbyists to produce products on their own. Due to the above-mentioned capabilities and advantages, this 3D printer can have potential to be adopted on a significant scale once it is commercially available in the market.

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2. INSPECTION SYSTEM FOR MANUFACTURING INDUSTRIES

In the manufacturing industry, a workpiece is subjected to various rigorous inspection techniques before it is shipped out of the production plant. Inspection of the workpiece and other components is given high importance as even the minutest fracture of the workpiece could drastically reduce the durability of the component. In the automotive and aerospace industries in particular, the inspection techniques plays a key role in achieving the safety and aesthetics of the components that are being manufactured. In order to check the quality of a component, image processing methods are employed by manufacturers. In this method, multiple cameras can be employed to take pictures of component surfaces from various angles which are then analyzed by a software program. The drawback with this conventional inspection method is that it is sometimes difficult to inspect the material substance as each material has its own unique surface structure. Most of the inspection systems currently available in the market are configured for specific materials and dimensions. Thus, there is a need for a novel inspection system that delivers high accuracy.

A group of researchers from Fraunhofer Institute for Industrial Mathematics ITWM, Germany, have developed a novel inspection system called Modular Algorithms for Surface InspeCtion (MASC). This inspection system is adapted on a customer-specific basis and integrated into the production process. Some of the other capabilities of this system are that it can be used for a diverse range of materials, such as metals, leather, textiles or paper and covers a size range from tiny components for medical technology to entire sheets of ceiling panels for

automobiles. Using this system, the surface of the workpiece is first illuminated and scanned using multiple cameras that are set at a wide range of angles. The cameras help in picking up the impact points or fractures that are only visible at all the different points of the component surface. For the analysis of the images that are captured by these cameras, the researchers have developed mathematical evaluation algorithms and have also built a comprehensive software library. According to the researchers, the basic version of this analysis software comprises more than 300 algorithms that can be combined in different combinations for carrying out various inspection processes, depending on the component and the task that is to be performed. When the system identifies a defect, the production process is automatically stopped and the machine operator is notified of the defect. These algorithms help in eliminating flaws that could be incorrectly determined by the inspection system. Once the testing parameters are set, this novel inspection is integrated into the production process by the customer. The system can be directly installed in assembly lines or with the help of robots.

A major advantage of this system is that it offers high levels of accuracy. Due to the above-mentioned capabilities and advantages, this system has opportunities to be adopted by a wide range of manufacturing sectors for quality inspection of their products and components.

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3. MANUFACTURING PROCESS FOR SELF-ASSEMBLING ROBOTS

Robots have been gaining increased deployment for applications such as parts assembly, transfer, painting and so on in industries such as automotive and aerospace.. Manufacturers and researchers around the world are currently working on developing novel manufacturing processes for producing robots with higher capabilities at lower cost and in a shorter time frame. Researchers are trying to develop a novel process for producing robots that are capable of self-assembling.

A group of researchers from the Wyss Institute for Biologically Inspired Engineering at Harvard University and Harvard's School of Engineering and Applied Sciences (SEAS) have developed novel self-folding robots. The researchers have used paper and Shrinky Dinks, the classic children's toy that shrinks when heated to develop a robot that assembles itself into a complex shape in four minutes, and crawls away without any human intervention. This innovation was inspired by the self-assembly process that occurs spontaneously in nature, such as the way linear sequences of amino acids fold into complex proteins with sophisticated functions. According to the researchers, this innovation has significantly high scope for increasing the way in which the robots could be manufactured in the future for various other applications. For instance, a group of robotic satellites that are sandwiched together could be sent to space, where they would be able to self-assemble on their own for performing functions such as taking images and collecting data. This latest development in robotic assembly is an advancement made by the team over the past few years, enabling robots to self-assemble with human intervention. For this robot, a complete electromechanical system was developed and embedded into a fabricated flat sheet. The flat sheet is composed of composite paper and polystyrene and a single flexible circuit board in the middle. A solid ink printer and laser machine was employed for manufacturing the flat sheet. The team then used computer design tools to come up with the optimal design and fold pattern. Once the optimal design was obtained, the flat sheet was then attached with two motors, two batteries and a micro controller which functions as the robot's brain. Hinges were also used in this robot and these hinges are programmed to fold at specific angles. Each hinge consists of embedded circuits that produce heat on command from the microcontroller. Heat that is generated then triggers the composites of the material in the robot to self fold in a series of steps. When the hinges are cooled after about four minutes, the polystyrene hardens, thereby making the robot stiff and the micro controller then signals to the robot to crawl away at a speed of about one-tenth of a mile per hour. This entire event consumes very minimal energy which in turn makes the robot energy efficient. Currently, the robot prototypes that have been developed operate on a timer waiting for about ten seconds after the batteries are installed after which they begin to fold. The researchers are currently working on modifying the triggering of the folding by an environmental sensor, such as temperature or pressure sensors. The researchers

believe that this process is complementary to 3D printing, which also holds great promise for quickly and inexpensively manufacturing robotic components but has issues with integration of electrical components.

