

CYBER WORLD

Gearing Up
Industry

Feature

Evolution of gears and machine tools

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2017
No. 51

GEAR TECHNOLOGY

Evolution of gears and machine tools

Gears of various sizes are used as mechanical components to transmit power in a wide range of products from watches to power-generating turbines. It is estimated that the market size of gears and gear assemblies across the world is approximately 200 ~ 300 billion dollars, and the market is anticipated to continue to expand in association with industrial development.



01. The Antikythera-Mechanism

It is believed that the mechanism was used for astronomical observation, etc.
(Aflo)

02. Leonardo da Vinci's sketches of gears

It is believed that most of the basic types of gears were devised in the time of da Vinci.
(Aflo)

03. Old Swiss 10 franc note

A gear invented by Leonhard Euler, a mathematical genius, is featured on this Swiss banknote.

04. IP bevel gears developed by the Japan Society of Mechanical Engineers

Their high efficiency is attracting global attention.
(Source: Proceedings of The JSME International Conference on Motion and Power Transmissions 2017)

05. CFRP gears with metal embedded in the teeth developed by Gifu University

Expectations for the reduction of the weight of gears are growing with the use of CFRP.

It is said that the history of gears dates back more than 2000 years ago, and the Antikythera-Mechanism, which was a part of a machine in the era of ancient Greece, is believed to be one of the oldest existing gear mechanisms in the world. In the technical history of gears, Leonardo da Vinci made the largest contribution to their development, and his studies reportedly provided significant evolution of gears in the late 15th century and establishment of the foundation of the basic shapes that are used in our time. During the industrial revolution in the late 18th century, sequential development of high-efficiency gear cutting machines enabled mass production of gears, which resulted in widespread use of gears in all manufacturing sectors. Supporting the subsequent outstanding progress of manufacturing, gears are considered to be a symbol of industrial development, and are also featured in the designs of banknotes and national emblems of various countries. While representative power transmission mechanisms in the


modern period include torque converters, belts and chain systems along with gears, it is acknowledged that gears are superior in terms of transmission efficiency, load capacity and longevity. Research and development of gears is actively promoted in industry, academia and government. In Japan, "IP (involute planar) bevel gear," a bevel gear with a new shape which can be produced 10 times faster than conventional ones, was developed in 2016 and drew much attention on a global scale. In the meantime, research on mass production of gears made of carbon fiber reinforced plastic (CFRP) is underway, and further progress is expected in the future.

Gears are continuously evolving with the times as an essential element in the development of manufacturing.


Types of gears and their usage

01


Transmit rotational motion in parallel direction



Spur gear (straight teeth)




Helical gear (helical teeth)




Herringbone gear (double-helical teeth)

Transform rotational motion into linear motion

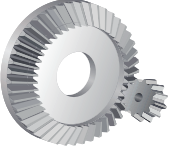


Spur rack and pinion gear (straight teeth)




Helical rack and pinion gear (helical teeth)


Change rotational direction by combination of gears with different rotational axes



Bevel gear (straight teeth)

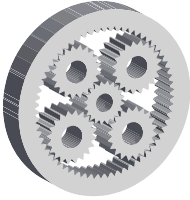


Worm gear



Hypoid gear (spiral bevel gear)

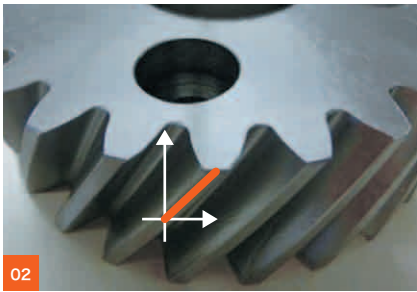
Change rotational speed by combination of gears



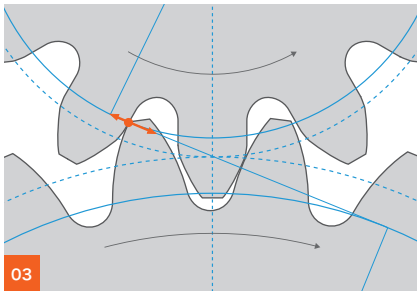
Planetary gear

Combination of spur gears rotating around each other inside an internal gear to change the speed based on the rotational ratio of the meshing gears

02



03



01. Representative gear types

02. Helical teeth

The teeth at an angle to the faces of the gear

03. Involute tooth profile

The action line (where power is transmitted) of the meshing is in a straight line

In addition to parallel transmission of rotational motion, the roles of gears include transformation of rotational motion into linear motion, change of the rotational direction by the combination of gears with different rotation axes and change of the rotational speed by the combination of gears in different sizes. To play such roles, a wide variety of gears have been developed, including spur gears, rack gears, worm gears and bevel gears. The directions of the teeth in the longitudinal direction are also different, such as straight teeth, helical teeth and spiral teeth, and the number of gear types is said to be more than ten when they are strictly classified in consideration of the tooth contour as well. The involute and trochoid contours are dominant at present. The involute tooth profile is particularly widely used in various industries because it provides smooth rotational motion and there are several methods of gear cutting. While most common materials of gears include carbon steel and

stainless steel, other materials such as engineering plastic, which reduces the weight of gears, leaded cast iron, which minimizes the sound of operation when gears are meshed, and hardened steel, which enhances strength, are also used. Gears have a wide variety of types, forms, and materials, and are used in various industrial products all over the world.

