AWARDS FOR 1991

JSME DISTINGUISHED ENGINEERS AWARD

Yasuo Kita (Shimazu Engineering Co.,Ltd.)
Takahisa Masuda (Toshiba Corp.)
Yoshikazu Satoh (Satoh System Engineering)

JSME MEDAL for the Best Papers

- Liquid Sloshing in an Axisymmentric Container in Low-Gravity Environments
  Masahiko UTSUMI, Ishikawajima-Harima Heavy Industries Company, Ltd.

- A Study of Package Cracking during the Reflow Soldering Process (2nd Report, Strength Evaluation of the Plastic by Using Stress Singularity Theory)
  Makoto KITANO, Asao NISHIMURA and Sueo KAWAI, Hitachi Ltd.

- Estimation of Transmission Error of Cylindrical Involute Gears by Tooth Contact Pattern
  Aizoh KUBO, Kyoto University, Takahashi KUBOKI, Sumitomo Metal Industries, Ltd. and Tetsuya NONAKA, Kyoto University

- Mechanisms of Heat Transfer Augmentation around the Stagnation Point of an Impinging Air Jet Laden with Solid Particles (Report 2, Effects of Thermal Properties of Ladan Partcles and Heat Transfer Surface on Heat Transfer Augmentation due to the Unsteady Heat Conduction)
  Yasuo KUROSAKI and Isao SATO, Tokyo Institute of Technology

- A Transversely Isotropic Inelastic Constitutive Model of Blood Vessels
  Eiichi TANAKA and Hiroshi YAMADA, Nagoya Universtiy

- Numerical Simulation of Gas-Solid Two-Phase Flow in a Vertical Pipe (On the Effect of Particle-to-Particle Collision)
  Toshitsugu TANAKA, Osaka University, Keiichiro KADONO, FANUC Ltd. and Yutaka TSUJI, Osaka University

- Vibration Reduction in Rolling Piston-type Cmopressors through Motor Torque Control (Basic Study on Theoretical Analysis and Computer Simulation)
  Mitsuru NAKAMURA, Hiroaki HATA, Hitachi Ltd.
  Yozo NAKAMURA, Xanavi Informatics Corp.
  Tsunehiro ENDO, and Kenichi IIZUKA, Hitachi Ltd.

- Development of a Method of Temperature Measurement in the Rarefied Gas Flow using the Visualized Images by LIF (Temperature Measurement using Two Laser Beams with Different Wave Length)
  Tomohide NIIMI and Tetsuo FUJIMOTO, Nagoya University, Kunikazu KONDO, Shizuoka Institute of Science and Technology, Norihiro SHIMIZU, JR-Tokai

- The Dynamic J Integral (J') and Its Use in Finite Element Simulation of Dynamic Crack Propagation
  Toshihisa NISHIOKA, Yutaka TAKEMOTO and Ryuichi MURAKAMI, Kobe University of Mercantile Marine

- Development of New Mode-Superposition Technique for Truncating the Lower- and / or Higher Frequency Modes (Part 1: Frequency Response Analysis for Damped System)
  Ichiro HAGIWARA, Nissan Motor Co.Ltd.
  and Zheng-dong MA, Jilin University of Technology

- Measurement of Cylinder Bore Deformation by Means of a Turning Piston with a Gap Sensor During Engine Operation
  Shoichi FURUHAMA, Musashi Institute of Technology, Hiroya FUJIMOTO, Nissan Motor Co., Ltd. (Formerly Musashi Institute of Technology Graduate School),
  Takaharu GOTO, Nissan Motor Co.,Ltd.

- Influence of Temperature Rise Shear Behaviour of an EHL Oil Film
  Masayoshi MURAKI, Mitsubishi Oil Co.,Ltd.,
  Yoshitsugu KIMURA, University of Tokyo, Instiute of Industrial Science

JSME MEDAL for the Development of New Techniques

Development of Taper Pipe Rolled Threads and Pipe Thread Rolling Machines

Masahiko Ishikawa	Watanabe Industry,Ltd., Zaike,Kawaguchi City, Japan
Takahashi Watanabe	ditto
Yasuo Sekine	ditto
Ryoji Shibata	ditto
Yasuo Ikeda	ditto

Thread rolling method is most commonly used for producing bolts and screws from steel rods. However, this method is not suitable for external thread rolling of tapered pipe.