The advantage of this process is that it helps manufacturers to develop robots with more capabilities and functions in a shorter time frame. Moreover, this process would help in the manufacture of inexpensive robots. Due to the above-mentioned advantages and capabilities, this process has opportunities to be adopted on a significant scale once it is commercially available.

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4. PATENT ANALYSIS OF COLD PRESSURE WELDING PROCESS

Welding processes usually employ heat or a combination of both heat and pressure for welding two material parts. In the cold pressure welding process, there is no heat employed for carrying out welding activity. The work pieces are welded together by applying a pre-determined force. When the force is applied, the deformation of plastic occurs which causes the residual oxide layers to be pressed out and a metallic bond is created. This type of welding is used for work pieces that are made of materials, such as copper and aluminum.

An advantage of this welding process is that it can be used for welding nano structures; and as this process does not involve any heat, it is highly suitable for manufacturing electronic components without breaking them. From the patents that are profiled in the exhibit, it is evident that research focuses on improving the cold pressure welding process or components, For example, Patent CN102315013 A (2011), assigned to Liaoning Xintai Co., Ltd., pertains to a foil-type coiling machine with a cold pressure welding device that replaces the traditional pneumoelectric welding mode for connecting outgoing lines of work piece copper (aluminum) foils and bars. Patent CN10179174 2B (2010), assigned to Shenzhen Polytechnic, pertains to a cold welding machine suitable for the formation of a fuse in lithium battery production.

Title	Publication Date/Publication Number	Assignee	Inventor	Abstract
Foil-type coiling machine with cold pressure welding device	May 27, 2011/CN 102315013 A	Liaoning Xintai Co., Ltd.	Wen Dianchen	The invention discloses a foil-type coiling machine with a cold pressure welding device. A cold pressure welding mode replaces the traditional pneumoelectric welding mode for connecting outgoing lines of workpiece copper (aluminum) foils and copper (aluminum) bars; copper (aluminum) metals are subjected to plastic deformation only by means of pressure without any external heat source, so that oxide films and other impurities between welding joints are extruded out, thus the pure metal forms solid welding, thereby ensuring the product quality of coils. A foil material feeding device, a foil material decoiling device, a deflection regulating device, a pre-welding cleaning device, a cold pressure welding device, an edge belt decoiling device, a layer insulation transmission device, an insulation shearing device, a coiling device, a layer insulation decoiling device, a trimming device, an end supporting device, a release plate recoiling machine and other components are connected with a main framework, and control signal output and input ends of the coiling machine are connected with control signal output and input ends of a control device; and the stepless frequency control of a motor is controlled through a Siemens motion and vector control module.
Solid phase welding of aluminum-based rotors for induction electric motors	August 31, 2010/US 20120049687 A1	Richard J. Osborne, Qigui Wang, Yucong Wang	Gm Global Technology Operations, Inc.	Squirrel cage rotors of aluminum end rings solid state welded to aluminum conductor bars for use in electric motors and methods of making them are described. In one embodiment, the method includes: providing a laminated steel stack having a plurality of longitudinal slots; placing a plurality of aluminum conductor bars in the longitudinal slots, the conductor bars having first and second ends extending out of the longitudinal slots; contacting the first and second ends of the conductor bars with a pair of aluminum end rings under pressure; and oscillating the first and second ends of the conductor bars, the end rings, or both to form an oscillation friction weld.

Cold welding machine	February 8, 2010/CN101791742B	Shenzhen Polytechnic	Liu Xianming, Zhong Jian, Chen Wei	The invention discloses a cold welding machine suitable for welding formation of a fuse in the lithium battery production. The cold welding machine mainly comprises a wire feeding mechanism, a pole piece positioning and driving mechanism, a welding formation mechanism and a solder spraying and reclaiming mechanism, wherein the wire feeding mechanism is driven by a step motor to feed wires, and meanwhile the pole piece positioning and driving mechanism delivers pole pieces to the welding formation mechanism to align with the solder wires accurately so as to realize the welding formation. The solder spraying and reclaiming mechanism is used for spraying the solder and reclaiming a part of solder during welding. Experiments show that the cold welding machine has the advantages of high intellectualization, accurate formation, good environment-friendly performance, high manufacturing yield and certain practical significance.
A process for continuous welding a composite pipe with outer stainless cladding layer	September 29, 2007/WO 2009003326 A1	Biao Yan, Mengjie Yan	Biao Yan, Mengjie Yan	A welding system (10) is disclosed. The welding system may have a power supply (18), a forging arrangement (16) configured to hold and move ends of two components (12, 14) to be welded together, and a plurality of contacts (25) connecting the power supply to the two components. The welding system may also have a controller (20) in communication with the power supply and the forging arrangement. The controller may be configured to regulate the power supply to selectively operate in a constant voltage mode and a constant current mode during different stages of a single weld cycle, and to actuate the forging arrangement to move the ends of the two components together during a final stage of the single weld cycle.
Roller type cold rolled sheet dislocation and location mechanism	September 7, 2006/CN 100443249 C	Lin Qinghai, Xue Xiaohan	Dalian Bao Tong Industrial Control Ltd.	One kind of cold-rolled plate roller dislocation positioning mechanism comprises a rack and assembly of its upper and lower rollers and transition rollers, upper and lower limit roller, its technical points are: in the idler roller of the transition and between the roller and the roller misalignment between at least one pair of locator, locator each dislocation of the C-type limit slot opening frame assembly lower positioning rollers, limit shelf above the top of the opening assembly of the upper trough positioning wheel, and to the upper and lower rollers positioned on the opposite side in the circumferential cut in the same vertical plane. Its simple structure, reasonable design, using the same limit will be two shelves two rollers positioned staggered butt cold-rolled sheet, with a small friction, moving fast, accurate positioning advantages of long life, virtually eliminating the existing There can not be a continuous positioning technology exists and send ills butt cold rolled sheet,