Gears are incorporated into various industrial products



Familiar products that contain gears include watches and cameras - small gears of less than 1 mm (0.039 in.) wide are used in the rotating mechanism for the hands of a watch and a zoom lens of a camera. Micro gears at micrometer levels are currently being developed, and are expected to contribute to the development of ultra-miniature machines. Equipment used in the railroad, shipbuilding, construction machinery, steel, energy, and other heavy industries use many gear boxes made with a combination of gears of various sizes. A gear box is the generic term of power transmitting mechanisms that decrease the revolving speed of power to attain torque or, conversely, increase the revolving speed. They are used in the driving systems of wheels of rail vehicles and turbine generators for wind and thermal power generation, for example. The aerospace industry has recently started the practical use of geared turbofan (GTF) engines, which are equipped with gear

boxes. GTF is an engine where gear boxes work to optimize the rotation of the turbofan while at the same time allow the compressor and turbine to rotate at their peak efficiency. While it has started to be adopted in small and medium-sized aircraft on a full scale, it is also employed by large aircraft and is expected to be used in a wider basis in the future. Incorporated in various industrial products, gears underpin the prosperity of modern society as a key player behind the evolution of machine technology.

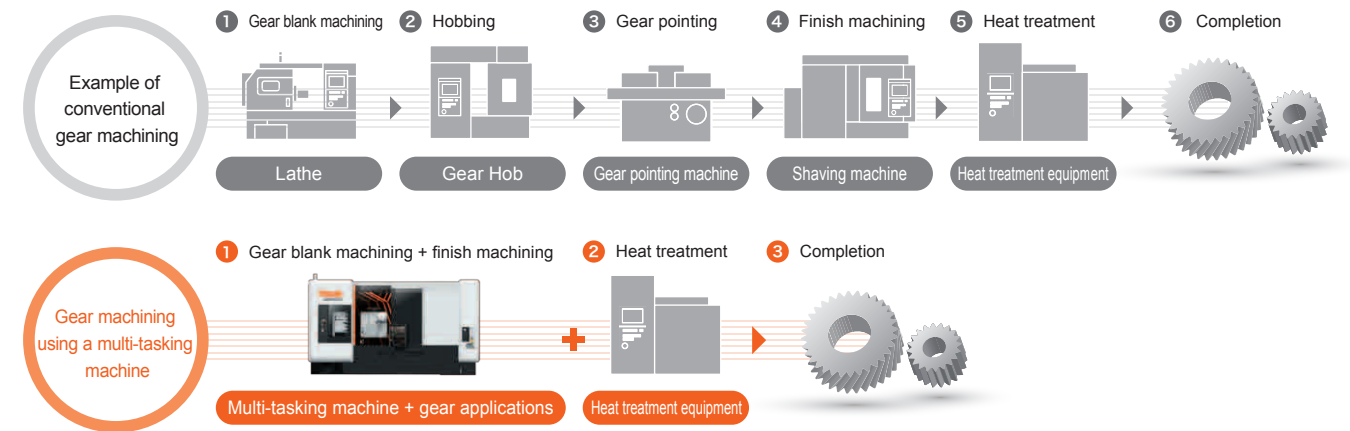
Gears used in the automotive industry



While gears are used in a wide range of industries worldwide, the automotive industry uses an especially large number of gears, and it is estimated that more than half of the gears in the world are produced for the automotive industry. Many gears are used in transmissions, differentials, steering systems and other key units. Automobile manufacturers are extremely competitive and focus on enhancing fuel efficiency and minimizing noise, vibration, and harshness, which also require more advanced gear machining. For example, while a shift to multi-stage transmissions to enhance fuel efficiency is in progress mainly in large vehicles, such transmissions contain more gears and tend to generate more noise. It is necessary to improve the machining accuracy and smoothness of the tooth surface while also reducing the cost of gears. The abatement of noise caused by gears is considered to be crucial since it is not only related to gasoline- and diesel-powered vehicles but also directly affects hybrid and electric vehicles, with their much quieter operation the sound

produced by gears in operation is more apparent. The manufacturers also recognize the importance of the production system being able to respond to the changing business environment as a critical requirement, and promote the establishment of production lines with flexible gear machining. In the case of spur gears, for example, conventional gear machining starts with the turning of the gear blank by a lathe, which is followed by gear cutting using a hob, tooth pointing using a gear pointing machine and finish machining using a gear shaving machine followed by heat treatment or heat treatment followed by finish machining by a gear shaving machine. Such a production line with specialized machines is effective in mass production but is considered to be unsuitable for a variety of products in low-volume production. Accordingly, there has been a shift to production lines with multi-tasking machines and other general-purpose machines in recent years.