As a result the thread cutting method had been used exclusively for this purpose, despite its many short comings.

In the thread rolling method, the thread rolling cylindrical dies is applied to and pushed into the pipe and threads are rolled by plastic working. In the former method, pipes tended to buckle and localized settling was also a problem and as a result thread rolling was not satisfactory. Because of these shortcomings, this method was not particularly suitable.

These shortcomings were overcome by the following measures and the taper pipe external thread rolling has now become possible for the most common and economical pipes, i.e., carbon steel pipes for ordinary piping. At the same time this method has also opened up a way for mass production of taper pipe rolled external thread (taper pipe rolled thread or rolled thread) using the thread rolling machine, with the features shown in the drawing, developed by us:

- Use of 3 or 5 rolling dies
- The pipe is aligned with the thread taper for reducing before thread rolling.
- The rotation speed of the work is set at several to ten times (1,000～3,000rpm) the conventional speed. Instead of forming the threads by using the force applied by the dies, a large part of the thread forming pressure is derived from the force of the rotary motion.

By changing the thread profile of the rolled thread to that of the taper pipe thread achieving superior air tightness(Japanese Patent No.1127864)it is possible to attain air tightness and mechanical strength several times stronger than that of cut threads. This method has been employed for all air piping for Shinkansen cars. It is also being employed for air piping for the rolling stock of other railroads. It is thus contributing to assuring railroad safety.

On the other hand,rolled thread is also attracting attention as a completely new method of joining pipes. It is also being used in various sectors for high pressure piping. Moreover, the pipe thread rolling machine developed by us is drawing attention for plastic working of various thin sheet piping. The use of this method is increasing in construction machinery, city gas, automobile parts and electrical parts and is thus contributing to material,energy and labor saving.

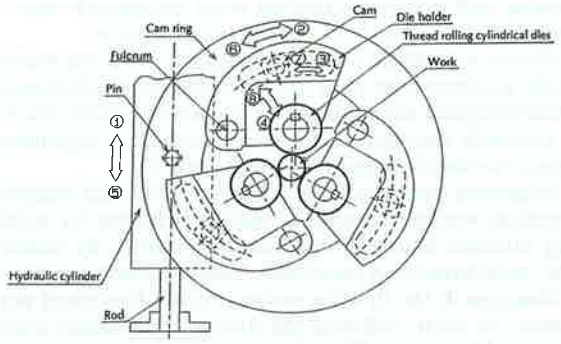


Figure: Thread Rolling Machine (Schematic Diagram of Basic Mechanism)

(U.S. patent No. 4,785,649, Chinese patent number: 2191, S. Korean patent No. 34720)

Nissan Hydraulic Active Suspension

Namie Irie — *Vehicle Research Laboratory, Nissan Research Center, Nissan Motor Co.,Ltd., Yokosuka-City, Japan.*

Naoto Fukushima — *Chassis Design Department Nissan Motor Co.,Ltd.*

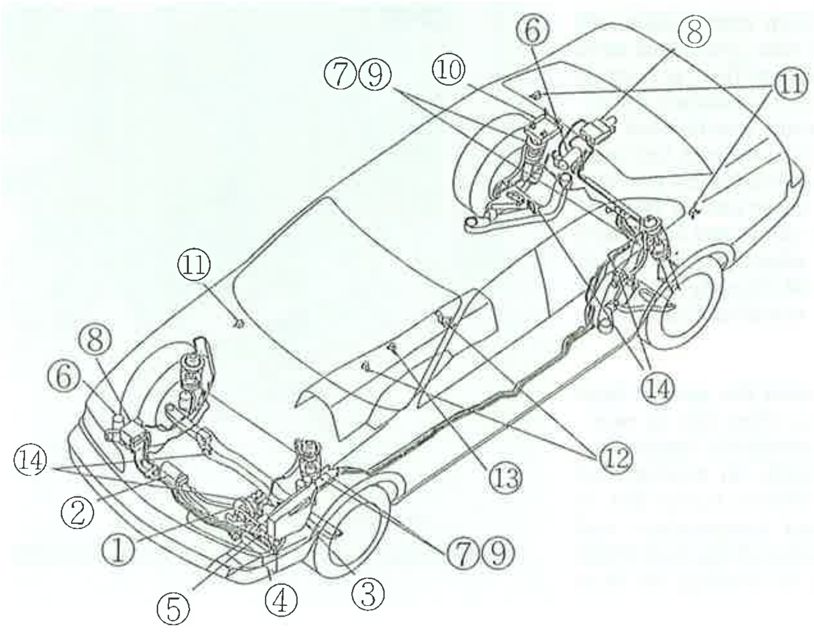
Toshiharu Takahashi ditto

Naohiko Inoue — *Nissan Research Center Nissan Motor Co.,Ltd.*

Akinobu Inaba — *Development &Test Engineering Department Nissan Research&Development,Inc.*