				cold-rolled sheet effectively complete butt before welding continuous positioning, long distance transmission, help to improve the laser butt welding quality cold-rolled plate.
Cold-compression welding wire machine	April 12, 2006/CN 100503129 C	Zhe Wang, Xu coach	BYD Company Limited	The invention provides a welding electrode will be cold welded wire bonding residues machine. The cold welding machine comprises a welding electrode made of a ceramic material. In this cold welding machine, welding electrode as prepared by the ceramic material, and metal wire material quite different chemical structure and smooth ceramic surface, so sonotrode normal circumstances would not bonded with solder residue together, so as not to affect the next weld, the welding efficiency can be improved, and the welding quality.
Compression and cold weld sealing methods and devices	November 04, 2005/CN 101080359 A	Jonathan · R. · Kepei Ta	Micro-chip companies	Providing the pressure-cold welding method, connection structure and vacuum sealed accommodating means. The method includes providing a first substrate, the first substrate comprises a first metal having a first coupling surface composed of at least one first connection structure; providing a second substrate, the second substrate comprising a second metal having a second connecting surface formed at least one second connection; the at least one first and the at least one second connecting structure connecting structure pressed together, so that the connection surface of the contact surface in one or more locally deformed and shear, the overall effect is reached in the bonding surface between the first metal and a second metal to form a metal-to-metal binding. Overlapping at the connecting surface effectively removes surface impurities, without heat input in the case of connection between the surface generated conveniently close contact. Vacuum sealing means may comprise pharmaceutical ingredients, biosensors, or MEMS devices.
Multifunction hydraulic head suitable for being applied to machines for bending and forming metallic sheets	June 27, 2005/US 20090282886 A1	Luigi Patuzzi	Finn-Power Oy	A multifunction hydraulic head for use with forming and bending machines for sheet metal and/or metal profiles is equipped with carriages (15) that slide horizontally on guide and shift shafts. Each carriage (15) of the said machine is equipped with a bracket (17) that is integral with the respective carriage, the bracket supporting the interchangeable work assemblies (18, 19, 20, 21) which include a mobile matrix (22, 24, 26, 28) and a fixed pressing unit (23, 25, 27, 29); furthermore, the sheet metal (11) is inserted between the matrices and the pressing unit of the installed unit, to be spot processed by the said work assemblies in accordance with the desired shape.

Liquid phase diffusion bonding method of metal machine part and such metal machine part	June 2, 2004/US 7804039 B2	Yasushi Hasegawa, Ryuichi Honma, Yutaka Takagi	Fukuju Industry Corporation Ltd, Nippon Steel Corporation	A liquid phase diffusion bonding method for a metal machine part superior in the quality of the joint and the productivity enabling the bonding time to be shortened, achieving homogenization of the bonding structure and improving the tensile strength, fatigue strength, and joint quality and reliability. This liquid phase diffusion bonding method of a metal machine part is characterized interposing an amorphous alloy foil for liquid phase diffusion bonding at bevel faces of metal materials, performing primary bonding by melt bonding said amorphous alloy foil and said metal material by resistance welding to form a joint, then performing secondary bonding by liquid phase diffusion bonding by reheating said joint to at least the melting point of said amorphous alloy foil, then holding it there to complete the solidification process of said joint.
Method for producing an insulating pack for an insulating part	December 23, 1998/US 6352787 B1	Evelyn Zwick, Alexander Wildhaber	Rieter Automotive (International)Ag	The invention relates to a method for producing an insulating pack (10), according to which a stack (9) of metallic lamellae is cold-welded simultaneously along a predefined contour and separated from a remaining area. The insulating pack produced according to the invention preferably has a plurality of knobbed and/or perforated aluminium foils (12, 14, 16) and at least one stretch film (18) and is characterized by a narrow welding seam (20) extending along the edge. The insulating pack can be used as an insulating part on its own or loosely inserted into an additional supporting or covering layer. Such insulating parts can be configured in an acoustically active manner and are used in the motor industry, machine industry and/or electronic or computer industry. Means for carrying out the method provided for in the invention provide for the use of a cutting blade with two cutting flanks. A preferred version of the cutting blade has cutting flanks inclined at different angles and can be configured as a rotary blade.

Exhibit 1 depicts patents related to cold pressure welding process.

Picture Credit: Frost & Sullivan

[Back to TOC](#)

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