Evolution of gear machining by multi-tasking machines



Mazak gear applications

SMOOTH
GEAR CUTTING



SMOOTH Gear Milling

Programs can be created without expensive CAD/CAM software. Gear teeth can be rough machined and finish machined by readily available end mills and ball end mills. Special and expensive gear tooling is not required. This method substantially reduces both lead time and cost for small lot gear production.



SMOOTH Gear Hobbing

This method synchronizes the rotation of the machine main spindle and milling spindle so that gear teeth can be machined by a gear hob. Programming is done conversationally. Hob shifting and tool retract functions effectively extend the tool life of gear hobs.



SMOOTH Gear Skiving

Skiving can be used to machine both spur gears and internal gears with fast cycle times.

Gear machining can be completed with a multi-tasking machine, which includes the functions of both a CNC lathe and a machining center, without setup changes in all procedures up to heat treatment including tooth cutting and finish machining, which used to be done by multiple special machines. For a wide variety of gears in low-volume production, this method can improve production efficiency and lower the cost through effects such as integration of steps to reduce machining time and the number of machines as well as enhancement of accuracy, in comparison with conventional production methods. It is likely in the future that potentials of gear machining using multi-tasking machines will further expand, for example, using hybrid multi-tasking machines with metal additive manufacturing to make gear segments which can be welded together to produce large-diameter gears.

Mazak offers a lineup of wide-ranging series of multi-tasking machines as well as three types of high-efficiency gear machining

applications - developed based on machining expertise accumulated over many years - SMOOTH Gear Milling, SMOOTH Gear Hobbing and SMOOTH Gear Skiving. A combination of multi-tasking machines and other Mazak machining tools with these applications allows completion of gear machining from gear blank machining and gear machining in one machine setup, and can dramatically improve the productivity of small-lot gear and large-diameter gear machining in particular.

The evolution of both gears of various sizes and types of machine tools that machine them will change the future of manufacturing and facilitate the growth of all industries. Mazak will continue to develop advanced machine tools and applications that meet manufacturers' requirements to further contribute to the evolution of manufacturing.



01

Customer Report 01

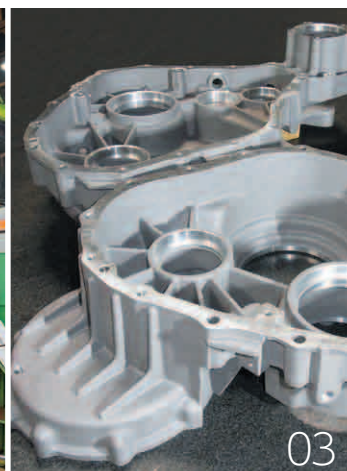
Committed to the modernization of agriculture as an all-round agricultural machinery manufacturer

Japan ISEKI KUMAMOTO MFG. CO., LTD.

Rice planting, harvesting and threshing are essential tasks in rice cultivation. They have been done by hand and with the help of animal power since ancient times. Agricultural work is very hard because it is performed in the natural environment. Seeing such pains with his own eyes, Mr. Kunisaburo Iseki founded Iseki Farm Implement Trading Co., the predecessor of ISEKI & CO., LTD., in southern Japan in 1926 with a desire to "free farmers from exhausting labor." One of the group companies is ISEKI KUMAMOTO MFG. CO., LTD., which manufactures combine harvesters and other products in Kumamoto.



02



03



04

- 01. General assembly line of "JAPAN," the flagship combine harvester
- 02. Parts processing time was reduced by 25% with the introduction of The Mazak PALLETECH
- 03. Transmission case machined by HCN-6000
- 04. Employees celebrating the resumption of production after recovery from damage caused by the Kumamoto Earthquake in April 2016

COMPANY PROFILE



ISEKI KUMAMOTO MFG. CO., LTD.

President and Chief Executive Officer : Hidenobu Morita
Address : 1400 Yasunaga, Mashiki-machi, Kamimashiki-gun, Kumamoto Japan
Number of employee : 245

ik.iseki.co.jp



ISEKI KUMAMOTO MFG. CO., LTD. was established as a plant of ISEKI & CO., LTD. specializing in the manufacturing of automatic threshers in Kumamoto City in 1949. Taking advantage of the strength of its business dedicated to threshers, the plant developed the world's first auto-threshing combine harvester HD50. The auto-threshing combine harvester integrates a harvester with an automatic thresher so that the two tasks can be handled by a single unit. The birth of this agricultural machine dramatically improved the work efficiency of rice harvesting, which used to be done by hand. In 2014, the Japan Institute of Invention and Innovation (JIII) selected the "Auto-threshing combine harvesters and rice transplanter" as one of the top "100 Postwar Japanese Innovations," such as the electric rice cooker. JIII praised the machine as the first model of unique auto-threshing combine harvesters that Japan can boast of to the world. In rice cultivation, farmers took 57.20 hours on average for rice reaping and threshing of 1,000 square meters (10,764 ft²) in 1954, but the labor time was considerably reduced to 3.54 hours by 2010. This shows that the goal of Mr. Iseki has been realized.