Active suspensions have become a central focus of passengercar chassis development today because they hold out the potential for achieving dramatic improvements in performance over conventional passive control systems. The latter have mainly controlled vehicle motions by switching the spring and damper rates according to the condition of the vehicle.

The first serious attempt to apply an active suspension to the automobile was a mechanical system developed by Automotive Products Co. which was based on a hydropneumatic suspension. Subsequently, Lotus developed an active suspension incorporating an electro-hydraulic servo system. The Lotus suspension has been tested in sports cars and also installed in racing cars. More recently,Nissan developed hydraulic active suspension and installed in the Infiniti Q45 sedan and this ushered in an era of active suspension use in production vehicles.



Component parts and features

	Parts name	Q'ty
(1)	Pump	1
(2)	Pump accumulator	2
(3)	Reservoir tank	1
(4)	Oil cooler	1
(5)	Multi-valve	1
(6)	Main accumulator	2
(7)	Sub-accumulator	4
(8)	Pressure control valve	4
(9)	Actuator	4
(10)	Controller	1
(11)	Up-down G-sensor	3
(12)	Horizontal G-sensor	2
(13)	Transversal G-sensor	1
(14)	Vehicle height sensor	4

Fig. 1 Vehicle loaded diagram

The layout of the Nissan hydraulic active suspension is shown in Fig.1.All of the major components were newly developed for this system.One of its major features is the combination of a pressure control valve with a small accumulator and hydraulic cylider with the specific aim of suppressing the increase in energy consumption.
The Nissan hydraulic active suspension achieves vehicle dynamic performance that was previously unobtainable with conventional suspensions. This performance results from skyhook damper control, a frequency-dependent damping mechanism and roll/pitch control.
The improved performance achieved with this suspension system works to stabilize vehicle behavior by minimizing attitude changes that can be induced by sudden driving maneuvers, crosswinds, road surface inputs or other changes in the driving environment. Improved performance, in turn, reduces the driver's workload under all sorts of driving conditions.

Development of Internally Circulating Fluidized Bed Boiler

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Tsutomu Higo ditto
Tetsuhisa Hirose ditto
Shigeru Kosugi ditto
Naoki Inumaru ditto

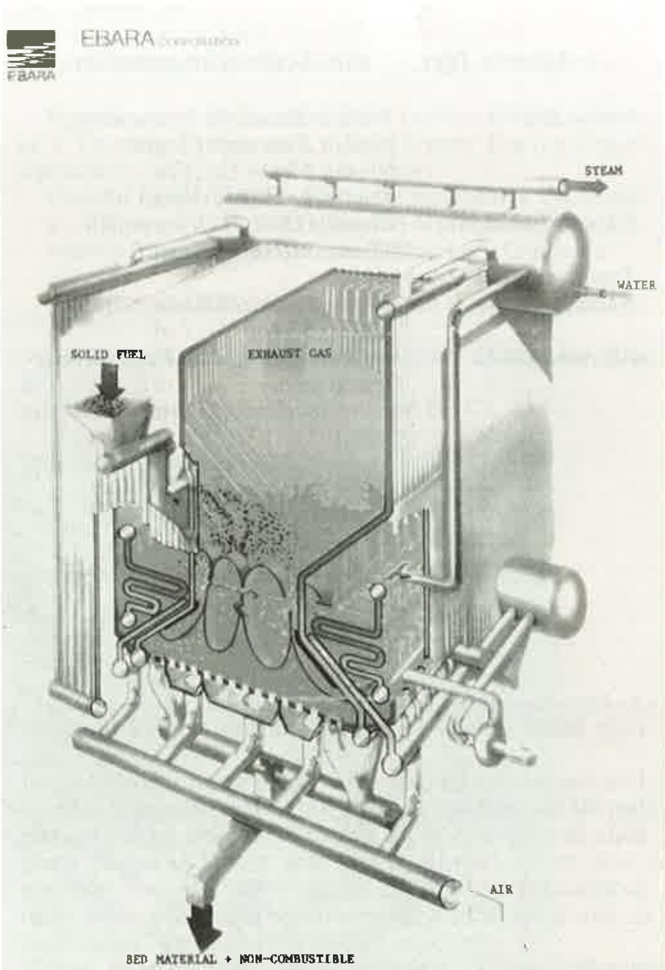
Fluidized bed combustion boilers or FBC have gained commercial use. However, they have some problems for instance complexity of coal feed systems and limitations in ability to follow load variations. The internally circulating fluidized bed combustion boiler or ICFB,is now in commercial use both for municipal/industrial solid waste incineration and coal-fired steam and power generation. It makes possible high-efficiency combustion with great ease of control of steam load while establishing improved standards in limiting SO_2 and NO_x emissions.

The technology is fundamentally an extension of the bubbling fluidized bed boiler, except a slanted partition wall has been added between the main combustion cell and the heat exchange cells on either side, and silica sand is used as the bed material. A rotational flow is formed within the main combustion cell, and a secondary circulation is established between the main combustion cell and the heat exchange cells. The circulation of bed material in the heat exchange cell is controlled by the volume of fluidizing air supplied to the lower part of the heat exchange cell.When fluidizing air is increased from zero to the Umf (minimum fluidization velocity),the descent rate of bed materials increases almost linearly. However beyond the Umf, the descent rate remains fairly constant.

For the ICFB,the relationship between the overall heat transfer coefficient and fluidizing gas flow rate in moving bed of the heat recovery cell is essentially linear, because of the descending motion velocity in moving bed and the change of heat transfer coefficient in the bed. It makes easy to control fluidized bed temperature and steam load at will. In addition, abrasion of the immersed heat exchange tubes is quite small by making the heat exchange cell a slowly moving bed.

With the existence of heat exchange cells, ICFB has marvellous controllability. Even instantaneous changes in the steam flow rate are achieved with only minor fluctuations in bed temperature and steam pressure.
It is important to keep the fluidized bed temperature within the range $825°C \pm 25°C$ in order to minimize SO_2 levels. In this temperature range, free sulfur is virtually the only source of SO_2, but outside this range SO_2 removal effect decreases. The ICFB can control bed temperature precisely in this range.
The re-circulation of porous char and the internal circulation in the main combustion cell combine to sharply reduce NO_x emissions. It is one of the special effect given by internally circulation.

In the ICFB, the separation of combustion and heat exchange functions enables non-combustibles to be passed to the outlets on either side of the main bed and discharged. Then the ICFB can be used as waste to energy plant, to utilize municipal/industrial wastes, even tires with wire belts.



INTERNALLY CIRCULATING FLUIDIZED-BED BOILER

Development of Manipulator System for Deep Submergence Research Vehicle " SHINKAI 6500"

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The Japan Marine Science and Technology Center built a manned deep submergence research vehicle, the SHINKAI 6500 during1987 through 1989. As arms for this vehicle, a manipulator system has been newly developed which is essential to the vehicle with its functions like collecting precious creatures and rocks in the deep sea, and installing and removing of clinometers and gravimeters both used for sensing earthquakes.

The manipulator system consists of two slave arms provided outside the vessel and the operating equipment and the control equipment both provided inside the vessel. The specifications of the system are shown in Table 1.

Slave arms: The slave arms work outside the vessel in the deep sea.One of them is the right arm which is skillful with seven-function and called the Manipulator. The other one is the left arm which is powerful enough to carry heavy things with five-function and called the Grabber.

In the deep sea, the vessel is exposed to the environment of 680 kgf/㎠ of external pressure and temperature of 0 to 2 degrees centigrade. Fig. 1 shows their appearances.

Operating equipment: The operating equipment is provided with the master arm for operating the Manipulator and the joystick for operating the Grabber both of which are compact and light-weight for convenient usage in the narrow cabin and are portable and removable when unnecessary.

Control equipment: The control equipment has the controlling part composed of a micro-computer, a servo-amplifier,etc. and the power unit part composed of DC sources, an amplifier for actuating the drive motor of the master arm, etc.