Mr. Morita, President

ISEKI newly constructed the current plant near Kumamoto City, in 1980 and moved there from the original location. The production plant was spun off into a separate company and established as ISEKI KUMAMOTO MFG. CO., LTD. in 2001. As a plant specializing in the manufacturing of combine harvesters and carrot harvesters, the plant set up an integrated system of production from the machining of raw material to shipment of products in 2011.

Productivity was increased with Mazak's FMS

"We have inherited the DNA of the founder to seek efficiency and labor saving of agriculture in a consistent manner and develop a large number of agricultural machines ahead of other companies. High technical power does not only widen the range of the products to market but also helps cultivate human resources," said Mr. Hidenobu Morita, President, who aims to establish ISEKI KUMAMOTO MFG. as a company known for technical power, the reason for the company's strength.



Gear box that supports high horsepower

The technical power of ISEKI KUMAMOTO MFG. in mechanical processing is underpinned by the Mazak Pallettech FMS composed of five horizontal machining centers. The Pallettech was initially installed in 2014 with three horizontal machining centers to replace the company's former product line consisting of seven machines. Subsequently, two more machining centers with additional pallet storage were added in 2015. They are mainly used for the machining of die castings and other castings for the transmission gearbox case and other drive components. "The same or higher workload is handled by a smaller number of machines. The machining time has also been reduced by 25%," stated Mr. Toshio Endou, Director and General Manager of the Production Engineering Department, who was impressed by the effect of the introduction of the Mazak Pallettech FMS.

▶ The world's first auto-threshing combine harvester developed by the company. It marked its 50th anniversary last year.

Customer Report 01

Japan ISEKI KUMAMOTO MFG. CO., LTD.

"Mazak also came to help us first when the Kumamoto Earthquake occurred in 2016. Thanks to the quick emergency response, we were able to restart part of our operation in two weeks. I was struck by the spirit of the Mazak staff that gave priority to the resumption of production," Mr. Endou said in appreciation of the quick support response of Mazak.



Mr. Endou, Director (second from left, first row) and employees

ISEKI Dream Gallery helps cultivate the understanding of the industry

In addition to cultivation of farms with agricultural machinery in Japan and other countries, ISEKI KUMAMOTO MFG. also focuses on cultivation of the understanding of the industry, for which the group is making concerted efforts. As part of this, the company opened the ISEKI Dream Gallery in its factory in 2014 to introduce the spirit and activities of the ISEKI Group in its commitment to farming machinery and agriculture to visitors including those involved in agriculture, students and other company employees from Kumamoto Prefecture and other areas. In the building, the history of the group and its main models is presented. The display of flagship machines and the technology section must give the visitors an opportunity to think about agriculture in future generations. The history of ISEKI KUMAMOTO MFG., which has contributed to the mechanization and modernization of agriculture as an "all-round agricultural machinery manufacturer" by inheriting the DNA of its founder, is steadily moving forward.





01

Customer Report 02

Contributing to convenient foods used worldwide

🇯🇵 Japan Fuji Manufacturing Co., Ltd.

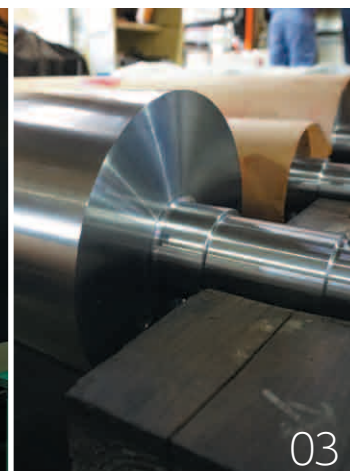
In the 1950s, when Japan started showing signs of high economic growth, a food that later dramatically changed the eating habits of the world was invented. It was instant noodles, which can be cooked by only adding hot water. People all over the world now eat about 97.7 billion cups of instant noodles in total every year (as of 2015). Fuji Manufacturing Co., Ltd. (President: Mr. Makoto Sakurazawa) located in Gunma produces equipment that manufactures instant noodles, and its global share is estimated to be 50%. Mazak machines are deeply involved in the production of instant noodle manufacturing equipment.