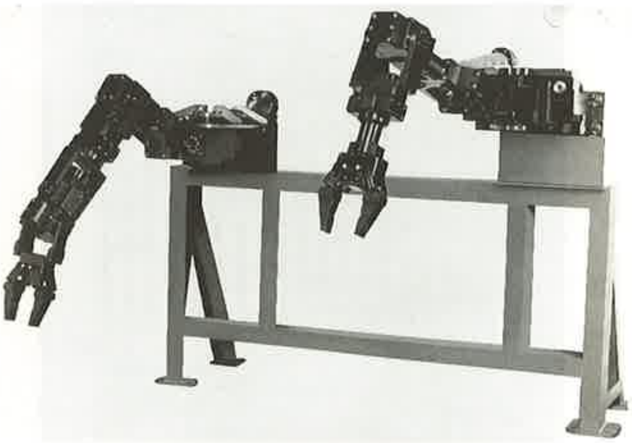

Fig. 1 View of the slave arms

For enhancing the working ability and sampling capability in the deep sea, the manipulator system has the following features.

(1) Symmetrical bilateral control: For servo-control of the manipulator gripping, symmetrical bilateral control has been adopted. The symmetrical bilateral control senses the force by servodeviation, and its potentiometer for position control eliminates all other force sensors. The system thus simplified, therefore, brings about high reliability of the manipulator system for the deep submergence research vehicle which is exposed to a very bad environment in the deep sea.

	manipulator	Grabber
Control method	master-slave	Joystick
Functions	7(six-function and one jaws)	5(four-function and one jaws)
Control	Electro-hydraulic servo system	
	1st-6th function : Unilateral control 7th function : symmetrical bilateral control	Rate control
Outreach	Max. 1.5 m	Max. 1.5 m
Lifting capacity	about 30 kgf	about 50 kgf
Gripping force	0.4~40 (adjustable)	4~75 kgf (adjustable)
Materials	Aluminum alloy	
Weight in water	82 kgf	64 kgf

Table 1. Specifications

(2) Sonic force-feedback system: In addition to the bilateral control,as an alternative feed back method of the gripping force to the operator, sonic force-sensing expression is made which utters sounds inside the cabin responding to the amplitude of the gripping force, thus compensating for the insensible gripping force level and the insensitivity to the gripping force paralysed due to the long work of the operator.

(3) Separation of the master arm and the drive motor:The master arm in the bilateral control tends to be heavy on accountof its provision of the actuator at the grip part for feedback of the force. In order to improve the operating ability of the master arm inside the narrow cabin, the drive motor for feedback of the gripping force has been separated and the resultant force is transmitted to the toggle of the grip part with a release wire.

(4) RMRC (Resolved Motion Rate Control): In controlling the Grabber, the RMRC mode has been added to each joint control mode by the joystick. The RMRC mode operates plural number of joints simultaneously by receiving the manual forward/rear, left/right, and up/down speed commands of the joystick and calculating them through the control equipment by integrating the manual position commands.

This manipulator system was subjected to the overall sea trial test starting in April, 1989; delivered to the Japan Marine Science and Technology Center; and its voyage has been made for one year now since 1990. In 1991, a full-scale research submergence was made in the North Fiji Basin, and the Manipulator and Grabber fully verified its excellent performance by mildly gripping vesicomyid clams and successfully setting and removing the measuring instruments.

Development of Low Emission and Good Fuel Economy City Bus Equipped with Diesel - Electric Hybrid Engine (HIMR system)

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Atsuomi Obata	ditto
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Masashi Shigemori	Hino Motors, Ltd.
Toshinobu Tajima	Industrial Systems Division Toshiba Corporation

In view of the air pollution in the world, research is being done with the idea of replacing commercial vehicles with methanol and electric vehicles. There are various problems yet to be solved particularly in the case of commercial vehicles.

Under these circumstances, Hino Motors, Ltd.has developed a diesel - electric hybrid system called " HIMR " (Hybrid Inverter controlled Motor and Retarder),which has been adapted to a conventional heavy duty diesel engine. This system aims at reducing exhaust emission gas, black smoke, noise, improving safety and increasing energy efficiency.