Gunma, Japan



02



03



04

- 01. An instant noodle machine under assembly
- 02. SLANT TURN NEXUS 500 CNC Turning Center
- 03. Noodle dough roll machined by a Mazak turning center
- 04. Mr. Sakurazawa, President (center, first row), and staff in the Manufacturing Department

COMPANY PROFILE //////////////////////////////////////



Fuji Manufacturing Co., Ltd.

President : Makoto Sakurazawa
Address : 15 Shinnozuka, Fujioka, Gunma Japan
Number of employees : 96

www.fuji-mfg.jp



Instant noodles became widespread and instantly popular after their introduction, which was followed by the release of other instant noodle products by food manufacturers one after another around that time. Production of instant noodles requires a process to fry the noodles in oil. The process used to be done by hand, which was harsh work for employees. Mr. Shimao Sakurazawa, the founder of Fuji Manufacturing and grandfather of the current president Mr. Makoto Sakurazawa, was consulted on the mechanization of the operation to improve the work environment. While Mr. Shimao Sakurazawa was initially producing automated equipment and power distribution panels of factories, he used his technical skills to develop a conveyor-type fryer for instant noodle manufacturing plants. With the development of the product, the company grew into a major manufacturer to produce and market instant noodle machinery. It is likely that this was helped by the large number of companies producing instant noodles in the same prefecture.



Mr. Makoto Sakurazawa, President, talking about his passion for manufacturing

"My grandfather was a born engineer. He became confident with the development of the fryer, which he attempted as a departure from the subcontracting work conducted since the company's foundation. He and my father (current Chairman) then expanded the business to cover the processes before and after it as well, and eventually started to engage in the manufacturing of the whole plant system. Instant noodles are classified into cup and packaged noodles, and also into fried and non-fried noodles. While we have a large number of competitors, we are the only manufacturer that produces equipment for the whole process from

input of raw materials and noodle production to filling into cups for all of the instant noodle types," said proudly by Mr. Sakurazawa.

"You can do a good job if you use new technologies"

The products of Fuji Manufacturing are highly valued in the instant noodle industry, currently playing active roles in hundreds of companies including more than 30 Japanese companies and companies in 47 foreign countries. Half of the products are manufactured for export, and the company goes far ahead of competitors with an estimated global share of 50%.

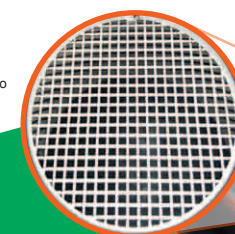
"I think we have inherited the DNA of my grandfather and my father concerning manufacturing. For example, we do not compromise by using the same manufacturing methods as other companies but always adopt state-of-the-art machines because you can do a good job if you use new technologies," Mr. Sakurazawa said while revealing his policy in equipment investment.



New models are aggressively introduced to do a better job

In fact, eight different Mazak machines, including vertical machining centers, CNC turning centers and laser processing machines, are in operation in the plant of Fuji Manufacturing. The company purchased new models almost every year in the last several years to be committed to the "use of new technologies to do a good job." The introduction of the OPTIPLEX 3015 FIBER II in 2016 enabled the basket hole-grid of baskets for

- ▶ Ultrafine basket hole-grid cut by the OPTIPLEX 3015 FIBER II. Special fixtures are effectively used to perform high-quality cutting.



Customer Report 02

🇯🇵 Japan Fuji Manufacturing Co., Ltd.

fryers to be cut 0.15 mm (0.006 in.) wide with high quality that was able to reduce the time for the production of instant noodles.

"In addition to the performance of the MAZATROL CNC, I appreciate the attitude of Mazak to enthusiastically respond to our requests for modification of the machines," said Mr. Sakurazawa who highly values Mazak based on the performance of the machines and the customer-oriented approach.



Frames of instant noodle machines are cut by Mazak's 3D laser processing machines with high efficiency

"We will not turn down any order"

The instant noodle machines developed by Fuji Manufacturing for saving labor have set various new records in the industry. For instance, the time to dry non-fried noodles, which used to be 50 to 60 minutes, has been decreased to only five to six minutes. The length of the machines has been roughly reduced by half as well in comparison with other machines. These are outcomes of the company's consistent policy to "not refuse any order."

While it is said that the world is facing a critical food situation for such reasons as population growth, increase in the level of food consumption and deterioration of the natural environment, Mr. Sakurazawa considers that the instant noodle machines they have exported to developing countries are supporting the food culture of local people.

"It is also our mission to supply equipment that can manufacture noodles with limited raw materials at a low cost." The company will play a larger and larger role through the contribution of its system to the food culture of people in the world.





Customer Report 03

Showing its presence in the domestic and international car industry

India JAYA HIND INDUSTRIES LTD.

JAYA HIND INDUSTRIES (JHI) is a part of the Dr. Abhay Firodia Group of companies; one of India's pioneering industrial houses focusing exclusively in the automotive domain. JAYA HIND INDUSTRIES, established in 1947 started manufacturing auto components primarily to support its vehicle manufacturing venture. Today, JAYA HIND INDUSTRIES is among the country's largest and most trusted, end to end solution provider for aluminum castings for global OEMs.



01. Many Mazak machines are in operation in the Akurdi Plant
02. High-speed and high-precision machining performed by the VARIAXIS i series
03. Horizontal machining center HCN series used for finish machining of die castings

COMPANY PROFILE



JAYA HIND INDUSTRIES LTD.

Managing Director : Prasan Firodia
Address : Mumbai-Pune Road, Akurdi, Pune-411035, India
Number of employees : 1,200
www.jayahind.com



JAYA HIND has developed a wide portfolio of critical parts ranging from 5 g to 30 kg, serving a variety of industries in automotive as well as non-automotive fields. With intelligent investments in tool design / manufacturing on the upstream side and in machine / assembly on downstream side, JAYA HIND is able to offer end to end solutions to auto manufacturers for their various weight reduction / localization requirements. With manufacturing facilities at Akurdi and Urse in Maharashtra, JAYA HIND has the largest in-house tool design and manufacturing capability and capacity in the die casting industry in India.



Mr. Shah, Vice President, talking about future plans for equipment

JAYA HIND has a credible list of both domestic and international customers.

Mazak's horizontal and 5-axis machining centers are playing an active role in Tool Room at JAYA HIND

The mold machining section engages six Mazak machines including four advanced 5-axis machining centers. Many Mazak machines are in operation in the die-cast parts machining plant as well, with horizontal machining centers playing a central role, for high-speed and high-precision

machining. Two units each of the HCN-4000 and HCN-5000 were additionally installed last year to boost production capacity, which increased the total number of Mazak machines installed in the company to 21. Mr. Rajesh V. Shah, Vice President for engineering, explained the effects of the adoption of Mazak machines, "The 5-axis machining centers have reduced the number of necessary steps for the whole process of the machining of mold components. It is also a great achievement that the shape accuracy and the quality of finish machining has been enhanced."



The number of steps for mold manufacturing was reduced with 5-axis machining centers

"We feel secure because any necessary spare parts are supplied promptly by the technology center in Pune, and the application support on machining is also excellent," commented Mr. Shah who is satisfied with Mazak's system to provide after-sales and other support services. "High-precision machining with Mazak machines has diminished variance from the required precision, which leads to a high reputation of our products from the delivery destinations."

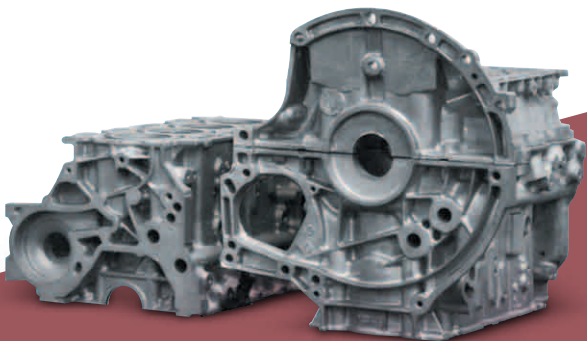


The quality of finish machining was improved with high-precision machining

Active introduction of equipment in anticipation of the development of the automotive industry

Demand for automobiles keeps expanding in India. With a total population of 1.3 billion, the rise in purchasing power as a result of economic development and other factors, steady growth of domestic demand is anticipated to continue in the future. With respect to automobile production, the Society of Indian Automobile Manufacturers has set the target of "raising the share of the car industry of the GDP to 12% in the next 10 years," and is accelerating efforts to respond to increasing domestic demand and promoting exports.

On this positive background of favorable macro-economic factors, JAYA HIND is well poised to expand its capabilities and capacities for die casting as well as CNC machining and has ambitious plans to add number of machining centers in coming years.



► Samples of a high-quality engine cylinder block and cylinder head manufactured by JAYA HIND

MAZAK PEOPLE

Automation Department, Ningxia Little Giant Machine Tool Co., Ltd.

 **Ms. Li Yingjie**

Aiming to gain a lot of experience and become a "true engineer"

Yamazaki Mazak operates many bases in Japan and other countries for various functions such as production, sales and before and after-sales service and support. MAZAK PEOPLE introduces employees who are active in the forefront of the Group companies. This issue features Ms. Li Yingjie, of automation design in Ningxia Little Giant Machine Tool Co., Ltd., a production base in China. She joined the company with the idea that she can make use of the knowledge of mechanical design and manufacturing she acquired in college.

Profile >> Ms. Li Yingjie

Originally from Ningxia Hui Autonomous Region (north western China), where Ningxia Little Giant Machine Tool Co., Ltd. is located, Ms. Li Yingjie joined the company in January 2010, and was assigned to the Engineering Department, mechanical design. She was transferred to the Automation Engineering Office, Engineering Tech. Department in November 2013. Since then, she has been consistently engaged in automation design.

— What were your first impressions after joining Mazak?