Figure shows,the three - phase AC motor is made with a rotor on the outer circumference of the engine flywheel and a stator on the inner circumference of the engine flywheel housing. The ratio of rotor diameter to the width is 10:1. The ultra - thin three - phase AC motor work as a starter when the inverter receives the starter SW signal at engine start. It also functions as a torque assistance motor corresponding to the signal proportional to the stroke of the accelerator given by the sensor on the pedal when the vehicle is accelerating. And when the brake is applied, it works as a retarder to provide a dynamic brake response to the signal from the retarder adjustment lever. The electric energy thus regenerated is accumulated in the battery. It can also act as an alternator (generator)to charge the battery when the regenerated brake energy is insufficient. This multi functional three - phase AC motor eliminates the need for a conventional starter and alternator. The system has 25 lead - acid batteries which guarantee a supply voltage of 300V, and a DC/DC converter to lower the voltage for powering 24V - drive components.

The fundamental functions of the HIMR system are the following,

(1) to start the engine (start by using HIMR - conventional starter is unnecessary)

(2) as a motor(assist the engine torque during starting and acceleration, thereby reduction emission gas, black smoke and noise)

(3) to generate electricity (generate large capacity of electricity - conventional generater is unnecessary)

(4)to regenerate the brake energy (convert the brake energy to electrical energy and charge the battery)

(5) to retard the speed (improve the safety)

Especially on item (2), torque assist is conducted during starting and acceleration, when the diesel engine is at high load range. This reduces NOx by 20 ~30%compared with the same type diesel bus, and black smoke is reduced by 70%during free acceleration.

On item(4), fuel consumption is improved by 5 ~15% regenerating the brake energy. The fuel consumption will be cut further if an easy - to - charge, compact and lightweight battery is developed in future.

On item(5), the deceleration is 2.6 times greater compared with the conventional exhaust brake performance, so it will be possible to greatly improve safety.

Now in order to advance the use of the new system, monitoring tests in the field of the city bus is operated in 8 cities, under a grant from the government.

Development of Top Bend Floater for Galvanneal Furnace in Continuous Galvanize Line

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Ken - ichi Yanagi	Mitsubishi Heavy Industries,Ltd.
Kazumasa Mihara	ditto
Namio Suganuma	Kawasaki Steel Corporation Mizushima Works
Sachihiro Iida	ditto

In the continuous galvanizing process, the quality of galvannealed strip is seriously influenced by a top roll. The toproll is conventionally located about 50m above a zinc pot to secure the cooling time for the strip so that molten zinc coated on strip surface solidifies completely before it comes to contact the roll. This arrangement,however, has the following problems:

(1) If strip is not cooled sufficiently before reaching the top roll, zinc adheres around the roll and it causes scratchs or dents on the strip surface.

(2) The strip is further cooled by the top roll, but often not uniformly, resulting in such troubles as deformation or walking of the strip.

(3) The strip temperature at the top roll must be maintained below a certain point determind by the roll material property. This constrains the range of heat cycles that can be realized by the process, delimiting the production rate.

To eliminate these problems, we have developed a bend floater which suspends the strip by air pressure.

The first commercial scale floater was installed in the continuous galvanizing line at Mizushima Works, Kawasaki Steel. Fig 1 shows its outlook.

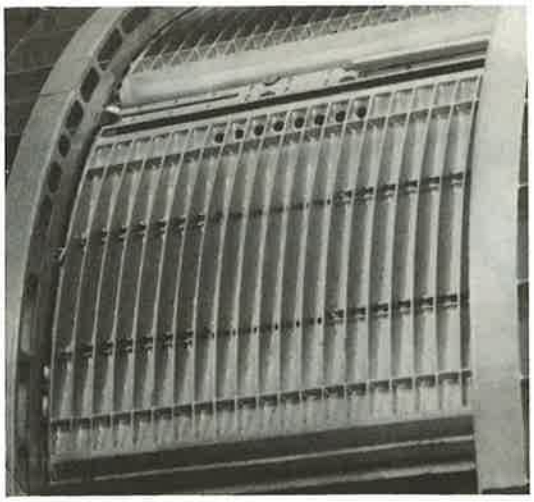

Fig. 1 Top Bend Floater

The floater generates the pressure between the floater and the strip by the momentum of gas jets from nozzles. The nozzles are arranged in the width direction, and produce gas flow to float the strip along the its length direction. But part of the gas also flows out sideways from both side edges due to the pressure produced beneath the strip.