When I joined the company, I found the excellent exterior design of Mazak machines very impressive. But I noticed more as I was trained, was the high quality and high precision in the products, sophisticated and easy-to-use CNC operation screens and production lines with consistent design. I was also surprised that new products are released from the bases around the world one after another.

— What is your current job?

I am now working mainly for mechanical design of automation tailored to requests from customers. The car industry is one of the industries with which we do business most often in the Chinese market. It is especially characteristic in China that many orders are made on a turnkey basis. Accordingly, fixtures for peripheral equipment and robots related to the production line are also designed and manufactured and then delivered together with the machines. While it is very difficult to design an automated system that integrates the motions of machines with those of robots, it is also rewarding at the same time. I work with two other members as a group to share jobs and cooperate with each other. We are close to each other in age and can express our opinions without hesitation, so we can perform the design of the items of which we are in charge smoothly. In fact, after completing many tasks in this group of three people, we can now handle jobs more efficiently.



Discussion to confirm customer's requirements are met

— What do you value when you are working?

It is teamwork because even if the ideas of one person are not enough, the combination with ideas of other members can make good results. Our team designed an automated system composed of horizontal machining centers and a gantry robot last year. In the system, multiple machines are connected and a gantry robot is installed over them to load material and unload finished parts automatically. I also believe that this automated system was completed because of the teamwork between mechanical design, control design and other relevant sections. This system was displayed at international trade exhibitions as well and received favorable comments from customers that were considering the automation of their plants.



This photograph was taken at the 2017 New Year party (Ms. Li is at the far left, first row).

— What is your future career goal?

I basically use a PC for design of course, but I consider that I should not only depend on the functions of a PC, it is essential to go to the factory floor to obtain the real sense of manufacturing to produce an exceptional design. I wish to be a "true engineer" who can design effectively using such sensitivity as well as the latest technologies in the future.

— What is the city of Yinchuan, where Little Giant is located, like?

Development in Yinchuan has advanced in recent years, and the city has brighter streets and a larger number of fashionable high-rise buildings and parks than before. The public transportation is also convenient. Development of such living environment and infrastructure allows Yinchuan to attract many companies and create jobs, and the city is now very vibrant. I guess that the growth of Mazak in Yinchuan has had a significant impact on the development of the city.

"Mazak gave me a stage to grow substantially through work," Ms. Li said positively. Looking at her future, she is enthusiastic about learning new technologies and new ways of thinking to improve her skills. It will not be so long before the future "true engineer" stands in the spotlight on a big stage.

How she spends her days off

I make it a rule to exercise and relax on weekends. I have been swimming for many years, because it is good for staying in shape. I can also relieve my stress. I think that shopping with friends and going to BBQs are also effective ways for reducing stress.



News & Topics Introduction of new products

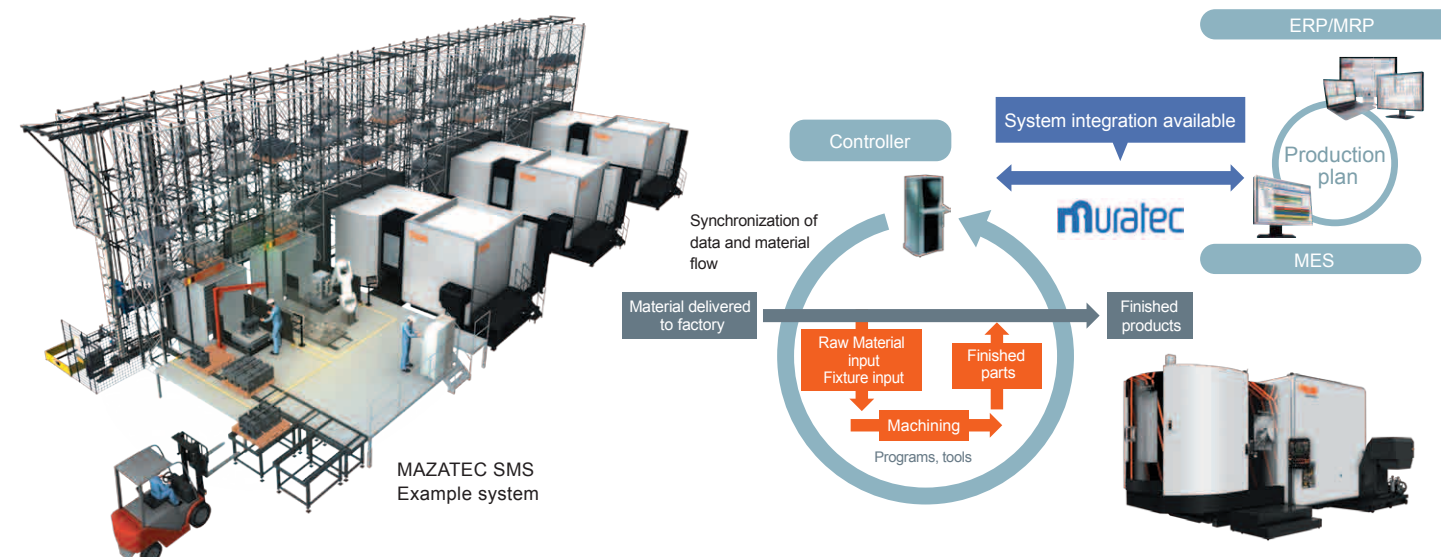


MAZATEC SMS [SMART MANUFACTURING SYSTEM]

Large capacity automatic production system developed in collaboration with Murata Machinery, Ltd.