This side flows of the gas is not uniform because there is little flow resistance under the strip, and as a result the strip running becomes very unstable.

To prevent this trouble and secure the stability of operation, the floater is provided with ribs and side plates. The ribs are mounted on the floater along the strip running direction to increase the flow resistance, while the side plates are outermost ribs designed to be higher than inner ribs to enclose the strip floating area. When the strip skews toward a side plate, a fluid force is generated in the corner of the side plate and pushes the strip back to the center.

The position of side plates can be changed according to the strip width to save the waste gas flows.

With this design, the floater developed by Mitsubishi Heavy Industries has such unique advantages as;

(1) reduced operation cost due to high efficiency,
(2) high stability of strip floating with little vibration,
(3) no walking of the strip.

It is readily expected that this floater will be used more widely not only for the galvanizing line, but many other processes where a high level of surface quality without scratches or dents is required.

Development of Flame Diagnostic System for Utility Boilers

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Norio Watanabe — Tokyo Electric Power Co., Engineering Research Center

Hironobu Matsuda — Shikoku Electric Power Co.,Inc., Saijoh Power Station

Hideto Hashimoto — Ishikawajima-Harima Heavy Industries Co.,Ltd., Boiler Plant Division

The combustion monitoring system in utility boilers generally consists of the equipments analyzing O2, NOx and dust in flue gas at the boiler exit. The data obtained are referred to optimize plant efficiency and control environmental air pollution, and flame detectors and in-furnace televisions are equipped to ensure operating. Such equiments are only to serve for rough evaluation of flame behavior in a furnace as a whole, and it is considered insufficient for further requirement of minimizing NOx, dust, and excessO2 in flue gas.

Accordingly,an attempt was made to develop a new type of flame monitoring system that could accurately evaluate flame behavior of individual burner on utility boilers. This combustion monitoring system (combustion diagnostic system) was developed by utilizing a spectroscopic analysis method. The system comprises of optical probes, optical fibers connecting the burners to a multi-spectrometer through an optical scanner for multiple burners of the boiler, and computers.

This system is shown in photograph 1 and figure 1.

The system can announce the evaluating items, for individual flame, such as the degree of ignition delay, flame stability, NOx emission, flame temperature and clinker formation on the burner mouth. An example of the evaluation on ignition delay is shown in figure 2. The informations of evaluating items are given as bar graphs with reference data at past time.

The demonstration tests were conducted on a 350 MW oil firing boiler and a 250 MW pulverized coal firing boiler, respectively. The system was concluded to be fully applicable for the supervising device. The burner adjustment work was also simplified by real-time system output evaluating flame behavior on individual burners. Consequently, excess air could be minimized with decrease of both NOx emission and unburnt loss or dust emission by balancing fuel/air distribution for individual burners.

Photograph 1. View of diagnostic cabinet

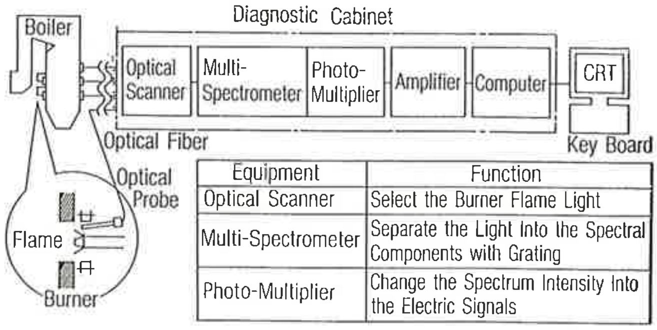

Figure 1. measuring system

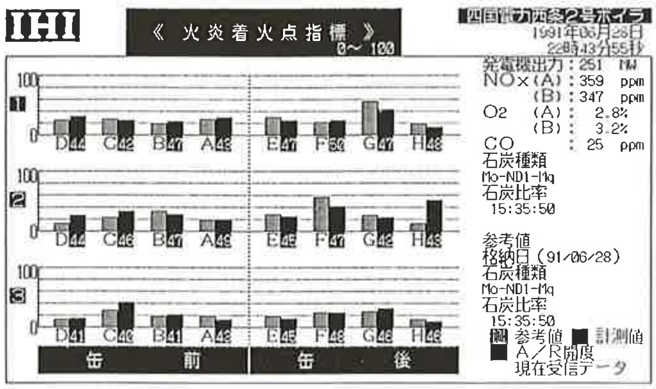

Figure 2. example of CRT display

Development of Auto-Focusing Ultrasonic Imaging Systems For Industrial Use

Takeshi Yamaguchi FA Factory, Hitachi Construction Machinery Co.,Ltd.
Kandatsu, Tsuchiura City, Japan
Yukio Arima ditto
Hiroaki Yanagimoto ditto
Yuichi Kunitomo ditto
Takeshi Nishizuka ditto

Industrial-use ultrasonic imaging systems non-destructively exhibits defects such as cracks and voids in various materials. Requiring a high resolution, they use high frequencies more than tenfold over those on medical diagnosing systems. Around 1984, ultrasonic imaging systems came into wide use to evaluate heat resistance in semiconductor packages and then bond strength of interfaces. Using focused ultrasound waves, however, these systems required a focusing technique which needs expert skill. Thus, in practice, no one but expert engineers and skilled technicians can handle these systems. This has limited the wide use of these tools.
Hitachi's newly developed system incorporates its accumulated know-how on measurement, in addition to the world's first auto-focusing function, enabling even unskilled operators to easily obtain high-quality ultrasonic images.

(1) Front-loading specimen table
The adoption of a front-loading specimen table is the world's first technique among industrial-use ultrasonic imaging systems which use water as the medium of ultrasonic propagation. Place a sample on the specimen table and press a push-button---this is all the work needed to have a sample set in a proper position in water.
(2) The touch screen offers user-friendly operation
All measuring operations can be made by touching the CRT display screen (touching-screen technique).
(3) Recording of measuring conditions using images as indexes Measuring parameters can be stored in the form of reduced images for measured results as indexes. This permits visual retrieval of indentical conditions for repeatable measurment.
(4) Auto-focusing function
The auto-focusing function, which is called the S-image method, is the primary feature of the new system.Starting at the top of the screen, the first scan is made with the focus just below the surface of the specimen. Each successive scan is made of a deeper focal position and different/incremental scan, S-image (multi-focus image)is obtained. This image is like a diagonal cross section of the specimen. To focus on a particular level, simply touch the most clear image at this level. Then, the line cursor will move to this location. The measuring parameters memorized in accordance with the image portion are automatically retrieved and set, and focusing work is completed. In other words, the S-image is what the finder is and the line cursor is what the focus frame is to the camera.
Although developed to observe the interior of semiconductor packages, the new system was proved to be capable of easily focusing interfaces of ceramics, metals, composite materials, etc. The development of the new system is expected to accelerate attempts to use acoustic images in evaluating the bond strength of various industrial products.

Photograph 1.

JSME AWARD FOR YOUNG ENGINEERS (RESEARCH)

Shin-ichi Aoyama (Nippon Telegraph and Telephone Corp.)
Koichi Gohda (Hiroshima University)
Masaki Hohjyo (Industrial Products Res. Inst. MITI)
Hiroshi Ishiguro (Tsukuba University)
Naoshi Izumi (Kyusyu University)
Kenji Katoh (Osaka City University)
Masamichi Kawai (Tsukuba University)
Satoyuki Kawano (Tohoku University)
Tsuyoshi Masuda (Nissan Motor Co.,Ltd.)
Masaaki Matsubara (Gunma University)
Shinsuke Mochizuki (Yamaguchi University)
Kazuyoshi Nakabe (Osaka University)
Kunito Okuyama (Yokohama National University)
Akihito Sano (Gifu University)
Jyoichi Sugimura (Kyushu University)
Michihiko Tabata (Mazda Motor Corp.)
Hideo Utsuno (Kobe Steel LTD.)
Shigeo Yamashita (National Defense Academy)
Mitsuaki Yanagida (Hitachi ,Ltd.)
Shinobu Yoshimura (Tokyo University)

JSME AWARD FOR YOUNG ENGINEERS (TECHNOLOGY)

Takuya Kondoh (Toyota Motor Corp.)
Shigetaka Nagamatsu (Toyota Motor Corp.)
Genpei Naitoh (Nissan Motor Co.,Ltd.)
Seiichiroh Suzuki (Toshiba Corp.)
Kazunari Yoshimura (Matsushita Electric Works, Ltd.)