Mazak has developed the MAZATEC SMS (Smart Manufacturing System), an automatic production system with an automatic warehousing function, in cooperation with Murata Machinery, Ltd. This new smart production system integrates a Mazak Flexible manufacturing system with machining centers and multi-tasking machines and Muratec Automated storage & retrieval systems(AS/RS). This system can be applied to machining centers and multi-tasking machines with pallet sizes from 400 to 1,000 mm (15.75" to 39.37"), as well as an automatic warehousing function that can store machine pallets as well as skids with raw material. The stocker shelves are designed to be able to provide the size and

large-capacity required for high-efficiency storage. The system improves the material handling process in a plant from storage of materials to shipment of finished products to further increase productivity. In addition, more sophisticated management can be achieved in conjunction with ERP and MES (Manufacturing Execution System) systems. The loading stations are designed to provide exceptional ease of operation and can be equipped with a robot for unmanned operation over extended periods of time. Mazak will continue to support customers by providing effective means for turning their plants into smart factories.



The Yamazaki Mazak Museum of Art was opened in April 2010 in Aoi Higashi-ku, the heart of Nagoya in order to contribute to the creation of a rich regional community through art appreciation and, consequently, to the beauty and culture of Japan and the world. The museum possesses and exhibits paintings showing the course of 300 years of French art spanning from the 18th to the 20th centuries collected by museum founder and first museum director Teruyuki Yamazaki (1928 - 2011), as well as Art Nouveau glasswork, furniture, and more. We look forward to seeing you at the museum.



ROBERT, Hubert [1733-1808]
"View of Méréville Park"
Date unknown
Oil on canvas

ROBERT, Hubert "View of Méréville Park"

THE YAMAZAKI MAZAK MUSEUM OF ART
Collection Showcase 1

Méréville Park is located in the village of Méréville in Essonne. It is on the southern edge of the Île-de-France region, 50 kilometers (31 mi.) south of Paris. The Marquis Jean-Joseph Laborde (1724-94) purchased the land in 1784 and spent a decade building the chateau and park. Hubert Robert, painter of the work shown here, was one of the designers of the park at Méréville.

This painting shows the rough rocks, flowing waterfalls, grottoes, and ponds that made the park of Méréville famous. It depicts the varied topography of the garden with a simple viewing platform made of wood with a thatched roof, a bridge that appears damaged, the circular temple on a hill overlooking the valley, which contained an image of the marquis's daughter, entitled Filial Heart, by the sculptor Augustin Pajou, and the dairy below it.

The owner of the park, the Marquis de Laborde, was condemned to the guillotine by the revolutionary tribunal of 1794. Robert himself was arrested in 1792 and incarcerated in the prisons of Saint-Lazare and Sainte-Pélagie but was released during the Thermidorian Reaction and made keeper of the galleries at the Louvre Palace, the precursor of the Louvre Museum, in 1795. Méréville Park later fell into disrepair. It was purchased by the Department of Essonne in the 21st century and is now being restored.

THE YAMAZAKI MAZAK MUSEUM OF ART
Collection Showcase 2

GALLÉ, Émile "Engraved and applied vase with wallflower design"

This vase has an unusual mouth. It is surmounted by a form with three appendages whose tips are fused with the vase body. The Pola Art Museum (near Tokyo) has an example with a similar mouth, but it is decorated with an enamel image of a bleeding heart (*Decentra spectabilis*), so it is not possible to say whether this three-part form is related to a particular flower or not. This vase is small but has a solid sense of weight. It is made of translucent orange glass embedded with pieces of white and overlaid by thick purple glass. Blooming wallflowers (*Cheiranthus allinonii*) are attached with the appliqué technique. There are three kinds of flowers, purple and orange with platinum foil inclusions and opal yellow glass placed over orange. There are a number of variants with the same design, but in this piece, fine roots are seen at the base of the stem. The detailed depiction of the plant's form, including the roots, demonstrates that Gallé's design ideas came from actual plant specimens or botanical drawings. The areas outside the flowers are engraved with a mountain landscape in relief. The design is reminiscent of the Alps and has a grand sense of scale.



GALLÉ, Émile [1846-1904]
"Engraved and applied vase with wallflower design"
1900